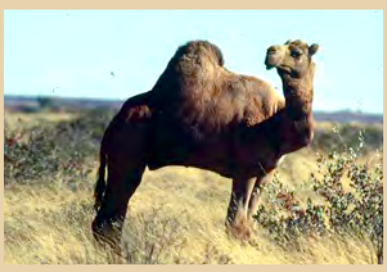
Great Western Woodlands

Draft Strategic Weed and Feral Animal Management Plan

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GREAT WESTERN WOODLANDS

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Cover photos
Main – prickly pear (*Opuntia* spp.); small (left to right) hudson pear (*Cylindropuntia rosea*); camel (*Camelus dromedarius*); coral cactus (*Cylindropuntia fulgida*); wild horse (*Equus callabus*).

Back cover photos
Main – mother-of-millions (*Bryophyllum* spp.); small (left to right); gazania (*Gazania* spp.); feral cat (*Felis catus*); pepper tree (*Schinus molle*); donkey (*Equua asinus*).

Great Western Woodlands Draft Strategic Weed and Feral Animal Management Plan

Department of Environment and Conservation

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WoNS Coordinator Athel Pine
WoNS Coordinator Opuntioid Cacti

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Acronyms

APVMA	Australia Pest and Veterinary Medicines Authority
ARRP Act	*Agriculture and Related Resources Protection Act 1976*
CMR	Conservation and Mining Reserve
CP	Conservation Park
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation Western Australia
DMP	Department of Mines and Petroleum Western Australia
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (Australian Government)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographical information system
GNRBG	Goldfields Nullarbor Rangelands Biosecurity Group
GWW	Great Western Woodlands
NRM	Natural Resource Management
NR	Nature Reserve
PCP	Proposed Conservation Park
PEC	Priority Ecological Community
SA	South Australia
TR	Timber Reserve
UCL	Unallocated Crown land
WA	Western Australia
WoNS	Weed of National Significance
WC Act	*Wildlife Conservation Act 1950*

INTRODUCTION TO THE PLAN

Background

The Great Western Woodlands (GWW) is the largest remaining area of intact Mediterranean-climate woodland on Earth. Covering almost 16 million hectares, this continuous band of native vegetation stretches from the edge of the Western Australian (WA) wheatbelt to Kalgoorlie-Boulder in the north, the inland deserts to the northeast, the Nullarbor Plain to the east and the coastal vegetation of the south. The GWW has been recognised as an internationally significant area of great biological richness. *A Biodiversity and Cultural Conservation Strategy for the Great Western Woodlands* was released by the WA state Minister for Environment on 3 November 2010 and provides a framework to manage the range of different uses of the woodlands to ensure the long-term protection of its natural and cultural values. It is available from the Department of Environment and Conservation (DEC) website www.dec.wa.gov.au/greatwesternwoodlands. The Strategy identified the threat of weed and feral animals to biodiversity and cultural values in the GWW and highlighted the need for a coordinated approach to their management.

Land tenure and stakeholders

Land tenure within the GWW is predominantly unallocated Crown land (UCL) (58.9%), but also includes large areas of pastoral lease (17.5%) and conservation reserve (16.1%). DEC manages conservation reserves (2,569,728 ha), but also has a responsibility to manage weeds, feral animals and fire on UCL (9,415,721 ha). The GWW incorporates 12 local government authorities and seven townships and more than 60% of the area is covered with active or pending mining tenements. About 25% of pastoral leases in the Coolgardie Bioregion (comprising most of the GWW) are under mining company ownership (DSEWPC, 2008). There are eight registered and four unregistered native title claims over the GWW, the largest being the Ngadju claim covering more than 7 million hectares of the GWW. Many other stakeholder groups and individuals are active in the GWW. Fig. 1 'Land Tenure' shows land tenure within the GWW. Success of the GWW Weed and Feral Animal Management Plan hinges on participation by the major stakeholder groups, in particular DEC (Goldfields Region, Esperance District and Central Wheatbelt District), pastoral managers and local government (especially the City of Kalgoorlie-Boulder and the Shires of Coolgardie, Dundas and Yilgarn) and mining companies.

About this plan

This plan has been developed to provide cross-tenure strategic direction in weed and feral animal management for all land managers in the GWW. Weed and feral animal threats and management options have been identified and prioritised here in the context of the entire GWW. The plan consists of two parts; the Strategic Weed Management Plan and the Strategic Feral Animal Management Plan. The plan will be effective from 2013 for a period of five years. It is recommended that the effectiveness of the plan be assessed in 2018 and revised accordingly for its next period of implementation.

GREAT WESTERN WOODLANDS
STRATEGIC WEED MANAGEMENT PLAN

STRATEGIC WEED MANAGEMENT PLAN

Introduction

Weeds are a potential threat to biodiversity and cultural values of the GWW. Weeds can impact biodiversity through the exclusion of native flora species, modification of the structure and composition of native vegetation communities, loss of native fauna habitat and by contributing to changes in fire regime (frequency and intensity) and hydrology. Aboriginal cultural values, e.g. ceremonial, burial, artifact or natural sites, may be impacted by weeds through physical degradation and loss of aesthetics at sites. Impacts of weeds on European cultural values can include reduced productivity of pastoral land and physical degradation and loss of aesthetics at historical sites. This GWW Strategic Weed Management Plan has been developed in response to a recognised need for a coordinated approach to weed management across the GWW. Knowledge of weeds in the GWW was previously available only for certain areas or species and the information sat with various different stakeholders. This plan pulls together that information along with new information gained from survey to give a better understanding of weed distribution, impacts and control priorities for the GWW.

Aims and objectives

Through its implementation, this Strategic Weed Management Plan aims to minimise the impact of weeds on biodiversity and cultural values of the GWW. Specific objectives are to:

1. Identify priority weed species and map their distribution across the GWW
2. Identify impacts of weeds to biodiversity and cultural values of the GWW
3. Eradicate, or otherwise contain, populations of priority weeds

Statutory requirements

Agriculture and Related Resources Protection Act 1976

The *Agriculture and Related Resources Protection Act 1976* (ARRP Act) (WA state legislation) is the major piece of legislation controlling weed management in WA. Land holders/managers in WA have a legal requirement to manage species declared under the ARRP Act. Species declared under the Act are known as ‘declared weeds’. There are 103 species in total declared for Shires that fall within the GWW. Declared species are classified P1–P5 under the Act. These rankings reflect management requirements and are summarised below.

P1 – Introduction of the plant into or movement of the plant within an area is prohibited
P2 – Plant to be eradicated in the area
P3 – Plant to be controlled by reduction in number or distribution of the plant or both
P4 – Spread of plant beyond where is currently occurs to be prevented
P5 – Particular action to be taken on public land or land controlled by local government

See the ARRP Act declared plants list for species declarations.

ARRP Act declared plants list

http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/dec_plants_list.pdf

Biosecurity and Agriculture Management Act 2007

The ARRP Act is due to be replaced by the *Biosecurity and Agriculture Management Act 2007* in 2013. The declared plants list will be replaced by the Western Australian Organism List. The declaration of some weed species may change under the new legislation.

Biosecurity and Agriculture Management Act 2007 (DAFWA)
http://www.agric.wa.gov.au/PC_93122.html?s=0

Weeds of National Significance

The Weeds of National Significance (WoNS) program coordinates the national effort against Australia's worst invasive plants. WoNS species are those that have degraded large portions of Australia's natural and productive landscape and require action at a national level to reduce their impact (Australian Government, 2008). For each WoNS species, there is a national management strategy, management committee and program coordinator. Classification as a WoNS does not carry with it any legislative requirements, but it does mean that species is more likely to be included under state weed legislation.

Weeds of National Significance
http://www.weeds.org.au/WoNS/

Asset identification

Due to the large size of the GWW (about 16 million ha) and the impracticality of conducting weed and feral animal management across its entirety, an asset-based approach has been adopted for this plan. For the purpose of the plan, 'assets' are considered to be those things identified as having high biodiversity or cultural value that may be threatened by weeds or feral animals. Assets are given priority for weed and pest management over non-asset areas. Assets identified for this plan are listed below. These assets also apply to the Strategic Feral Animal Management Plan.

Biodiversity assets

- Threatened flora and fauna and their habitat as listed under the *Wildlife Conservation Act 1950* (WC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (listed in Appendix 1)
- Priority flora and fauna and their habitat as listed by DEC (listed in Appendix 2)
- Priority ecological communities (PEC) as listed by DEC (listed in Appendix 3)
- Conservation reserves (DEC-managed land) – current and proposed
- Banded iron ranges – as centres of diversity and endemism (as listed in CALM, 2003)
- Refugia – Peak Charles, granite outcrops and caves (as listed in CALM, 2003)
- Rowles Lagoon and associated lakes and Lake Cronin (as listed in the Directory of Important Wetlands in Australia)
- Sub-regionally important wetlands (as listed in CALM, 2003)
- All other fresh, brackish and saline permanent and ephemeral waterbodies

There are no threatened ecological communities within the GWW, as listed under the WC Act or EPBC Act. There are no Ramsar (Convention on Wetlands of International Importance, especially as Waterfowl Habitat) listed sites in the GWW.

Cultural assets

- Aboriginal heritage sites, including those listed by the Department of Indigenous Affairs WA, e.g. ceremonial, mythological, burial, artifact and natural sites
- European heritage sites, including those listed by the WA Heritage Commission and Department of Planning for the Heritage Council of WA, e.g. water pipeline and rail infrastructure and abandoned town sites
- Pastoral land

Weed prioritisation

Weed prioritisation was carried out to identify those species that pose the greatest threat to biodiversity and cultural values of the GWW, but for which there was a strong likelihood of control. To identify priority weeds for management, three factors were considered:

- Invasiveness
- Impact on assets
- Feasibility of control

Invasiveness considered the behaviour of the weed in Australia and its anticipated behaviour in the GWW. *Impact on assets* involved identifying whether the species was impacting on biodiversity and cultural assets in the GWW. *Feasibility of control* was assessed based on how widely distributed the species was in the GWW.

A 'prioritisation matrix' was used to rank priority species in relation to one another. For each species a score of 1–5 was assigned for each prioritisation factor; invasiveness, impacts on assets and feasibility of control. These scores are explained below:

- Invasiveness: 1 = less invasive; 5 = more invasive
- Impact on assets: 1 = not impacting assets; 5 = impacting assets
- Feasibility of control: 1 = widespread distribution; 5 = small distribution

These scores were added together to give a 'priority index' for each species. This is a subjective score used to rank the species in relation to each other; the higher the score, the higher the priority for control. Those species with a higher score were considered more invasive, were impacting on assets and had a higher feasibility of control. Species with lower scores were less invasive, not impacting on assets and had a lower feasibility of control. The maximum score possible is 15 and the minimum 3. Priority weed species, their scoring and relevant notes are given in Table 1.

Ten priority environmental weeds and five priority pastoral weeds were identified. For the purposes of this plan, environmental weeds are considered to be those that impact predominantly on natural environments. Pastoral weeds are those that impact predominantly on pastoral land. While eradication of pastoral weeds from the GWW is unlikely, these have been included to alert land managers to the most problematic pastoral species that they are likely to encounter in the GWW.

Table 1. Priority weed species and priority index scoring

Scientific name		Common name	ARRP Act	WoNS	Invasiveness		Impacts on assets		Feasibility of control		Priority index
Environmental weeds	*Cylindropuntia* spp.	e.g. Coral Cactus, Devils Rope, Hudson Pear, Jumping Cholla	–	WoNS	Species present in the GWW for possibly up to100 years, but extent and density of populations is still low. Spread is relatively slow compared with other parts of Australia.	3	Not impacting on assets; occurring predominantly on disturbed land within town sites. Reportedly occurring on pastoral land.	1	High feasibility of control; limited distribution, small isolated populations, low densities and relatively slow rate of spread.	5	9
	Opuntia spp.	e.g. Common Prickly Pear, Drooping Prickly Pear, Wheel Cactus	–	WoNS	Species present in the GWW for possibly up to100 years, but extent and density of populations is still low. Spread is relatively slow compared with other parts of Australia.	3	Not impacting on assets; occurring predominantly on disturbed land within town sites. Reportedly occurring on pastoral land.	1	High feasibility of control; limited distribution, small isolated populations, low densities and slow rate of spread.	5	9
	Tamarix spp.	Athel Pine, Tamarisk	P1	WoNS	Most historical plantings (up to ≈100 years old) have not spread. Two cases known where it has spread into a waterbody (Lake Boonderoo and Cowarna Downs); both populations probably established after 1995.	3	Historical plantings not impacting on assets. Lake Boondaroo population is large and impacting the waterbody. Cowarna Downs population is smaller is not yet impacting on the waterbody.	3	Feasibility of control is site-dependant. Removal of individual historical plantings is achievable. Control is feasible at Cowarna Downs. Control at Lake Boonderoo would be a major undertaking.	3	9
	Bryophyllum spp.	Mother-of-Millions	–	–	Planted in most townships as a garden species, but has spread at only a handful of locations. Largest population is along a drainage line in Kambalda.	3	Not impacting on assets; occurring only on disturbed land within town sites.	1	High feasibility of control; limited distribution, small isolated populations and relatively slow rate of spread. Control of Kambalda population will be more difficult and will require committed follow-up.	4	8
	Lycium ferocissimum	African Boxthorn	–	WoNS	Common on disturbed land within town sites, but not occurring at high densities. Not behaving as aggressively as in other parts of Australia.	2	Not impacting on assets; occurring only on disturbed land within town sites.	1	High feasibility of control; limited distribution, small isolated populations, low densities and relatively slow rate of spread.	4	7
	Asparagus asparagoides	Bridal Creeper	P1	WoNS	Only limited spread from historical plantings. Not behaving as aggressively in the GWW as in southern and southwestern WA.	2	Not impacting on assets; occurring only on disturbed land. Southern populations are immediately adjacent to intact native vegetation and could potentially invade these areas.	2	Feasibility of control is site-dependant. Species is being contained at southern sites through biocontrol. High feasibility of control at northern sites.	3	7
	Schinus molle	Pepper Tree	–	–	Many historical plantings are spreading, especially in disturbed areas and along drainage lines.	2	Not impacting on assets, although the Booanya population is immediately adjacent to intact native vegetation and could potentially	2	Feasibility of control is site-dependant. Removal of individual historical plantings is achievable. Control of larger populations is feasible with	3	7

Scientific name		Common name	ARRP Act	WoNS	Invasiveness		Impacts on assets		Feasibility of control		Priority index
							invade this area.		committed follow-up.		
	Acetosa vesicaria	Ruby Dock	–	–	Occurs along the length of the Transline from Kalgoorlie to WA-SA border demonstrating invasion potential, but has otherwise has only limited spread.	4	Not impacting on assets; occurring only on disturbed land.	1	Feasibility of control is site-dependant. Low feasibility of control for linear populations, e.g. Transline. High feasibility of control for isolated outliers, e.g. mine sites.	1	6
	Gazania spp.	Gazania	–	–	Not behaving as aggressively in the GWW as elsewhere in WA. Not spreading beyond disturbed areas in townships.	2	Not impacting on assets; occurring only on disturbed land within town sites.	1	Low feasibility of control. Occurring in isolated populations, but at high densities. Containment unlikely for town site populations.	2	5
	Cenchrus ciliaris	Buffel Grass	–	–	Not behaving as aggressively as in other parts of Australia.	2	Not impacting on assets; occurring only along the road verge.	1	Low feasibility of control for road verge populations; reinvasion from the north via the Goldfields Hwy is inevitable.	1	4
Pastoral weeds	*Carthamus lanatus*	Bathurst Burr	P1, P2–P3	–	Restricted mostly to pastoral and ex-pastoral land.	2	Impacting on pastoral and ex-pastoral land.	1	Low feasibility of control on pastoral land. Species is associated with disturbance caused by pastoral activity.	1	4
	Marrubium vulgare	Horehound	P1, P2–P4	–	Restricted mostly to pastoral and ex-pastoral land.	2	Impacting on pastoral and ex-pastoral land.	1	Low feasibility of control on pastoral land. Species is associated with disturbance caused by pastoral activity.	1	4
	Echium plantagineum	Paterson's Curse	P1, P3–P4	–	Restricted mostly to pastoral and ex-pastoral land.	2	Impacting on pastoral land.	1	Low feasibility of control on pastoral land. Species is associated with disturbance caused by pastoral activity.	1	4
	Xanthium spinosum	Saffron Thistle	P1, P3–P4	–	Restricted mostly to pastoral and ex-pastoral land.	2	Impacting on pastoral and ex-pastoral land.	1	Low feasibility of control on pastoral land. Species is associated with disturbance caused by pastoral activity.	1	4
Invasiveness: 1= less invasive, 5= more invasive; impact on assets: 1= not impacting assets, 5= impacting assets; feasibility of control: 1= widespread distribution, 5= small, isolated pops.											

Weed survey method

Desktop study

A desktop study was carried out to identify preexisting weed information and spatial data for the GWW. A search of *FloraBase*, the WA Herbarium database, was carried out to identify all exotic flora records in the GWW (these records are included as Appendix 4). There were 742 records in total for 190 exotic species within the GWW in *FloraBase*. The *FloraBase* data was useful for indicating disturbed areas (weed records are clustered in these areas), but contained few records for the species identified as priority. Relevant stakeholders were also contacted and weed information and data requested. Some spatial data was available from DEC, Main Roads WA and some mining companies, but otherwise weed information for the GWW was mostly anecdotal.

Field survey

The experience of DEC staff and other stakeholders was that, in general, weeds in the GWW are restricted mainly to disturbed areas. It was not possible to survey the entirety of assets across the study areas due to time constraints and resource availability. Instead, surveys targeted disturbed areas, within or adjacent to assets. Sites of disturbance were considered to be townships, roads and tracks, rail lines, power lines, pipe lines, pastoral areas, mining, artificial water points and historical sites (e.g. homesteads, abandoned town sites).

Using geographical information software (GIS) software, a GWW 'assets' map was overlaid with a 'disturbance' map; where these features on the two layers intersected indicated disturbed areas within assets. As weeds are associated with disturbance, these areas were where weeds potentially threatened assets. This exercise was completed to identify areas that should be targeted for survey. This sub-sample of the GWW selected for survey proved to be sufficient as the degree of weed invasion and species present became predictable based on the intensity and type of disturbance. 'Target' areas and the actual areas surveyed are shown in Fig. 2 'Survey Track 2012'. Targeted searches for priority weed species were carried out within target survey areas. Opportunistic observation was used throughout the whole survey effort.

The Goldfields Nullarbor Rangelands Biosecurity Group (GNRBG) communicated concerns regarding weeds on pastoral land in the GWW on behalf of pastoral managers in the region. Pastoral managers however, mostly did not provide specific weed information or data and it was not possible to access pastoral land for survey, so there is no new data for this tenure type. Ex-pastoral land, e.g. Credo and Jaurdi proposed conservation parks (PCP) now managed by DEC, may be useful for indicating the types and level of disturbance on active pastoral land.

Data collection

The location of priority weed occurrences was recorded using GPS. For each weed record, the following attribute data was collected:

- Species
- Location (e.g. Great Eastern Highway, Balbinya Homestead)
- Area of the population (20, 50 or 100m diameter)
- Density of population (<5%, 6–75% or 76–100% cover abundance)

- Growth stage (juvenile, adult or seeded)
- Other relevant information (e.g. specimen voucher number, environmental conditions)

The resulting data was a point-based data set. Each point in the data set represented an individual plant or circular population up to 100 m in diameter and up to 100% cover abundance. All data collected was uploaded into a DEC-managed geodatabase for storage. A sample of the field data collection sheet used during this project is included as Appendix 5.

Mapping

The data collection method allowed individuals or clusters of a particular species to be recorded. This point data in its original form is not useful for mapping at a GWW scale because it provides a high level of detail over smaller areas, which becomes irrelevant over larger areas. Instead of plotting points onto a map, a grid system was used to present the data. This involved using the raw point data to assign density values to grids on a map. As weeds occur in such low densities across the GWW (easily <1% cover abundance), it was not possible to calculate density in terms of percentage cover. Instead, a relative weed density was calculated based on the number of waypoints (or weed clusters) occurring per grid. For whole-of-GWW maps, i.e. Fig. 3–13 and 16–25, a 10 km^2 (1000 ha) grid was used. The grid system provided a practical method for mapping weeds across a large area.

For land managers wishing to implement local weed control programs, DEC can supply raw point data collected in 2012 (shapefiles) or weed maps for priority species in the area of concern. Fig. 14 and 15 (*Opuntia* spp. in the Kalgoorlie and Coolgardie townships) are examples of the type of map that can be supplied. These maps use a 0.5 km^2 (25 ha) grid transposed over a smaller area. They show a higher level of detail and are more suitable for operational purposes. Land managers can use such maps as the baseline to begin a weed control program. For shapefiles or weed maps, please contact DEC Goldfields Region:

Priority weed populations in the GWW

Table 2 shows priority weed populations identified during the survey and their approximate area (ha). The area of weed populations was calculated using GIS software. While the population areas appear large, the density of weeds within those areas is very low (easily <1% cover abundance).

Table 2. Priority weed populations in GWW

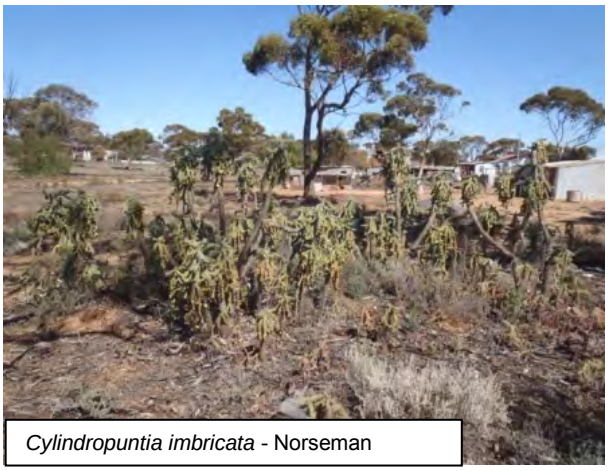
Species	Total area in GWW (ha)*	Occurrence in GWW	Population area (ha)*	Responsible land manager
Cylindropuntia spp.	3467	Bullfinch	1	Shire of Yilgarn
		Norseman	15	Shire of Dundas
		Kambalda	1	Shire of Coolgardie
		Coolgardie	750	
		Kalgoorlie	2700	City of Kalgoorlie-Boulder
Opuntia spp.	9018	Cocklebiddy Roadhouse	1	DEC Esperance District
		Mt Jackson Station	1	DEC Goldfields Region
		Catherer School	2	Shire of Yilgarn
		Marvel Loch	2	
		Southern Cross	25	

Species	Total area in GWW (ha)*	Occurrence in GWW	Population area (ha)*	Responsible land manager
		Yellowdine	200	
		Norseman	300	Shire of Dundas
		Boorabbin	1	Shire of Coolgardie
		Dedari Pump	1	
		Widgiemooltha	15	
		Bullabulling	70	
		Kambalda	1000	
		Coolgardie	1800	
		Kalgoorlie	5600	City of Kalgoorlie-Boulder
Mother-of-Millions	158	Kambalda	1	Shire of Coolgardie
		Coolgardie	100	
		Norseman	56	Shire of Dundas
Tamarix spp.	3132	Karonie Siding	1	Australia Rail Track Corporation
		Cundeelee Mission	2	Aboriginal Affairs Planning Authority
		Bullfinch	6	Shire of Yilgarn
		Dedari Pump	1	Shire of Coolgardie
		Coolgardie	42	
		Kambalda	70	
		Norseman	500	Shire of Dundas
		Kalgoorlie	2250	City of Kalgoorlie-Boulder
		Cowarna Downs	10	Pastoral Lessee / Southern Rangelands NRM
		Lake Boonderoo	250 (in 2008)	Pastoral Lessee / Southern Rangelands NRM
African Boxthorn	7951	Southern Cross	1	Shire of Yilgarn
		Norseman	300	Shire of Dundas
		Coolgardie	900	Shire of Coolgardie
		Kalgoorlie	6750	City of Kalgoorlie-Boulder
Bridal Creeper	5	Balbinya HS	1	DEC Esperance District
		Deralinya HS	1	
		Booanya HS	1	DEC Esperance District / Balladonia Lessee
		Boorabbin town site	1	DEC Goldfields Region
		Yellowdine town site	1	Shire of Coolgardie
Pepper Tree	3164	Cocklebiddy	100	DEC Esperance District
		Booanya Homestead	64	Balladonia Lessee
		Coolgardie	1000	Shire of Coolgardie
		Kalgoorlie	2000	City of Kalgoorlie-Boulder
Ruby Dock	5750	Coolgardie	150	Shire of Coolgardie
		Norseman	300	Shire of Dundas
		Transline	2600	Australia Rail Track Corporation / Brookfield Rail
		Kalgoorlie	2700	City of Kalgoorlie-Boulder
Gazania	3750	Marvel Loch	50	Shire of Yilgarn
		Southern Cross	200	
		Norseman	400	Shire of Dundas
		Coolgardie	600	Shire of Coolgardie
		Kambalda	900	
		Kalgoorlie	1600	City of Kalgoorlie-Boulder
Buffel Grass	3950	Goldfields Hwy (north of Kambalda and Kalgoorlie)	250	City of Kalgoorlie-Boulder
		Kalgoorlie	3600	
		Great Eastern Hwy (east of Coolgardie)	625	Shire of Coolgardie
Pastoral weeds	?	Pastoral land	?	Pastoral managers
Paterson's Curse	?	Hyden-Norseman Rd	10	DEC Esperance District
* Weeds scattered in very low densities (<1%) across these areas ** Pepper Tree populations only included where they are spreading				

Priority weed profiles

Cylindropuntia

Profile and impacts



Cylindropuntia imbricata - Norseman

Cylindropuntia spp. are not declared under the ARRP Act. The opuntioid cacti were listed as WoNS in 2012. *Cylindropuntia* spp. are shrubby, spiny cacti with rope or coral-like segments. They are distinctive and easy to recognise. They are drought tolerant, able to respond to water quickly and can grow on different soil and topography types. *Cylindropuntia* spp. are well-adapted to the arid and semi-arid rangelands of Australia. *C. fulgida* (Coral Cactus), *C. imbricata* (Devils Rope) and *C. rosea* (Hudson Pear) have been observed in the GWW. They impact pastoral land by restricting stock movements, injuring stock and humans and causing damage to vehicles and machinery. Dense populations can exclude native flora species. Birds, bats and marsupials have been found dead after being trapped in *Cylindropuntia* spp. plants. The spines on *C. rosea*, which occurs at Coolgardie, are particularly nasty and are strong enough to piece leather boots. Residents should be careful walking through areas infested with this species. This genus has shown to be highly invasive in other parts of Australia and there is a threat that it will behave the same in the GWW.

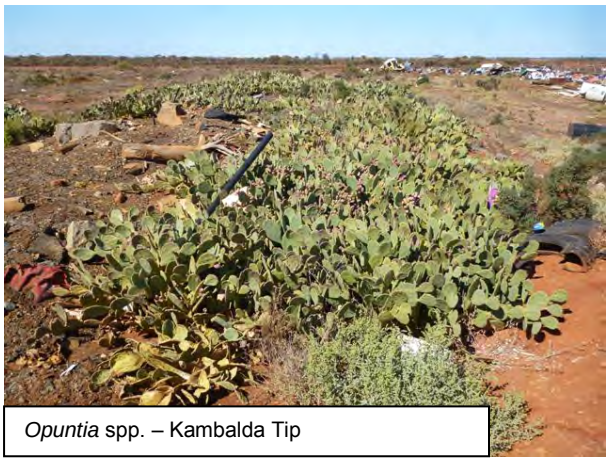
Distribution in the GWW

Cylindropuntia spp. occurs in the Goldfields, Midwest, Gascoyne and Pilbara Regions of WA. A large population of *C. fulgida* exists at Leonora, 200 km north of the northern boundary of the GWW. Control was attempted on this population in 2007, but no follow-up was carried out. Within the GWW, small, isolated populations have been found on disturbed land within the townships of Kalgoorlie, Coolgardie, Kambalda, Norseman and Bullfinch. It has also been recorded at Westonia, about 50 km west of the GWW boundary. *Cylindropuntia* spp. reportedly occurs on pastoral land in the GWW (pers. comm. Ross Woods[1]), but this has not been confirmed. It has not been observed invading undisturbed, native vegetation within the GWW. It does not appear to be spreading as rapidly as in other parts of the state, perhaps due to climatic conditions, e.g. low winter temperatures and frost. It is an ideal time to control the species while it is still has a limited distribution. The distribution of *Cylindropuntia* spp. in the GWW is shown in Fig. 3 '*Cylindropuntia* spp. Distribution'

[1] Ross Woods – Executive Officer, GNRBG

Opuntia

Profile and impacts



Opuntia spp. – Kambalda Tip

Opuntia spp. are not declared under the ARRP Act. The opuntioid cacti were listed as WoNS in 2012. *Opuntia* spp. are an erect cactus to 4m, often spiny, with flat, round, dull-green segments. It is drought tolerant, able to respond to water quickly and can grow on different soil and topography types. *Opuntia* spp. are well-adapted to the arid and semi-arid rangelands of Australia. It impacts pastoral land by restricting stock movements, injuring stock and humans and causing damage to vehicles and machinery. Dense populations can exclude native flora species. The fruit is eaten and seeds dispersed by birds. This genus has shown to be highly invasive in other parts of Australia and there is a threat that it will behave the same in the GWW.

Distribution in the GWW

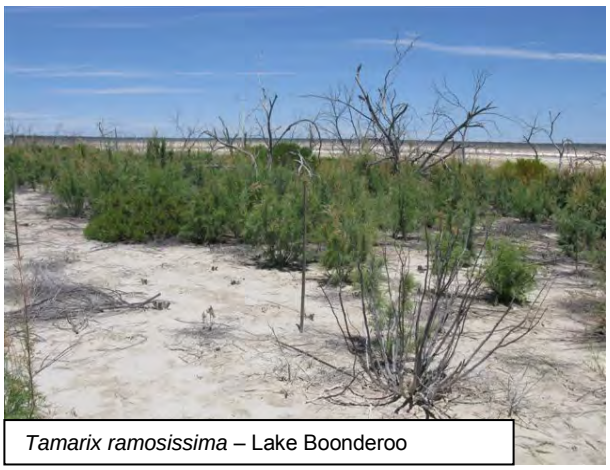
Opuntia spp. occurs in the Goldfields, South Coast, Midwest, Gascoyne and Pilbara regions of WA. This genus is the most common type of invasive cactus in the GWW. Small, isolated populations have been found on disturbed land within Kalgoorlie, Coolgardie, Kambalda, Southern Cross, Bullfinch, Norseman, Widgiemooltha, Cocklebiddy Roadhouse, Mount Jackson Station and at various historical sites along the Great Eastern Highway. It is planted commonly as a garden species in backyards in townships of the GWW. A large population exists just south of Salmon Gums, about 30 km south of the southern boundary of the GWW. It also occurs at Broad Arrow, Moorine Rocks and on Yarri Road; all these sites are less than 10 km outside of the GWW boundary. *Opuntia* spp. reportedly occurs on pastoral land in the GWW (pers. comm. Ross Woods), but this has not been confirmed. *Opuntia* spp. has not been observed invading undisturbed native vegetation in the GWW. *Opuntia* spp. is found at some European heritage sites, e.g. Bullabulling, Boorabbin and Yellowdine town sites, Dedari and Ghooli pump stations and the Catherer School site. It could be considered to be impacting on the aesthetics of these sites. Some of these sites are actively promoted for tourism, for example, as stops along the Golden Pipeline heritage trail. *Opuntia* spp. does not appear to be spreading as rapidly in the GWW as in other parts of Australia, perhaps due to climatic conditions, e.g. low winter temperatures and frost. It is an ideal time to control the species while it is still has a limited distribution. The distribution of *Opuntia* spp. in the GWW is shown in Fig. 4 '*Opuntia* spp. Distribution'.

Athel Pine / Tamarisk

Profile and impacts

There are three species of *Tamarix* spp. that occur in Australia; *T. aphylla* (Athel Pine), *T. parviflora* (Smallflower Tamarisk) and *T. ramosissima* (Tamarisk). *T. aphylla* is declared P1 under the ARRP Act and is listed as a WoNS. *T. ramosissima* (Smallflower Tamarisk) and *T. parviflora* (Tamarisk) are not declared under the ARRP Act or listed as WoNS, but they are invasive species. *Tamarix* spp. is a tree to 18m with weeping light

green foliage that browns off under dry conditions. Seeds are tiny and transported easily by wind or water. Flood events create suitable conditions for dispersal; heavy rain washes seed into the watercourse and scours out embankments, providing the soil disturbance and water necessary for germination. Seedlings need a lot of water initially, but once established are very drought-resistant. *Tamarix* spp. is tolerant of saline conditions. They take up salt from groundwater and excrete it through leaves and branches, increasing surface soil salinity and creating unfavourable conditions for other species. *Tamarix* spp. invades watercourses and waterbodies, usually establishing during a flood event. *Tamarix* spp. presents a potential threat to fresh, brackish and saline permanent and ephemeral waterbodies of the GWW.



Tamarix ramosissima – Lake Boonderoo

Distribution in the GWW

There are serious infestations of this species in most states of Australia. *Tamarix* spp. occurs in all regions of WA. Within the GWW, *Tamarix* spp. has been planted widely as a shade tree throughout the townships of Kalgoorlie, Coolgardie, Kambalda, Norseman and Bullfinch. It has also been planted at some historical sites, e.g. homesteads and railway sidings. It is likely to occur at most homesteads in the GWW. *Tamarix* spp. is currently being managed around the water catchment dam in Norseman by Shire of Dundas. The distribution of *Tamarix* spp. in the GWW is shown in Fig. 5 '*Tamarix* spp. Distribution'.

A large population of *T. ramosissima* occurs in Lake Boonderoo, on Boonderoo Station just outside the eastern boundary of the GWW, south of the Kitchener railway siding. Lake Boonderoo is the terminal lake for the Ponton Creek catchment, which flows from Lake Raeside (near Leonora) through the northeast corner of the GWW. While Lake Boonderoo itself is just outside the GWW boundary (the western bank of the lake falls along the eastern boundary of the GWW), more than 150 km of Ponton Creek and the associated catchment area fall within the GWW. This watercourse is one of the largest in the GWW and therefore an important asset. It is believed that this Tamarisk population may have established sometime after 1995 when the flooding rains associated with Cyclone Bobby filled Lake Boonderoo. The population was discovered in 2005 and control was attempted in 2008 and 2009, but there has been no follow-up control since. As of 2008, 250 ha of the lake's margin were infested with *T. ramosissima*. It was not possible to resurvey the population during the development of this plan due to resource availability and time constraints.

A new population of *Tamarix* spp. was identified in 2012 in Swan Lake and its feeder creek, a small freshwater system on Cowarna Downs Station, about 100 km southeast of Kalgoorlie. Swan Lake is listed as a sub-regionally important wetland for the Eastern Goldfields IBRA Subregion, which forms part of the Coolgardie Bioregion. The lake is semi-permanent and often persists when other waterbodies have dried up (CALM, 2003). It performs an important function for water birds in the area (CALM, 2003) and as such is an important asset in the GWW. The creek line runs past a homestead where there is a mature *Tamarix* spp. tree, which could possibly be the source of the seed. The species has yet to be identified. The population in Swan Lake contains only a few

mature plants and the rest seedlings and so may have established only recently. The creek flows through a grazed paddock.

Lake Boonderoo and Cowarna Downs are the only known sites within or near to the GWW where *Tamarix* spp. has invaded a watercourse. Although most plantings in GWW have not spread, these sites demonstrate its ability to spread into the environment under the right conditions. *Tamarix* spp. should be considered a serious threat to fresh, brackish and saline permanent and ephemeral waterbodies of the GWW and historical trees removed as a precaution.

Mother-of-Millions

Profile and impacts

Mother-of-Millions (*Bryophyllum* spp.) is not declared under the ARRP Act or listed as a WoNS. Mother-of-Millions is a drought-tolerant succulent to 1m that quickly invades disturbed areas. It has been planted widely as a garden species in Australia, including the townships of the GWW. Mother-of-Millions has fleshy segments, which break off easily and are able to reshoot. It grows in a dense layer across the ground and is difficult to control once established. It is toxic to cattle if ingested. This species is particularly problematic in New South Wales and Queensland. There is a strong possibility of it becoming more widespread in the GWW.

Bryophyllum spp. – Coolgardie

Distribution in the GWW

There are only two *FloraBase* records of the species in WA, but this survey has shown it to be more widespread. Within the GWW, a handful of isolated populations have been found on disturbed sites in the townships of Coolgardie, Kambalda and Norseman. It has also been observed planted in gardens in these townships. The Kambalda population is the largest; it is about 5m wide and follows a drainage line for about 500m. It also occurs at Salmon Gums, about 20 km south of the southern GWW boundary. All populations appear to have spread from garden plantings. It has not been observed invading undisturbed native vegetation in the GWW. The distribution of Mother-of-Millions in the GWW is shown in Fig. 6 ‘Mother-of-Millions Distribution’.

African Boxthorn

Profile and impacts

African Boxthorn (*Lycium ferocissimum*) is not declared under the ARRP Act. It was listed as a WoNS in 2012. African Boxthorn is a bushy shrub or tree that invades mostly open areas, such as woodlands, rangelands, low coastal scrub, pastoral land and disturbed areas. It is able to invade undisturbed native vegetation. The species is problematic throughout much of southern Australia. It forms dense thickets and excludes native flora species. The woody spines can harm stock and puncture tyres. African Boxthorn is drought tolerant, but generally occurring where rainfall is greater than

200mm annually. It is tolerant of fire. It grows on all soil types, but prefers sandy or loamy soils. The fruit is eaten and seed dispersed by native and non-native animals.

African Boxthorn – Coolgardie

Distribution in the GWW

African Boxthorn has a mostly coastal distribution in WA, extending from the WA-SA border along the coast up to the Carnarvon region. In the GWW, it is found scattered on disturbed land in and around the townships of Kalgoorlie, Coolgardie, Norseman and Southern Cross. Boxthorn reportedly occurs on pastoral land within the GWW (pers. comm. John Kerr[2]), but this has not been confirmed. It is a common weed in the coastal areas to the south of the GWW. Boxthorn has not been observed invading undisturbed native vegetation in the GWW. The distribution of African Boxthorn in the GWW is shown in Fig. 7 'African Boxthorn Distribution'.

Bridal Creeper

Profile and impacts

Bridal Creeper is declared P1 under the ARRP Act. It is a WoNS. Bridal Creeper is a vine that invades undisturbed vegetation and smothers groundcover and understory species in Mallee, dry sclerophyll forest and heath vegetation. It tends to occur in part or full-shade conditions so may be more of a threat to woodland communities as opposed to open or cleared areas. It grows on most soil types, but prefers alkaline sandy soils and thrives in high nutrient areas. It is tolerant of drought, salt, frost and water-logging. It is difficult to control as the creeping stems are usually intertwined with native vegetation. Bridal Creeper is problematic throughout southern Australia, including southwest WA where it is considered a serious weed threat to biodiversity.

Bridal Creeper – Deralinva.Homestead

Distribution in the GWW

Bridal Creeper is widespread through southwestern and southern coastal WA. It is not common in the GWW. It occurs as small isolated populations at the Yellowdine and Boorabbin town sites and at the Deralinya, Balbinya and Booanya Homesteads, near the southeastern boundary of the GWW. The Yellowdine and Boorabbin sites are significant as they are the furthest inland records of the species in WA. The Boorabbin plants are growing within the drip line of a large fig tree, suggesting the species cannot tolerate full sun in the GWW climate. The Deralinya, Balbinya and Booanya populations were

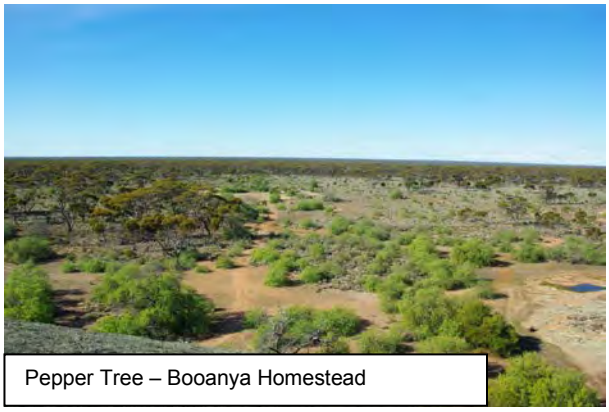
[2] John Kerr – Biosecurity Officer, DAFWA Kalgoorlie

inoculated with a biocontrol agent (Leaf Rust Fungus) several years ago by South Coast NRM and Esperance Weed Action Group. The persistence of Bridal Creeper at these homesteads indicates that the southern woodland areas of the GWW, at least, provides suitable habitat for the species. Bridal Creeper has not been observed invading undisturbed native vegetation in the GWW. The distribution of Bridal Creeper in the GWW is shown in Fig. 8 'Bridal Creeper Distribution'.

Pepper Tree

Profile and impacts

Pepper Tree is not declared under the ARRP Act or listed as a WoNS. It is a spreading tree to 12m with weeping lime green foliage that gives off a peppery aromatic smell when crushed. Pepper Tree is drought and fire tolerant and able to grow in a variety of habitats. It can be particularly aggressive along watercourses, forming dense stands and outcompeting native species. Pepper Tree has been planted widely throughout Australia as a shade tree at town sites, homesteads and in cattle yards.



Pepper Tree – Booanya Homestead

Distribution in the GWW

It has been recorded in the Goldfields, Midwest, South Coast, South West and Kimberley Regions of WA. It is common within the townships of the GWW, where it has been planted widely as a street tree. Pepper Tree occurs at most historical sites and homesteads. Pepper Tree has been observed spreading from original plantings in Kalgoorlie, Coolgardie, Cocklebiddy and Booanya Homestead. In Kalgoorlie and Coolgardie, plants are spreading predominantly along drainage lines in disturbed areas. At Booanya Homestead, Pepper Trees have spread outwards from the original planting in a radius of 800m. Pepper Tree was no observed spreading into undisturbed native vegetation at any of these sites. The distribution of Pepper Tree in the GWW is shown in Fig. 9 'Pepper Tree Distribution'.

Ruby Dock

Profile and impacts

Ruby Dock is not declared under the ARRP Act or listed as a WoNS. It is a drought tolerant erect annual to 0.5m with fleshy leaves and distinctive upright clusters of pink flowers. It is most common in disturbed areas, e.g. road verges, railways and mine sites, but also invades undisturbed grassland, open woodland and watercourses. It prefers sandy alluvial and gravely

Ruby Dock – Transline

ironstone soils. It is an aggressive species that forms dense infestations and excludes native species. Seed dispersal is by wind and water, though grazing may assist spread. Ruby Dock is one of the major weed threats in the Kimberley, Pilbara and Gascoyne regions.

Distribution in the GWW

Ruby Dock is common across the arid and semi-arid rangelands of WA, but less common in the southern inland areas. Ruby Dock is present in the GWW, but not in high densities. It occurs on disturbed land within the townships of Kalgoorlie, Coolgardie, Kambalda and Norseman, around Cocklebiddy, along the Transline and at some historical sites. It may also occur on pastoral land within the GWW. Ruby Dock was reported as occurring on the Paddington Gold, Calooli Station (Ramelius Resources) and Koolyanobbing (Cliffs Asia Pacific) mine sites. It was also observed growing on an island in Lake Ballard, a salt lake 50 km north of the GWW boundary. The Lake Ballard site demonstrates the dispersal potential of Ruby Dock. The distribution of Ruby Dock in the GWW is shown in Fig. 10 'Ruby Dock Distribution'.

Gazania

Profile and impacts

Gazania is not declared under the ARRP Act or listed as a WoNS. Gazania is a hardy, low-growing perennial herb with distinctive bright red, yellow, orange, pink or white flowers. It is drought tolerant and able to grow on a variety of soil types, but preferring sandy soils. Gazania can be an aggressive species growing in a dense mat across the ground, outcompeting and replacing native groundcover species. It is drought, salt and fire tolerant. Gazania may pose a threat to the woodland communities growing on sandy soils.

Gazania – Coolgardie

Distribution in the GWW

Gazania occurs in the South West, South Coast, Midwest and Goldfields Regions of WA. Within the GWW it is common on disturbed land, particularly road and rail verges, within and around the townships of Kalgoorlie, Coolgardie, Kambalda, Norseman, Southern Cross and Marvel Loch. It is planted as a garden and street species in most townships. Gazania also occurs at Salmon Gums, about 20 km south of the GWW boundary. It has not been observed moving into undisturbed vegetation within the GWW. The distribution of Gazania in the GWW is shown in Fig. 11 'Gazania Distribution'.

Buffel Grass

Profile and impacts

Buffel Grass is not declared under the ARRP Act or listed as a WoNS. Buffel Grass was nominated for listing as a 'Key Threatening Process' under the EPBC Act in 2012. It was not included on the Finalised Priority Assessment List for 2012, but could be

Buffel Grass – Goldfields Hwy

reconsidered in the future (pers. comm. Tim Reynolds[3]). The SA Government has just released the SA Buffel Grass Strategic Plan 2012–2017, making SA the only state in Australia attempting to formally manage the species. Buffel Grass is a hardy, drought and fire tolerant grass that prefers lighter soils and grows vigorously in arid environments. It is sensitive to frost and water-logging. Buffel Grass grows quickly in response to rainfall, out-competes native species and forms a dense cover across the ground. It has the potential to modify fire regime by increasing ground fuel loads and thus may threaten fire-sensitive woodland communities of the GWW. Buffel Grass is highly desired as a pasture species in the arid and semi-arid rangelands. It is considered the greatest weed threat to biodiversity across the Australian arid zone (Biosecurity SA, 2012).

Distribution in the GWW

Buffel Grass is widespread through northern parts of WA (Kimberley, Pilbara and Midwest). Buffel Grass is not widespread in the GWW. It was observed along the road verge of the Great Eastern Highway east of Coolgardie and Goldfields Highway north of Kambalda and Kalgoorlie and on disturbed land within the Kalgoorlie and Coolgardie townships. It has been reported as occurring in the Fraser Range area. In 2011 Buffel Grass was recorded by Main Roads along a 100 km stretch of the Eyre Highway from the WA-SA border eastwards (the SA side). It was not observed on the Eyre Highway west of the WA-SA border during 2012 surveys. It has not been observed spreading more than a few metres from the road verge. Buffel Grass is reportedly not widespread on pastoral land in the GWW (pers. comm. Ross Woods). The frost sensitivity of Buffel Grass may limit its spread further south. Its preference for lighter-textured soils may limit establishment in woodland communities of the GWW, which grow predominantly on heavier clay soils. It has not been observed growing in undisturbed vegetation within the GWW. The distribution of Buffel Grass in the GWW is shown in Fig. 12 ‘Buffel Grass Distribution’.

Pastoral weeds

Profile and impacts

The most common and problematic pastoral weeds in the GWW, as identified through consultation with the Department of Agriculture and Food (DAFWA) and GNRBG, are Bathurst Burr (*Xanthium spinosum*), Horehound (*Marrubium vulgare*), Paterson’s Curse (*Echium plantagineum*) and Saffron Thistle (*Catharmus lanatus*). Bathurst Burr is declared P1 and P2–P3 depending on the Shire. Horehound is declared P1 and P2–P4 depending on the Shire. Paterson’s Curse and Saffron Thistle. None of the pastoral weeds are WoNS species. Eradication of these species from the GWW is unlikely, but they have been included here to alert land managers to the pastoral species they are most likely to encounter.

[3] Tim Reynolds – Research Officer, Biosecurity SA

Distribution in the GWW

Bathurst Burr and Saffron Thistle – Credo PCP

As survey was not carried out on pastoral land, *FloraBase* was the primary source of spatial data for pastoral weeds, though anecdotal information was also available for these species. These species mostly occur on and near to pastoral and ex-pastoral. The majority of pastoral land in the GWW occurs as a cell surrounding Kalgoorlie. In some areas these species are beyond control, whilst in other areas they are being actively managed. Pastoral weeds are not common outside of pastoral areas in the GWW. The distribution of pastoral weeds in the GWW is shown in Fig. 13 'Pastoral Weeds Distribution'.

The southern part of Credo PCP has dense infestations of Bathurst Burr, Saffron Thistle and Horehound. The catchment for Rowles Lagoon and associated lakes falls within this area. These species occur in the upper parts of the catchment, but have not yet reached the lower parts of the catchment and the lakes themselves (pers. comm. Vanessa Jackson[4]). DEC is currently attempting control for these species on Credo PCP.

Hampton Hill and Mount Monger Stations are reported to be actively managing Bathurst Burr (pers. comm. Ross Woods). Woolyeenger and Jimberlana Stations reportedly have infestations of Bathurst Burr and large control programs have been carried out in the past for this species at Coolgardie (pers. comm. John Kerr).

There is a large infestation of Horehound on Balladonia Station, which has been successfully inoculated with a biocontrol agent (the Plume Moth) (pers. comm. John Kerr). Release of the Plume Moth was attempted in Credo PCP in 1999, but this was unsuccessful (pers. comm. John Kerr). The Plume Moth prefers wetter, cooler conditions and it is though the climate of the GWW, for the most part, is too hot and dry to support this biocontrol agent (pers. comm. John Weiss[5])

Some of these pastoral species have been reported at mine sites in the GWW. Bathurst Burr occurs on Madoonia Downs (Anglo Gold Ashanti) and Calooli Station (Ramelius Resources). Bathurst Burr and Horehound have been reported at the Paddington Gold mine site. Saffron Thistle has been reported at the Koolyanobbing (Cliffs Asia Pacific), Calooli Station (Ramelius Resources), Paddington Gold, Forrestania Nickel and Norseman Gold mine sites.

Paterson's Curse shows more potential for moving beyond pastoral areas. It occurs in most of the GWW townships and as an isolated 1 km long population occurs along the Hyden-Norseman Rd. The Hyden-Norseman Rd population has been identified as a priority for control. It also reportedly occurs at Lake Johnston and in Nuytsland Nature Reserve (NR).

[4] Vanessa Jackson – Operations Officer, DEC Goldfields Region
[5] John Weiss – Department of Primary Industries, Victoria

A summary of weed invasion in the GWW

Extent of weed invasion in the GWW

In general, the GWW has experienced a relatively low level of weed invasion and most of the native vegetation is intact and free of weeds. This is possibly a product of relatively low historical disturbance and extreme climatic factors, e.g. high summer temperatures, winter frosts and low rainfall. Even pastoral-related activities in some areas have had a low impact due to unpotable groundwater resulting in a reliance on dams and necessarily lower stocking rates (pers. comm.. Ian Kealley[6]). In the GWW, weeds are found predominantly in disturbed areas. Sites with the highest levels of weed invasion are in townships, historical sites (e.g. old town sites and homesteads) and pastoral and ex-pastoral land. Undisturbed, intact native vegetation in the GWW, both from observation and anecdotal sources, appears to have a relatively high level of resistance to weed invasion.

Priority weeds

Cylindropuntia spp., *Opuntia* spp., Mother-of-Millions, *Tamarix* spp., African Boxthorn, Bridal Creeper, Pepper Tree and Gazania were observed only in townships and historical sites and have probably spread from original historical plantings. *Cylindropuntia* spp., *Opuntia* spp. and African Boxthorn reportedly occur on pastoral land though this was not confirmed during the study. Buffel Grass was observed only along the road verge of the Great Eastern Highway east of Coolgardie and Goldfields Highway north of Kambalda and Kalgoorlie. It reportedly has not established on pastoral land. Ruby Dock occurs along the length of Transline from Kalgoorlie to the WA-SA border, but is otherwise scattered and in low densities across the GWW. None of these species are behaving as aggressively in the GWW as they are elsewhere in Australia. Bathurst Burr, Horehound, Paterson's Curse and Saffron Thistle appear to be associated with pastoral activity and are not common beyond pastoral areas. The extent and density of these weeds within active pastoral stations is unknown. None of the species investigated were observed invading undisturbed areas.

Road, rail and pipe lines

Onion Weed (*Asphodelus fistulosus*) and African Lovegrass (*Eragrostis curvula*) are the most common species on road verges. Neither was observed growing more than 5 m from the road verge or invading adjacent undisturbed native vegetation. Most secondary dirt roads and tracks are either weed free or have only occasional occurrences of common low-threat species, e.g. Prickly Melon (*Citrullus lanatus*) or Wild Sage (*Salvia verbenaca*). This includes popular tourist tracks such as the Holland Track and the Lake King-Norseman Rd. The Transline, from Kalgoorlie to the WA-SA border, is colonised with Ruby Dock. Otherwise, rail, power and pipe line verges are colonised mostly with common low-threat species, e.g. African Lovegrass or Maltese Cockspur (*Centaurea melitensis*).

Mine sites

Many mine sites are recording weed occurrences as part of their environmental operations. They are reporting mostly common low-threat species, e.g. Prickly Melon and Wards Weed (*Carrichtera annua*), though some reported the presence of Ruby Dock, Bathurst Burr and Saffron Thistle.

[6] Ian Kealley – Regional Manager, DEC Goldfields Region

Fire and weed invasion

DEC fire access tracks have not been invaded by weeds following track upgrades carried out from 2006–12 as part of DEC's fire mitigation program (pers. comm. Ryan Butler[7]). This may be a product of the sandplain vegetation (where tracks are located) having a relatively high level of weed resistance and also weed hygiene practices being implemented by DEC during these operations, i.e. vehicle and machinery washdown. Fires scars, both from wildfires and prescribed burning, do not appear susceptible to weed invasion (pers. comm. Ryan Butler; pers. obs.).

Impacts to assets

Lake Boonderoo, just outside the eastern boundary of the GWW south of the Kitchener railway siding, is being impacted by *Tamarix ramosissima* (Smallflower Tamarisk). As of 2008, about 250 ha of the lakes margin was infested. The watercourse feeding Lake Boonderoo, Ponton Creek flows across the northeastern part of the GWW and may in time be impacted should the population continue to spread. Swan Lake, a freshwater system on Cowarna Downs Station 100 km southeast of Kalgoorlie, is also threatened by *Tamarix* spp., which has established over about 3 ha of the lake and its feeder creek.

The PECs at the southern end of Fraser Range, the 'Fraser Range vegetation complex' (Priority 1) and 'Plant assemblages of the Southern Hills vegetation complex' (Priority 1), have been invaded by Onion Weed and Wild Sage. This is a secondary impact from overgrazing, which has caused the loss of native ground and shrub species and spread of weeds that are unpalatable to stock.

The productivity of active pastoral land in the GWW is reportedly impacted by Bathurst Burr, Horehound, Paterson's Curse and Saffron Thistle. Credo PCP, a DEC reserve, is impacted by Saffron Thistle, Horehound and Bathurst Burr, a product of historical pastoral activity. The catchment for Rowles Lagoon falls into the southern part of Credo PCP, though the hydrology of the system doesn't appear impacted by these species.

DEC is unaware of any Aboriginal heritage sites being impacted by weed invasion. The aesthetics of some European heritage sites have been impacted by *Opuntia* spp. and *Cylindropuntia* spp., e.g. the Coolgardie township, Bullabulling, Boorabbin and Yellowdine town sites, Dedari and Ghooli pump stations and the Catherer School site. Some of these sites are actively promoted for tourism, for example, as stops along the Golden Pipeline Heritage Trail.

At this stage, DEC is not aware of any other weed impacts to assets in the GWW.

[7] Ryan Butler – Regional Fire Coordinator, DEC Goldfields Region

Management options

Table 3. Management options for priority weed population

Species	Responsible land manager(s)	Populations	Management options
Cylindropuntia spp.	City of Kalgoorlie-Boulder / DEC Goldfields Region	Kalgoorlie	• DEC Goldfields Region to carry out initial control of all known *Opuntia* spp. populations in spring 2012 and autumn 2013. • Shires to carry out monitoring and maintenance control for all known *Opuntia* spp. populations from 2013 onwards. • Shires to discourage use of *Opuntia* spp. as a garden species.
	Shire of Coolgardie / DEC Goldfields Region	Coolgardie and Kambalda	
	Shire of Dundas / DEC Goldfields Region	Norseman	
	Shire of Yilgarn / DEC Goldfields Region	Bullfinch	
	DEC (Goldfields, Esperance and Central Wheatbelt)	Pastoral land	• DEC (Goldfields, Esperance and Central Wheatbelt) to obtain information and / or data for *Cylindropuntia* spp. on pastoral land.
Opuntia spp.	DEC Esperance District	Cocklebiddy Roadhouse	• DEC to carry out initial control autumn 2013 and monitoring and maintenance control from 2013 onwards.
	DEC Goldfields Region	Mt Jackson Station	
	City of Kalgoorlie-Boulder / DEC Goldfields Region	Kalgoorlie	• DEC Goldfields Region to carry out initial control of all known *Cylindropuntia* spp. populations in spring 2012 and autumn 2013. • Shires to carry out monitoring and maintenance control for all known *Cylindropuntia* spp. populations from 2013 onwards. • Shires to discourage use of *Cylindropuntia* spp. as a garden species.
	Shire of Coolgardie / DEC Goldfields Region	Bullabulling, Boorabbin, Coolgardie, Dedari, Kambalda and Widgiemooltha	
	Shire of Dundas / DEC Goldfields Region	Norseman	
	Shire of Yilgarn / DEC Goldfields Region	Catherer School, Marvel Loch, Southern Cross and Yellowdine	
	Pastoral managers / GNRBG / DEC (Goldfields, Esperance and Central Wheatbelt)	Pastoral land	• DEC (Goldfields, Esperance and Central Wheatbelt) to obtain information and / or data for *Opuntia* spp. on pastoral land.
Tamarix spp.	Boonderoo Station lessee / Southern Rangelands NRM	Lake Boonderoo, Boonderoo Station	• Southern Rangelands NRM to resurvey Lake Boonderoo *Tamarix* spp. population and assess feasibility of control and if feasible, develop and implement a control program.
	Cowarna Downs Lessee / Southern Rangelands NRM	Swan Lake, Cowarna Downs Station	• Southern Rangelands NRM, in conjuction with the Cowarna Downs lessee, to develop and implement a control program for *Tamarix* spp. at Swan Lake, Cowarna Downs.
	DEC Goldfields Region	Kalgoorlie Arboretum	• Land managers to remove all historical plantings from townships, historical sites and homesteads.
	Aboriginal Affairs Planning Authority	Cundeelee Mission	
	City of Kalgoorlie-Boulder	Kalgoorlie	
	Shire of Coolgardie	Coolgardie, Kambalda and Dedari	
	Shire of Dundas	Norseman	
	Shire of Yilgarn	Bullfinch	
Mother-of-Millions	Shire of Coolgardie / DEC Goldfields Region	Coolgardie and Kambalda	• DEC Goldfields Region to carry out initial control of all known Mother-of-Millions populations in spring 2012 and autumn 2013. • Shires to carry out monitoring and maintenance control for all known Mother-of-Millions populations from 2013 onwards. • Shires to discourage use of Mother-of-Millions as a garden species.
	Shire of Dundas	Norseman	
African	City of Kalgoorlie-Boulder	Kalgoorlie	• Shires to eradicate African Boxthorn from townships.

Species	Responsible land manager(s)	Populations	Management options
Boxthorn	Shire of Coolgardie	Coolgardie	
	Shire of Dundas	Norseman	
	Shire of Yilgarn	Southern Cross	
	DEC (Goldfields, Esperance and Central Wheatbelt)	Pastoral land	• DEC (Goldfields, Esperance and Central Wheatbelt) to obtain information and / or data for African Boxthorn on pastoral land.
Bridal Creeper	DEC Esperance District / Balladonia Lessee	Booanya, Balbinya and Deralinya Homesteads	• Booanya, Balbinya and Deralinya populations inoculated with biocontrol agent several years ago. DEC Esperance District to monitor homestead populations annually. If populations continue to spread, alternative control options to be investigated.
	DEC Goldfields Region	Boorabbin town site	• DEC Goldfields Region to carry out initial control in 2013 and annual maintenance control until eradicated.
	Shire of Coolgardie	Yellowdine town site	• DEC Central Wheatbelt District to carry out initial control in 2013 and annual maintenance control until eradicated.
Pepper Tree	City of Kalgoorlie-Boulder	Kalgoorlie	• Shires to control Pepper Trees in townships where they are considered a threat. • DEC Goldfields Region to remove Pepper Trees from Mt Jackson Homestead. • Where Pepper Trees have a historical or cultural significance, the male trees can be removed only and the female trees left. Where Pepper Trees are providing soil stabilisation or shade, rehabilitation or replacement with native species could be considered.
	Shire of Coolgardie	Coolgardie, Kambalda, Bullabulling, Dedari and Boorabbin,	
	Shire of Yilgarn	Southern Cross, Marvel Loch, Bullfinch and Yellowdine	
	Shire of Dundas	Norseman	
	DEC Goldfields Region	Mt Jackson Station	
	DEC Esperance District / Balladonia Lessee	Booanya Homestead	• DEC Esperance District in conjunction with Balladonia Lessee to remove all Pepper Trees at Booanya in 2013 and carry out annual maintenance control until eradicated.
	DEC Esperance District	Cocklebiddy	• DEC Esperance District to assess feasibility of control and control options.
Ruby Dock	City of Kalgoorlie-Boulder	Unknown	• All land managers to control small outlier populations of Ruby Dock as they appear.
	Shire of Coolgardie	Unknown	
	Shire of Dundas	Unknown	
	Mining companies	Mine sites	
Gazania	City of Kalgoorlie-Boulder	Kalgoorlie	• All land managers to control small outlier populations of Gazania as they appear.
	Shire of Coolgardie	Coolgardie, Kambalda	
	Shire of Dundas	Norseman	
	Shire of Yilgarn	Southern Cross and Marvel Loch	
Buffel Grass	City of Kalgoorlie-Boulder	Kalgoorlie	• City of Kalgoorlie-Boulder to include Buffel Grass in any local weed control programs.
	Main Roads	Goldfields Hwy and Great Eastern Hwy	• Main Roads to include Buffel Grass in their roadside weed spraying program.
	DEC (Goldfields, Esperance and Central Wheatbelt)	All populations	• DEC (Goldfields, Esperance and Central Wheatbelt) to monitor the spread of Buffel Grass.
Pastoral weeds	All land managers	Unknown	• Manage as per ARRP Act requirements, focusing on small outlying infestations.
Paterson's Curse	DEC Esperance District / Shire of Dundas	Hyden-Norseman Rd	• Annual maintenance control of Paterson's Curse on Hyden-Norseman Rd to be carried out until eradicated.
All species	All responsible parties	All populations	• All land managers to monitor spread of priority weeds. • All land managers to provide weed information and spatial data to DEC Goldfields.
	DEC (Goldfields, Esperance and Central Wheatbelt)	All populations	• DEC to resurvey GWW in 2018 focusing on priority weeds. Effectiveness of the GWW Strategic Weed Management Plan to be assessed.

Cost estimate for initial control

Below is a cost estimate for the initial treatment of identified populations of priority weed species. The costing takes into account the cost of herbicide and worker salaries. Calculations are based on using a chemical control method, e.g. frill and fill, cut stump or foliar spraying. The cost of controlling long linear populations, e.g. Ruby Dock along the Transline, have been calculated based on using a boom spray unit. This exercise aims to provide land managers and those managing funding with an indication of likely minimum costs associated with managing priority weeds for one control season.

Labour costs

The basis of estimating manual labour costs is to estimate the number of 'Person Days' it will take to control a defined weed population. For example, 'five person days' means it will take one person five days or five persons one day to carry out the control of a defined population. These estimates are based on data collected by DEC Goldfields Region staff during weed control operations. This estimate does not include travel time. As the mapping work had already been done, there was no search component included in this time calculation. The population areas appear high, but it is important to remember that weeds occur in very low densities within these areas. For example, treatment of *Cylindropuntia* spp., *Opuntia* spp. and Mother-of-Millions across 5600 ha of the Kalgoorlie township was done in 6 person days because these species occurred in very low densities and field staff knew where to find the plants. Salary costs were calculated based on the current Australian minimum wage of $15.96 / hour or $121.30 / day for a 38-hour week. In reality the salary costs are likely to be much higher.

Herbicide costs

The DEC cactus (*Cylindropuntia* spp., *Opuntia* spp. and Mother-of-Millions) control program commenced at the end of 2012, so herbicides usage estimates for these species reflect the actual volumes used during with the control program. These species were calculated together because they were treated at the same time using the same control method. To estimate herbicide usage rates for the other priority species, standards from the Working for Water Program (Department of Water Affairs, Pretoria South Africa) were used. Working for Water was a national weed management program in South Africa that commenced in 1995. South African standards were used as no Australian examples, as far as could be ascertained, were available at the time. Herbicide costs were based on Australian costs quoted by herbicide suppliers at the time of writing (early 2013).

Ongoing costs

These figures reflect the minimum control costs (herbicide and salaries) for the initial treatment only. Other associated costs that are difficult to quantify may include spray equipment depreciation and maintenance costs, surfactants and dyes, personal protective equipment and transport costs. These calculated costs are likely to be incurred each year for several years until a maintenance level of weed control is reached and then weed control costs may begin to decrease. It is important to note that initial treatments must be followed up by follow-up treatments until a maintenance level of weed control is reached. If treatments are carried out regularly and in a timely manner, weed populations will diminish in extent and density. As the weed populations diminish in size and density, so too will control costs. Weed management should only be

undertaken where follow-up control can be carried out. If funding is not available to carry out ongoing control, then investment in initial control is usually not worthwhile.

Table 4. Cost estimate for initial control of cacti (*Cylindropuntia* spp., *Opuntia* spp. and Mother-of-Millions

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Boorabbin	1	0.5	61	0.01	0.2	61
Dedari	1	0.5	61	0.01	0.2	61
Ghooli	1	0.5	61	0.01	0.2	61
Moorine Rock	1	0.5	61	0.01	0.2	61
Mt Jackson Stn	1	0.5	61	0.01	0.2	61
Westonia	1	0.5	61	0.01	0.2	61
Catherer School	2	0.5	61	0.02	0.3	61
Marvel Loch	2	0.5	61	0.02	0.3	61
Widgiemooltha	15	0.5	61	0.2	2	63
Southern Cross	25	2	243	0.3	4	247
Bullabulling	70	2	243	0.7	11	254
Bullfinch	70	0.5	61	0.7	11	72
Yellowdine	200	1	121	2	32	153
Norseman	300	6	728	4	58	785
Kambalda	1000	2	243	10	160	403
Coolgardie	2100	10	1213	21	336	1549
Kalgoorlie	5600	6	728	28	448	1176
TOTAL	**9390**	**34**	**$4124**	**67**	**$1064**	**$5188**

Table 5. Cost estimate for initial control of *Tamarix* spp.

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Karonie Siding	1	1	121	0.01	0.1	121
Dedari Pump	1	1	61	0.01	0.1	61
Cundeelee	2	1	61	0.01	0.2	61
Bullfinch	6	1	61	0.04	0.6	61
Cowarna Downes	10	4	485	6	96	581
Coolgardie	42	2	243	0.3	4	247
Kambalda	70	2	243	0.4	7	249
Norseman	500	4	485	3	48	533
Kalgoorlie	2250	4	485	14	216	701
TOTAL	**2882**	**19**	**$2244**	**23**	**$372**	**$2616**
Note: Cost of control at Lake Boonderoo has not been calculated as the current extent and density of the population is unknown. The population was last surveyed in 2009 and it was not possible to resurvey in 2012.						

Table 6. Cost estimate for initial control of African Boxthorn

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Southern Cross	1	1	121	0.005	0.1	121
Norseman	300	4	485	1	22	507
Coolgardie	900	6	728	4	65	793
Kalgoorlie	6750	6	728	30	486	1214
TOTAL	**7951**	**17**	**$2062**	**36**	**$572**	**$2635**

Table 7. Cost estimate for initial control of Bridal Creeper

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Deralinya HS	1	1	121	0.9	9	130
Balbinya HS	1	1	121	0.9	9	130
Booanya HS	1	1	121	0.9	9	130
Boorabbin	1	0.5	61	0.3	3	64
Yellowdine	1	0.5	61	0.3	3	64
TOTAL	**5**	**4**	**$485**	**3.3**	**$33**	**$518**

Table 8. Cost estimate for initial control of Pepper Tree

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Booanya	64	6	728	8	123	851
Cocklebiddy	100	6	728	1	19	747
Coolgardie	1000	10	1213	12	192	1405
Kalgoorlie	2000	10	1213	24	384	1597
TOTAL	**3164**	**32**	**$3882**	**45**	**$718**	**$4600**

Table 9. Cost estimate for initial control of Ruby Dock

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Coolgardie	150	8	970	5	45	1015
Norseman	300	8	970	9	90	1060
Transline	2600	20	2426	78	780	3206
Kalgoorlie	2700	8	970	81	810	1780
TOTAL	**5750**	**44**	**$5337**	**173**	**$1725**	**$7062**

Table 10. Cost estimate for initial control of Gazania

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Marvel Loch	50	4	485	1	6	491
Southern Cross	200	4	485	2	24	509
Norseman	400	10	1213	5	48	1261
Coolgardie	600	10	1213	7	72	1285
Kambalda	900	4	485	11	108	593
Kalgoorlie	1600	10	1213	19	192	1405
TOTAL	**3750**	**42**	**$5095**	**45**	**$450**	**$5545**

Table 11. Cost estimate for initial control of Buffel Grass

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Goldfields Hwy	100	10	1213	4	38	1251
Great Eastern Hwy	250	25	3033	9	94	3126
Kalgoorlie	3600	10	1213	54	540	1753
TOTAL	**3950**	**45**	**$5459**	**67**	**$671**	**$6130**

Table 12. Cost estimate for initial control of Bathurst Burr, Saffron Thistle and Horehound on Credo PCP

Population	Area (ha)	Person days total	Salary total ($)	Herbicide total (L)	Herbicide total ($)	Salary + herbicide ($)
Credo Station	3200	40	4852	38	384	5236
TOTAL	**3200**	**40**	**$4852**	**38**	**$384**	**$5236**
Note: As GWW-wide data for pastoral weeds is unavailable, Credo PCP (ex-pastoral now managed by DEC) has been used as an example for costing of pastoral weed control. DEC carried out weed mapping on Credo PCP in 2009; Bathurst Burr, Horehound and Saffron Thistle are common across the southern end of the reserve.						

Weed control information

Principles of weed management

Weed control must be seen as comprising of three phases: initial, follow-up and long-term maintenance phase. The ultimate objective must be to rehabilitate affected areas back to indigenous vegetation, which then retards the recolonisation by weed species Successful weed control is a long-term effort because almost all weeds can rapidly re-colonize affected areas after initial clearance. Weeds will resprout from the stumps of cut trees and plants, germinate from seeds buried in the soil and disperse back into the area from adjacent, uncontrolled populations.

Efforts at control must be properly planned and budgetary constraints taken into consideration, because they are expensive. There are many examples of efforts that have failed not because of lack of good intentions, but because efforts have been misdirected in terms of incorrect priorities, untimely delays in follow-up, and ultimately the drying up of funding. Initial control is usually the most expensive phase in terms of labour-related costs, because of the density of the plants and the volume of material that must be removed either by stacking and or burning. The first follow-up can also be costly in terms of herbicide costs, if there is mass germination of seeds buried in the ground. Obviously the older the infestation, the more seeds there will be. Follow-up control should be continuous and timely.

Herbicides registered for priority weeds

Table 13 shows the herbicides registered in WA for priority weed species as per the Australian Feral Pest and Veterinary Medicines Authority (APVMA) PUBCRIS database (accessed Jan 2013). A herbicide needs to be registered for the species it is being used on and in the state where it is being used. If a herbicide is not registered for a particular species or state, the APVMA may grant an off-label permit for its use. Contact the APVMA for details www.apvma.gov.au. Always read herbicide labels thoroughly and apply as per label instructions.

Table 13. Herbicides registered for use in WA on priority species

Species	Herbicide
Cylindropuntia spp.	MSMA is registered for use on Devils Rope (*Cylindropuntia imbricata*) only in WA. No off-label APVMA permits currently exist in Australia for *Cylindropuntia* spp.
Opuntia spp.	Monosodium methylarsonate, picloram + triclopyr and triclopyr are registered for use on *Opuntia* spp. in WA. A current off-label APVMA permit exists for the use of glyphosate on *Opuntia* spp. in SA.
Tamarix spp.	As of end 2012, no herbicides were registered specifically for *Tamarix* spp in Australia. Current off-label APVMA permits exist for the use of fluroxypyr and triclopyr on Athel Pine (*Tamarix aphylla*) in the NT.
Mother-of-Millions	Fluroxypyr, picloram + triclopyr and 2, 4-D are registered for use on Mother-of-Millions in WA. No off-label APVMA permits currently exist in Australia for Mother-of-Millions.
African Boxthorn	Aminopyralid + picloram + triclopyr, glyphosate, hexazinone, oxyfluorfen, picloram, picloram + triclopyr, tebuthiuron, triclopyr, 2,4-D, 2,4-D + picloram and 2,4-D + triclopyr are registered for use on African Boxthorn in WA. No off-label APVMA permits currently exist in Australia for African Boxthorn.
Bridal Creeper	As of Jan 2013, no herbicides were registered specifically for Bridal Creeper in Australia and no current off-label APVMA permits exist.
Pepper Tree	As of Jan 2013, no herbicides were registered specifically for Pepper Tree in Australia and no current off-label APVMA permits exist.
Ruby Dock	As of Jan 2013, no herbicides were registered specifically for Ruby Dock in Australia and no current off-label APVMA permits exist.
Gazania	As of Jan 2013, no herbicides were registered specifically for Gazania in Australia and no current off-label APVMA permits exist.
Buffel Grass	Diquat and paraquat. An off-label permit exists for use of fluproponate, fluazifop-p and

	glyphosate in NSW, SA, WA, QLD and ACT only.
Bathurst Burr	Many herbicides are registered for use on Bathurst Burr in WA – see APVMA website.
Horehound	Many herbicides are registered for use on Horehound in WA – see APVMA website.
Paterson's Curse	Many herbicides are registered for use on Paterson's Curse in WA – see APVMA website.
Saffron Thistle	Many herbicides are registered for use on Saffron Thistle in WA – see APVMA website.

Opuntia spp.

Cylindropuntia imbricata

Overview of control methods

Table 14. Summary of control methods

Type	Method	Description
Physical	Hand pulling / grubbing	Hand-pulling is useful for isolated occurrences of seedlings or other small, soft, non-bulbous weeds. Grubbing (digging out) is useful for larger plants. Hand pulling and grubbing is not recommended for plants with extensive root, tuber or rhizome systems. Try to minimize soil disturbance during hand-pulling and grubbing. Any seeds or fruiting material should be bagged, buried or burnt.
	Slashing / mowing	Slashing and mowing can be used as part of an integrated weed management program. It will not eradicate weeds, but can be used to suppress growth or prevent seeding (by removing the fruiting head of the plant). Slashing or mowing should be carried out prior to seed set and then followed up with another method of control such as foliar spraying. It is useful for grass weeds.
	Mechanical	Mechanical control involves using machinery to cut or uproot larger woody species. It is useful for dense populations of woody weeds. Mechanical control usually needs to be followed by some form of chemical control, e.g. foliar spraying. The volume of herbicide required following mechanical control is lower than what it would have been on the untreated population.
	Grazing	Grazing can reduce weed spread by preventing seeding and stressing and trampling the plants. The weed species needs to be palatable to livestock and grazing carried out at the right stage in the species lifecycle.
Chemical	Foliar spray	Foliar spraying is the application of herbicides usually diluted with water at a specific rate onto the foliage of plants using spray equipment. It is a highly effective method. There is a risk of off-target damage and this method should not be used during rainy or windy conditions.
	Cut stump	This involves cutting (e.g. with a chainsaw, loppers or saw) the stem or trunk of the plant as close to the ground as possible, then painting herbicide onto the sapwood layer of the exposed surface. The herbicide needs to be applied within 10 seconds before the plant cells begin to close over.
	Frill / drill and fill	Frill and fill involves cutting a downwards 45° slice into the trunk of the plant and applying herbicide to the inner exposed surfaces. Drill and fill, or stem injection, involves drilling a downwards 45° hole into the trunk and applying herbicide to the hole. The aim is to get the herbicide into the sapwood tissue. For larger trees, this method is less intensive than mechanical or cut stump control and there is no off-target damage. The herbicide needs to be applied within 10 seconds before the plant cells begin to close over.
	Scrape and paint	This method is useful for wine and scrambling plants with a woody stem. Use a knife to scrape a 20 mm to 1 m length of bark off to expose the sapwood. Apply the herbicide to the exposed surface. The herbicide needs to be applied within 10 seconds before the plant cells begin to close over.
	Basal bark	Basal barking involves mixing an oil-soluble herbicide with diesel and spraying the full circumference of the trunk. It is effective only for plants with a stem diameter <5 cm. Bark thickness can be a factor affecting absorption of the herbicide.
Fire		Many native plant communities are tolerant of fire whilst many weed species are not. The use of fire for weed control depends on many factors including the response of the weed to burning, habitat, the fire regime employed and the time of year.
Biocontrol		Biocontrol uses organisms from the weed species native range that are specific to, and live off, the plant. Biocontrol agents are usually invertebrate or fungal species. Biocontrol is useful for larger weed populations, as small, low density populations will not support the agent. Biocontrol often does not eradicate the weed species, but suppresses its growth and spread. It is useful as part of an integrated weed management program.
Hygiene		The aim of weed hygiene is to prevent weed seed spread. When working in infested areas, weed seed should be removed from clothing, boots, vehicles, machinery and tools before moving to clean areas.
Note: Description of control methods adapted from *Natural Heritage Trust Weed CRC Management Introductory Weed Management Manual.*		

Control options for priority weeds

Table 15. Control options for priority weeds

Species	Fire	Physical				Chemical				Biocontrol		
		Slash / mow	Cultivate	Hand pull / grubbing	Grazing	Chemical foliar spray	Cut stump	Scrape and paint	Basal bark	Approved biocontrol target	Agents available	Suited to GWW climate
Cylindropuntia spp.	■		■	■		■			■	■		
Opuntia spp.	■		■	■		■			■	■	■	
Tamarix spp.			■			■	■		■			
Mother-of-Millions	■			■		■				■		
African Boxthorn	■		■			■	■		■			
Bridal Creeper						■		■		■	■	■
Pepper Tree						■	■					
Ruby Dock				■		■						
Gazania				■	■	■						
Buffel Grass		■		■		■						
Bathurst Burr	■	■				■				■		
Horehound	■	■		■		■				■	■	
Paterson's Curse				■		■				■		
Saffron Thistle	■	■				■				■		
Note: When manually removing *Cylindropuntia* spp., *Opuntia* spp. and Mother-of-Millions, plants should be buried at depth to avoid segments reshooting.												

Weed resources for land managers

General weed

Hussey BMJ, Keighery GJ, Dodd J, Lloyd SG and Cousens RD, 2007. *Western Weeds: A guide to the weeds of Western Australia*, Ed 2. The Weed Society of Western Australia, Victoria Park WA.

Declared Plant Control Handbook: Recommendations for the Control of Declared Plants in WA, 7th Edition (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/decplants_handbook.pdf

Common Regional Feral animals of WA (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/commregpestbulletinnew.pdf

Cylindropuntia spp.

Opuntioid Cactus Strategic Plan (Weeds of National Significance)
http://www.weeds.org.au/WoNS/opuntioidcacti

Jumping Cholla Cactus 'Solarisation' as a Control Option (DAFWA Rangelands Memo)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/regions/nrr/rangelands_memo_april2012.pdf

Opuntia spp.

Opuntia spp. (DAFWA Factsheet)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/prickly_pear.pdf

Opuntioid Cactus Strategic Plan (Weeds of National Significance)
http://www.weeds.org.au/WoNS/opuntioidcacti/

Tamarix spp.

National *Tamarix* spp. Best Practice Management Manual
http://www.weeds.org.au/WoNS/athelpine

Tamarix spp. Weed Management Guide (WoNS)
http://www.environment.gov.au/biodiversity/invasive/weeds/publications/guidelines/wons/pubs/t-aphylla.pdf

Tamarix species – how to tell the difference (NT Government)
http://www.weeds.org.au/WoNS/athelpine/docs/Tamarisk_ID_final.pdf

Mother-of-Millions

Mother-of-Millions (Weeds Australia)
http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tplandcard=H14

Mother-of-Millions (QLD DAFF Factsheet)
http://www.daff.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Mother-Millions-PP33.pdf

African Boxthorn

African Boxthorn National Management Guide
http://www.weeds.org.au/WoNS/africanboxthorn

South Coast NRM is winning the war against African boxthorn (South Coast NRM)
http://www.southcoastnrm.com.au/files/1/files/Winning%20Boxthorn%20war%20-%20May%2025.pdf

Bridal Creeper

Bridal Creeper Strategic Plan (WoNS)
http://www.weeds.org.au/docs/bcstrat.pdf

Bridal Creeper Best Practice Manual (WoNS)
http://www.weeds.org.au/WoNS/asparagusweeds

Bridal Creeper, declared plant in WA (DAFWA)
http://www.agric.wa.gov.au/dps/version02/01_plantview.asp?page=3andcontentID=87and

Pepper Tree

Pepper Tree Factsheet (Biosecurity QLD)
http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Schinus_molle_var._areira.htm

Ruby Dock

Ruby Dock (Weeds Australia)
http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tplandstate=ands=andibra=allandcard=H87

Ruby Dock Factsheet (Biosecurity QLD)
http://keyserver.lucidcentral.org/weeds/data/03030800-0b07-490a-8d04-0605030c0f01/media/Html/Acetosa_vesicaria.htm

Gazania

Gazania (Weeds Australia)
http://www.weeds.org.au/cgi-bin/weedident.cgi?tpl=plant.tplandcard=E18

Gazania Weed Management Guide (Adelaide and Mount Lofty NRM Board)
http://www.amlrnrm.sa.gov.au/Portals/2/pest_plants/Factsheets/GAZANIA_factsheet_lr.pdf

Buffel Grass

Buffel Grass Weed Management Guide (CRC for Weed Management)
http://www.southwestnrm.org.au/sites/default/files/uploads/ihub/weeds–crc–2008–buffel–grass–cenchrus–ciliaris.pdf

Buffel Grass Management Guide for Central Australia (NT Government)
http://lrm.nt.gov.au/__data/assets/pdf_file/0014/19211/buffel_guide_web_version.pdf

SA Buffel Grass Strategic Plan (2012 – 2017)
http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/177656/91806_SA_Buffel_Grass_Strat_Plan_FIN_WEB.pdf

Bathurst Burr

Bathurst Burr (DAFWA Farmnote)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/fn_bathurst_burr_2012.pdf

Horehound

Horehound (DAFWA Farmnote)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/horehound.pdf

Paterson's Curse

Paterson's Curse (DAFWA Farmnote)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/patersons_curse_fn.pdf

How to control Paterson's Curse (DAFWA Farmnote)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/fn2006_paterson_control.pdf

Saffron Thistle

Saffron Thistle (DAFWA Farmnote)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/weed/decp/saffronthistle.pdf

Weed hygiene in mining

Draft Guidelines for Environmentally Responsible Mineral Exploration and Prospecting in WA (DMP) http://www.dmp.wa.gov.au/834.aspx

Code of Practice Booklet on weed and Plant disease hygiene for machinery in the civil construction industry (Civil Contractors Federation)
http://www.civilcontractors.com/Uploads/files/LR%20CCF%20Machinery%20Hygiene%20Bklt%2040pp.pdf

GREAT WESTERN WOODLANDS STRATEGIC FERAL ANIMAL MANAGEMENT PLAN

STRATEGIC FERAL ANIMAL MANAGEMENT PLAN

Introduction

Feral animals are a potential threat to biodiversity and cultural values of the GWW. Feral predators impact on biodiversity primarily through predation of, and competition with, native fauna species. Impacts of feral herbivores on biodiversity can include grazing and trampling of native vegetation, destruction of native fauna habitat, soil disturbance and erosion, changes to hydrology, damage to and fouling of waterbodies and spread of weed seed and disease. Feral animals may impact on Aboriginal cultural values, e.g. ceremonial, burial or artifact sites, by trampling, damaging, eroding or fouling sites. Feral animal impacts to European cultural values can include reduced productivity of pastoral land, damage to infrastructure, and damage and loss of aesthetics at historical sites. This GWW Strategic Feral Animal Management Plan has been developed in response to a recognised need for a coordinated approach to feral animal management across the GWW. This plan pulls together what is known about feral animals in the GWW and makes a desktop assessment of feral animal threats and management options.

Aims and objectives

Through its implementation, this GWW Strategic Feral Animal Management Plan aims to minimise, where possible, the impact of feral animals on biodiversity and cultural values of the GWW. Specific objectives are to;

1. Map the distribution of feral animal species across the GWW
2. Identify impacts of feral animal to biodiversity and cultural values of the GWW
3. Identify management options for feral animals

Statutory requirements

Agriculture and Related Resources Protection Act 1976

Land holders / managers in WA have a legal requirement to manage feral animals declared under the ARRP Act. Declared species are classified A5–A7 under the Act. These rankings reflect management requirements and are summarised below.

A1 – Entry prohibited
A2 – Subject to eradication in the wild
A3 – Keeping prohibited
A4 – Entry subject to permits and/or conditions
A5 – Numbers to be reduced/controlled
A6 – Keeping subject to permits and/or conditions
A7 – A management program for each species outlines the area and conditions under which controls may be applied. Programs are for the whole of the State or as indicated for each species.

ARRP Act Declared Animals List

http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/declared_animals.pdf

DEC, as well as being responsible for feral animal control on conservation reserves, is responsible for feral animal control on UCL, under a Memorandum of Understanding with the Department of Regional Development and Lands.

Biosecurity and Agriculture Management Act 2007

The ARRP Act is due to be replaced by the *Biosecurity and Agriculture Management Act 2007* in 2013. The declared animals list will be replaced by the Western Australian Organism List. The declaration of some feral animal species may change under the new legislation.

Biosecurity and Agriculture Management Act 2007 (DAFWA)
http://www.agric.wa.gov.au/PC_93122.html?s=0

Mapping method

The information available regarding feral animal occurrences in the GWW was largely anecdotal with only a limited amount of spatial data. A grid system was used to map feral animal occurrences across the GWW. Using GIS software, a 10 km^2 grid was overlaid onto the GWW map and feral animal occurrences manually digitized based on where DEC Goldfields, Esperance District and Central Wheatbelt District staff had observed or presumed them to be. Feral animal densities for the GWW are unknown and difficult to estimate, as is the case for much of Australia. Some published studies have attempted to estimate feral animal population densities for certain parts of Australia. Some of these density values are quoted in the 'Distribution in the GWW' section for each species, to give an idea of the potential density that feral animals may be occurring at in the GWW.

Feral animal populations in the GWW

Table 16. Feral animals populations in the GWW

Common name	Species name	ARRP Act	EPBC Act	Occurrence	Population area (≈ha)	Responsible land manager	Total area (≈ha)
Wild dog	*Canis* spp.	A5 in pastoral / agricultural areas	–	Presumed all of GWW	16,000,000	All land managers	16,000,000
Cat	*Felis catus*	Excluded from declaration	Key Threatening Process	Presumed all of GWW	16,000,000	All land managers	16,000,000
Fox	*Vulpes vulpes*	A5	Key Threatening Process	Presumed all of GWW	16,000,000	All land managers	16,000,000
Goat	*Capra hircus*	A4, A5 and A6	Key Threatening Process	Pastoral cell surrounding Kalgoorlie	1,380,000	Pastoral, DEC Goldfields, Shire of Coolgardie and City of Kalgoorlie-Boulder	1,380,000
Donkey	*Equus asinus*	A4, A5 and A6	–	Credo PCP (northern part)	90,000	DEC Goldfields	720,000
				Cave Hill and surrounding area	280,000	DEC Goldfields	
				Koolyanobbing – Bullfinch area	350,000	Pastoral, DEC Goldfields and Central Wheatbelt and Shire of Yilgarn	
Horse	*Equus callabus*	A5 in pastoral / agricultural areas	–	Norseman	40,000	DEC Esperance and Shire of Dundas	890,000
				Bullabulling Station – Kangaroo Hills TR area	120,000	DEC Goldfields, pastoral and Shire of Coolgardie	
				Mt Jackson and ex-Diemals Stations	250,000	DEC Goldfields	
				Balladonia Rd area	480,000	DEC Esperance and Balladonia Station	
Wild Cattle	*Bos* spp.	Excluded from declaration	–	Credo PCP (southern part)	290,000	DEC Goldfields	1,190,000
				Mt Jackson – Mt Manning area	900,000	DEC Goldfields	
Camel	*Camelus dromedarius*	A4, A5 and A6	–	Northwestern GWW	1,960,000	DEC Goldfields, pastoral and Shires of Coolgardie and Yilgarn	9,130,000
				Eastern GWW	7,170,000	DEC Goldfields and Esperance, pastoral, City of Kalgoorlie-Boulder, Shires of Coolgardie, Dundas and Esperance	
Rabbits*	*Oryctolagus cuniculus*	A5 when at large or running wild	Key Threatening Process	Presumed all of GWW	16,000,000	All land managers	16,000,000
House Mouse*	*Mus musculus*	Excluded from declaration	–	Presumed all of GWW	16,000,000	All land managers	16,000,000
Black rat*	*Rattus rattus*	Excluded from declaration	–	Presumed all of GWW	16,000,000	All land managers	16,000,000
European honeybee*	*Apis mellifera*	Not listed	–	Presumed all of GWW	16,000,000	All land managers	16,000,000

* Rabbits, mice, rats and European honeybees are not addressed in this plan due to the low feasibility of control for these species. It is presumed that rabbit populations are being suppressed as much as is practically possible in the GWW through biocontrol, i.e. the myxoma virus and calicivirus.

Feral predators

Feral predators occurring in the GWW include wild dogs (*Canis* spp.), cats (*Felis catus*) and foxes (*Vulpes vulpes*). Under the ARRP Act, wild dogs (*Canis lupis familiaris*) (when running wild in pastoral and agricultural areas) and dingo-dog hybrids (*Canis lupis dingo* x *Canis lupis familiaris*) are declared A5 (numbers to be reduced / controlled) and dingoes (*Canis lupis dingo*) A7 (subject to specific management plans). For the purpose of this plan, a wild dog is defined as any non-domesticated dog. Under the ARRP Act, foxes are declared A5 and cats are excluded from declaration.

Wild dogs

Distribution in the GWW

Wild dogs are presumed to occur throughout the whole of the GWW. Wild dog densities are unknown for the GWW and are likely to fluctuate with environmental conditions and food and water availability. Wild dog density in the Fortescue River area of the Pilbara was estimated to be just over 20 dogs per km^2 (excluding pups) during a period of presumed adequate food supply and no control work (DAFWA, 2005). Densities were estimated to be lower in more arid, inland areas due to lower abundance of food and water. A PhD study (Stephens, 2012) of wild dog genetics in Australia has shown wild dogs in the GWW region to be less hybridised with a relatively high level of dingo purity. In general, across Australia, wild dogs closer to major townships were more hybridised; this likely to be true for wild dogs near major townships of the GWW (pers. comm. Ross Woods), e.g. Kalgoorlie, Southern Cross and Norseman. The distribution of wild dogs in the GWW is shown in Fig. 16 'Feral Predator Distribution'.

Impacts

Pastoral operations in the GWW, particularly those with sheep, are impacted by wild dogs through stock losses. Elevated numbers of wild dogs are not desirable for conservation purposes either as it can lead to over predation of native prey species. Though in some areas wild dogs may be helping to suppress kangaroo populations that are unnaturally high due to the presence of artificial water points. Feral predator relationships are not well understood for GWW as is the case for the rest of Australia, but it is possible that wild dogs may be suppressing cat and fox numbers within the GWW to some extent, thereby relieving some predation pressure on native fauna species.

Management

The *Western Australia Wild Dog Management Strategy* (DAFWA, 2005) guides wild dog management in WA. The state is split into zones and wild dog management within each zone is carried out by the relevant Biosecurity Groups. Most of the GWW falls into Zone 9 (Kalgoorlie Zone). Wild dog management within this zone is guided by the *Zone 9 Control Authority Regional Wild Dog Management Plan*. Within the GWW, the GNRBG, Northern Mallee Declared Species Group and DEC are responsible for implementing wild dog control.

The primary objective of dog control in Zone 9 (and by default the GWW) is stock protection. The plan requires that pastoral managers control dogs within their boundaries and pastoral neighbours maintain a dog free buffer along adjacent land of 10 km for cattle and 15 km for sheep. About 17.5% of the GWW is stocked; this includes the cell of pastoral stations surrounding Kalgoorlie, the northwest pastoral block (Ex-Diemals, Mount Jackson, Kawana, Ennuin and Brontie Stations) Fraser Range and Southern Hills towards the east and the western edges of some Nullarbor stations (Balladonia, Noondoonia, Woorlba, Koonjarra and Boonderoo Stations). Unstocked land comprises at least 75% of the GWW; 58.9% of this is UCL and 16.1% conservation reserve. DEC has a requirement to manage wild dogs in buffer areas on these lands.

Western Australia Wild Dog Management Strategy 2005 (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/ddf/farmers_sm.pdf

DEC has been conducting wild dog control within pastoral buffers since 2003. Dogs are controlled using predominantly 1080 baits (laid by vehicle and aerially), but also with strychnine and steel jaw traps in some areas. Dog control methods are carried out as per the *Wild Dog Management Best Practice Manual* (DAFWA, 2006). Four contract doggers are employed for areas that incorporate the GWW; one each for the Kalgoorlie, Nullarbor, Esperance and western Wheatbelt areas. As much of the pastoral and agricultural interface is baited as possible; the only areas not baited is where access is problematic. Doggers check and rebait buffers every 6–8 weeks by vehicle. Steel jaw traps and strychnine are used along the eastern boundary of the Kalgoorlie pastoral cell (i.e. Yindi, Avoca Downes and Cowarna Downs) and the Vermin Proof Fence. Aerial baiting is carried out 1–2 times per year on pastoral land and in buffers. Aerial baiting is usually conducted in late autumn coinciding with mating and early pregnancy, and in early spring when pups are beginning to move about. The location of dogging activities in the GWW is shown in Fig. 17 'Wild Dog Control'. Dogging activities are also carried out along the Vermin Proof Fence (the southwest boundary of the GWW), but are not shown on this map.

Cats and foxes

Distribution in the GWW

Cats and foxes are addressed here together as the distribution, impact and management of these species is similar. Cats and foxes are presumed to occur throughout the whole of the GWW, though densities are unknown and probably fluctuate with environmental conditions and changes to food and water availability. Studies of cat and fox densities have not been attempted for the GWW with the exception of the Mount Jackson Range area (detailed under 'Management' below). Cat and fox densities across Australia vary greatly with habitat. Cats have been recorded in the Gibson Desert in WA at densities of 0.03/km^2 during drought and 0.13/km^2 during a non-drought period (Burrows and Christensen, 1994). At a rubbish dump outside of Canberra, they were recorded in densities of 90/km^2 (Wilson et al. 1994). Foxes have been recorded in densities ranging from 0.5/km^2 in semi-arid grazing land in WA (Marlow, 1992) to 16/km^2 in suburban Melbourne (Marks and Bloomfield, 1999). From these studies we can infer that cats and foxes in the GWW probably occur in higher densities around townships and lower densities in more remote undisturbed areas where food and water is scarcer. Feral predator relationships are not well understood for the GWW, but it is likely that dogs are

suppressing cat and fox numbers to some extent. The distribution of cats and foxes in the GWW is shown in Fig. 16 'Feral Predator Distribution'.

Impacts

The primary impact of cats and foxes in the Australian landscape is the predation of, and competition with, native fauna. The vertebrate fauna of the Coolgardie Bioregion, which comprises more than 80% of the GWW, is in a degraded to fair condition (McKenzie et al., 2002). The mammal fauna of this bioregion has experienced the worst decline with more than 40% of the original assemblage now regionally extinct (McKenzie et al., 2002). The situation is similar for the Mallee Bioregion, which comprises a further 16% of the GWW (McKenzie et al., 2002). Feral predators, notably cats and foxes, are one of the factors that have contributed to this decline. Critical weight range mammals (i.e. those weighing 35–5500g) are most susceptible to predation by cats and foxes. All native fauna species recorded in the GWW and potentially impacted by cat and fox predation are listed in Appendix 6. Threatened and priority species occurring or potentially occurring in the GWW and impacted by cat and fox predation are listed in Table 17 below. Threatened species confirmed as occurring in the GWW that are most susceptible to cat and fox predation are the Chuditch (*Dasyurus geoffroii*) and Malleefowl (*Leipoa ocellata*). The Chuditch, listed as Vulnerable under the WC Act and EPBC Act, has been recorded in the west and southwestern parts of the GWW over the last 20 years and most recently in 2010. The Chuditch along with the Echidna (not threatened) are the only critical weight range mammals known to occur in the GWW at present. The Malleefowl, listed as Vulnerable under the WC Act and EPBC Act, has been recorded consistently in GWW since 1908. Being a ground-dwelling species, the Malleefowl is particularly vulnerable to cat and fox predation.

Management

At present the control techniques do not exist to remove cats and foxes entirely from the landscape. Cat and fox baits have been developed and can be used to bait areas where populations of native prey species are known to occur. The Mount Jackson Range area, in the proposed ex-Mount Jackson Conservation and Mining Reserve (CMR) north of Koolyanobbing, is the only site in the GWW where active management of cats or foxes is being carried out. Cliffs Iron Ore Asia Pacific, who conduct mining operations in the area, in conjunction with DEC, began cat baiting in 2004 as a condition of their mining approval. The aim of this cat baiting is to protect Malleefowl known to occur in the area. The baiting is funded by Cliffs and coordinated by DEC Goldfields Region. The Mount Jackson Range area is baited aerially once a year with 1080 Eradicat baits. Baiting is carried out during winter when food is scarcer and cats are more likely to take baits. DEC conducts cat population density surveys before and after each aerial bait drop. Presence of cats is detected using a sand pad method and density is measured as an index. The data collected suggests that cat populations decline following baiting, but that they also recover by the time the next baiting is carried out. In general, monitoring the response of cat or fox populations to baiting is difficult as populations fluctuate naturally with environmental conditions and it can be difficult to distinguish the impact of baiting. Since baiting commenced, there has been an increase in Malleefowl sightings in area by Cliffs staff (pers. comm. Sandra Thomas[8]).

[8] Sandra Thomas – Senior Environmental Officer, DEC Environmental Management Branch

Table 17. Priority and threatened fauna occurring in the GWW and likely to be threatened by cats and foxes

Group	Scientific Name	Common name	Priority	WC Act	EPBC Act	Occurrence in GWW (Note: recent = last 10 years, i.e. after 2003)
Birds	*Ardeotis australis*	Australian Bustard	4	–	–	Recorded consistently across the GWW since 1977.
	Charadrius rubricollis	Hooded Plover	4	–	–	Two records in 1905 and then 6 records from 1995–2003 from various locations across GWW. Ground-nesting species.
	Falcunculus frontatus subsp. leucogaster	Crested Shrike-tit	4	–	–	Three records for the GWW. Last recorded 1985 in Dundas NR. A tree-top nesting species.
	Hylacola cauta subsp. whitlocki	Shy Heathwren	4	–	–	Recorded across the western half of GWW. All recent records are from Forrestania area.
	Leipoa ocellata	Malleefowl	–	VU	VU	Recorded across much of GWW; less so towards eastern parts. Recorded consistently in the GWW from 1908 through to 2012.
	Oreoica gutturalis subsp. gutturalis	Crested Bellbird	4	–	–	Occurs in the more northern and western parts of the GWW. A ground feeder; rarely perches high.
	Pezoporus flaviventris	Western Ground Parrot	–	CR	EN	Known to occur in Cape Arid NP. Not recorded in GWW. Possible but unlikely to occur in the GWW. A ground-nesting species.
	Platycercus haematogaster subsp. narethae	Naretha Blue Bonnet	–	S	–	Recorded in 1984 10 km west of Caiguna. A hollow-nesting species.
	Pomatostomus superciliosus subsp. ashbyi	White-browed Babbler	4	–	–	Recorded across western half of GWW. Recent records from Southern Cross and Forrestania area. It nests in tree forks.
	Psophodes nigrogularis subsp. oberon	Western Whipbird	4	–	–	Recorded in southwest corner of GWW in 2000 and 2001. A ground-nesting species.
Mammals	*Dasyurus geoffroii*	Chuditch / Western Quoll	–	VU	VU	Historical records (>10 years) mostly from western parts of GWW. Recent records from Beringbooding Rock (wheatbelt) and the Forrestania area.
	Macropus irma	Western Brush Wallaby	4	–	–	Occurs in the southwest GWW. All recent records are from the Forrestania area.
	Myrmecobius fasciatus	Numbat	–	VU	VU	Known to occur in Karroun Hill NP during 1980–90's. A baiting and release program was attempted here unsuccessfully. The population has since disappeared. Limited records for the GWW; most recent in 2001 in the McDermid Rock area (Hyden-Norseman Rd). Probably locally extinct.
	Phascogale calura	Red-tailed Phascogale	–	EN	EN	One sub-fossil record from a Nullarbor cave only. Occurrence in GWW is possible.
	Pseudomys occidentalis	Western Mouse	4	–	–	Recorded in the southwest GWW; two records since 1995.
	Pseudomys shortridgei	Heath Rat	–	VU	VU	Not recorded in the GWW. May occur in the southwest corner, but probably not.
Reptiles	*Acanthophis antarcticus*	Southern Death Adder	3	–	–	Recorded only at Caiguna in 1971 and Booanya Rock pre-1950's.
	Aspidites ramsayi	Woma Python	–	S	–	All records pre-1968. Possibly occurs, but probably locally extinct.
	Morelia spilota subsp. imbricata	Carpet Python	4	–	–	Occurs through most of the GWW.
	Paroplocephalus atriceps	Lake Cronin Snake	3	–	–	Occurs in the southwest of the GWW.
Note: CR = Critically endangered, EN = Endangered, VU = Vulnerable, S = Schedule 4 Other specially protected fauna						

Feral herbivores

Feral herbivores occurring in the GWW include goats (*Capra hircus*), donkeys (*Equus asinus*), wild horses (*Equus callabus*), wild cattle (*Bos spp*.) and camels (*Camel dromedarius*). Under the ARRP Act, goats, donkeys and camels are listed A4 (entry subject to permits and / or conditions), A5 (numbers to be reduced / controlled) and A6 (keeping subject to permits and / or conditions). Horses are declared A5 when running wild in pastoral or agricultural areas, rabbits A5 when at large or running wild and wild cattle are excluded from declaration.

Feral herbivore threats to native vegetation

PECs and threatened flora occurring within the range of feral herbivores in the GWW are listed in Tables 19 and 20 respectively below. Priority flora was not assessed as hundreds of species fall within the ranges of feral animals in the GWW. There are no threatened ecological communities in the GWW, as listed under the WC Act or EPBC Act. To assess the impact of feral herbivores on PECs and populations of threatened flora, the condition of these populations and communities was assessed. Condition was ranked using the DEC Vegetation Condition Scale, modified from Trudgen (1991) by B. J. Keighery for the Swan Coastal Plain Survey 1993. The DEC Vegetation Condition Scale rankings are described in Table 18 below. Populations and communities ranked as 'pristine' are the least disturbed, while those ranked as 'completely degraded' are the most disturbed. Rankings were assigned subjectively to PECs and threatened species populations according to the advice of Jennifer Jackson[9], Dave Pickles[10] and Julie Waters[11]. Information was also sourced from the DEC species Recovery Plan if one was available. If populations or communities were identified as being degraded, then the contribution to this by feral herbivores was assessed.

Table 18. DEC Vegetation Condition Scale

Ranking	Condition of vegetation
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. For example, damage to trees caused by fore, the presence of non-aggressive weeds and occasional vehicle tracks.
Very good	Vegetation structure altered and obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance top vegetation structure caused by very frequent fire, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely degraded	The structure of the vegetation is no longer intact and the areas is completely or almost completely without native e species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.
Note: Scale modified from Trudgen 1991 by B. J. Keighery for the DEC Swan Coastal Plain Survey 1993).	

[9] Jennifer Jackson – Flora Conservation Officer, DEC Goldfields Region
[10] Dave Pickles – Ex–Environmental Impact Assessment Coordinator, DEC Goldfields Region
[11] Julie Waters – Acting Conservation Officer (Flora and Fauna), DEC Esperance District

Table 19. PECs occurring within the ranges of feral herbivores in the GWW

Species	Population	PEC	Ranking	Location	Condition of PEC
Goat	Kalgoorlie pastoral cell	Mt Belches *Acacia quadrimarginea* / *Ptilotus obovatus* Banded Ironstone community	Priority 3	Randalls Timber Reserve (TR)	Good. PEC exists within a grazed area – goats probably contributing to degradation.
Donkey	Koolyanobbing – Bullfinch area	Koolyanobbing vegetation complex	Priority 1	Brontie Station	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from donkeys are not obvious.
		Highclere Hills (Mayfield) vegetation complex banded iron formation	Priority 1	30 km NW of Bullfinch	Unknown.
Wild horse	Mt Jackson and ex-Diemals Stations	Die Hardy Range / Diemals vegetation complex banded iron formation	Priority 1	Die Hardy Range, Proposed Die Hardy Range Class 'A' NR	Excellent – pristine. Any impacts from wild horses are not obvious.
		Mt Jackson Range vegetation complexes banded iron formation	Priority 1	Mt Jackson Range, Mt Manning – Helena Aurora CP	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from wild horses are not obvious.
		Windarling Ranges vegetation complex banded iron formation	Priority 1	Windarling Range, Proposed ex-Mt Jackson Conservation and Mining Reserve	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from wild horses are not obvious.
Wild cattle	Mt Jackson – Mt Manning area	Die Hardy Range/Diemals vegetation complex banded iron formation	Priority 1	Die Hardy Range, Proposed Die Hardy Range Class 'A' NR	Excellent – pristine. Any impacts from wild cattle are not obvious.
		Finnerty Range vegetation complexes banded iron formation	Priority 1	Proposed ex-Jaurdi CP	Excellent – pristine. Any impacts from wild cattle are not obvious.
		Helena and Aurora Range vegetation complexes banded iron formation	Priority 1	Helena Aurora Range, Mt Manning – Helena Aurora CP	Excellent – pristine. Any impacts from wild cattle are not obvious.
		Lake Giles vegetation complexes banded iron formation	Priority 1	Lake Giles	Very good – excellent. Disturbance is associated with mining. Any impacts from wild cattle are not obvious.
		Mt Dimer vegetation complexes banded iron formation	Priority 1	Mt Dimer, Jaurdi PCP	Very good – excellent. Disturbance is associated with mining. Any impacts from wild cattle are not obvious.
		Mt Jackson Range vegetation complexes banded iron formation	Priority 1	Mt Jackson Range, Proposed ex-Mt Jackson Conservation and Mining Reserve	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from wild cattle are not obvious.
		Mt Manning Range vegetation complex banded iron formation	Priority 1	Mt Manning Range, Mt Manning CP	Excellent – pristine. Any impacts from wild cattle are not obvious.
		Windarling Ranges vegetation complex banded iron formation	Priority 1	Windarling Range, Proposed Die Hardy Range Class 'A' NR	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from wild cattle are not obvious.
Camel	Eastern GWW	Fraser Range vegetation complex	Priority 1	Fraser Range station	Good. Vegetation at the southern end of Fraser Range degraded from pastoral activity; the contribution of camels to this is probably negligible.
		Plant assemblages of the Southern Hills vegetation complex	Priority 1	Southern Hills station	Good. Vegetation on Southern Hills Station is degraded from pastoral activity; the contribution of camels to this is probably negligible.
		Woodline Hills vegetation complex	Priority 4	Proposed Woodline Hills NR	Excellent. Disturbance is associated with mining exploration. Any impacts from camels are not obvious.

Species	Population	PEC	Ranking	Location	Condition of PEC
					Surrounding areas have been grazed.
	Northwestern GWW	Die Hardy Range/Diemals Vegetation complex banded iron formation	Priority 1	Die Hardy Range, Proposed Die Hardy Range Class 'A' NR	Excellent – pristine. Any impacts from camels are not obvious.
		Finnerty Range Vegetation complexes banded iron formation	Priority 1	Jaurdi PCP	Very good – excellent. Disturbance is associated with mining. Any impacts from camels are not obvious.
		Helena and Aurora Range Vegetation complexes banded iron formation	Priority 1	Helena Aurora Range, Mt Manning – Helena Aurora CP	Excellent – pristine. Any impacts from camels are not obvious.
		Lake Giles Vegetation complexes banded iron formation	Priority 1	Lake Giles	Very good – excellent. Disturbance is associated with mining. Any impacts from camels are not obvious.
		Mt Dimer Vegetation complexes banded iron formation	Priority 1	Mt Dimer, Jaurdi PCP	Very good – excellent. Disturbance is associated with mining. Any impacts from camels are not obvious.
		Mt Jackson Range Vegetation complexes banded iron formation	Priority 1	Mt Jackson Range, Proposed ex-Mt Jackson Conservation and Mining Reserve	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from camels are not obvious.
		Mt Manning Range Vegetation complex banded iron formation	Priority 1	Mt Manning Range, Mt Manning CP	Excellent – pristine. Any impacts from camels are not obvious.
		Windarling Ranges Vegetation complex banded iron formation	Priority 1	Windarling Range, Proposed Die Hardy Range Class 'A' NR	Very good for areas not being mined. Disturbance is associated with mining. Any impacts from camels are not obvious.

Table 20. Threatened flora occurring within the ranges of feral herbivores in the GWW

Species	Population	Threatened flora	WC Act	EPBC Act	Location(s)	Population condition (in GWW)
Goat	Kalgoorlie pastoral cell	*Gastrolobium graniticum*	VU	EN	Known from seven populations in the Coolgardie and Midwest Regions.	Excellent. Any impacts from goats are not obvious.
Donkey	Koolyanobbing – Bullfinch area	*Tetratheca erubescens*	VU	–	Known only from Koolyanobbing.	Excellent. Any impacts from donkeys are not obvious.
Wild horse	Balladonia Rd	*Eremophila denticulata subsp. trisulcata*	EN	EN	Known from five localities over a range of 46 km north and northwest of Mt Ragged.	Unknown. Palatable species. Grazing and trampling by wild horses is a moderate threat.
	Mt Jackson and ex-Diemals Stations	*Ricinocarpos brevis*	CR	EN	Three of the five known populations occur on Windarling Range. The other five occur at Newdegate, outside the SW corner of the GWW.	Very good. Any impacts from wild horses are not obvious.
		Tetratheca paynterae subsp. cremnobata	VU	–	Known only from the Die Hardy Ranges.	Excellent – pristine. Any impacts from wild horses are not obvious.
		Tetratheca harperi	VU	VU	Known only from four populations on the Mt Jackson Range.	Excellent. Any impacts from wild horses are not obvious.
		Tetratheca paynterae subsp. paynterae	CR	EN	Known only from the Windarling Range.	Very good – good. Disturbance is associated with mining. Any impacts from wild horses are not obvious.
	Bullabulling Station – Kangaroo Hills TR area	*Gastrolobium graniticum*	VU	EN	Known from seven populations in the Coolgardie and Midwest Regions.	Excellent. Any impacts from wild horses are not obvious.
Wild cattle	Mt Jackson – Mt Manning area	*Myriophyllum lapidicola*	VU	EN	Known from six populations over 190 km range in the Mukinbuddin, Westonia, Yilgarn and Menzies area. Nominated for listing as Critically Endangered. GWW populations probably extinct.	Unknown.
		Leucopogon spectabilis	CR	CR	Known from four populations on the Helena Aurora Range.	Excellent – pristine. Any impacts from wild cattle are not obvious.
		Ricinocarpos brevis	CR	EN	Three of the five known populations occur on Windarling Range. The other five occur at Newdegate, outside the SW corner of the GWW.	Very good. Disturbance is associated with mining. Any impacts from wild cattle are not obvious.
		Tetratheca aphylla subsp. aphylla	VU	VU	Known only from the Helena Aurora Range.	Excellent. Any impacts from wild cattle are not obvious.
		Tetratheca harperi	VU	VU	Known from four populations on the Mt Jackson Range.	Excellent. Any impacts from wild cattle are not obvious.
		Tetratheca paynterae subsp. cremnobata	VU	–	Known only from the Die Hardy Ranges.	Excellent – pristine. Any impacts from wild cattle are not obvious.
		Tetratheca paynterae subsp. paynterae	CR	EN	Known only from the Windarling Range.	Very good – good. Disturbance is associated with mining. Any impacts from wild cattle are not obvious.

Species	Population	Threatened flora	WC Act	EPBC Act	Location(s)	Population condition (in GWW)
Camel	Eastern GWW	*Darwinia sp. Mt Heywood*	VU	–	Known only from Mt Heywood in the southeast GWW.	Unknown. Very spiky – unlikely to be grazed.
		Daviesia microcarpa	CR	EN	Known from two populations; one at Norseman and another at Southern Cross.	Unknown. Very spiky – unlikely to be grazed.
		Eremophila ciliata	CR	–	Known only from a small area 70 km northwest of Mt Ragged in Cape Arid NP.	Unknown. Palatable species. Known to be grazed by rabbits.
		Eremophila denticulata subsp. trisulcata	EN	EN	Known from five localities over a range of 46 km north and northwest of Mt Ragged.	Unknown. Palatable species. Grazing and trampling by camels a moderate threat.
		Eucalyptus platydisca	VU	VU	Known only from the Dundas Hills east of Norseman.	Unknown. Eucalypts are unlikely to be impacted by camels.
		Eucalyptus merrickiae	VU	VU	Occurs in the Esperance District, between Scadden and Salmon Gums and sporadically around Mt Ridley.	Unknown. Eucalypts are unlikely to be impacted by camels.
		Myoporum turbinatum	CR	EN	Known from a small area about 80 km northeast of Esperance.	Unknown. Palatable species. Known to be grazed by rabbits.
		Ricinocarpos trichophorus	VU	EN	Scattered populations in the Esperance region.	Unknown.
	Northwest GWW	*Leucopogon spectabilis*	CR	CR	Known from four populations on the Helena Aurora Range.	Excellent – pristine. Any impacts from camels are not obvious.
		Myriophyllum lapidicola	VU	EN	Known from six populations over 190 km range in the Mukinbuddin, Westonia, Yilgarn and Menzies area. Nominated for listing as Critically Endangered. GWW populations probably extinct.	Unknown.
		Ricinocarpos brevis	CR	EN	Three of the five known populations occur on Windarling Range.	Very good. Disturbance is associated with mining. Any impacts from camels are not obvious.
		Tetratheca aphylla subsp. aphylla	VU	–	Known only from the Helena Aurora Range.	Excellent. Any impacts from camels are not obvious.
		Tetratheca harperi	VU	VU	Known from four populations on the Mt Jackson Range.	Excellent. Any impacts from camels are not obvious.
		Tetratheca paynterae subsp. cremnobata	VU	–	Known only from the Die Hardy Ranges.	Excellent – pristine. Any impacts from camels are not obvious.
		Tetratheca paynterae subsp. paynterae	CR	EN	Known only from the Windarling Range.	Very good – good. Disturbance is associated with mining. Any impacts from camels are not obvious.
Note: CR = Critically endangered, EN = Endangered, VU = Vulnerable, S = Schedule 4 Other specially protected fauna						

Goats

Distribution in the GWW

Goats are now restricted more or less to the pastoral cell surrounding Kalgoorlie where they remain semi-protected from wild dogs by pastoral buffer baiting (pers. comm. Ian Kealley). Goat herds in the fringes of this area reportedly are comprised predominantly of males, as the females and kids are more susceptible to dog attacks (pers. comm. Harry Larkin). The density of goats within this area of the GWW is unknown, but probably fluctuates with environmental conditions and food and water availability. In Queensland goats have been reported as occurring in densities from 1/km^2 (Lee and Cremesco, 1995) to 24/km^2 depending on habitat (Thompson et al., 1999). The distribution of goats in the GWW is shown in Fig. 18 'Goat Distribution'.

Impacts

Impacts of goats can include overgrazing of native vegetation, damage to soil, erosion, fouling water holes and competition with native species for food water and shelter (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), 2011). At present, the impact of goats in the GWW is difficult to quantify as they are occurring predominantly on pastoral land already disturbed from years of sheep and cattle grazing. These areas have the typical impacts associated with pastoral activity; degraded native vegetation, minimal regeneration, weed incursion, soil disturbance and erosion, particularly along water courses. It is likely goats are contributing to these impacts along with other stock animals. Integra Mining Limited who have operations in the Randalls TR area have reported having difficulty with mine site rehabilitation due to grazing by goats (Frodsham, 2012). PECs and threatened flora and occurring within the known range of goats in the GWW are listed in Tables 19 and 20. The 'Mount Belches *Acacia quadrimarginea* / *Ptilotus obovatus* banded iron vegetation community' is the only PEC that falls within the range of goats in the GWW. This PEC is degraded, but as the area is used for grazing, this cannot be attributed to goats only. One threatened flora species, *Gastrolobium granticum*, occurs within the range of goats in the GWW (the Coolgardie area). These populations are in excellent condition and appear to be stable (pers. comm. Jennifer Jackson).

Goats were not observed to be impacting Aboriginal or European cultural assets in GWW.

Management

The Kambalda Regional Weed and Feral Animal Control Program is a project that was initiated in 2008 and funded by St Ives as an offset for the Cave Rocks Gold Mine operation. The project aims at managing weeds and feral animals in the Kambalda area including the trapping and removal of goats from Woolibar Station. So far, goat trapping and removal has been carried out in 2009–10. The eradication of goats from the GWW may be difficult as can be a desirable species for pastoral diversification activities. It is recommended that DEC continue to monitor goats, opportunistically during routine operations, so that any population changes can be detected.

Donkeys

Distribution in the GWW

In the GWW, donkeys are known to occur in three general areas; the Koolyanobbing – Bullfinch area, the area incorporating Cave Hill and the surrounding granite outcrops and the northern end of Credo PCP. These populations do not appear to be connected. The density of these populations is thought to be low, but this is uncertain (pers. comm. DEC Goldfields Region staff). In Australia donkeys generally occur in average densities of 0.1/km^2, though in the East Kimberley they have been recorded in densities of 1/km^2 (SA Arid Lands NRM). Donkeys need to drink regularly and will favour areas with permanent water (DSEWPC, 2011). In the Cave Hill area, the water that pools on the granite outcrops (both in natural depressions and man-made dams) provides a permanent source of water. By the end of a dry summer, donkeys are usually concentrated in these areas. The populations in Credo PCP and the Koolyanobbing – Bullfinch area are probably supported by the dams on pastoral land in these areas. The distribution of donkeys in the GWW is shown in Fig. 19 'Donkey Distribution'.

Impacts

Impacts of donkeys can include overgrazing of native vegetation, damage to soil, erosion, fouling water holes and damage to native fauna habitat (DSEWPC, 2011). Donkeys often occur in rocky areas where they may potentially impact on Aboriginal cultural sites, which are often located in such country.

The impact of donkeys in the Koolyanobbing – Bullfinch area is difficult to quantify as they are occurring predominantly on pastoral or ex-pastoral land already disturbed from years of grazing. PECs and threatened flora occurring within the known range of donkeys in the GWW are listed in Tables 19 and 20. Two PECs occur within the range of the Koolyanobbing – Bullfinch donkey population: the 'Koolyanobbing vegetation complex' and 'Highclere Hills (Mayfield) vegetation complex banded iron formation'. The 'Koolyanobbing vegetation complex' is disturbed, but this is mostly from mining activity, e.g. exploration tracks and drill pads (pers. comm. Jennifer Jackson). This PEC does not appear to be impacted by donkeys (pers. comm. Jennifer Jackson). The condition of the 'Highclere Hills (Mayfield) vegetation complex banded iron formation' is unknown. One threatened flora species, *Tetratheca erubescens*, occurs within the range of the Koolyanobbing – Bullfinch population. This population is in excellent condition and appears to be stable (pers. comm. Jennifer Jackson). Donkeys were not observed to be impacting Aboriginal or European cultural assets in the Koolyanobbing – Bullfinch area.

The impact of donkeys in the Cave Hill area is also not obvious. Outside of well-worn walking tracks, vegetation is not trampled and there is no obvious damage to water holes. No PECs or threatened flora is known to occur within the range of this population. Two Priority 2 flora species are known to occur on the Cave Hill outcrop; *Bossiaea laxa* and *Goodenia corralina*. These species are known only from this location and have not been recorded elsewhere. The populations are in good condition and appear to be stable (pers. comm. Jennifer Jackson). Donkeys may potentially cause damage to the dam (a European cultural asset) that has been built on Cave Hill.

The northern end of Credo PCP is generally in good condition and the impact of donkeys in this area is not obvious. No PECs or threatened flora occurs within the range of this population. No Aboriginal or European cultural assets were observed to be impacted.

Management

There is concern regarding the potential growth and impact of the Cave Hill donkey population. DEC conducted a preliminary study in 2012 to assess the feasibility of control for donkeys in this area. A population survey at Cave Hill was attempted in early 2012 using motion censored digital cameras. The cameras recorded an estimated 15 individuals in total using four main water points on the Cave Hill outcrop over a two month period. The range covered by these individuals, and whether the other granite outcrops support different groups is uncertain. There are at least four other watering points within 30 km of Cave Hill where donkeys have been observed; Sunday Soak, 87 Mile Dam and two other unnamed granite outcrops southwest of Cave Hill. The preliminary study identified the need for further surveys of the area surrounding Cave Hill, especially around watering points, to develop a better understanding of population size, range and movements. This survey has been planned for 2013 and an assessment of control feasibility and options will be made following this.

It is recommended that DEC also continue to monitor donkeys in Credo PCP and the Koolyanobbing – Bullfinch area, so that any population changes can be detected.

Horses

Distribution in the GWW

In the GWW, wild horses are known to occur in the Balladonia Rd area, on Mount Jackson Station and ex-Diemals Stations, the Bullabulling Station, Calooli Station Kangaroo Hills TR area (referred to as the Bullabulling Station – Kangaroo Hills TR population) and around Norseman. Horses prefer open forest or scrub with access to water and these areas provide such habitat. The density of wild horses is the GWW is unknown. In Australia generally occur in average densities of 0.1/km^2 (SA Arid Lands NRM). The distribution of wild horses in the GWW is shown in Fig. 20 'Wild Horse Distribution'.

Impacts

Impacts of horses can include overgrazing of native vegetation, damage to soil, erosion, damage to water holes, competition with domestic stock for grazing land and damage to farm infrastructure (Feral Animals CRC, 2006). Wild horses near to major roads and townships have the potential to cause serious motor vehicle accidents; this is especially true for the population in Norseman and the Bullabulling Station – Kangaroo Hills TR area. The impact of wild horses in the GWW is difficult to quantify as they are occurring predominantly on already disturbed pastoral or ex-pastoral land. The impact of the Balladonia Rd population on less-disturbed UCL is not obvious.

PECs and threatened flora and occurring within the known range of horses in the GWW are listed in Tables 19 and 20. Three PECs occur within the range of the Mount Jackson and ex-Diemals Station population; the 'Die Hardy Range / ex-Diemals vegetation

complex banded iron formation', Mount Jackson Range vegetation complexes banded iron formation' and 'Windarling Range vegetation complex banded iron formation'. The Mount Jackson and Windarling Range communities have experienced a level of disturbance, but this is mostly associated with mining, e.g. exploration tracks and drill pads (pers. comm. Jennifer Jackson). The 'Die Hardy Range / ex-Diemals vegetation complex banded iron formation' is in excellent condition. None of these PECs show signs of being impacted by horses (pers. comm. Jennifer Jackson).

Six threatened flora species occur within the range of wild horses in the GWW; these are *Eremophila denticulata subsp. trisulcata*, *Gastrolobium graniticum*, *Ricinocarpos brevis*, *Tetratheca harperi*, *Tetratheca paynterae subsp. cremnobata* and *Tetratheca paynterae subsp. paynterae*. *R. brevis* and *T. paynterae subsp. paynterae* occurring on the Windarling Range have experienced a level of disturbance, but this is associated with mining (pers. comm. Jennifer Jackson). All other threatened flora populations are in excellent to pristine condition and appear to be stable, except for *E. denticulata subsp. trisulcata* for which the population condition is unknown (pers. comm. Jennifer Jackson).

Horses were not observed to be impacting Aboriginal or European cultural assets in the GWW.

Management

In 2012 Diemals Station was transferred from pastoral lease to UCL and proposed conservation reserve (the Proposed Die Hardy Range Class 'A' NR and ex-Diemals CMR). Watering point closure will eventually commence in the DEC managed reserve area when resources are available and conditions are suitable. Closure of watering points is usually carried out progressively during wetter periods so that cattle mortality is avoided and cattle can continue to be mustered. Closure of watering points, by default, will also reduce horse numbers in the NR. Water point closure will not be carried out on the now-UCL portion of ex-Diemals Station. It is expected that horse population will continue to persist in this area as well as the now-UCL portion of ex-Diemals Station and on the neighbouring Mount Jackson Station, which will continue to be managed as pastoral lease until at least 2015.

Other than this, there is no active management of wild horses being carried out or planned for the GWW. A better understanding of the population density, movements and impacts of horses in the GWW is required before management options can be considered. It is recommended that DEC continue to monitor horse occurrences across the GWW, so that any population changes can be detected.

Wild cattle

Distribution in the GWW

In the GWW, wild cattle are known to occur in Credo PCP (mostly the southern half) and the area incorporating Mount Jackson, ex-Diemals and Kawana Stations, Proposed ex-Mount Jackson CMR, Mount Manning – Helena and Aurora Conservation Park (CP) and Mount Manning NR. The latter is referred to in this plan as the Mount Jackson – Mount Manning wild cattle population. These populations do not appear to be connected. Cattle occur in Credo PCP because it was pastoral lease up until 2007. Mount Manning –

Helena and Aurora CP and Mount Manning NR have never been grazed and wild cattle in these reserves are believed to be coming from the adjacent Mount Jackson (pastoral lease) and ex-Diemals Stations (ex-pastoral). The density of these populations is unknown. The distribution of wild cattle in the GWW is shown in Fig. 21 'Wild Cattle Distribution'.

Impacts

Mount Jackson Station, ex-Diemals Station and Credo PCP have the typical impacts associated with cattle grazing; degraded native vegetation, weed incursion, soil disturbance and erosion, particularly along water courses. Cattle appear to be in lower densities in the Mount Manning – Helena and Aurora CP and Mount Manning NR and impacts are not obvious.

PECs and Threatened flora occurring within the known range of wild cattle in the GWW are listed in Tables 19 and 20. Eight PECs associated with banded iron formation ranges occur within the range of the Mount Jackson – Mount Manning population. The 'Die Hardy Range / ex-Diemals vegetation complex banded iron formation', 'Helena and Aurora Range vegetation complexes banded iron formation' and 'Mount Manning Range vegetation complex banded iron formation' are in excellent to pristine condition. All other PECs have experienced a level of disturbance, mostly associated with mining, e.g. exploration tracks and drill pads. Impacts from cattle on these PECs are not obvious (pers. comm. Jennifer Jackson). Malleefowl are known to occur in Credo PCP and the Mount Jackson – Mount Manning area. As they are ground nesting birds, wild cattle may potentially be impacting on Malleefowl habitat.

Seven threatened flora species occur within the range of the Mount Jackson – Mount Manning population in the GWW; these are *Myriophyllum lapidicola*, *Leucopogon* spectabilis, *Tetratheca aphylla subsp. aphylla*, Ricinocarpos *brevis*, *Tetratheca harperi*, *Tetratheca paynterae subsp. cremnobata* and *Tetratheca paynterae subsp. paynterae*. *R. brevis* and *T. paynterae subsp. paynterae*, occurring on the Windarling Range, have experienced a level of disturbance, but this is associated with mining (pers. comm. Jennifer Jackson). All other threatened flora populations are in excellent to pristine condition and appear to be stable, except for *M. lapidicola*, which is probably extinct in the GWW (pers. comm. Jennifer Jackson).

No PECs or threatened flora occurs on Credo PCP.

The catchment for Clear and Muddy Lakes NR and Rowles Lagoon CP fall within Credo PCP where cattle occur. Impacts of cattle on the southern end of Credo, i.e. changes to vegetation and erosional processes, may impact the hydrology of the system. Cattle have direct access to the lakes, which can lead to disturbance around the lakes edge and fouling of the water. It is desirable for cattle to be removed from Credo PCP to protect the Clear and Muddy Lakes and Rowles Lagoon catchment.

Wild cattle were not observed to be impacting Aboriginal or European cultural assets in GWW.

Management

DEC is aiming to remove feral cattle on Credo PCP from 2013. An initial cattle muster was carried out in 2007 when DEC took over its management. Closure of watering points has been carried out progressively since 2007. Cattle will continue to be controlled on Credo when resources and conditions permit.

In 2012 Diemals Station was transferred from pastoral lease to UCL and proposed conservation reserve (the Proposed Die Hardy Range Class 'A' NR and ex-Diemals CMR). Mustering of cattle on ex-Diemals Station commenced at the end of 2012 and it is planned that this will continue through 2013. Watering point closure will eventually commence in the Proposed Die Hardy Range Class 'A' NR and ex-Diemals CMR when resources are available and conditions are suitable. ex-Diemals and Mount Jackson Stations are not well fenced from the DEC-managed reserves to the east and while there is stock on these stations, cattle will continue to stray onto the reserves.

Camels

Distribution in the GWW

In the GWW, camels are presumed to occur across most of the area east of the Coolgardie-Esperance Highway, and north of the Transline in the northwest of the GWW. These populations probably become connected further to the north of the GWW. The density of camels across these areas in unknown, but it is thought to be low as they are sighted only occasionally (pers. comm. DEC Goldfields staff). Saalfeld and Edwards (2010) calculated the average density of camels in the Australian rangelands to be 0.29/km^2. The highest density they recorded was 0.5->2/km^2 for the Great Sandy Desert. It is unknown whether the GWW would support a permanent population of camels or whether the camels sighted are just individuals dispersing from a more northerly and easterly population cores. The age and sex structure of camel mobs in the GWW is also unknown, but this could provide useful information about the nature of camel movements in the GWW, e.g. whether females are nursing in the GWW or if it is being used as temporary browsing habitat only. The distribution of camels in the GWW is shown in Fig. 22 'Camel Distribution'.

Impacts

Camels impact the landscape through browsing and trampling of native vegetation and damaging of natural and artificial water sources. Camels near to major roads and townships have the potential to cause serious motor vehicle accidents; this is true for the Eyre Highway where camels are sometimes seen as road kill. Impacts of camels in the GWW are not obvious and it may be that camels are not in high enough densities to be having a serious impact.

Three PECs and fifteen threatened flora species occur within the range of camels in the GWW; these are listed in Tables 19 and 20. The 'Fraser Range vegetation complex' (the southern part) and 'Plant assemblages of the Southern Hills vegetation complex' are both degraded, but this but this is a product of overgrazing by sheep and cattle and the impact of camels is probably negligible. The condition of the 'Woodline Hills vegetation complex' is unknown. Populations of *Leucopogon spectabilis*, *Tetratheca aphylla subsp.*

aphylla, *Tetratheca harperi* and *Tetratheca paynterae subsp. cremnobata* are in excellent to pristine condition and appear to be stable (pers. comm. Jennifer Jackson). *Ricinocarpos brevis* and *Tetratheca paynterae subsp. paynterae*, occurring on the Windarling Range, have experienced a level of disturbance but this is associated with mining and any impacts from camels are not obvious (pers. comm. Jennifer Jackson). Population condition for the other nine threatened flora species occurring within the range of camels, *Darwinia sp. Mount Heywood*, *Daviesia macrocarpa*, *Eremophila ciliata*, *Eremophila denticulata subsp. trisulcata*, *Eucalyptus platydisca*, *Eucalyptus merrickiae*, *Myoporum turbinatum*, *Myriophyllum lapidicola* and *Ricinocarpos trichophorus*, is unknown. *Darwinia spp*. and *D. macrocarpa* are unlikely to be grazed as they are very spiky and the eucalypt species are also unlikely to be impacted by camels (pers. comm. Julie Waters).

Camels were not observed to be impacting Aboriginal or European cultural assets in GWW.

Management

DEC conducts opportunistic control of camels during routine operations, but other than this, no active management of camels is occurring in the GWW. Camels are in low densities in the GWW and additional management is probably not required at this stage.

Summary of feral animal impacts

Table 21. Summary of feral animal impacts in the GWW

Species	Population	General condition of the environment	PEC	Threatened species	Other impacts
Dog	All GWW	N/A	N/A	Presumed impact on most species through predation.	Stock losses on pastoral land.
Cat / fox	All GWW	N/A	N/A	Presumed impact on most species through predation, esp. Malleefowl and Chuditch.	None observed.
Goat	Kalgoorlie pastoral cell	Pastoral areas are already disturbed – goats are probably contributing to this.	Mt Belches PEC has been degraded by pastoral activity – goats are probably contributing.	No obvious impacts to threatened flora.	Degradation of pastoral land.
Donkey	Credo PCP (northern part)	Minimal disturbance – country in excellent condition.	No PECs.	No threatened flora.	No other impacts observed.
	Cave Hill area	Minimal disturbance – country in excellent condition.	No PECs.	No threatened flora.	Potential impact on Cave Hill dam.
	Koolyanobbing – Bullfinch area	Disturbance associated with pastoral, mining and townships.	No obvious impacts to PECs.	No obvious impacts to threatened flora.	No other impacts observed.
Horse	Norseman	Disturbance associated with the Norseman township and mining.	No PECs.	No threatened flora.	Potential for car accidents.
	Bullabulling Stn – Kangaroo Hills area	Disturbance associated with townships, pastoral and mining.	No PECs.	No obvious impacts to threatened flora.	Potential for car accidents.
	Mt Jackson and ex-Diemals Stations	Degraded pastoral land.	No obvious impacts to PECs.	No obvious impacts to threatened flora.	No other impacts observed.
	Balladonia Rd area	UCL in excellent condition. Disturbance associated with pastoral activity on Balladonia Station.	No PECs.	No obvious impacts to threatened flora.	No other impacts observed.
Wild cattle	Credo PCP (southern part)	Southern end of Credo PCP degraded due to historical pastoral activity. Catchment for Muddy and Clear Lakes and Rowles Lagoon has been impacted.	No PECs.	No threatened flora.	No other impacts observed.
	Mt Jackson – Mt Manning area	Mt Jackson and ex-Diemals Stations are degraded due to pastoral activity. DEC reserves to the east in excellent condition other than areas being mined.	No obvious impacts to PECs.	No discernible impact on threatened flora. Potential impacts to Malleefowl habitat.	No other impacts observed.
Camel	Northwestern GWW	Pastoral and ex-pastoral areas disturbed. UCL and DEC reserves mostly in excellent condition other than areas being mined.	No obvious impacts to PECs.	No obvious impacts to threatened flora.	No other impacts observed.
	Eastern GWW	Pastoral and ex-pastoral areas disturbed. UCL and DEC in excellent condition other than areas being mined.	No obvious impacts to PECs.	No obvious impacts to threatened flora. Unknown impact for some SE species.	Potential for car accidents.
Note: Other than the impact of wild dogs on pastoral land, feral animals were not obsered to be impacting noticeably Aboriginal or European cultural assets.					

Wild Horse

Camel

Donkey

Management options

Table 22. Management options for feral animals in the GWW

Species	Populations	Responsible land manager	Management options	Timeframe
Dog	Pastoral land and pastoral interface	Pastoral managers, Biosecurity Groups and DEC	• Continue implementation of Zone Control Authority 9 Dog Management Plan.	Ongoing
Cat / fox	Mount Jackson Range	DEC Goldfields Region and Cliffs Iron Ore Asia Pacific	• DEC Goldfields Region and Cliffs to continue Mount Jackson Range cat baiting program.	Ongoing
			• Cliffs and DEC Goldfields to continue recording Malleefowl sightings.	Ongoing
Goat	Kalgoorlie pastoral cell	Pastoral, DEC Goldfields Region, Shire of Coolgardie and City of Kalgoorlie-Boulder	• Continue implementation of Kambalda Weed and Feral animal Management Program. • All land managers to continue monitoring goat population.	Ongoing
Donkey	Credo PCP (northern part)	DEC Goldfields Region	• DEC Goldfields Region to continue monitoring donkey population at Credo PCP.	Ongoing
	Cave Hill and surrounding area	DEC Goldfields Region	• DEC Goldfields Region to conduct further population surveys, assess feasibility of control and, if feasible, carry out control at Cave Hill.	2013
	Koolyanobbing – Bullfinch area	Pastoral, DEC Central Wheatbelt District and Shire of Yilgarn	• Pastoral managers, DEC Central Wheatbelt District and Shire of Yilgarn to continue monitoring Koolyanobbing – Bullfinch donkey population.	Ongoing
Horse	Norseman	DEC Esperance District and Shire of Dundas	• DEC Esperance District to continue monitoring Norseman horse population.	Ongoing
	Bullabulling Station – Kangaroo Hills TR area	DEC Goldfields , pastoral and Shire of Coolgardie	• DEC Goldfields Region, pastoral managers and Shire of Coolgardie to continue monitoring Bullabulling Station – Kangaroo Hills TR horse population.	Ongoing
	Mt Jackson and ex-Diemals Stations	DEC Goldfields Region and Cliffs Iron Ore Asia Pacific	• DEC Goldfields Region to continue monitoring ex-Diemals horse population. • Cliffs to continue monitoring Mount Jackson horse population.	Ongoing
	Balladonia Rd area	DEC Esperance District and Balladonia Station	• DEC Esperance District and Balladonia Station lessee to continue monitoring Balladonia Rd horse population.	Ongoing
Wild cattle	Credo PCP (southern part)	DEC Goldfields Region	• DEC Goldfields Region to continue dam closure and commence mustering and removal of cattle on Credo PCP.	2013 onwards
	Mt Jackson – Mt Manning area	DEC Goldfields Region	• DEC Goldfields Region to continue mustering and removal of cattle in the proposed Die Hardy Range Class 'A' NR and ex-Diemals CMR. • DEC Goldfields Region to commence dam closure in the proposed Die Hardy Range Class 'A' NR and ex-Diemals CMR.	2013 onwards
Camel	Northwestern GWW	DEC Goldfields Region, pastoral, City of Kalgoorlie-Boulder, Shires of Coolgardie, Dundas and Esperance District	• All land managers to continue opportunistic control of the northwest camel population. • All land managers to continue monitoring of the northwest camel population.	Ongoing
	Eastern GWW	DEC Goldfields Region and Esperance District, pastoral and Shires of Coolgardie and Yilgarn	• All land managers to continue opportunistic control of the eastern camel population. • All land managers to continue monitoring of the eastern camel population.	
All species	All populations	DEC Goldfields Region	• DEC Goldfields Region to review GWW Strategic Feral Animal Management Plan after five years.	2018

Feral animal control methods

Table 23 gives an overview of the control options available for feral animal species occurring in the GWW. Feral animal management should always be carried out in accordance with best practice methods and must comply with the *Animal Welfare Act 2002* and its regulations. Where best practice methods are available, they have been included in 'Feral Animal Resources for Land Managers'. The DEC document *Minimum standards for Wildlife Rehabilitation in WA* (DEC, 2008) details acceptable and unacceptable methods for euthanasia (Chapter 2, pages 6–10) for native wildlife; this can also be applied to feral species.

Table 23. Control options for feral animals

Species	Baiting	Shooting	Trapping	Mustering	Judas method	Fencing	Water point closure
Dog							
Cat							
Fox							
Goat							
Donkey							
Horse							
Wild cattle							
Camel							

Feral animal resources for land managers

General feral animal

Managing feral animals and their impacts: managing for biodiversity in the rangelands (Invasive Animals CRC)
http://www.environment.gov.au/land/publications/pubs/rangelands-feral-book-hires.pdf

Code of Practice for the Capture and Marketing of Feral Animals in WA (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/aap/code_of_practice_feral_animals.pdf

Minimum standards for Wildlife Rehabilitation in WA (DEC)
http://www.dec.wa.gov.au/community-and-education/volunteer-programs/wildlife-rehabilitation-and-courses/minimum-standards-for-wildlife-rehabilitation.html

Wild dog

Western Australia Wild Dog Management Strategy 2005 (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/ddf/farmers_sm.pdf

Wild Dog Management Best Practice Manual 2006 (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/ddf/bulletin4677.pdf

Aerial Baiting of Wild Dogs with 1080 (DSEWPC)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/dog005-aerial-baiting-wild-dogs-1080.pdf

Cat

The feral cat (Felis catus) (DSEWPC)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cat.pdf

Model code for the humane control of feral cats (NSW DPI)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cop-feral-cats.pdf

Fox

European Red Fox (Vulpes vulpes) (DSEWPC)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/european-red-fox.pdf

Model code for the humane control of foxes (NSW DPI)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cop-foxes.pdf

Goat

Feral Goat (Capra hircus) (DSEWPC)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/feral-goat.pdf

The Grazing of Goats in Pastoral Areas of WA: Best Management Practice Guidelines (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/regions/nrr/warangelandsbmpwelfaregoats.pdf

Monitoring techniques for vertebrate feral animals (NSW DPI)
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/218532/Monitoring-techniques-for-vertebrate-pests---goats.pdf

Donkey

Feral Donkey Farmnote (DAFWA)
http://www.agric.wa.gov.au/objtwr/imported_assets/content/pw/vp/fer/f12100.pdf

Feral horse (Equus caballus) and feral donkey (Equus asinus) (DSEWPC)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/feral-horse.pdf

Horse

Model code of practice for the humane control of feral horses (NSW DPI)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/cop-feral-horses.pdf

Proceedings of the national feral horse management workshop (Invasive Animals CRC)
http://www.feral.org.au/wp-content/uploads/2010/03/FeralHorse.pdf

Camel

National Feral Camel Action Plan 2010 (DSEWPC)
http://www.environment.gov.au/biodiversity/invasive/publications/pubs/feral-camel-action-plan.pdf

Camel survey reports (DEC)
http://www.dec.wa.gov.au/our-environment/science-and-research/animal-conservation-research/feral-camels-in-wa/feral-camel-survey-reports.html

MONITORING AND EVALUATION

Monitoring weeds

To monitor weed and pest occurrences across the GWW, DEC has set up a 'weeds geodatabase'. A geodatabase is a database designed to store spatial data and information. It can be used to produce maps showing changes in weed distribution in the GWW. It will be maintained and updated by DEC Goldfields Region staff in Kalgoorlie. The database will be for weed records on both DEC and non-DEC managed tenure within the GWW. DEC will continue to monitor and record weed occurrences during routine operations on DEC-managed tenure and opportunistically on other tenure types. Any data in the geodatabase can be made available to external bodies on request.

Land managers and others active in the GWW are encouraged to forward any weed or information or data to DEC office in the GWW (see inside cover for details) for inclusion in the database. For weed data to be included in the geodatabase, the minimum following attributes are required:

- Species
- Location
- Coordinates (GDA94)

Other useful information is: area of the population (20, 50 or 100 m diameter), density of the population (<5%, 6–75% or 76–100%), growth stage (juvenile, adult or seeded) and other relevant environmental conditions (e.g. disturbance, topographical features).

Monitoring feral animals

DEC has a statewide system for recording fauna occurrences (including feral animals) across WA. If you see a feral animal, please fill out a DEC Fauna Report Form and forward it to the address given on the form. All records are added to centrally-managed database. The Fauna Report Form is available from:

http://www.dec.wa.gov.au/management-and-protection/threatened-species/monitoring/standard-report-forms.html

Otherwise, please report feral animals via the phone, email or in person to a DEC office in the GWW (see inside cover for contact details).

How will we know if this plan is working?

It is recommended that the effectiveness of this GWW Strategic Weed and Feral Animal Management Plan be assessed in five years (in 2018). Effectiveness can be determined using the performance indicators listed in Table 24, which are linked to the management options outlined earlier in the plan (Table 3). The weed and pest geodatabases should be regularly updated over the next five years, so that they may be used in 2018 to identify changes in weed and feral animal distribution. It is recommended that another GWW wide weed survey is carried out in 2018, focusing on known populations of priority species.

Asparagus asparagoides

Cylindropunta rosea

Lycium ferocissimum

Table 24. Performance indicators to assess the plan in 2018

Pest species	Performance indicator
Cylindropuntia spp., *Opuntia* spp. and Mother-of-Millions	Funding has been secured and Shires and pastoral managers are engaging in cacti control. Extent and density of cacti populations is decreasing – Shires and pastoral managers to advise, otherwise DEC (Goldfields, Esperance and Central Wheatbelt) to survey.
Tamarix spp.	Southern Rangelands NRM has assessed the feasibility of control of Tamarisk on Lake Boonderoo and (if feasible) a control program has commenced. Extent and density of the population is decreasing.
	Southern Rangelands NRM is coordinating a control program for *Tamarix* spp. on Swan Lake, Cowarna Downs. Extent and density of the population is decreasing.
	Historical individual *Tamarix* spp. trees have, or are being, been removed from townships and historical sites
African Boxthorn	Shires are engaging in control of African Boxthorn within townships. Extent and density of the populations is decreasing.
	DEC Goldfields Region has obtained data and / or information regarding the distribution of African Boxthorn on pastoral land.
Bridal Creeper	DEC Goldfields Region has eradicated the Boorabbin Bridal Creeper population.
	DEC Central Wheatbelt District has eradicated the Yellowdine Bridal Creeper population.
	DEC Esperance District has conducted annual monitoring of Bridal Creeper at Booanya, Balbinya and Deralinya Homesteads. If populations have spread, alternative control methods have been investigated and a control program initiated.
Pepper Tree	DEC Esperance District in conjunction with the Balladonia lessee has eradicated Pepper Trees from Booanya Homestead.
	DEC Esperance District has assessed feasibility of control for Pepper Tree at Cocklebiddy and (if feasible) control program has commenced.
	DEC (Goldfields Region, Esperance District and Central Wheatbelt District), City of Kalgoorlie-Boulder and the Shires of Coolgardie, Dundas and Yilgarn have monitored the spread of Pepper Trees in townships.
Ruby Dock	DEC (Goldfields Region, Esperance District and Central Wheatbelt District), City of Kalgoorlie-Boulder, Shire of Coolgardie, Shire of Dundas and mining companies have monitored the spread of Ruby Dock from town sites and the Transline. Small outlier populations are being controlled as they appear.
Gazania	DEC (Goldfields Region and Esperance and Central Wheatbelt Districts), City of Kalgoorlie-Boulder and the Shires of Coolgardie, Dundas and Yilgarn have monitored the spread of Gazania from townships. Small outlier populations are being controlled as they appear.
Buffel Grass	DEC (Goldfields Region, Esperance District and Central Wheatbelt District), City of Kalgoorlie-Boulder, Shire of Coolgardie and Main Roads have monitored the spread of Buffel Grass. Small outlier populations are being controlled as they appear.
Pastoral weeds	All land managers are managing pastoral weeds as per ARRP Act / BAM Act requirements.
Paterson's Curse	DEC Esperance District and Shire of Dundas are conducting annual maintenance control of Paterson's Curse on Hyden-Norseman Rd.
All weed species	DEC (Goldfields Region, Esperance District and Central Wheatbelt District) are recording weed occurrences and adding them to the weed geodatabase. Stakeholders are forwarding weed data and information to DEC for inclusion in the geodatabase.
Wild dogs	Pastoral managers, Biosecurity Groups and DEC are implementing the Zone 9 Control Authority Regional Wild Dog Management Plan
Cats / foxes	DEC Goldfields Region and Cliffs Iron Ore Asia Pacific have continued cat baiting program and recording of Malleefowl occurrences in the Mount Jackson Range area.
Goats	The Kambalda Regional Weed and Pest Animal Program is continuing and more goat musters have been carried out on Woolibar Station.
Donkeys	DEC Goldfields Region has carried out further donkey surveys in the Cave Hill area and (if feasible) control has been carried out.
Wild horses	Relevant stakeholders have monitored the Mt Jackson – ex-Diemals Station, Koolyanobbing – Bullfinch and Balladonia Rd area horse populations.
Wild cattle	DEC Goldfields Region has carried out a cattle muster on Credo PCP and ex-Diemals Station in 2013. If cattle remain, additional musters have been carried out or planned. Water point closure has commenced in the Proposed Die Hardy Range Class 'A' NR and ex-Diemals CMR. DEC Goldfields have been monitoring the Mt Jackson – Mt Manning and Credo PCP wild cattle populations.
Camels	Relevant stakeholders have monitored the eastern and northwestern camel populations.
All feral animal species	DEC (Goldfields Region, Esperance District and Central Wheatbelt District) are recording feral animal occurrences and adding them to feral animal geodatabase. Stakeholders are forwarding feral animal data and information to DEC for inclusion in the geodatabase.

References

Australian Government, 2008. Weeds of International Significance Update 2008. QLD Department of Primary Industries and Fisheries.

DSEWPC, 2008. *Coolgardie Bioregion*. Department of Sustainability, Environment, Water, Population and Communities. Retrieved from http://www.environment.gov.au/land/publications/acris/pubs/bioregion-coolgardie.pdf.

Burrows N and Christensen P, 1994. Hunting the Hunter. Landscope 10: 37–41.

CALM (Department of Conservation and Land Management), 2003. *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management WA.

DAFWA, 2006. Wild Dog Management Best Practice Manual 2006. Department of Agriculture and Food WA.

DAFWA, 2005. Western Australia Wild Dog Management Strategy 2005. Department of Agriculture and Food WA.

Frodsham T, 2012. Salt creek mine rehabilitation trial: integrated approaches to waste landform rehabilitation and feral goat management. Integra Mining Limited, Western Australia.

Lee JM and Cremesco, PW, 1995. Distribution and density of feral goats in the Mulga Lands of Queensland. Land Protection Branch, Queensland Department of Natural Resources and Mines,
Brisbane.

Marks CA and Bloomfield TE, 1999. Distribution and density estimates for urban foxes (*Vulpes vulpes*) in Melbourne: implications for rabies control. Wildlife Research, 26: 763–775.

Marlow N, 1992. Ecology of the introduced red fox (Vulpes vulpes) in the arid zone. PhD thesis, University of New South Wales.

SA Arid Lands NRM Board. Control of large feral herbivores (factsheet). Retrieved from http://www.saalnrm.sa.gov.au/Portals/8/Publications_Resources/Factsheets_Brochures/SAAL-Control_Of_Large_Feral_Herbivores-FS-122009.pdf.

Biosecurity SA, 2012. SA Buffel Grass Strategic Plan 2012–2017: A plan to reduce the weed threat of Buffel Grass in South Australia. Government of South Australia.

Saalfeld AC and Edwards GP, 2010. Distribution and abundance of the feral camel (*Camelus dromedarius*) in Australia. The Rangeland Journal, 32(1): 1–9.

Stephens, D. (2011) The molecular ecology of Australian wild dogs: hybridisation, gene flow and genetic structure at multiple geographic scales. PhD thesis, University of WA. Retrieved from http://www.feral.org.au/wp-content/uploads/2012/05/DStephens_PhDThesis.pdf.

Thompson, J., Riethmuller, J., Kelly, D., Boyd-Law, S. and Miller, E. 1999 Feral goat management in South–West Queensland – Final Report to the Bureau of Rural Sciences. Queensland Department of Natural Resources and Mines, Brisbane.

Wilson, P.M., Tidemann, C.R. and Meischke, H.R.C. (1994). Are cats on rubbish dumps a problem? Pp. 163–174, in D.W. Paxton (ed.) Urban Animal Management. Australian Veterinary Association, Sydney.

Appendix 1: Threatened flora and fauna occurring in the GWW

Table 25. All threatened flora and fauna occurring in the GWW

Threatened species	WC Act	EPBC Act	No. of records
Flora			
Acacia denticulosa	VU	VU	9
Acacia lanuginophylla	VU	EN	7
Acacia lobulata	EN	EN	6
Anigozanthos bicolor subsp. minor	VU	EN	1
Banksia sphaerocarpa var. dolichostyla	VU	VU	59
Boronia adamsiana	VU	VU	19
Boronia revoluta	VU	VU	28
Conostylis lepidospermoides	VU	EN	19
Darwinia sp. Mt Heywood (R. Davis 11066)	VU	–	6
Daviesia microcarpa	CR	EN	20
Drummondita longifolia	VU	VU	20
Eremophila ciliata	CR	–	6
Eremophila denticulata subsp. denticulata	VU	VU	5
Eremophila denticulata subsp. trisulcata	EN	EN	11
Eremophila subteretifolia	CR	EN	1
Eremophila vernicosa	VU	VU	1
Eremophila virens	EN	EN	3
Eremophila viscida	EN	EN	1
Eucalyptus brevipes	VU	EN	14
Eucalyptus merrickiae	VU	VU	9
Eucalyptus platydisca	VU	VU	43
Eucalyptus steedmanii	VU	VU	50
Eucalyptus synandra	VU	VU	17
Frankenia conferta	VU	EN	1
Frankenia parvula	EN	EN	11
Gastrolobium graniticum	VU	EN	47
Isopogon robustus	CR	CR	15
Kunzea acicularis	VU	–	2
Leucopogon spectabilis	CR	CR	25
Marianthus aquilonaris	CR	–	13
Melaleuca sciotostyla	EN	EN	3
Muelleranthus crenulatus	VU	–	4
Myoporum turbinatum	CR	EN	2
Myriophyllum lapidicola	VU	EN	4
Philotheca falcata	EN	CR	5
Rhizanthella gardneri	CR	EN	3
Ricinocarpos brevis	VU	EN	21
Ricinocarpos trichophorus	VU	EN	7
Tetratheca aphylla	VU	VU	7
Tetratheca aphylla subsp. aphylla	VU	VU	31
Tetratheca aphylla subsp. megacarpa	VU	VU	4
Tetratheca erubescens	VU	–	21
Tetratheca harperi	VU	VU	20
Tetratheca paynterae subsp. cremnobata	VU	–	15
Tetratheca paynterae subsp. paynterae	CR	EN	17
Thomasia gardneri	EX	EX	6
Fauna			
Aspidites ramsayi	S	–	11
Cacatua leadbeateri	S	–	12
Calyptorhynchus banksii subsp. naso	VU	–	1
Calyptorhynchus latirostris	EN	EN	12
Cyclodomorphus branchialis	VU	–	1
Dasycercus cristicauda	VU	VU	2
Dasyurus geoffroii	VU	VU	22
Egernia stokesii subsp. badia	VU	EN	1
Falco peregrinus	S	–	32
Falco peregrinus subsp. macropus	S	–	16
Idiosoma nigrum	VU	–	1
Leipoa ocellata	VU	VU	68

Threatened species	WC Act	EPBC Act	No. of records
Leporillus conditor	VU	VU	3
Macrotis lagotis	VU	VU	6
Morelia spilota subsp. imbricata	S	–	19
Myrmecobius fasciatus	VU	VU	8
Ogyris subterrestris subsp. petrina	CR	–	17
Phascogale calura	EN	EN	1
Platycercus haematogaster subsp. narethae	S	–	1
Pseudomys fieldi	VU	VU	2
Pseudomys shortridgei	VU	VU	2
Tartarus murdochensis	VU	–	1
CR = Critically endangered, EN = Endangered, VU = Vulnerable, S = Schedule 4 Other specially protected fauna			

Appendix 2: Priority flora and fauna occurring in the GWW

Table 26. Priority flora and fauna ranking scale

Priority	Description
Priority 1	Taxa with few, poorly known populations on threatened lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2	Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3	Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority 5	Taxa in need of monitoring (conservation dependent). Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Table 27. Priority flora and fauna occurring in the GWW

Priority species	Priority	No. records
Flora		
Acacia adinophylla	1	25
Acacia diaphana	1	7
Acacia dorsenna	1	12
Acacia epedunculata	1	6
Acacia hystrix subsp. continua	1	3
Acacia sclerophylla var. teretiuscula	1	1
Acacia sp. Bungalbin Hill (J.J. Alford 1119)	1	4
Acacia sp. Esperance (M.A. Burgman 1833b)	1	1
Acacia sp. Lake Johnson (N. Gibson and M. Lyons 1959)	1	3
Acacia sp. Petrudor Rocks (B.R. Maslin 7714)	1	1
Acacia tetraneura	1	5
Acacia websteri	1	16
Allocasuarina globosa	1	14
Allocasuarina tessellata	1	1
Anacampseros sp. Eremaean (F. Hort, J. Hort and J. Shanks 3248)	1	1
Aotus lanea	1	3
Aotus prosacris	1	2
Astartea sp. Esperance (A. Fairall 2431)	1	1
Astartea sp. Mt Dimer (C. McChesney TRL4/72)	1	1
Astartea sp. Red Hill (K.R. Newbey 8462)	1	4
Astus duomilius	1	1
Austrostipa pycnostachya	1	2
Austrostipa sp. Mt Holland (W.A. Thompson and J. Allen 948)	1	1
Baeckea ochropetala	1	3
Baeckea sp. Beringbooding (A.R. Main 11/9/1957)	1	4
Baeckea sp. Blue Haze Mine (P. Armstrong 06/910)	1	8
Baeckea sp. Bulla Bulling (D.J.E. Whibley 4648)	1	2
Baeckea sp. Bullfinch (K.R. Newbey 5838)	1	1
Baeckea sp. Bungalbin Hill (B.J. Lepschi and L.A. Craven 4586)	1	20
Baeckea sp. Crossroads (B.L. Rye and M.E. Trudgen 241186)	1	8
Baeckea sp. Die Hardy Range (E. Mattiske J91)	1	1
Baeckea sp. Exclamation Lake (M.E. Trudgen 1524)	1	1
Baeckea sp. Gnarlbine Rocks (G. Barrett GRH469)	1	4

Priority species	Priority	No. records
Baeckea sp. Helena and Aurora Range (G.J. Keighery 4424)	1	2
Baeckea sp. Lake Cronin (K.R. Newbey 9191)	1	1
Baeckea sp. Pigeon Rocks (D. Grace DJP 281)	1	12
Baeckea sp. Sheoaks Rocks (M.E. Trudgen MET5452)	1	4
Baeckea sp. Wialki (G.M. Storr s.n. 4/10/1958)	1	2
Baeckea sp. Yacke Yackine Dam (K.R. Newbey 9195)	1	3
Beyeria rostellata	1	14
Boronia baeckeacea subsp. patula	1	3
Bossiaea arcuata	1	12
Bossiaea aurantiaca	1	12
Bossiaea saxosa	1	10
Bossiaea simulata	1	7
Brachyloma nguba	1	3
Brachyloma sp. Forrestania White (M. Hislop and F. Hort MH 2591)	1	2
Caesia sp. Ennuin (N. Gibson and M.N. Lyons 2737)	1	1
Calothamnus superbus	1	1
Chamelaucium sp. Koolyanobbing (V. Clarke 644)	1	9
Chamelaucium sp. Parker Range (B.H. Smith 1255)	1	4
Chorizema circinale	1	6
Cryptandra exserta	1	2
Cryptandra polyclada subsp. aequabilis	1	5
Cyathostemon sp. Dowak (J.M. Fox 86/271)	1	4
Dampiera plumosa	1	1
Darwinia sp. Mt Ney (M.A. Burgman and S. McNee 1274)	1	8
Dicrastylis archeri	1	4
Dicrastylis capitellata	1	7
Dillwynia sp. Capel (P.A. Jurjevich 1771)	1	1
Dodonaea hexandra	1	1
Drummondita wilsonii	1	8
Eremophila arachnoides subsp. tenera	1	1
Eremophila lucida	1	16
Eremophila perglandulosa	1	6
Eremophila praecox	1	7
Eucalyptus dielsii x platypus	1	1
Eucalyptus distuberosa subsp. aerata	1	12
Eucalyptus jimberlanica	1	10
Eucalyptus misella	1	8
Eucalyptus myriadena subsp. parviflora	1	9
Eucalyptus sp. Esperance (M.E. French 1579)	1	5
Eucalyptus sp. Mukinbudin (D. Nicolle and M. French DN 3486)	1	1
Eucalyptus websteriana subsp. norsemanica	1	12
Euryomyrtus sp. Parker Range (N. Gibson and M. Lyons 2269)	1	3
Eutaxia andocada	1	3
Gastrolobium hians	1	14
Gastrolobium involutum	1	14
Gastrolobium tenue	1	2
Gnephosis intonsa	1	12
Goodenia heatheriana	1	5
Goodenia turleyae	1	1
Grammosolen sp. Mt Ridley (W.R. Archer 1210911)	1	1
Grevillea lissopleura	1	7
Grevillea lullfitzii	1	22
Grevillea marriottii	1	7
Grevillea phillipsiana	1	16
Guichenotia anota	1	1
Hemigenia dulca	1	1
Hibbertia axillibarba	1	7
Hibbertia carinata	1	6
Jacksonia jackson	1	20
Jacksonia lanicarpa	1	1
Keraudrenia cacaobrunnea subsp. undulata	1	15
Labichea sp. Mt Holland (W.A. Thompson and J. Allen 949)	1	2
Lepidosperma amantiferrum	1	4
Lepidosperma bungalbin	1	9

Priority species	Priority	No. records
Lepidosperma ferriculmen	1	5
Lepidosperma jacksonense	1	10
Lepidosperma sp. Mt Caudan (N. Gibson and M. Lyons 2081)	1	3
Lepidosperma sp. Parker Range (N. Gibson and M. Lyons 2094)	1	1
Leptospermum macgillivrayi	1	8
Leucopogon remotus	1	1
Leucopogon rugulosus	1	14
Leucopogon sp. Bonnie Hill (K.R. Newbey 9831)	1	7
Leucopogon sp. Kambalda (J. Williams s.n. PERTH 07305028)	1	2
Leucopogon sp. Yellowdine (M. Hislop and F. Hort MH 3194)	1	5
Leucopogon validus	1	6
Melaleuca agathosmoides	1	15
Micromyrtus papillosa	1	13
Millotia newbeyi	1	4
Mirbelia densiflora	1	21
Mirbelia taxifolia	1	9
Olearia newbeyi	1	3
Persoonia baeckeoides	1	11
Persoonia leucopogon	1	3
Phebalium appressum	1	3
Philotheca deserti subsp. brevifolia	1	3
Philotheca gardneri subsp. globosa	1	9
Philotheca nutans	1	5
Prostanthera splendens	1	11
Pterostylis sp. laterite (D.L. Jones 3081 and M.A. Clements)	1	1
Ptilotus procumbens	1	1
Ptilotus rigidus	1	2
Rhagodia sp. Yeelirrie Station (K.A. Shepherd et al. KS 1396)	1	1
Scaevola archeriana	1	1
Scaevola tortuosa	1	2
Stenanthemum liberum	1	6
Stylidium validum	1	7
Tecticornia flabelliformis	1	2
Teucrium sp. dwarf (R. Davis 8813)	1	2
Thryptomene sp. Mt Clara (R.J. Cranfield 11702)	1	2
Thysanotus baueri	1	2
Verticordia roei subsp. meiogona	1	7
Verticordia sieberi var. pachyphylla	1	7
Xanthoparmelia fumigata	1	1
Acacia amyctica	2	7
Acacia ascendens	2	1
Acacia asepala	2	12
Acacia concolorans	2	12
Acacia heterochroa subsp. robertii	2	14
Acacia kerryana	2	11
Acacia subrigida	2	1
Angianthus newbeyi	2	1
Astartea sp. Jyndabinbin Rocks (K.R. Newbey 7689)	2	4
Asteridea archeri	2	3
Astroloma sp. Grass Patch (A.J.G. Wilson 110)	2	1
Baeckea sp. Jaurdi Station (L.W. Sage and F. Hort 2229)	2	1
Baeckea sp. Mt Gibbs (G.F. Craig 7031)	2	3
Baeckea sp. Mt Glasse (P.G. Wilson 5717)	2	1
Baeckea sp. North Ironcap (R.J. Cranfield 10580)	2	5
Bentleya diminuta	2	2
Boronia acanthoclada	2	1
Boronia corynophylla	2	5
Boronia westringioides	2	12
Bossiaea laxa	2	5
Brachysola halganiacea	2	2
Chthonocephalus multiceps	2	3
Conospermum sigmoideum	2	9
Conostephium uncinatum	2	8
Cyathostemon sp. Lake King (M.E. and M.E. Trudgen 1462)	2	2

Priority species	Priority	No. records
Dampiera orchardii	2	2
Darwinia luehmannii	2	4
Darwinia sp. Peak Charles (A.S. George 10627)	2	4
Daviesia newbeyi	2	3
Daviesia pauciflora	2	1
Daviesia sarissa subsp. redacta	2	4
Dicrastylis obovata	2	10
Drosera salina	2	6
Elachanthus pusillus	2	4
Eucalyptus educta	2	15
Eucalyptus fraseri subsp. melanobasis	2	11
Eucalyptus jutsonii	2	1
Eutaxia hirsuta	2	1
Eutaxia lasiocalyx	2	4
Frankenia brachyphylla	2	2
Gastrolobium acrocaroli	2	9
Goodenia corralina	2	1
Goodenia jaurdiensis	2	4
Goodenia scapigera subsp. graniticola	2	6
Goodenia varia	2	2
Gratiola pedunculata	2	1
Guichenotia asteriskos	2	2
Hakea rigida	2	7
Halgania sp. Peak Eleanora (M.A. Burgman 3547 B)	2	2
Hemigenia tenelliflora	2	1
Hibbertia charlesii	2	7
Hydrocotyle coraginaensis	2	3
Hydrocotyle decipiens	2	1
Keraudrenia adenogyna	2	20
Kunzea salina	2	4
Lepidium merrallii	2	3
Lepidobolus spiralis	2	2
Levenhookia pulcherrima	2	2
Lissanthe scabra	2	9
Logania exilis	2	7
Logania nanophylla	2	4
Malleostemon sp. Adelong (G.J. Keighery 11825)	2	2
Melaleuca eximia	2	3
Olearia laciniifolia	2	7
Opercularia hirsuta	2	5
Otion rigidum	2	10
Persoonia spathulata	2	1
Phebalium clavatum	2	9
Philotheca apiculata	2	23
Phlegmatospermum eremaeum	2	10
Pimelea halophila	2	1
Pterostylis sp. striped sepal greenhood (G. Brockman GBB355)	2	2
Rumex crystallinus	2	1
Seorsus clavifolius	2	1
Stylidium sejunctum	2	17
Stylidium thylax	2	1
Styphelia sp. Great Victoria Desert (N. Murdoch 44)	2	1
Thysanotus brachyantherus	2	3
Trachymene pyrophila	2	3
Verticordia dasystylis subsp. dasystylis	2	19
Verticordia multiflora subsp. solox	2	18
Verticordia pulchella	2	3
Acacia ancistrophylla var. perarcuata	3	4
Acacia crenulata	3	6
Acacia cylindrica	3	13
Acacia desertorum var. nudipes	3	21
Acacia dissona var. indoloria	3	4
Acacia eremophila numerous-nerved variant (A.S. George 11924)	3	2
Acacia eremophila var. variabilis	3	4

Priority species	Priority	No. records
Acacia euthyphylla	3	2
Acacia filifolia	3	2
Acacia formidabilis	3	4
Acacia glaucissima	3	4
Acacia improcera	3	4
Acacia inophloia	3	1
Acacia repanda	3	6
Acacia sedifolia subsp. pulvinata	3	5
Acacia singula	3	20
Acacia sp. Burdett Road (B.R. Maslin 8218)	3	2
Acacia truculenta	3	8
Acacia undosa	3	3
Adenanthos gracilipes	3	19
Allocasuarina eriochlamys subsp. grossa	3	22
Alyxia tetanifolia	3	3
Astartea sp. Bungalbin Hill (K.R. Newbey 8989)	3	18
Atriplex lindleyi subsp. conduplicata	3	2
Austrostipa blackii	3	9
Baeckea grandibracteata subsp. Parker Range (K. Newbey 9270)	3	9
Baeckea sp. Elsewhere Road (M.E. Trudgen 5420)	3	3
Baeckea sp. Hatter Hill (K.R. Newbey 3284)	3	20
Baeckea sp. Hyden (J.M. Brown 141)	3	1
Baeckea sp. Merredin (K.R. Newbey 2506)	3	2
Baeckea sp. Parker Range (M. Hislop and F. Hort MH 2968)	3	6
Baeckea sp. Tammin (R. Coveny 8319 and B. Habberley)	3	1
Banksia lullfitzii	3	18
Banksia rufa subsp. flavescens	3	8
Banksia viscida	3	24
Banksia xylothemelia	3	2
Beyeria sulcata var. truncata	3	6
Bossiaea atrata	3	1
Bossiaea celata	3	14
Bossiaea concinna	3	5
Bossiaea flexuosa	3	19
Bossiaea sp. Jackson Range (G. Cockerton and S. McNee LCS 13614)	3	12
Calytrix creswellii	3	15
Calytrix nematoclada	3	1
Calytrix plumulosa	3	2
Comesperma calcicola	3	4
Conostephium marchantiorum	3	4
Cryptandra crispula	3	6
Cryptandra polyclada subsp. polyclada	3	4
Cyathostemon sp. Salmon Gums (B. Archer 769)	3	7
Daviesia elongata subsp. implexa	3	4
Daviesia uncinata	3	1
Dielsiodoxa leucantha	3	2
Dillwynia acerosa	3	8
Diocirea acutifolia	3	15
Diocirea microphylla	3	11
Elatine macrocalyx	3	1
Eremophila chamaephila	3	1
Eremophila compressa	3	4
Eremophila purpurascens	3	23
Eremophila succinea	3	7
Eremophila veronica	3	6
Eucalyptus brockwayi	3	73
Eucalyptus creta	3	13
Eucalyptus exigua	3	24
Eucalyptus famelica	3	1
Eucalyptus frenchiana	3	21
Eucalyptus histophylla	3	17
Eucalyptus mimica subsp. mimica	3	1
Eucalyptus semiglobosa	3	2
Euryomyrtus recurva	3	3

Priority species	Priority	No. records
Eutaxia acanthoclada	3	12
Eutaxia actinophylla	3	15
Eutaxia nanophylla	3	3
Eutaxia rubricarina	3	2
Frankenia drummondii	3	5
Frankenia glomerata	3	1
Galium leptogonium	3	1
Gastrolobium cruciatum	3	1
Gastrolobium semiteres	3	13
Gnephosis sp. Norseman (K.R. Newbey 8096)	3	7
Gompholobium cinereum	3	4
Gonocarpus pycnostachyus	3	4
Goodenia laevis subsp. laevis	3	5
Grevillea eriobotrya	3	7
Grevillea fulgens	3	1
Grevillea georgeana	3	44
Grevillea insignis subsp. elliotii	3	18
Grevillea pilosa subsp. redacta	3	14
Gunniopsis rubra	3	2
Gyrostemon prostratus	3	1
Hakea pendens	3	23
Hibbertia lepidocalyx subsp. tuberculata	3	6
Hibbertia pachyphylla	3	9
Homalocalyx grandiflorus	3	4
Isoetes brevicula	3	1
Isolepis australiensis	3	3
Isopogon alcicornis	3	1
Labichea eremaea	3	2
Lasiopetalum fitzgibbonii	3	1
Lepidium fasciculatum	3	1
Lepidium genistoides	3	6
Lepidosperma ferricola	3	25
Lepidosperma lyonsii	3	5
Lepidosperma sp. Pigeon Rocks (H. Pringle 30237)	3	3
Leucopogon sp. Ironcaps (N. Gibson and K. Brown 3070)	3	11
Leucopogon sp. Yanneymooning (F. Mollemans 3797)	3	7
Melaleuca coccinea	3	23
Melaleuca macronychia subsp. trygonoides	3	14
Melaleuca ochroma	3	2
Menkea draboides	3	1
Microcybe pauciflora subsp. grandis	3	5
Micromyrtus elobata subsp. scopula	3	6
Micromyrtus serrulata	3	8
Microseris scapigera	3	7
Mirbelia sp. Helena and Aurora (B.J. Lepschi 2003)	3	16
Neurachne annularis	3	22
Oxymyrrhine plicata	3	4
Parmeliopsis macrospora	3	8
Persoonia cymbifolia	3	15
Persoonia scabra	3	7
Phebalium brachycalyx	3	3
Philotheca coateana	3	3
Pityrodia chrysocalyx	3	7
Pityrodia sp. Yilgarn (A.P. Brown 2679)	3	27
Prostanthera nanophylla	3	3
Pseudactinia sp. Bungalbin Hill (F.H. and M.P. Mollemans 3069)	3	16
Ptilotus blackii	3	1
Pultenaea adunca	3	2
Pultenaea daena	3	7
Spartothamnella sp. Helena and Aurora Range (P.G. Armstrong 155-109)	3	14
Stenanthemum bremerense	3	15
Stenanthemum newbeyi	3	31
Stylidium choreanthum	3	26
Stylidium pulviniforme	3	11

Priority species	Priority	No. records
Styphelia sp. Bullfinch (M. Hislop 3574)	3	11
Synaphea bifurcata	3	1
Trachymene anisocarpa var. trichocarpa	3	3
Tricoryne sp. Morawa (G.J. Keighery and N. Gibson 6759)	3	2
Verticordia gracilis	3	3
Verticordia mitodes	3	10
Verticordia stenopetala	3	13
Verticordia verticordina	3	1
Xanthoparmelia dayiana	3	2
Adenanthos ileticos	4	6
Allocasuarina hystricosa	4	1
Banksia arborea	4	34
Banksia shanklandiorum	4	1
Calamphoreus inflatus	4	19
Conospermum toddii	4	1
Darwinia polycephala	4	9
Dicrastylis cundeeleensis	4	1
Eremophila biserrata	4	16
Eremophila caerulea subsp. merrallii	4	10
Eremophila parvifolia subsp. parvifolia	4	6
Eremophila racemosa	4	29
Eremophila serpens	4	7
Eucalyptus caesia	4	3
Eucalyptus cerasiformis	4	28
Eucalyptus deflexa	4	30
Eucalyptus desmondensis	4	1
Eucalyptus dolichorhyncha	4	3
Eucalyptus formanii	4	43
Eucalyptus georgei subsp. fulgida	4	20
Eucalyptus georgei subsp. georgei	4	24
Eucalyptus kruseana	4	20
Eucalyptus pterocarpa	4	17
Eucalyptus rhomboidea	4	34
Eucalyptus rugulata	4	17
Eucalyptus stoatei	4	5
Eucalyptus x brachyphylla	4	16
Goodenia berringbinensis	4	1
Grevillea aneura	4	23
Grevillea dissecta	4	4
Grevillea erectiloba	4	16
Grevillea fastigiata	4	1
Grevillea prostrata	4	8
Grevillea secunda	4	2
Grevillea tetrapleura	4	24
Gyrostemon ditrigynus	4	22
Haegiela tatei	4	9
Marianthus mollis	4	2
Melaleuca fissurata	4	6
Microcorys sp. Forrestania (V. English 2004)	4	33
Microtis quadrata	4	1
Myriophyllum balladoniense	4	26
Myriophyllum petraeum	4	11
Pilostyles collina	4	4
Pimelea physodes	4	1
Prostanthera carrickiana	4	4
Sowerbaea multicaulis	4	18
Stylidium merrallii	4	2
Tecticornia entrichoma	4	8
Wurmbea murchisoniana	4	4
Fauna		
Branchinella basispina	1	2
Branchinella denticulata	1	1
Budginmaya eulae	1	1
Daphnia jollyi	1	7

Priority species	Priority	No. records
Jalmenus aridus	1	4
Acanthophis antarcticus	3	6
Paroplocephalus atriceps	3	10
Amytornis textilis subsp. textilis	4	1
Ardeotis australis	4	57
Charadrius rubricollis	4	12
Falcunculus frontatus subsp. leucogaster	4	3
Hylacola cauta subsp. whitlocki	4	16
Macropus irma	4	15
Oreoica gutturalis subsp. gutturalis	4	29
Pomatostomus superciliosus subsp. ashbyi	4	16
Pseudomys occidentalis	4	12
Psophodes nigrogularis subsp. oberon	4	8
Isoodon obesulus subsp. fusciventer	5	4

Appendix 3: PECs occurring in the GWW

Possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community List under priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5. Table 28 lists all the priority ecological communities occurring in the GWW.

Table 28. PECs occurring in the GWW

Priority Ecological Community	Priority
Allocasuarina globosa Assemblages on Greenstone Rock	1
Bremer Range vegetation complexes	1
Die Hardy Range/Diemals vegetation complex (Banded Ironstone Formation)	1
Duladgin Quartzite Ridge vegetation complex	3
Finnerty Range vegetation complexes (Banded Ironstone Formation)	1
Fraser Range Vegetation complex	1
Helena and Aurora Range vegetation complexes (Banded Ironstone Formation)	1
Highclere Hills (Mayfield) vegetation complex (Banded Ironstone Formation)	1
Ironcap Hills veg complexes (Mt Holland, Middle, North and South Ironcap Hills, Digger Rock and Hatter	3
Koolyanobbing vegetation complex	1
Lake Giles vegetation complexes (Banded Ironstone Formation)	1
Mount Belches *Acacia quadrimarginea* / *Ptilotus obovatus* Banded Ironstone Community	3
Mount Dimer vegetation complexes (Banded Ironstone Formation)	1
Mount Jackson Range vegetation complex (Banded Ironstone Formation)	1
Mount Manning Range vegetation complex (Banded Ironstone Formation)	1
Parker Range vegetation complexes	3
Plant Assemblages of the Southern Hills vegetation complex	1
Subterranean faunal ecosystems of Nullarbor caves	1
Windarling Ranges vegetation complex (Banded Ironstone Formation)	1
Woodline Hills vegetation complex	4

Appendix 4: All exotic flora species recorded in the GWW

Table 29. All exotic flora recorded in the GWW (data source: *FloraBase*)

Species	No. records	Species	No. records
Acacia pycnantha	1	*Lepidium africanum*	3
Acetosa vesicaria	6	*Lepidium didymum*	1
Agave americana	2	*Limonium lobatum*	2
Aira caryophyllea	2	*Limonium sinuatum*	5
Aira cupaniana	3	*Lycium ferocissimum*	2
Alhagi maurorum	5	*Lysimachia arvensis*	20
Allium ampeloprasum	1	*Lythrum hyssopifolia*	2
Alyssum linifolium	6	*Malva parviflora*	4
Amaranthus viridis	1	*Malva pseudolavatera*	1
Ambrosia psilostachya	1	*Marrubium vulgare*	1
Arctotheca calendula	6	*Medicago laciniata var. laciniata*	5
Arctotheca populifolia	1	*Medicago minima*	9
Argemone ochroleuca subsp. ochroleuca	1	*Medicago orbicularis*	1
Asclepias curassavica	1	*Medicago polymorpha*	7
Asparagus asparagoides	4	*Medicago sativa*	2
Asparagus officinalis	1	*Melilotus indicus*	1
Avena sativa	2	*Mesembryanthemum crystallinum*	3
Brassica napus	1	*Mesembryanthemum nodiflorum*	12
Brassica rapa	1	*Moluccella laevis*	1
Brassica tournefortii	9	*Monoculus monstrosus*	12
Briza minor	3	*Moraea miniata*	1
Bromus diandrus	3	*Moraea setifolia*	2
Bromus hordeaceus	1	*Nicotiana glauca*	7
Bromus rubens	12	*Nothoscordum gracile*	1
Buglossoides arvensis	1	*Oligocarpus calendulaceus*	15
Bupleurum semicompositum	5	*Oncosiphon suffruticosum*	19
Caesalpinia gilliesii	2	*Orbea variegata*	1
Callitriche stagnalis	1	*Orobanche minor*	3
Campylopus introflexus	9	*Oxalis bowiei*	2
Capsella bursa-pastoris	2	*Oxalis pes-caprae*	1
Carduus pycnocephalus	1	*Papaver hybridum*	1
Carduus tenuiflorus	1	*Parapholis incurva*	1
Carpobrotus aequilaterus	2	*Parentucellia latifolia*	3
Carrichtera annua	22	*Pennisetum setaceum*	1
Carthamus lanatus	7	*Pennisetum villosum*	1
Cenchrus ciliaris	1	*Pentameris airoides*	1
Cenchrus longispinus	1	*Pentameris airoides subsp. airoides*	30
Centaurea calcitrapa	1	*Petrorhagia dubia*	1
Centaurea melitensis	27	*Phalaris paradoxa*	1
Centaurea solstitialis	1	*Phyla canescens*	1
Centaurium erythraea	3	*Poa annua*	2
Centaurium tenuiflorum	2	*Poa bulbosa*	1
Cerastium balearicum	1	*Polycarpon tetraphyllum*	1
Cerastium glomeratum	1	*Polygonum aviculare*	1
Chenopodium album	1	*Portulaca oleracea*	1
Chenopodium murale	1	*Portulacaria afra*	1
Chloris virgata	1	*Proboscidea louisianica*	1
Cichorium intybus	1	*Raphanus raphanistrum*	1
Citrullus colocynthis	1	*Rapistrum rugosum*	1
Citrullus lanatus	5	*Reichardia tingitana*	2
Cleretum papulosum subsp. papulosum	4	*Reseda luteola*	1
Conium maculatum	2	*Ricinus communis*	1
Conyza bonariensis	2	*Rostraria cristata*	2
Conyza sumatrensis	1	*Rostraria pumila*	12
Crassula natans	2	*Rumex crispus*	1
Crassula natans var. minus	2	*Sagina apetala*	2
Cucumis myriocarpus	3	*Salvia reflexa*	3
Cuscuta epithymum	3	*Salvia verbenaca*	18
Cuscuta planiflora	2	*Scabiosa atropurpurea*	1
Cylindropuntia fulgida var. mamillata	2	*Schinus molle var. areira*	4
Cynodon dactylon	1	*Schismus arabicus*	5
Cyperus tenellus	2	*Schismus barbatus*	9

Species	No. records	Species	No. records
Datura ferox	1	*Setaria verticillata*	1
Datura inoxia	1	*Silene gallica var. gallica*	2
Dittrichia graveolens	2	*Silene nocturna*	1
Echium plantagineum	10	*Sisymbrium erysimoides*	3
Ehrharta longiflora	2	*Sisymbrium irio*	10
Ehrharta villosa	1	*Sisymbrium orientale*	8
Emex australis	3	*Sisymbrium runcinatum*	3
Eragrostis cilianensis	3	*Solanum hystrix*	1
Eragrostis curvula	1	*Solanum nigrum*	7
Erodium aureum	4	*Sonchus asper*	2
Erodium botrys	2	*Sonchus oleraceus*	35
Erodium cicutarium	25	*Sorghum halepense*	1
Erodium moschatum	1	*Spergularia diandra*	6
Euphorbia maculata	1	*Spergularia rubra*	4
Galenia pubescens var. pubescens	1	*Stellaria media*	1
Galium murale	3	*Symphyotrichum squamatum*	1
Galium spurium	3	*Taraxacum officinale*	1
Gazania linearis	3	*Tragopogon porrifolius*	2
Glandularia aristigera	1	*Tribulus terrestris*	6
Hedypnois rhagadioloides subsp. cretica	4	*Trifolium campestre var. campestre*	1
Helianthus annuus	4	*Trifolium hirtum*	1
Heliotropium europaeum	6	*Trifolium tomentosum var. tomentosum*	2
Heliotropium supinum	1	*Urochloa panicoides*	2
Herniaria cinerea	2	*Ursinia anthemoides subsp.*	4
Hordeum glaucum	6	*Urtica urens*	1
Hordeum leporinum	2	*Vellereophyton dealbatum*	2
Hornungia procumbens	3	*Vicia monantha subsp. triflora*	3
Hypochaeris glabra	21	*Vulpia bromoides*	2
Isolepis marginata	3	*Vulpia muralis*	9
Juncus bufonius	11	*Vulpia myuros*	14
Juncus capitatus	2	*Vulpia myuros forma megalura*	1
Juncus hybridus	1	*Vulpia myuros forma myuros*	6
Lactuca serriola forma serriola	4	*Xanthium spinosum*	2

Appendix 5: Sample field weed data collection sheet

Waypoint no. / coordinates	**Date**	**Species**	**Location**	**Diameter 20, 50, 100m**	**Density <5, 6–75, 76–100%**	**Growth stage J, A, S**	**Treated Yes / No**	**Comments**
Waypoint 26	01/01/2013	E.g. *Opuntia* spp.	Coolgardie township	100m	<5%	Adult	Chemical	Growing on degraded bare land
Waypoint 27	01/01/2013	E.g. Athel Pine	Creekline south of homestead	20m	6–75%	Juvenile	Manual	New infestation along creekline
Waypoint 28	01/01/2013	E.g. Bathurst Burr	Surrounding paddock dam	50m	76–100%	Seedlings	No	All seedlings
Recorder:								

Appendix 6: All native fauna species recorded in the GWW

Table 30. All native fauna species recorded in the GWW

Group	Common name	Scientific name	No. records
Amphibian	Bleating Froglet	*Crinia pseudinsignifera*	66
	Crawling Toadlet	*Pseudophryne guentheri*	29
	Humming Frog	*Neobatrachus pelobatoides*	67
	Kunapalari Frog	*Neobatrachus kunapalari*	139
	Moaning Frog	*Heleioporus eyrei*	2
	Motorbike Frog	*Litoria moorei*	1
	Northern Burrowing Frog	*Neobatrachus aquilonius*	1
	Plonking Frog	*Neobatrachus wilsmorei*	2
	Shoemaker Frog	*Neobatrachus sutor*	39
	Slender Tree Frog	*Litoria adelaidensis*	18
	Spotted–thighed Frog	*Litoria cyclorhyncha*	128
	Turtle Frog	*Myobatrachus gouldii*	12
	Western Banjo Frog	*Limnodynastes dorsalis*	79
	Western Spotted Frog	*Heleioporus albopunctatus*	17
	Western Toadlet	*Pseudophryne occidentalis*	322
	White–footed Trilling Frog	*Neobatrachus albipes*	33
Birds	Atlantic Yellow–nosed Albatross	*Thalassarche chlororhynchos*	1
	Australasian Grebe	*Tachybaptus novaehollandiae*	61
	Australasian Shoveler	*Anas rhynchotis*	25
	Australian Black–shouldered Kite	*Elanus caeruleus subsp. axillaris*	5
	Australian Bustard*	*Ardeotis australis*	75
	Australian Hobby	*Falco longipennis*	100
	Australian Kestrel	*Falco cenchroides*	461
	Australian Magpie	*Cracticus tibicen*	769
	Australian Owlet–nightjar	*Aegotheles cristatus*	99
	Australian Pelican	*Pelecanus conspicillatus*	7
	Australian Peregrine Falcon	*Falco peregrinus subsp. macropus*	15
	Australian Raven	*Corvus coronoides*	1049
	Australian Ringneck	*Platycercus zonarius*	10
	Australian Shelduck	*Tadorna tadornoides*	219
	Australian Spotted Crake	*Porzana fluminea*	5
	Australian White Ibis	*Threskiornis molucca*	8
	Australian Wood Duck	*Chenonetta jubata*	114
	Banded Lapwing	*Vanellus tricolor*	112
	Banded Stilt	*Cladorhynchus leucocephalus*	18
	Bar–tailed Godwit	*Limosa lapponica*	3
	Barn Owl	*Tyto alba subsp. delicatula*	2
	Baudin's Cockatoo (long–billed black–cockatoo)	*Calyptorhynchus baudinii*	14
	Black Falcon	*Falco subniger*	2
	Black Kite	*Milvus migrans*	1
	Black Swan	*Cygnus atratus*	87
	Black–breasted Buzzard	*Hamirostra melanosternon*	12
	Black–eared Cuckoo	*Chrysococcyx osculans*	2

Group	Common name	Scientific name	No. records
	Black–faced Cormorant	*Phalacrocorax fuscescens*	1
	Black–faced Cuckoo–shrike	*Coracina novaehollandiae*	886
	Black–faced Woodswallow	*Artamus cinereus*	354
	Black–fronted Dotterel	*Charadrius melanops*	1
	Black–winged Stilt	*Himantopus himantopus*	56
	Blue–billed Duck	*Oxyura australis*	4
	Blue–breasted Fairy–wren	*Malurus pulcherrimus*	142
	Blue–winged Kookaburra	*Dacelo leachii*	1
	Boobook Owl	*Ninox novaeseelandiae*	169
	Bourke's Parrot	*Neophema bourkii*	2
	Broad–tailed Thornbill	*Acanthiza apicalis*	743
	Brown Falcon	*Falco berigora*	321
	Brown Goshawk	*Accipiter fasciatus*	83
	Brown Honeyeater	*Lichmera indistincta*	892
	Brown Songlark	*Cincloramphus cruralis*	102
	Brown–headed Honeyeater	*Melithreptus brevirostris*	379
	Brush Bronzewing	*Phaps elegans*	16
	Budgerigar	*Melopsittacus undulatus*	35
	Bush Stone–curlew	*Burhinus grallarius*	4
	Carnaby's Cockatoo	*Calyptorhynchus latirostris*	21
	Cattle Egret	*Ardea ibis*	4
	Chestnut Quail–thrush	*Cinclosoma castanotus*	60
	Chestnut Teal	*Anas castanea*	13
	Chestnut–breasted Quail–thrush	*Cinclosoma castaneothorax*	2
	Chestnut–rumped Thornbill	*Acanthiza uropygialis*	589
	Cockatiel	*Nymphicus hollandicus*	41
	Collared Sparrowhawk	*Accipiter cirrocephalus*	49
	Common Bronzewing	*Phaps chalcoptera*	391
	Common Greenshank	*Tringa nebularia*	10
	Common Sandpiper	*Actitis hypoleucos*	9
	Crested Bellbird	*Oreoica gutturalis*	772
	Crested Bellbird (southern)*	*Oreoica gutturalis subsp. gutturalis*	25
	Crested Pigeon	*Ocyphaps lophotes*	354
	Crested Shrike–tit	*Falcunculus frontatus*	12
	Crimson Chat	*Epthianura tricolor*	68
	Curlew Sandpiper	*Calidris ferruginea*	6
	Diamond Dove	*Geopelia cuneata*	1
	Dusky Woodswallow	*Artamus cyanopterus*	312
	Eastern Great Egret	*Ardea modesta*	6
	Eastern Reef Egret, Eastern Reef Heron	*Egretta sacra*	2
	Elegant Parrot	*Neophema elegans*	31
	Emu	*Dromaius novaehollandiae*	512
	Eurasian Coot	*Fulica atra*	112
	Fairy Martin	*Hirundo ariel*	1
	Fan–tailed Cuckoo	*Cacomantis flabelliformis*	91
	Forest Red–tailed Black–Cockatoo	*Calyptorhynchus banksii subsp. naso*	4
	Fork–tailed Swift	*Apus pacificus*	2

Group	Common name	Scientific name	No. records
	Freckled Duck	*Stictonetta naevosa*	11
	Galah	*Cacatua roseicapilla*	14
	Gilbert's Whistler	*Pachycephala inornata*	146
	Glossy Ibis	*Plegadis falcinellus*	2
	Golden Whistler	*Pachycephala pectoralis*	174
	Great Cormorant	*Phalacrocorax carbo*	10
	Great Crested Grebe	*Podiceps cristatus*	6
	Great Knot	*Calidris tenuirostris*	1
	Grey Butcherbird	*Cracticus torquatus*	1023
	Grey Currawong	*Strepera versicolor*	706
	Grey Falcon	*Falco hypoleucos*	1
	Grey Fantail	*Rhipidura fuliginosa*	7
	Grey Shrike–thrush	*Colluricincla harmonica*	844
	Grey Teal	*Anas gracilis*	201
	Grey–breasted White–eye	*Zosterops lateralis*	206
	Grey–fronted Honeyeater	*Lichenostomus plumulus*	61
	Ground Cuckoo–shrike	*Coracina maxima*	58
	Hardhead	*Aythya australis*	38
	Hoary–headed Grebe	*Poliocephalus poliocephalus*	100
	Hooded Plover*	*Charadrius rubricollis*	8
	Hooded Robin	*Petroica cucullata*	7
	Horsfield's Bronze Cuckoo	*Chrysococcyx basalis*	11
	Jacky Winter	*Microeca fascinans*	345
	Kelp Gull	*Larus dominicanus*	1
	Little Black Cormorant	*Phalacrocorax sulcirostris*	16
	Little Button–quail	*Turnix velox*	17
	Little Corella	*Cacatua sanguinea*	8
	Little Crow	*Corvus bennetti*	318
	Little Eagle	*Aquila morphnoides*	1
	Little Grassbird	*Megalurus gramineus*	1
	Little Woodswallow	*Artamus minor*	31
	Magpie Goose	*Anseranas semipalmata*	1
	Magpie–lark	*Grallina cyanoleuca*	615
	Major Mitchell's Cockatoo	*Cacatua leadbeateri*	12
	Malleefowl***	*Leipoa ocellata*	121
	Marsh Sandpiper	*Tringa stagnatilis*	1
	Masked Lapwing	*Vanellus miles*	2
	Masked Woodswallow	*Artamus personatus*	49
	Mistletoebird	*Dicaeum hirundinaceum*	59
	Mulga Parrot	*Platycercus varius*	16
	Musk Duck	*Biziura lobata*	52
	Naretha Blue Bonnet**	*Northiella haematogaster subsp. narethae*	1
	New Holland Honeyeater	*Phylidonyris novaehollandiae*	79
	Orange Chat	*Epthianura aurifrons*	5
	Pacific Black Duck	*Anas superciliosa*	123
	Pacific Gull	*Larus pacificus*	9
	Painted Button–quail	*Turnix varia*	1

Group	Common name	Scientific name	No. records
	Pallid Cuckoo	*Cuculus pallidus*	4
	Peaceful Dove	*Geopelia striata*	1
	Peregrine Falcon	*Falco peregrinus*	45
	Pied Butcherbird	*Cracticus nigrogularis*	635
	Pied Cormorant	*Phalacrocorax varius*	7
	Pied Honeyeater	*Certhionyx variegatus*	31
	Pied Oystercatcher	*Haematopus longirostris*	6
	Pink–eared Duck	*Malacorhynchus membranaceus*	40
	Purple–crowned Lorikeet	*Glossopsitta porphyrocephala*	742
	Purple–gaped Honeyeater	*Lichenostomus cratitius*	94
	Rainbow Bee–eater	*Merops ornatus*	258
	Rainbow Lorikeet	*Trichoglossus haematodus*	3
	Red Wattlebird	*Anthochaera carunculata*	1595
	Red–backed Kingfisher	*Todiramphus pyrrhopygia*	3
	Red–capped Parrot	*Platycercus spurius*	2
	Red–capped Plover	*Charadrius ruficapillus*	45
	Red–capped Robin	*Petroica goodenovii*	583
	Red–eared Firetail	*Stagonopleura oculata*	3
	Red–kneed Dotterel	*Erythrogonys cinctus*	11
	Red–necked Avocet	*Recurvirostra novaehollandiae*	27
	Red–necked Stint	*Calidris ruficollis*	8
	Red–tailed Black–Cockatoo	*Calyptorhynchus banksii*	61
	Red–throated Pipit	*Anthus cervinus*	2
	Redthroat	*Pyrrholaemus brunneus*	397
	Regent Parrot	*Polytelis anthopeplus*	138
	Restless Flycatcher	*Myiagra inquieta*	62
	Rock Parrot	*Neophema petrophila*	3
	Ruddy Turnstone	*Arenaria interpres*	1
	Rufous Fieldwren	*Calamanthus campestris*	32
	Rufous Night Heron	*Nycticorax caledonicus*	5
	Rufous Songlark	*Cincloramphus mathewsi*	62
	Rufous Treecreeper	*Climacteris rufa*	321
	Rufous Whistler	*Pachycephala rufiventris*	323
	Sacred Kingfisher	*Todiramphus sanctus*	61
	Samphire Thornbill	*Acanthiza iredalei*	2
	Sanderling	*Calidris alba*	1
	Scarlet–chested Parrot	*Neophema splendida*	3
	Sharp–tailed Sandpiper	*Calidris acuminata*	14
	Shy Groundwren	*Hylacola cauta*	27
	Shy Heathwren (western)	*Hylacola cauta subsp. whitlocki*	16
	Singing Honeyeater	*Lichenostomus virescens*	761
	Slaty–backed Thornbill	*Acanthiza robustirostris*	7
	Sooty Oystercatcher	*Haematopus fuliginosus*	10
	Southern Scrub–robin	*Drymodes brunneopygia*	122
	Southern Whiteface	*Aphelocephala leucopsis*	96
	Spiny–cheeked Honeyeater	*Acanthagenys rufogularis*	990
	Splendid Fairy–wren	*Malurus splendens*	122

Group	Common name	Scientific name	No. records
	Spotless Crake	*Porzana tabuensis*	1
	Spotted Harrier	*Circus assimilis*	38
	Spotted Nightjar	*Eurostopodus argus*	47
	Spotted Pardalote	*Pardalotus punctatus*	72
	Square–tailed Kite	*Hamirostra isura*	1
	Straw–necked Ibis	*Threskiornis spinicollis*	18
	Striated Pardalote	*Pardalotus striatus*	1215
	Stubble Quail	*Coturnix pectoralis*	20
	Tawny Frogmouth	*Podargus strigoides*	71
	Tawny–crowned Honeyeater	*Phylidonyris melanops*	3
	Thick–billed Grasswren (western)	*Amytornis textilis subsp. textilis*	1
	Torresian Crow	*Corvus orru*	39
	Tree Martin	*Hirundo nigricans*	7
	Twenty–eight Parrot	*Platycercus zonarius subsp. semitorquatus*	12
	Varied Sittella	*Daphoenositta chrysoptera*	138
	Variegated Fairy–wren	*Malurus lamberti*	2
	Wedge–tailed Eagle	*Aquila audax*	452
	Weebill	*Smicrornis brevirostris*	1534
	Welcome Swallow	*Hirundo neoxena*	419
	Western Gerygone	*Gerygone fusca*	92
	Western Little Wattlebird	*Anthochaera lunulata*	27
	Western Long–billed Corella	*Cacatua pastinator*	3
	Western Rosella	*Platycercus icterotis*	89
	Western Rosella (inland)	*Platycercus icterotis subsp. xanthogenys*	15
	Western Shrike–tit, Crested Shrike–tit	*Falcunculus frontatus subsp. leucogaster*	3
	Western Spinebill	*Acanthorhynchus superciliosus*	10
	Western Wedgebill	*Psophodes occidentalis*	2
	Western Whipbird	*Psophodes nigrogularis*	1
	Western Whipbird (Mallee)*	*Psophodes nigrogularis subsp. oberon*	1
	Western Yellow Robin	*Eopsaltria australis subsp. griseogularis*	35
	Whistling Kite	*Haliastur sphenurus*	80
	White–backed Magpie	*Cracticus tibicen subsp. dorsalis*	7
	White–backed Swallow	*Cheramoeca leucosternus*	3
	White–bellied Sea–Eagle	*Haliaeetus leucogaster*	1
	White–browed Babbler*	*Pomatostomus superciliosus*	426
	White–browed Babbler (western wheatbelt)	*Pomatostomus superciliosus subsp. ashbyi*	11
	White–browed Scrubwren	*Sericornis frontalis*	76
	White–browed Treecreeper	*Climacteris affinis*	14
	White–browed Woodswallow	*Artamus superciliosus*	4
	White–cheeked Honeyeater	*Phylidonyris nigra*	1
	White–eared Honeyeater	*Lichenostomus leucotis*	708
	White–fronted Chat	*Epthianura albifrons*	165
	White–fronted Honeyeater	*Phylidonyris albifrons*	13
	White–necked Heron	*Ardea pacifica*	35
	White–winged Fairy–wren	*Malurus leucopterus*	104
	White–winged Triller	*Lalage tricolor*	2
	Willie Wagtail	*Rhipidura leucophrys*	949

Group	Common name	Scientific name	No. records
	Wood Sandpiper	*Tringa glareola*	7
	Yellow–billed Spoonbill	*Platalea flavipes*	6
	Yellow–plumed Honeyeater	*Lichenostomus ornatus*	1026
	Yellow–rumped Pardalote	*Pardalotus punctatus subsp. xanthopyge*	15
	Yellow–rumped Thornbill	*Acanthiza chrysorrhoa*	562
	Yellow–throated Miner	*Manorina flavigula*	1008
	Zebra Finch	*Taeniopygia guttata*	61
Inverte-brates	Arid Bronze Azure Butterfly	*Ogyris subterrestris subsp. petrina*	17
	Graceful Sunmoth	*Synemon gratiosa*	1
	Tree–stem Trapdoor Spider	*Aganippe castellum*	304
	butterfly	*Jalmenus aridus*	5
	fairy shrimp	*Branchinella basispina*	2
	freshwater crustacean	*Daphnia jollyi*	2
	millipede	*Atelomastix priona*	2
Mammals	Ash–grey Mouse	*Pseudomys albocinereus*	77
	Bilby	*Macrotis lagotis*	5
	Black–flanked Rock–wallaby, Black–footed Rock–wallaby	*Petrogale lateralis subsp. lateralis*	1
	Bolam's Mouse	*Pseudomys bolami*	55
	Boodie	*Bettongia lesueur subsp. graii*	1
	Brush–tailed Phascogale, Wambenger (SW subsp)	*Phascogale tapoatafa subsp. (WAM M434)*	1
	Chocolate Wattled Bat	*Chalinolobus morio*	106
	Chuditch, Western Quoll***	*Dasyurus geoffroii*	23
	Crest–tailed Mulgara	*Dasycercus cristicauda*	1
	Echidna	*Tachyglossus aculeatus*	7
	Euro	*Macropus robustus*	10
	Fat–tailed Dunnart	*Sminthopsis crassicaudata*	97
	Gilbert's Dunnart	*Sminthopsis gilberti*	28
	Gould's Wattled Bat	*Chalinolobus gouldii*	298
	Greater Long–eared Bat	*Nyctophilus timoriensis subsp. timoriensis*	14
	Greater Stick–nest Rat	*Leporillus conditor*	2
	Grey–bellied Dunnart	*Sminthopsis griseoventer*	6
	Hairy–footed Dunnart	*Sminthopsis hirtipes*	20
	Honey Possum	*Tarsipes rostratus*	31
	Inland Broad–nosed Bat	*Scotorepens balstoni*	28
	Inland Forest Bat	*Vespadelus baverstocki*	11
	Kultarr	*Antechinomys laniger*	7
	Lesser Long–eared Bat	*Nyctophilus geoffroyi*	35
	Lesser Stick–nest Rat	*Leporillus apicalis*	2
	Little long–tailed Dunnart	*Sminthopsis dolichura*	175
	Mitchell's Hopping–mouse	*Notomys mitchellii*	110
	Northern Quoll	*Dasyurus hallucatus*	1
	Numbat***	*Myrmecobius fasciatus*	8
	Ooldea Dunnart	*Sminthopsis ooldea*	6
	Quenda, Southern Brown Bandicoot	*Isoodon obesulus subsp. fusciventer*	7
	Red Kangaroo	*Macropus rufus*	7
	Red–tailed Phascogale, Kenngoor***	*Phascogale calura*	1
	Rufous Hare–wallaby	*Lagorchestes hirsutus subsp. hirsutus*	1

Group	Common name	Scientific name	No. records
	Sandy Inland Mouse	*Pseudomys hermannsburgensis*	61
	Shark Bay Mouse, Djoongari	*Pseudomys fieldi*	1
	Southern Forest Bat	*Vespadelus regulus*	94
	Southern Freetail–bat	*Mormopterus planiceps*	72
	Southern Ningaui	*Ningaui yvonneae*	68
	Spinifex Hopping–mouse	*Notomys alexis*	45
	Stripe–faced Dunnart	*Sminthopsis macroura*	3
	Western Barred Bandicoot	*Perameles bougainville subsp. fasciata*	1
	Western Brush Wallaby*	*Macropus irma*	10
	Western Bush Rat	*Rattus fuscipes*	2
	Western Grey Kangaroo	*Macropus fuliginosus*	25
	Western Mouse*	*Pseudomys occidentalis*	5
	Western Pygmy–possum	*Cercartetus concinnus*	178
	White–striped Freetail–bat	*Tadarida australis*	108
	White–tailed Dunnart	*Sminthopsis granulipes*	57
	Wongai Ningaui	*Ningaui ridei*	21
	Woolley's Pseudantechinus	*Pseudantechinus woolleyae*	8
Reptiles	Bardick	*Echiopsis curta*	6
	Barking Gecko	*Nephrurus milii*	165
	Beaked Gecko	*Rhynchoedura ornata*	40
	Bicycle Dragon	*Ctenophorus cristatus*	292
	Black–naped Snake	*Neelaps bimaculatus*	12
	Broad–banded Sand Swimmer	*Eremiascincus richardsonii*	29
	Bull Skink	*Egernia multiscutata*	45
	Bungarra or Sand Monitor	*Varanus gouldii*	47
	Bynoe's Gecko	*Heteronotia binoei*	439
	Carpet Python*	*Morelia spilota subsp. imbricata*	20
	Central Military Dragon	*Ctenophorus isolepis subsp. gularis*	29
	Central Netted Dragon	*Ctenophorus nuchalis*	12
	Clawless Gecko	*Crenadactylus ocellatus*	23
	Common Scaly Foot	*Pygopus lepidopodus*	33
	Crested Dragon	*Ctenophorus isolepis*	3
	Crowned Snake	*Elapognathus coronatus*	1
	Desert Death Adder	*Acanthophis pyrrhus*	1
	Desert Skink	*Egernia inornata*	80
	Desert Wood Gecko	*Diplodactylus wiru*	1
	Dugite	*Pseudonaja affinis*	30
	Dwarf Bearded Dragon	*Pogona minor subsp. minima*	1
	Dwarf Bicycle Dragon	*Ctenophorus mckenziei*	2
	Fraser's Legless Lizard	*Delma fraseri*	44
	Gilled Slender Blue–tongue Skink	*Cyclodomorphus branchialis*	1
	Goldfields Spiny–tailed Gecko	*Strophurus assimilis*	76
	Gwardar	*Pseudonaja nuchalis*	2
	Heath Monitor	*Varanus rosenbergi*	8
	Jan's Banded Snake	*Simoselaps bertholdi*	53
	Jewelled South–west Ctenotus, skink (Swan Coastal Plain pop P3)	*Ctenotus gemmula*	2
	Keeled Legless Lizard	*Pletholax gracilis*	2

Group	Common name	Scientific name	No. records
	Lake Cronin Snake*	*Paroplocephalus atriceps*	11
	Mallee Sand Dragon	*Ctenophorus fordi*	62
	Marbled Gecko	*Christinus marmoratus*	43
	Master's Snake	*Drysdalia mastersii*	3
	Moon Snake	*Furina ornata*	7
	Mulga Snake	*Pseudechis australis*	31
	Night Skink	*Egernia striata*	5
	Nullarbor Bearded Dragon	*Pogona nullarbor*	1
	Nullarbor Earless Dragon	*Tympanocryptis houstoni*	10
	Oblong Turtle	*Chelodina oblonga*	1
	Ornate Crevice Dragon	*Ctenophorus ornatus*	182
	Pebble Dragon	*Tympanocryptis cephala*	31
	Pygmy Spiny–tailed Skink	*Egernia depressa*	29
	Racehorse Monitor	*Varanus tristis*	13
	Ring–tailed Dragon	*Ctenophorus caudicinctus*	1
	Ringed Brown Snake	*Pseudonaja modesta*	42
	Rosen's Snake	*Suta fasciata*	31
	Salt Pan Dragon	*Ctenophorus salinarum*	203
	South Coast Gecko	*Diplodactylus calcicolus*	99
	Southern Death Adder*	*Acanthophis antarcticus*	4
	Southern Sand Plain Gecko	*Lucasium bungabinna*	23
	Spotted Military Dragon	*Ctenophorus maculatus*	17
	Thorny Devil	*Moloch horridus*	78
	Western Bluetongue	*Tiliqua occipitalis*	17
	Western Netted Dragon	*Ctenophorus reticulatus*	154
	Western Spiny–tailed Skink (interior WA and Shark Bay), Gidgee Skink, Stokes' Skink	*Egernia stokesii subsp. badia*	1
	Woma**	*Aspidites ramsayi*	8
* DEC priority species ** Listed as Threatened under WC Act *** Listed as Threatened under WC and EPBC Act			

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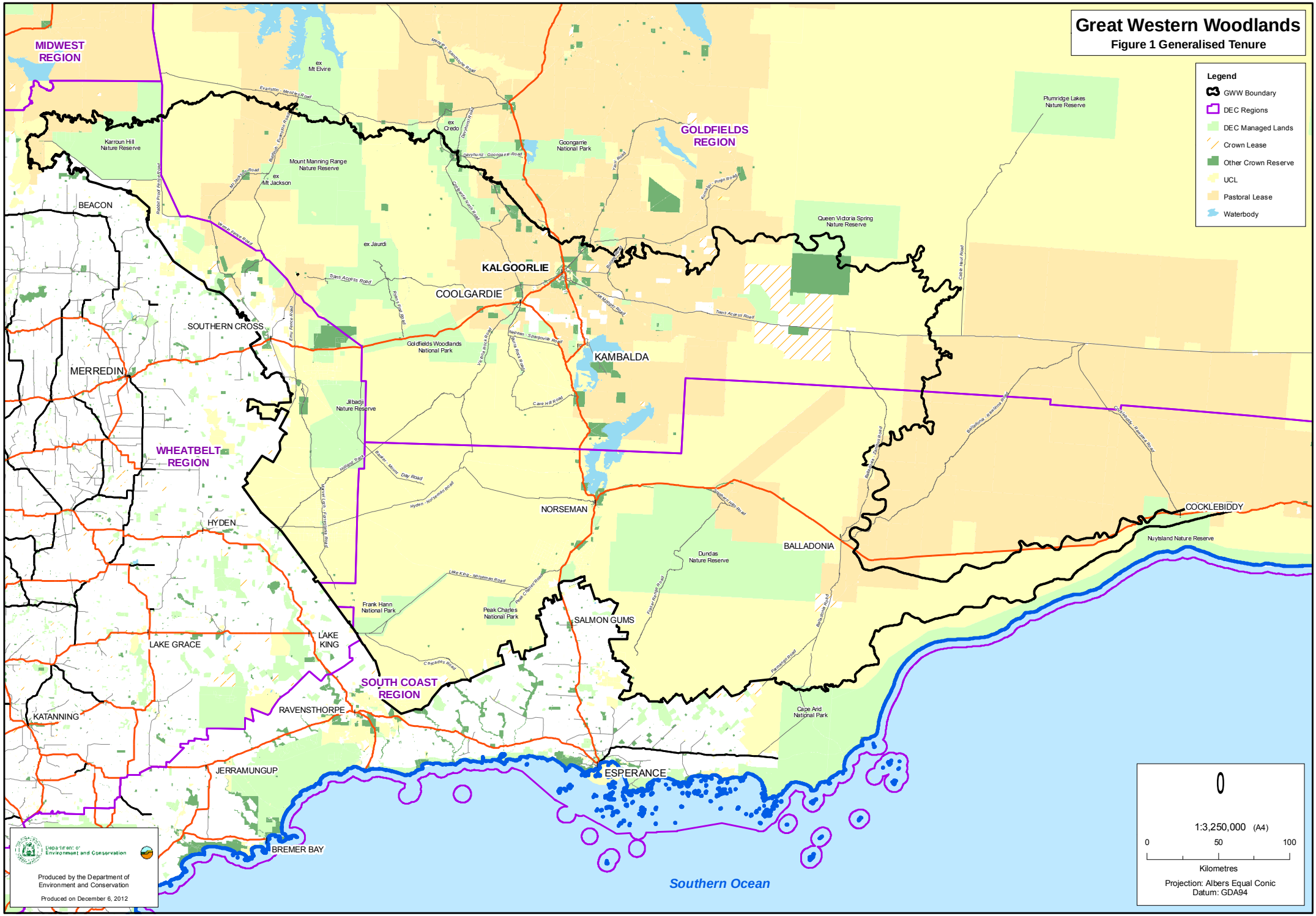
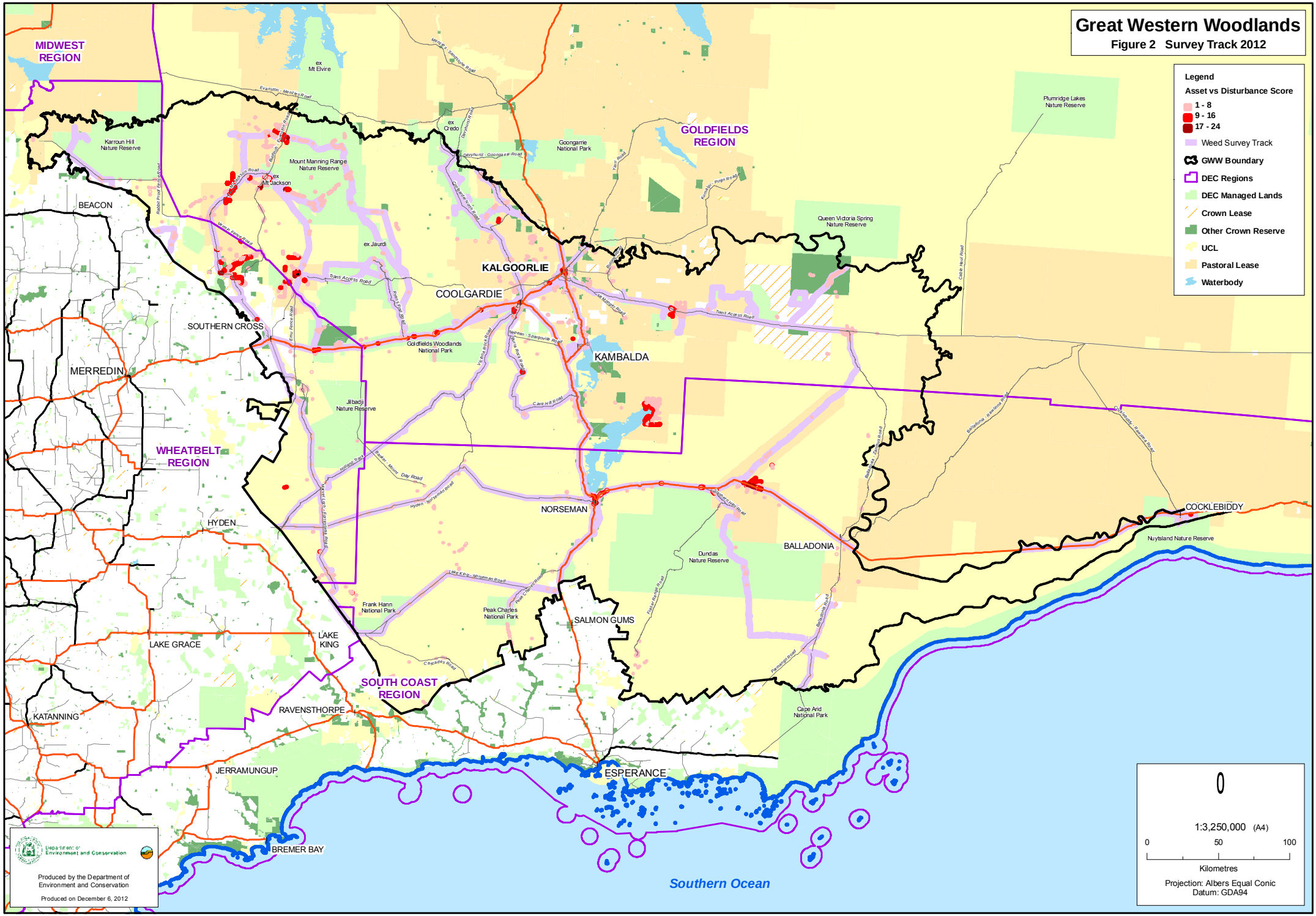
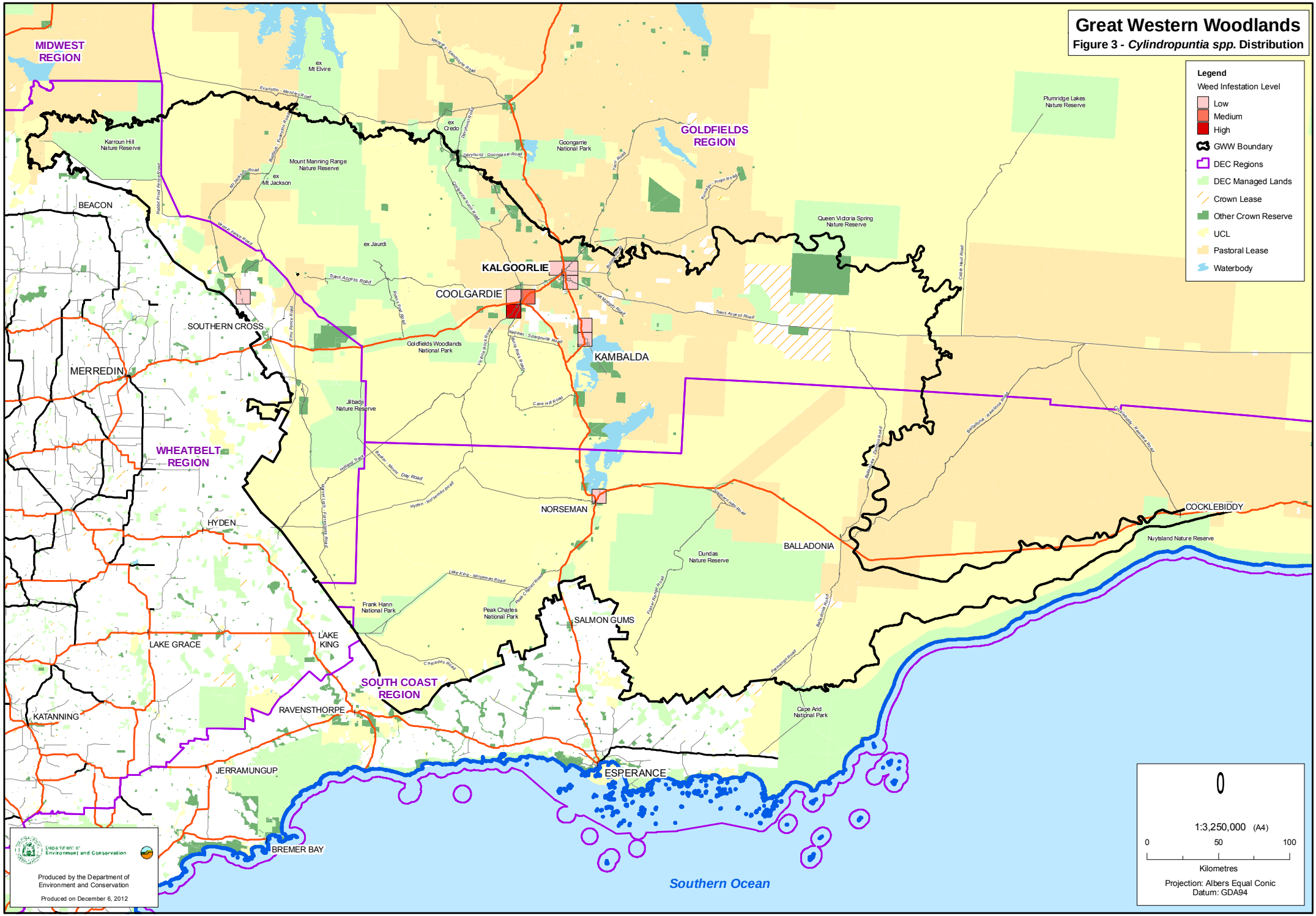
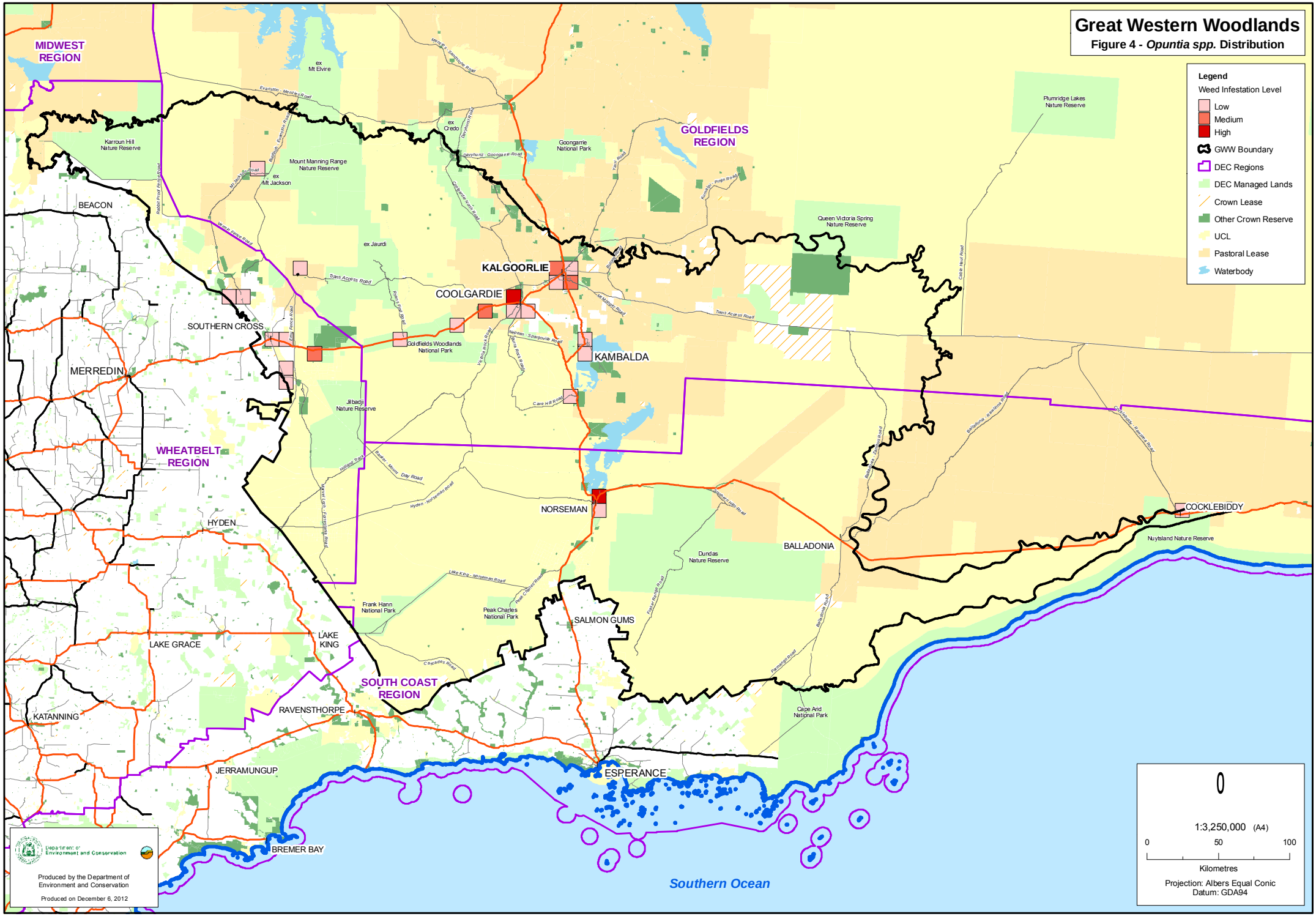
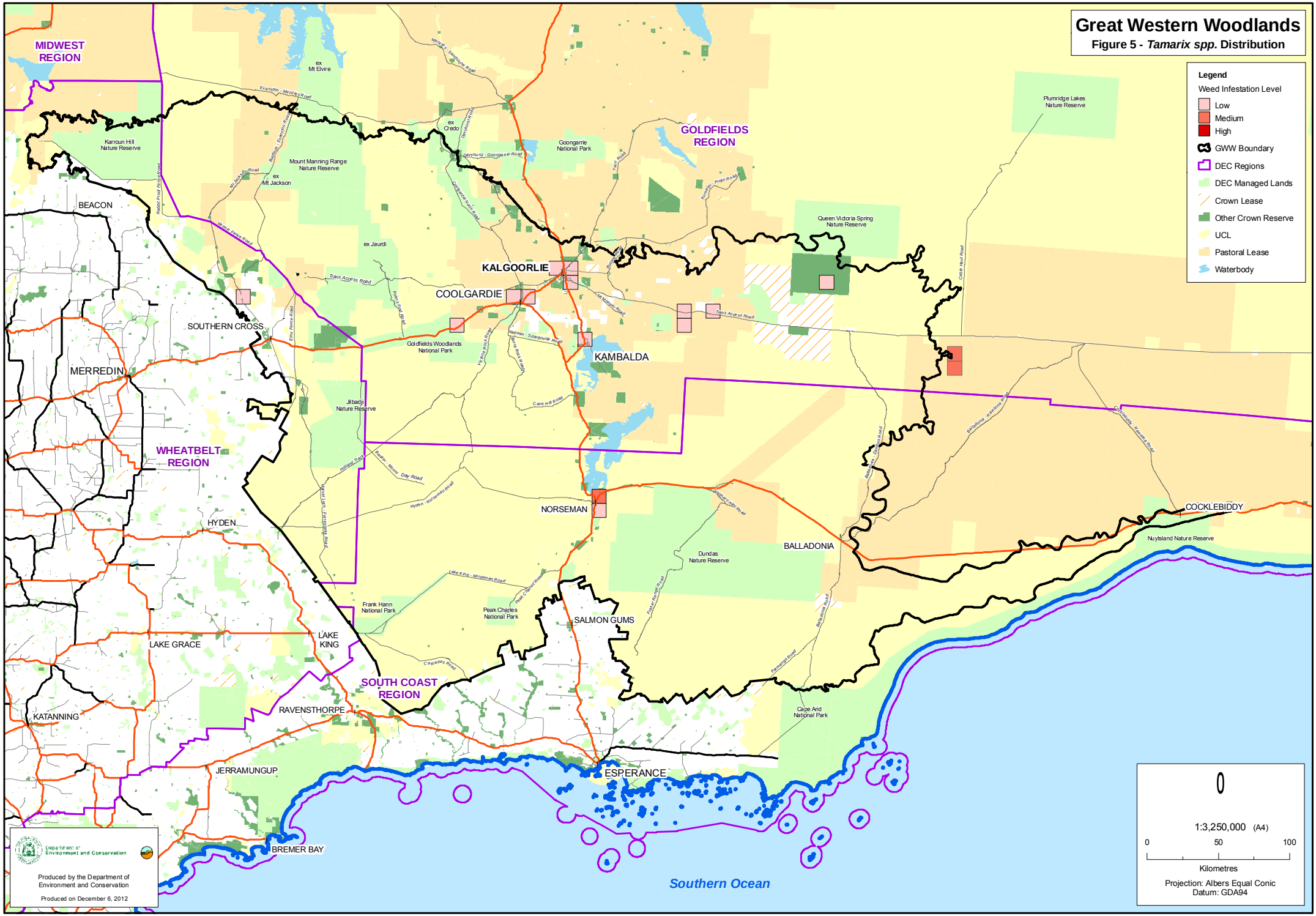
GREAT WESTERN
WOODLANDS

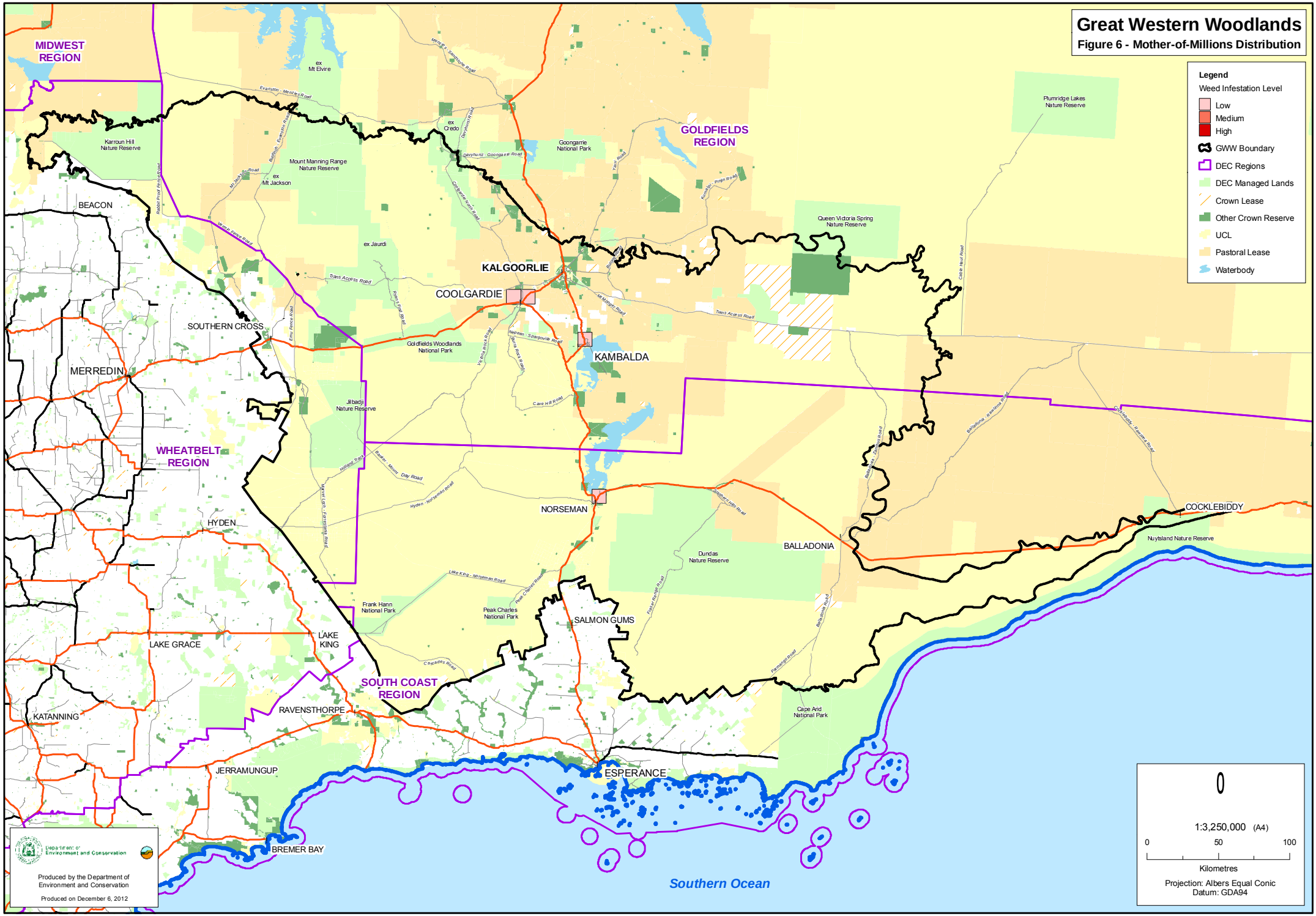


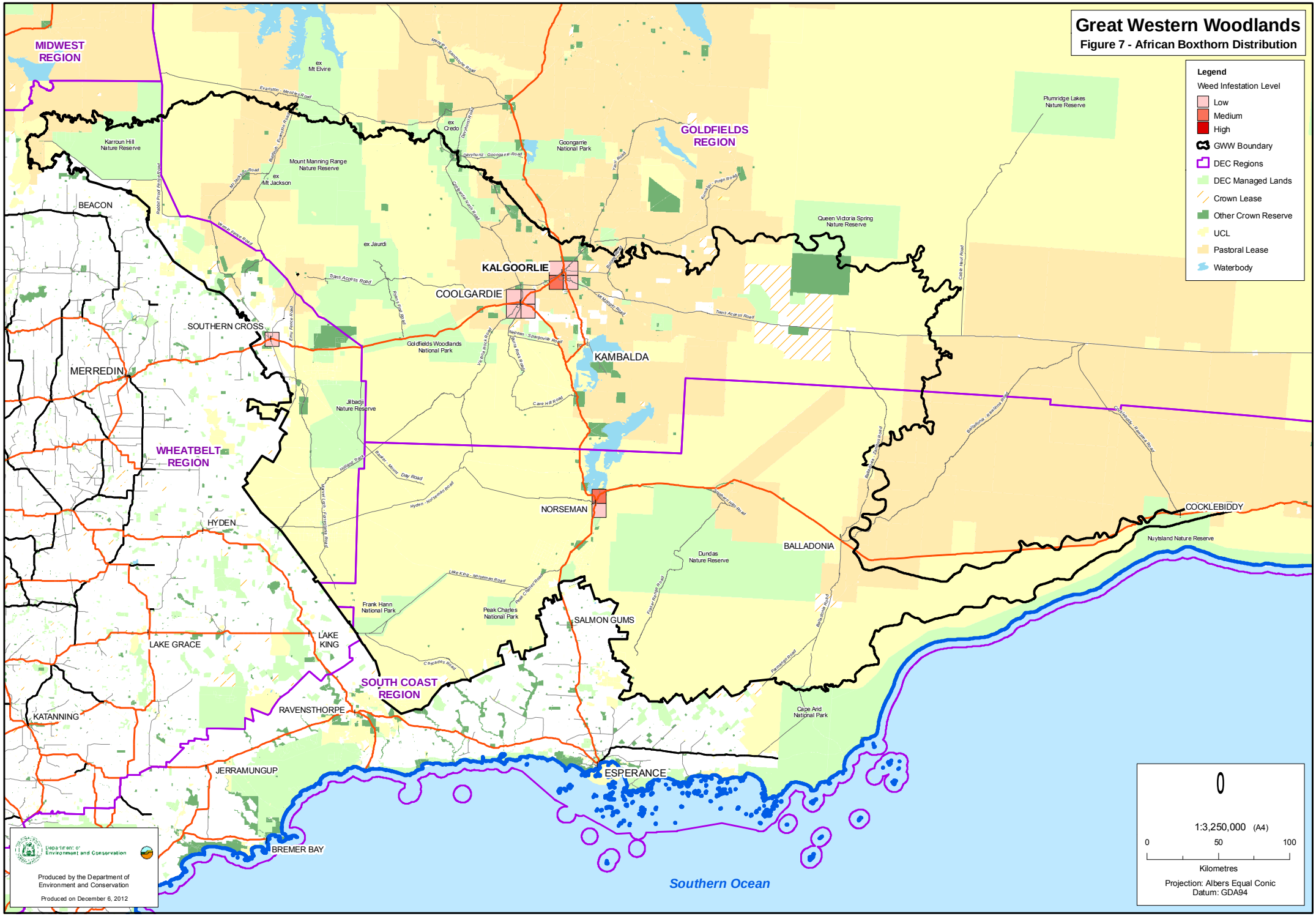


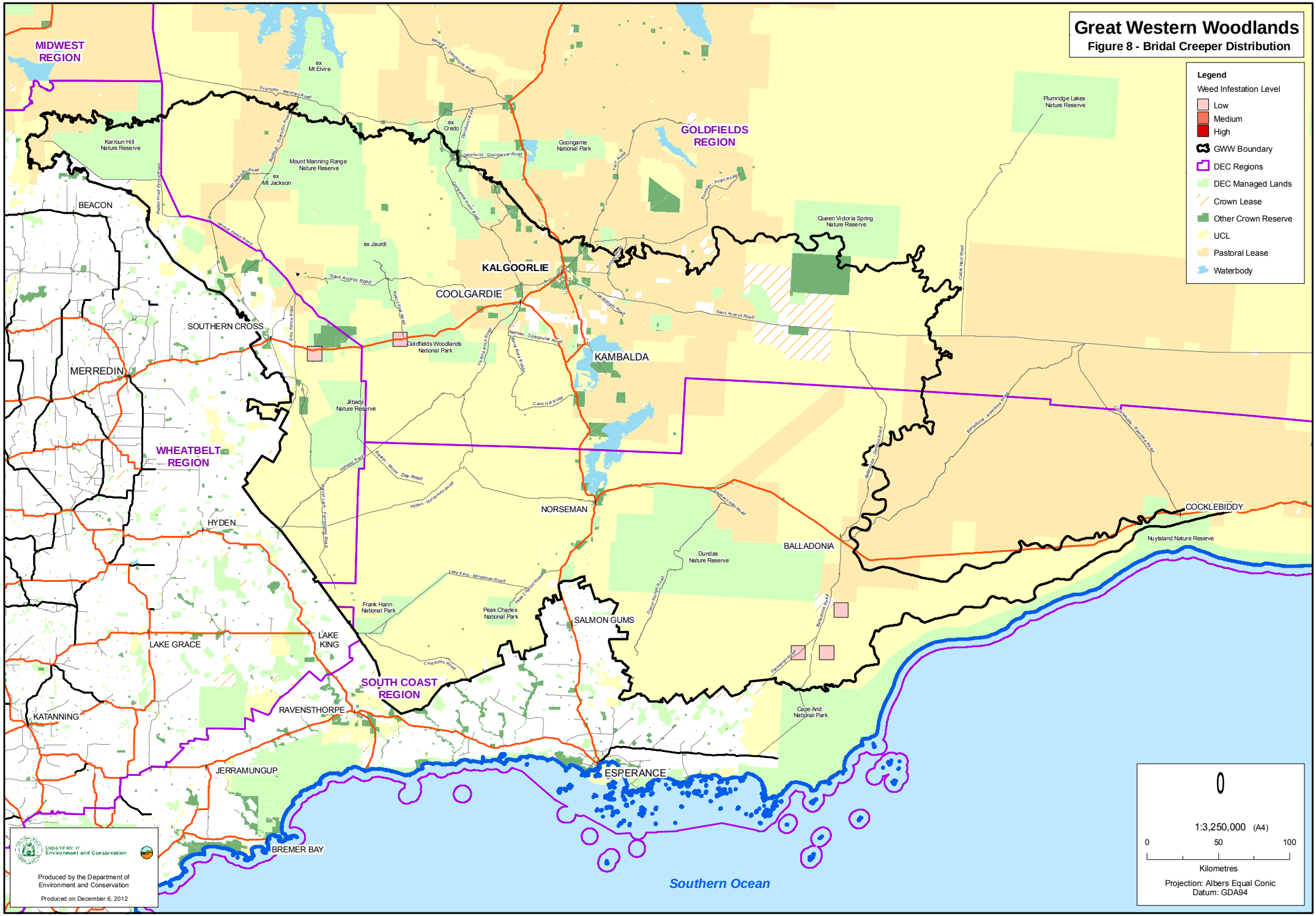


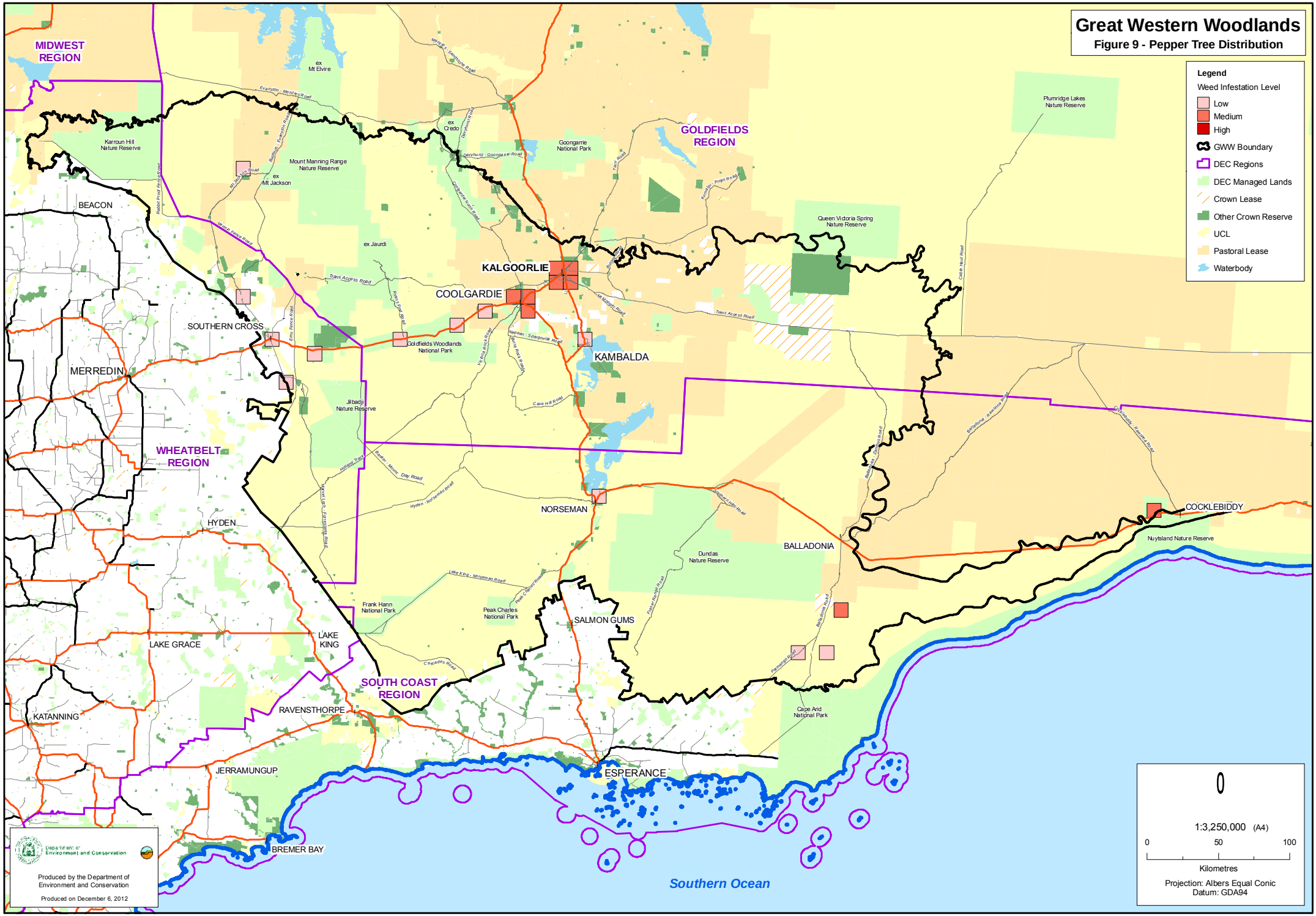






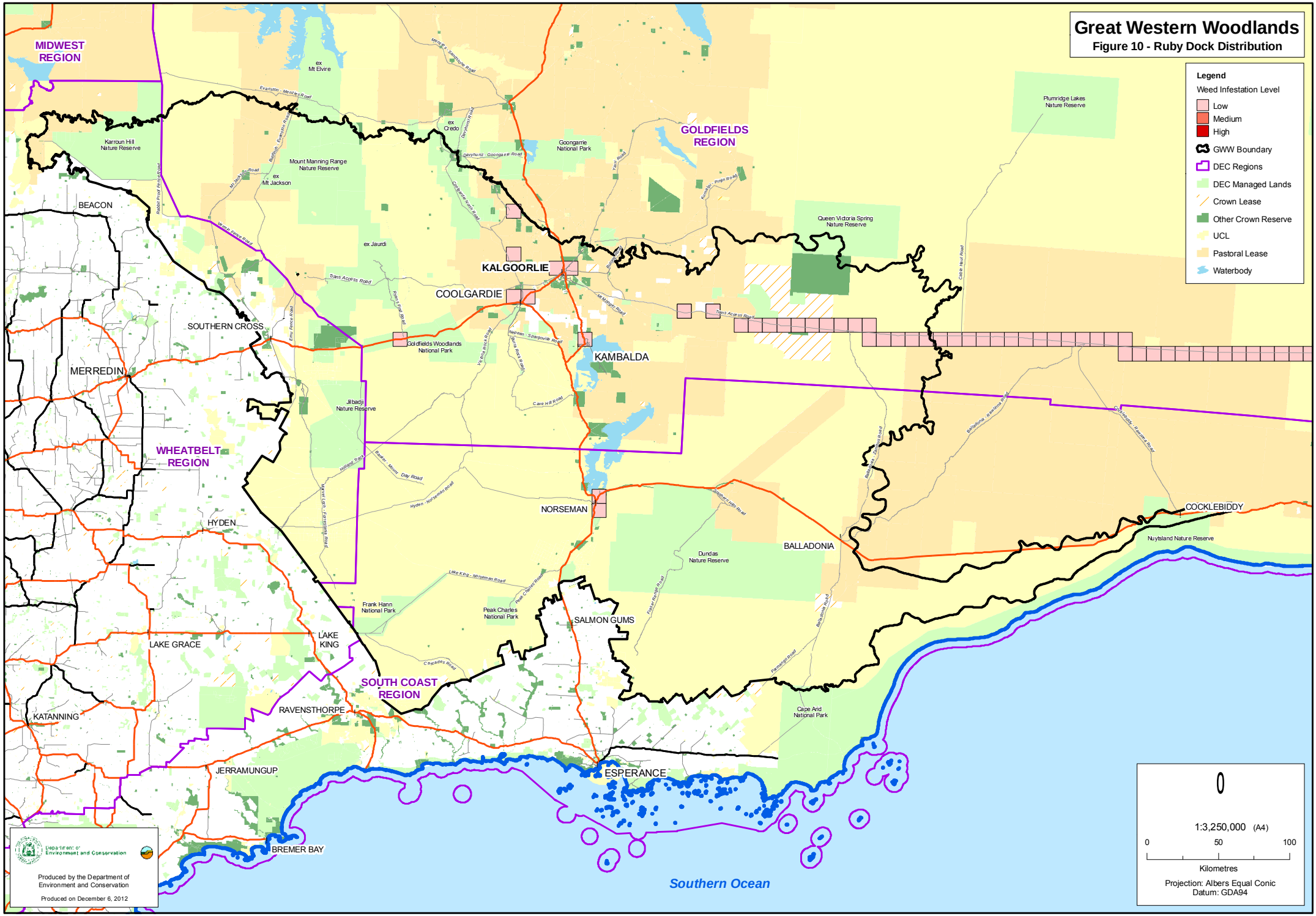


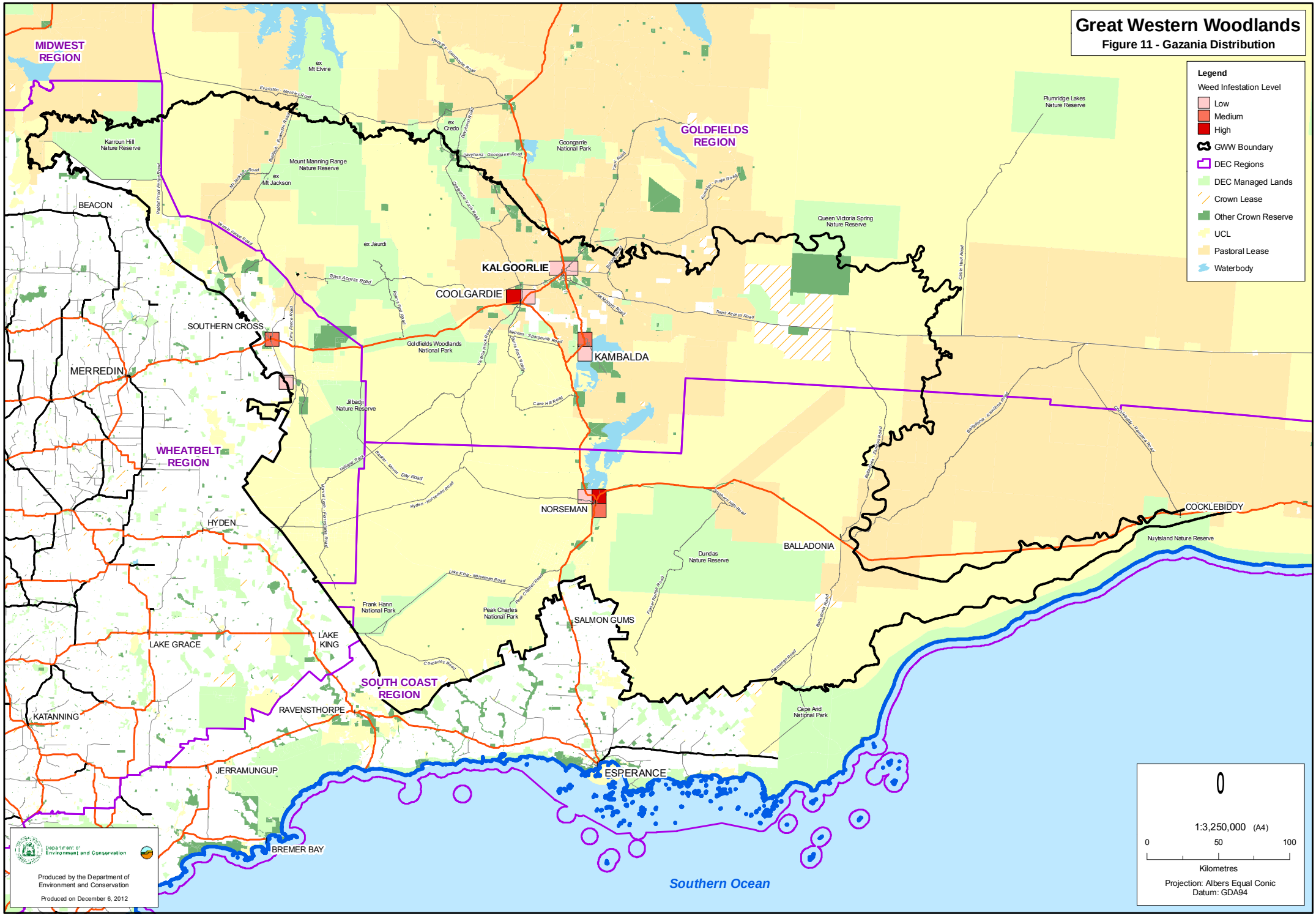


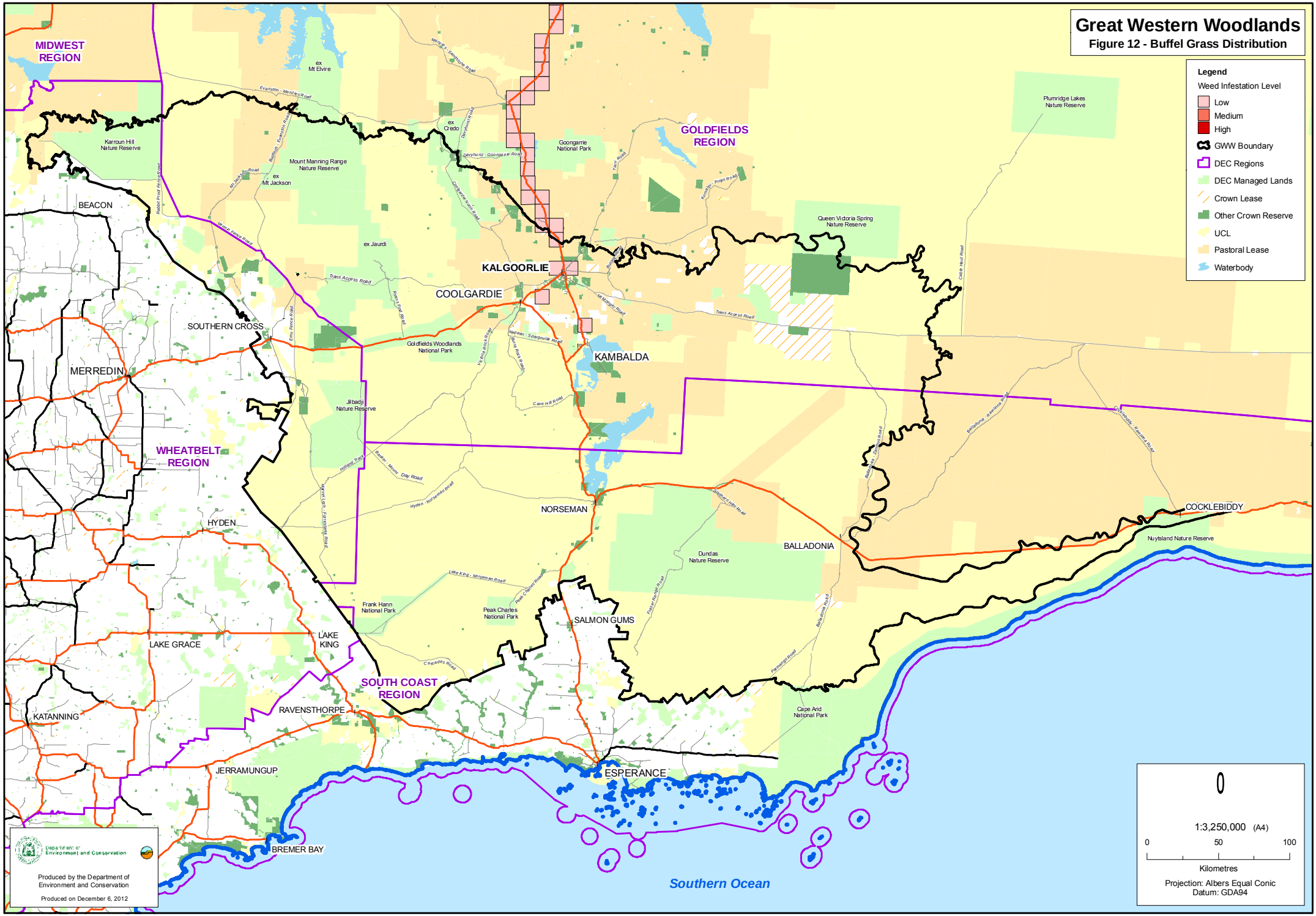


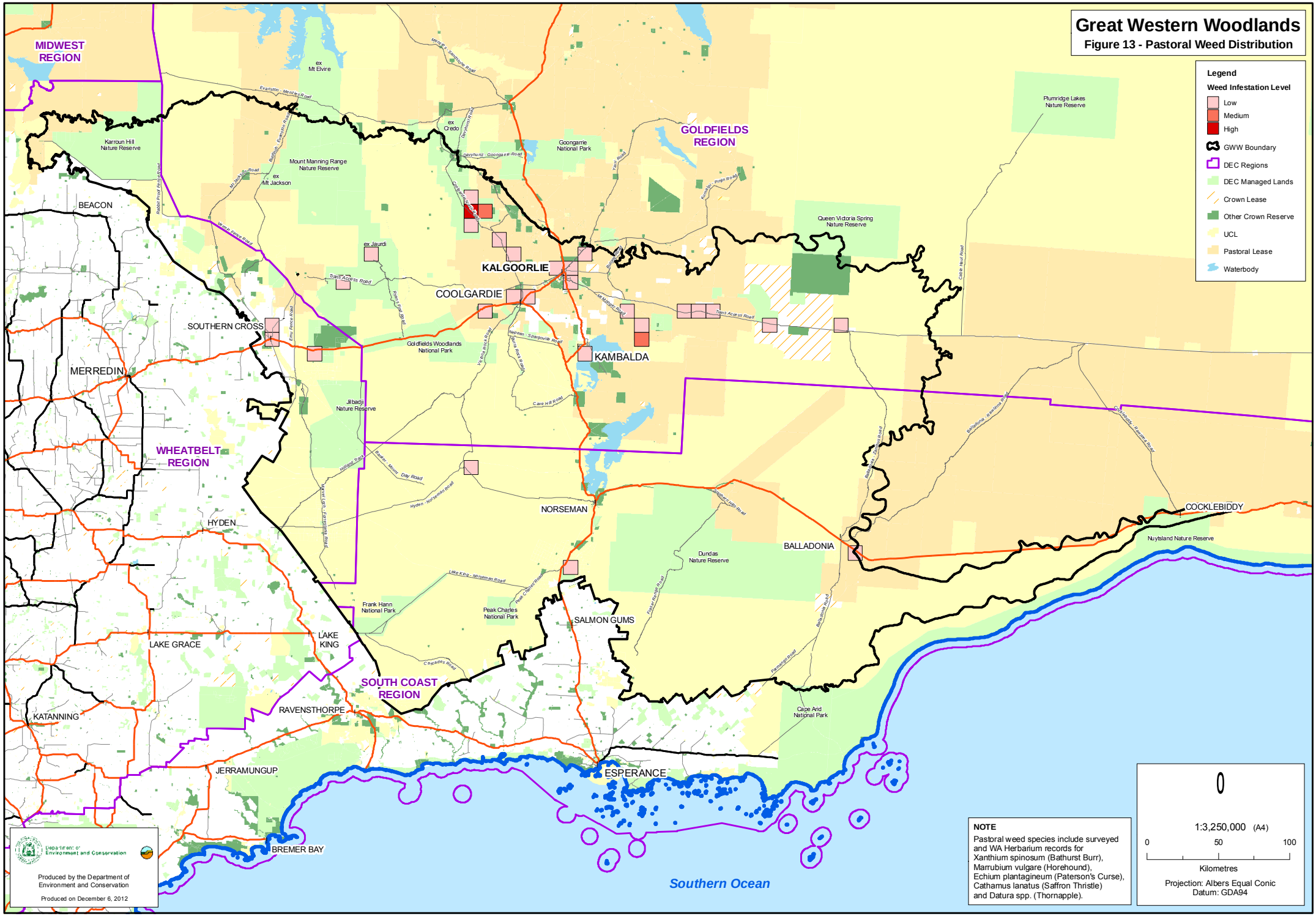
Great Western Woodlands

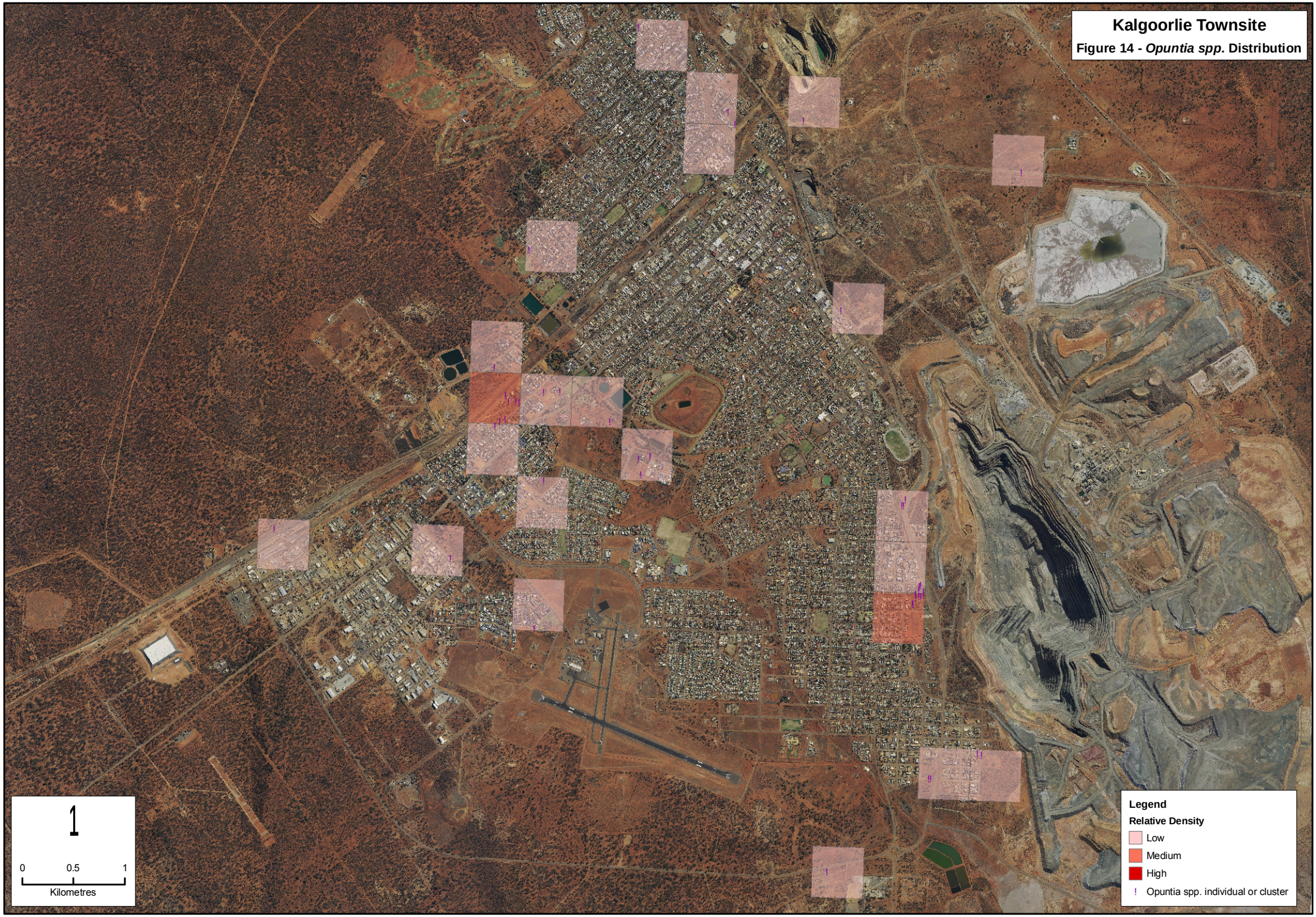
Figure 10 - Ruby Dock Distribution

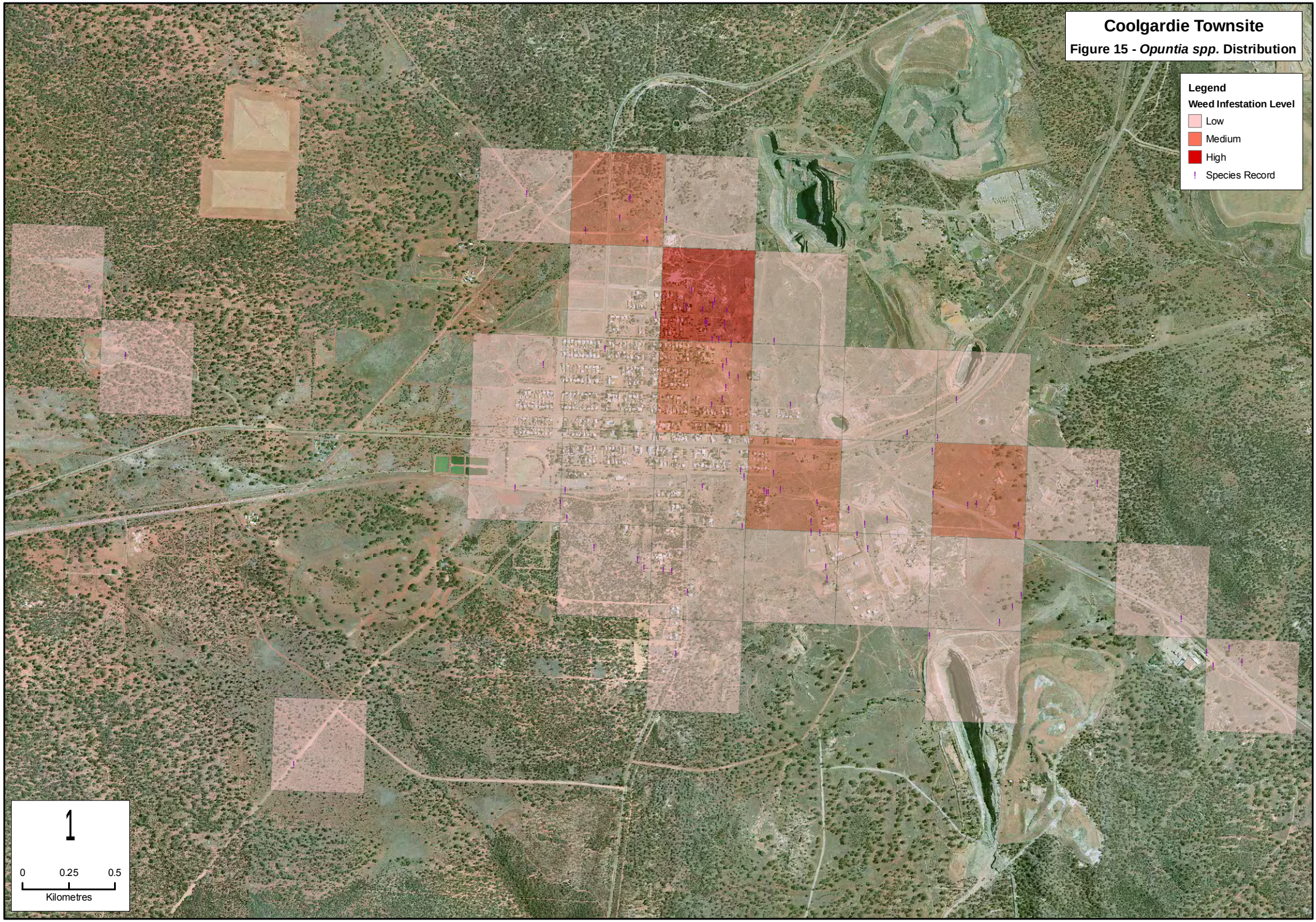









Kalgoorlie Townsite
Figure 14 - Opuntia spp. Distribution
1
0
0.5
1
Kilometres
Legend
Relative Density
Low
Medium
High
Opuntia spp. individual or cluster


Coolgardie Townsite
Figure 15 - Opuntia spp. Distribution
Legend
Weed Infestation Level
Low
Medium
High
Species Record
1
0
0.25
0.5
Kilometres