



## **Gondwana Link: Lindesay Link (ID: 1806 )**

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## **Basic**

### **Project Information**

**Contact Name:** Keith Bradby

**Contact Organization:** Gondwana Link Ltd.

**Data Effective Date:** July 26, 2012

**Hectares:**167,000

**Sharing Status:**

**Ecoregion(s):**

- Southwest Australia Woodlands

**Operational Unit(s):**

- Non-TNC

**Country(ies):**

- Australia

**Associated Initiative(s):** None

**Project Description:**

Following scoping meetings and a field trip in September 2011, a community workshop on 24 October 2011 launched the Lindsay Link Conservation Action Plan (CAP) which was initiated by the Wilson Inlet Catchment Committee (WICC, <http://www.wicc.southcoastwa.org.au/>), facilitated by Greening Australia ([www.greeningaustralia.org.au/](http://www.greeningaustralia.org.au/))/Gondwana Link ([www.gondwanalink.org](http://www.gondwanalink.org)) for the area between the Mt. Lindsay National Park (Walpole Wilderness Area) and the Porongurup National Park, with funding provided by South Coast NRM (<http://www.southcoastnrm.com.au/>). Over the next nine months a number of meetings, workshops and field trips (held on 21 November 2011, 12 December 2011, 23 February 2012, 22 March 2012, 29 March 2012, 24 May 2012, 6 June 2012, 18 June 2012 & 28 June 2012) were organised to develop the CAP further which was uploaded to the ConPro Website (<http://conpro.tnc.org/>) in July 2012. Although there were a number of members that attended and contributed to the CAP, the core committee comprised the following people: Bill Hollingworth (Wilson Inlet Catchment Committee, WICC), Stephen Frost (WICC), Elissa Stewart (WICC), Lynn Heppell (WICC), Barry Heydenrych (Greening Australia/Gondwana Link), Wendy Bradshaw (South Coast NRM), Murray Anning & Leanne Tomlinson (Australian Bluegum Plantations) and Geoff Rolland (Albany Plantation Forestry Company).

**Site/Scope Description:**

Gondwana Link is one of the largest and most ambitious ecological programs in Australian history. Designed to protect and restore ecological resilience within one of the world's biodiversity hotspots, the completed Gondwana Link will stretch for 1000 kilometres across south western Australia, from the wet karri forests of the far south west to the mallee and woodland on the edge of the Nullarbor plain to the east.

The Lindsay Link forms an important landscape between the Walpole Wilderness Area (Mt. Lindsay National Park) and the Porongurup National Park and is an important part of the Gondwana Link pathway and Forest to Fitzgerald Macro-Corridor.

The Walpole Wilderness Area is 363,000 ha in size comprising 10 major national parks and protects ½ the old growth jarrah and karri forests of the south west. This area has approximately 2000 higher plant species, over 600 species of fungi and 235 orchids (65% of Western Australia's total). The area supports mammals such as the quokka, rare & endemic frogs, crayfish and trapdoor spider it has high value waterways, wetlands and associated biodiversity and strong Noongar Aboriginal cultural values.

An important subset of this area, the Mt. Lindsay - Little Lindsay Vegetation Complex has been listed as a Threatened Ecological Community as it has a limited distribution and is threatened by factors such as *Phytophthora cinnamomi* dieback and inappropriate fire regimes.

The Porongurup National Park is the largest inland remnant of native vegetation between the Stirling Ranges and the coast. It contains a disjunct flora association of the karri (*Eucalyptus diversicolor*) forest community - considered a relic of several thousand years ago when karri covered a larger area of the south west of Australia. The combination of raised hills and granite soils of the Porongurup National Park supports a range of plant communities and associated fauna, from tall open karri forest to low herblands. Over 700 native species of vascular plants have been recorded in the Porongurup National Park to date (one of the richest concentrations of plant species in Australia) and the area has been recognised as a separate vegetation system in its own right. Both the Walpole Wilderness Area and Porongurup National parks provide damp refuges for Gondwanan relictual species such as certain spiders, which are more closely related to groups in mountainous areas of eastern Australia, Tasmania, New Zealand and other Gondwanan continents, than to the surrounding lowlands in the region.

It is not surprising therefore that the Lindsay Link area is so rich in biological diversity and endemism. The Lindsay Link landscape is approximately 167,000 ha in extent, with the area of focus having both threats (degrading natural values in a fragmented landscape) and opportunities (improving functional ecological connectivity) that need to be addressed. Apart from the connection and opportunities that the rivers, in particular the Hay River provide, important linkage areas that could function as "macro-corridors" from the southeast to the northwest of the project area have been identified by the Department of Conservation and South Coast NRM. The Lindsay Link landscape occurs primarily within the catchment of the Hay River, one of a number of rivers that drain into the Wilson Inlet. The group responsible for this Conservation Action Plan is the Wilson Inlet Catchment Committee Inc. (WICC), the peak community-based Natural Resource Management (NRM) organization in the Wilson Inlet Catchment that has been active since the early 1990s. WICC consists of voluntary community representatives and employs NRM officers to facilitate on-ground activities. WICC's area of responsibility includes parts of three local government areas; the City of Albany, the Shire of Plantagenet and the Shire of Denmark. WICC is involved in all areas of Landcare, integrated catchment management, and natural resource management achieving on-the ground results with land managers and owners. WICC's main focus is on:

- Reducing nutrification of the waterways and eutrophication of Wilson Inlet
- Sustainable agriculture and improvement of productivity
- Maintaining biodiversity and conserving our natural environment

**Project Goal Comment:**

To maintain and improve the distinctive nature of our landscape including native bush, wildlife and healthy waterways co-existing with a productive & vibrant rural and farming community.

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**Team Info:**

Full Team Compliment:

- Amanda Keesing; Gondwana Link Ltd; Project Advisor, Team Member
  - Barry Heydenrych; Greening Australia/Gondwana Link; Process Facilitator, Team Member
  - Basil Schur; Greenskills; Stakeholder, Team Member
  - Bill Hollingworth; Wilson Inlet Catchment Committee; Leader/Manager, Team Member
  - Ellissa Stewart; Wilson Inlet Catchment Committee; Process Facilitator, Team Member
  - Geoff Rolland; Albany Plantation Forest Company; Stakeholder, Team Member
  - Karl Hansom; South Coast NRM; Stakeholder, Team Member
  - Keith Bradby; Gondwana Link Ltd.; Team Contact, Team Member
  - Kevin Collins; Banksia Farm & Friends of Mondurup Reserve; Project Advisor, Team Member
  - Leanne Tomlinson; Australian Bluegum Plantations; Stakeholder, Team Member
  - Lynn Heppell; Wilson Inlet Catchment Committee; Process Facilitator, Team Member
  - Murray Anning; Australian Bluegum Plantations; Stakeholder, Team Member
  - Stephen Frost; Wilson Inlet Catchment Committee; Leader/Manager, Team Member
  - Wendy Bradshaw; South Coast NRM; Project Advisor, Team Member
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**Action Plan:**

- 80% of Hay River protected from livestock and other threats by 2014 and 60% of tributaries & wetlands protected from livestock and other threats by 2020 : (Currently as at June 2012, only two landholders are holding up the process of completing stock exclusion fencing along the river) (Target = Wetlands including rivers & creeks)
- Ensure that 90% of key granite outcrop ecosystems are protected using appropriate management by 2016. : (Some granite outcrops are already under grazing systems - we are dealing with the intact i.e. salvageable systems here) (Target = Granite outcrops & ridges)
- Identify, engage with landholders and map all key Albany Blackbutt areas by 2013 to implement key management actions by 2015. : (Management plans and actions are needed (e.g. fencing & revegetation) - some of the areas are in conservation reserves and need management plans developed) (Target = Albany Blackbutt & banksia woodlands)
- Identify, engage with landholders and map all key Wandoo & Karri outliers by 2013 so as to implement key management actions by 2015. : (Management actions include fencing & revegetation for understorey replacement and connectivity) (Target = Karri & Wandoo outliers)
- Improve status of and connectivity for black gloved wallabies by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (In particular increasing understorey, connectivity of bush and integrated feral animal control) (Target = Black-gloved wallabies)
- Improve status of and connectivity for honey possums by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (It is suspected that integrated feral animal control is one of the key strategies needed) (Target = Honey possums)
- To ensure no net loss of area of Jarrah-Marri forest during the period 2013-2020 and the condition of remnants (structure & composition) is measurably improving during this period : (Use vegetation condition rating such as the Keighery/Kasehagen scale or Vegmachine to monitor) (Target = Jarrah-Marri forests)

**Targets**

Focal Conservation Target	Target Type	Habitat Type
Albany Blackbutt & banksia woodlands <sup>Target - 1</sup>		<ul style="list-style-type: none"> <li>• Shrubland :: Mediterranean-type Shrubby Vegetation</li> </ul>

Focal Conservation Target	Target Type	Habitat Type
Black-gloved wallabies <sup>Target - 2</sup>		<ul style="list-style-type: none"> <li>• Forest</li> <li>• Riparian Areas</li> <li>• Shrubland :: Mediterranean-type Shrubby Vegetation</li> </ul>
Granite outcrops & ridges <sup>Target - 3</sup>		<ul style="list-style-type: none"> <li>• Shrubland</li> <li>• Inland Rocky Areas</li> </ul>
Honey possums <sup>Target - 4</sup>		<ul style="list-style-type: none"> <li>• Shrubland :: Mediterranean-type Shrubby Vegetation</li> </ul>
Jarrah-Marri forests <sup>Target - 5</sup>		<ul style="list-style-type: none"> <li>• Forest :: Temperate</li> </ul>
Karri & Wandoo outliers <sup>Target - 6</sup>		<ul style="list-style-type: none"> <li>• Forest</li> </ul>
Wetlands including rivers & creeks <sup>Target - 7</sup>		<ul style="list-style-type: none"> <li>• Wetlands</li> <li>• Rivers, Streams, Creeks</li> <li>• Riparian Areas</li> </ul>

Notes:

<sup>Target - 1</sup> **Description:** This vegetation type has been described as *Eucalyptus staeri* mallee-heath on low yellow sand-hills (30-90m) with species including *Banksia (Dryandra) nivea*, *Banksia (Dryandra) plumosa*, *Lysinema ciliata* & *Melaleuca thymoides* by Connell, S. & ATA Environmental, (2001) as part of the "Vegetation survey of the Albany Hinterland". This conservation target also includes banksia woodlands on sand, sometimes associated with yate wetlands and proteaceous-dominant vegetation that grades from sand onto laterite ridges, with some turnover of species which is important for a range of fauna species including nectivorous birds and honey possums. Some *Allocasuarina fraseriana* occurs in these systems, that are primarily associated with a "grey-sand landscape", but have highly variable soil structures throughout the project area. Examples of this vegetation type occur in the Narrikup reserve & surrounds, in which there are seven species of proteaceae in close proximity to each other, and in the Spencer Road area. Sometimes these systems also contain moit (*Eucalyptus decipiens*) grading into *Banksia quercifolia* where sand starts to get wetter (this species is prone to *Phytophthora dieback*) and *Banksia littoralis* in very wet/riparian areas. This conservation target is subject to a number of threats in particular historical clearing that caused altered hydrology (mainly waterlogging), threats associated with *Phytophthora dieback* and grazing.

<sup>Target - 2</sup> **Description:** The black-gloved (or western brush) wallaby (*Macropus irma*) is known from the area - is possibly in decline - and relies on dense understorey habitat for protection from predators and landscape-scale bushland connectivity. If strong black-gloved wallaby populations can be sustained in the area it is believed that other species such as the brush-tailed possum, and other "snack-sized" mammals (35-5,500) such as quendas (also known as bandicoots) that are vulnerable to predation, will also benefit. The black-gloved wallaby was very common in the early days of settlement and periodically large numbers were traded commercially for skins. Wallaby ranges have been seriously reduced and fragmented due to past clearing for agriculture and the quality of existing habitat has also declined to a large extent. Current threats to wallabies include foxes, dogs, vehicles and a lack of suitable habitat. It is known from the wheatbelt that black-gloved wallabies can survive in reserves of less than 500 hectares providing there is both dense vegetation for shelter and more open areas for feeding. The same research suggests that wallabies cannot survive in bush areas of less than about 100 hectares in size. Black-gloved wallabies sometimes intermingle with kangaroos but (unlike kangaroos) do not venture far into paddocks (will forage up to about 200 metres from bush). Little is known about the density of black gloved wallabies, although it is known that they drink water every day and occur in small family groups of 2-4 individuals.

<sup>Target - 3</sup> **Description:** Patterns of plant species diversity on granite outcrops in south western Australia mirror those for the region and show diversity, with a species-rich flora with high levels of species turnover within and between rocks as well as endemism and rarity (Yates et. al., 2003). These systems give rise to herblands with *Borya* (resurrection plants), orchids and species of *Stylidium* (trigger plants) and *Drosera* (sundews) and on deeper soils, heath vegetation with larger trees typically occurs. Apart from the large expanses of granite outcrops at the extremes of the project area (Mt. Lindesay National Park to the west and the Porongurup National Park to the east) there are a number of smaller granite outcrops across the Lindesday Link. These include the Neils Road granite outcrops along the Hay River, Mt. Barker and Mt. Barrow and typical plant species associated with these systems include *Eucalyptus cornuta*, *Thryptomene* spp., *Eutaxia obovatus* & *Verticordia* spp. Granite outcrops with their rock sheets that collect water and small habitat niches in between rocks are important as they can serve as climate refugia for some species (including Gondwanan relics of a wetter age) that have contracted from the drying landscape to these wetter sites. The diversity of microhabitats and soil moisture regimes supported by granite outcrops has facilitated the persistence of refugial species beyond their main range and evolution of several endemic species in the south-west (Hopper et al. 1997). For example, 16% of orchids and 24% of eucalypts on south-west granites are endemic (Hopper et al. 1997). Other species potentially seeking refuge in granite outcrops are skinks and obligate seeder species, which are protected from frequent fire by rock barriers (Hopper 2000). Granite outcrops therefore provide a special evolutionary role; and each system has its own characteristics and often endemics, but fire management is critical. Although factors such as reduced rainfall and drying of granite outcrops (exacerbated climate change) is a threat, these systems have some natural resilience as they have the ability to get go from very wet to very dry over the course of their seasonal cycles. However, these systems are fragile to physical disturbance - it can take 100s of years to recover post disturbance - the shallow soil comprises thin layers that are easily disturbed. In addition the addition of nutrients from high numbers of rabbits or sheep has the ability to negatively affect the sensitive soil on which these systems are based, as well as introduce one the biggest threats, weeds. Granite outcrops are often important cultural sites - containing constructed lizard traps and water holes. While some granite outcrops have been spared direct clearing due to their unsuitability for agriculture most face a range of threats including weeds, feral animals, grazing, inappropriate fire regimes & *phytophthora dieback*.

<sup>Target - 4</sup> **Description:** The honey possum *Tarsipes rostratus* is unique in being the only non-flying mammal entirely dependent on flowers for its nutrition. It feeds on nectar and pollen in the Proteaceae, Epacridaceae and Myrtaceae families and particularly favours *Banksia* species. It is endemic to the south west corner of Western Australia and although not yet listed as threatened, its range has contracted considerably in recent times and its preferred habitat of *Banksia* woodlands is declining as a result of continued clearing and the impact of *Phytophthora cinnamomi dieback*. Although research has shown that honey possums have relatively small home ranges (0.13 - 0.79 ha for males and 0.07 - 0.14 ha for females) they have been shown to move 0.5 km overnight and pollen in their snouts has been found from plants located a few kilometres away. In addition honey possums show some of the highest levels of genetic variation found in vertebrates, indicating a significant level of out-breeding, suggesting that they were able to move freely throughout their range in the past, interchanging their genes. In addition to habitat loss, bush fires can threaten honey possums and although research has shown that honey possums were able to re-invade a burnt territory from an unburnt refuge area after a few years, a viable population that depends on the full suite of mature flowering plants requires at least 20 to

30 years after a fire. It is worth noting that the interval of natural fire (i.e. caused by lightning) in the southern parts of Western Australia is between 30 to 100 years. Honey possums have a low rate of reproduction that evolved in an environment of infrequent and irregular fire. It is likely that this low reproductive rate will not be enough to sustain future populations exposed to fire at more frequent intervals.

**Target - 5 Description:** Jarrah/Marri varies from Forest to Low Woodland occurring on a range of soil types including granites, laterites and deep sands. The dominant over-storey trees are Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*). Understorey species include banksias and other proteaceous plants, sheoaks, grass trees, melaleucas & tea trees and a range of acacias and members of the pea family. This diverse vegetation type is susceptible to a range of threats including dieback, rabbits and kangaroos and the effects of a drying climate. Jarrah & Marri forests and woodlands offer a diverse range of habitat and food sources for fauna, and the range of "snack sized" (to a predator such as a fox) marsupials (35-5,500g) have been identified as an important component as part of these systems. In addition Jarrah & Marri forests are important for the three black cockatoo species that occur in the project area, i.e. Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo *Calyptorhynchus baudinii* and the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*.

**Target - 6 Description:** This conservation target comprises two seemingly different vegetation types, Karri (*Eucalyptus diversicolor*), a high-rainfall forest system of the south coast and Wandoo (*Eucalyptus wandoo*), a lower rainfall woodland system of the inland wheatbelt region. However, these two systems have been lumped together as outliers as they are both near the limits of their distribution ranges (northern most, and almost easternmost extent for Karri and southern most extent for Wandoo) in the Lindsay Link area, occur in small isolated patches across the area and are subject to a number of similar threats. Wandoo woodlands are characterised by a few tree species, in particular wandoo (white gum, *Eucalyptus wandoo*) with a dominant ground layer of restios, lilies, orchids, grasses & daisies and a scattered shrub understorey of hakeas, acacias & pea flowers. This range of trees and shrubs, flowering at different times of the year, provides a continuous source of nectar for birds such as honeyeaters and insects which in turn provide food for insectivorous birds such as the western yellow robin, golden whistler and rufous tree creeper. A number of species such as the endangered Carnaby's cockatoo rely on old trees with hollows for breeding and nesting. In addition phascogales, bats and birds utilise the upper branches and hollows of standing wandoo trees and possums often rest in tree hollows during the day and come out at night to feed on the leaves. Old wandoo trees with their large branches also provide nesting sites for a range of birds including ducks, owls and eagles. Wandoo woodlands occur on duplex soils (gravel over clay & clay-loams) that have a high value for agriculture and as a consequence have been largely cleared in the past leading to fragmentation and loss of habitat for wildlife. Threats such as selective logging, changed disturbance such as loss of digging, fungi-eating small ("snack sized" to a predator such as a fox) mammals and inappropriate fire regimes have further modified stand density and canopy cover of wandoo communities. Although clearing has largely ceased, degradation of habitat fragments continues. Many remaining trees are dying while natural regeneration and tree planting efforts are not keeping pace with this loss. Furthermore competition for tree hollows, that only start to form when the trees are more than 150 - 200 years old, by feral bees and non-native bird species is seriously diminishing the habitat value of existing trees. Karri forest is distinguished by the dominance of *Eucalyptus diversicolor* (Karri) trees in the canopy. One of the three subunits described by Sandiford and Barret (2010) occurs in the project area and has been described as follows: 9c Redmond Karri Forest This sub-unit was recorded on the north west boundary of the survey area along a broad valley on skeletal soils overlying a very dark exposed lateritic rock. All areas had been recently burnt (2002) and post fire opportunistic species including *Rulingia corylifolia*, *Acacia pulchella* and *Opercularia hispida* were dominant beneath a *Bossiaea linophylla* Tall Open Scrub. Other species present were *Leucopogon obovatus*, *Cyathochaeta avenacea*, *Ficinia nodosa*, *Opercularia hispida*, *Pteridium esculentum*, *Xanthosia candida* and *Tetrarrhena laevis*. The occurrence of sub-unit 9c on skeletal dark lateritic soil may be unusual as Karri forests are typically found on deep loam or sand. Floristic Summary: Lifeform %cover Species: Trees 10-30m M *Eucalyptus diversicolor*, *Eucalyptus cornuta*; Trees <10 m V *Agonis flexuosa*, *Allocasuarina decussata*, *Hakea oleifolia*; Shrubs >2m S-M *Trymalium odoratissimum*, *Chorilaena quercifolia*, *Thomasia solanacea*, *Hibbertia furfuracea*, *Bossiaea linophylla*, *Templetonia retusa*, *Acacia pentadenia*, *Rulingia corylifolia*; Shrubs <2m V *Acacia alata*, *Tremandra stelligera*; Sedges/rushes V *Lepidosperma effusum*, *Ficinia nodosa*, *Desmodium flexuosum*, *Lepidosperma squamatum*, *Lepidosperma densiflora*; Herbs V *Opercularia hispida*, *Hardenbergia comptoniana*, *Clematis pubescens*, *Billardiera variifolia*, *Lagenophora huegelii*, *Pteridium esculentum*; Grasses *Tetrarrhena laevis*, *Poa porphyroclados*, *Microlaena stipoides*. Key identifying Features: • Canopy of *Eucalyptus diversicolor* (Karri). Conservation species *Thomasia solanacea* P3, *Gahnia scleroides* P3 Karri forests are important for a number of fauna species including quokka, chuditch, possums, bandicoot and also have a rich invertebrate diversity. The high open karri forests are the predominant habitat of parrots and cockatoos such as the western rosella *Platycercus icterotis*, and the white-breasted robin *Eopsaltria georgiana* and the red-winged fairy wren *Malurus elegans* are also common in these forests. Karri forests have recently been found to be important as breeding trees for the endangered Carnaby's Black Cockatoos (*Calyptorhynchus latirostris*) and are known to be important for the vulnerable Baudin's Black Cockatoo (*Calyptorhynchus baudinii*).

**Target - 7 Description:** This is a large and complex conservation target that may need to be split into smaller components at a later stage. It includes lotic (running water) and lentic (still water) wetlands: rivers, streams and creeks; also some perched wetlands; both fresh and saline. Swamp yate, *Eucalyptus occidentalis* is often associated with wetlands and creeks, as are the grey sands with Albany Blackbutt (*Eucalyptus staeri*) and in some instances *Eucalyptus cornuta* in wetlands associated with granite. In addition *Eucalyptus rudis* occurs in some of these systems in the project area, including in naturally saline systems at Pardalup and Tenterden. *Baumea articulata* is an indicator of fresh water. Velvet rush is a good indicator for southern part of the area, and *Banksia littoralis* is also associated with fresh water. *Melaleuca raphiophylla* is usually associated with fresh water but also has a degree of salt tolerance. The marron (*Cherax cainii*), a native freshwater crayfish is no longer common today, but other species such as the endemic amphipod *Perithia branchialis*, or the koonacs *Cherax crassimanus* and *C. preissii*, or fish species could be used as indicators of water quality. Water rats are still found in the Hay River system. Cook et al. (2008) noted that the Hay River was one of a few systems that appeared to be a 'hotspot' for total macro-species richness and endemism for EPT taxa (mayflies - Order Ephemeroptera, stoneflies - Order Plecoptera and caddisflies - Order Trichoptera) in the Western South Coast bioregion. Furthermore the mud minnow, *Galaxiella munda*, a species listed as 'restricted' by the Australian Society for Fish Biology, was found in only four river systems (Gardner, Shannon, Deep and Hay Rivers) in the Western South Coast bioregion Cook et al. (2008). The following information comes from Heppel (2007) The Upper Hay Catchment Plan. The Upper Hay Catchment plan will protect the following key assets: • The Wilson Inlet - an internationally recognized estuary of significance • The Hay River and its tributaries such as, Sheep Wash Creek, • Lake Kwornicup Nature Reserve • Sheep Wash and Mitchell National Parks • High value grazing, horticultural and viticulture land. • Named wetlands within the Eyrie and Kwornicup groups • the Eyrie, Fern, Kokokup, Don, Nyandyetup, Mowilylip and Barnes Lakes • Pardalup and Owingup Lagoons. • Noogunillup, Nyoongarup, Kwornicup and Quichenup Swamps, • Old Barrack Spring and Moolagup Water Hole Riparian fringing vegetation The natural vegetation of the Hay River is predominantly forest with a great range of forms and diversity of species. Karri (*Eucalyptus diversicolor*) forest occurs in the hilly country, usually on loamy soils derived from granite outcrops or along incised mainstream valleys. Jarrah (*Eucalyptus marginata*) formations dominate over much of the area. Throughout the area there are broad swampy drainage lines which carry Paperbark or *Banksia* woodlands and reed swamps, with sandy flats subject to seasonal inundation bearing low woodland of jarrah, marri, wandoo or swamp yates. Major threats to foreshore vegetation in the freshwater areas of the rivers the fringing vegetation is mostly healthy, but where fences have not been maintained or are absent, livestock have grazed and trampled out native species and, along with frequent fires, have encouraged the growth of introduced grasses. The loss of deep-rooted native vegetation has led to the erosion and subsidence of river embankments in places. The fringing vegetation of the river valleys represents a significant ecological corridor connecting patches of remnant bush along the banks of the river. In 1995 only 39% of the Hay River foreshores that bordered agricultural land were fenced off, while 173 ha Hay River foreshore areas were identified as in need of revegetation (APACE Green Skills and Pen, 1995). The condition of river and tributary foreshores in the Wilson Inlet Catchment has been a major concern of both communities and agencies alike. This has consequently generated reports that have effectively assessed the problems of degradation and addressed the appropriate solutions with regard to required fencing and revegetation. The Unicorn suite of wetlands include: Pardalup Lagoon and Lake Kwornicup these wetlands are very important for the maintenance of a large number of water birds and many are listed on International Treaties. • Lake Kwornicup supports at least 15 species of water birds at least one breeds (Grey Teal) and two are listed on both the Japan Australia and China Australia Migratory Bird Agreements. Watkins (1993) classified this wetland as internationally important for the Banded Stilt. • Lake Kwornicup also contributes to the maintenance of the Hooded Plover populations which are largely concentrated on the South Coast. On a national scale this species is considered rare and in need of protection (Garnet 1992) and is also listed as vulnerable under the Commonwealth Endangered Species Act 1992. The wetlands in the Mitchell Creek, Sheep Wash Creek, and Hay River floodplains and basins are representative of wetland types and processes within the 'Mitchell Creek suite'. The channels, wetland slopes, floodplains and basins form

a linked geomorphic, sedimentological and hydrological system within the broad shallow gently sloping valleys. (Semeniuk, 1998). • They found 5 priority flora species in and around the creeks in this suite: Laxmannia jamessi (Declared rare flora), Spyridium riparium, Andersonia sp (priority 1), Eucalyptus virginiae (priority 2), Billardiera sp(priority 3)

## Threats

Threat ( <i>Common Taxonomy</i> )	Targets Threatened
Feral animals (cats, feral dogs, foxes) (Invasive & Other Problematic Species & Genes :: Invasive Non-Native/Alien Species)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Grazing (stock & roos, rabbits, pigs) (Understorey loss) (Natural System Modifications :: Other Ecosystem Modifications)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Historical clearing & drainage causing altered hydrology (inundation & salinity) (Natural System Modifications :: Dams & Water Management/Use)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Dieback (Phytophthora, marri canker) (Invasive & Other Problematic Species & Genes :: Invasive Non-Native/Alien Species)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Weeds (Invasive & Other Problematic Species & Genes :: Invasive Non-Native/Alien Species)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Climate change (Climate Change & Severe Weather :: Habitat Shifting & Alteration)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Land management practices causing excess nutrients in systems (Agriculture & Aquaculture :: Livestock Farming & Ranching)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>

Threat ( <i>Common Taxonomy</i> )	Targets Threatened
Fire (Natural System Modifications :: Fire & Fire Suppression)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Clearing causing habitat fragmentation (lack of connectivity) (Natural System Modifications :: Other Ecosystem Modifications)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Lack of funding to implement strategies as on-ground actions (Undefined :: Undefined)	<ul style="list-style-type: none"> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Black-gloved wallabies</li> <li>• Granite outcrops &amp; ridges</li> <li>• Honey possums</li> <li>• Jarrah-Marri forests</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Wetlands including rivers &amp; creeks</li> </ul>
Lack of awareness by landholders and the broader community as to the value of biodiversity (Undefined :: Undefined)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Lack of engagement in practical conservation actions by the community (Undefined :: Undefined)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>
Lack of funding for monitoring (Undefined :: Undefined)	<ul style="list-style-type: none"> <li>• Jarrah-Marri forests</li> <li>• Wetlands including rivers &amp; creeks</li> <li>• Granite outcrops &amp; ridges</li> <li>• Karri &amp; Wandoo outliers</li> <li>• Albany Blackbutt &amp; banksia woodlands</li> <li>• Honey possums</li> <li>• Black-gloved wallabies</li> </ul>

## Strategies

Strategy ( <i>Common Taxonomy</i> )	Threats Addressed
<p>Buffer around wetlands &amp; waterways to prevent nutrient and sediment input : (Watch market forces with regards chemical use etc. Dave Weavers Dept Ag. report says that buffering may not have a good effect at nutrient reduction cause of the way P moves by leaching rather than moving across the system. CENRM Stream study on Geoff Rolland - managed property, shows good benefits on buffering on stream nutrient reduction)</p> <p><i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-

Strategy ( <i>Common Taxonomy</i> )	Threats Addressed
<p>Collate info on past and current burning practices to feed into better informed fire regimes and management : (Get DEC data later (Amanda Keesing has one dataset- need to get approval). Use VegMachine data Fire information on Plantation properties - can possibly get and feed into. Shire of Denmark (Nathan) getting data on how often remnants have recently burned - road sides and Plantagenet Shire as well. Supplement with literature search) <i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Collate information on plant genetics and movement of plants around granite outcrops : (Prof. Steve Hopper has info on genetics of granite spp. Possible later strategy to buffer the granite outcrops) <i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-
<p>Determine Phytophthora status of remnants to determine priorities for protection : (Has been done for Mondurup reserve. Shire reserves will require Management Plan and Dieback Hygiene Management Plan - Reserves - gets looked after by parks and gardens services section Develop and prioritise a list of remnants in the Lindesay Link including private land (e.g. Mt. Barrow - Pickles, Cooper &amp; Dufty &amp; Peter Brockman - vineyard) and shire reserves. Undertake interpretation on key areas) <i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-
<p>Develop &amp; implement urban biodiversity strategy : (This initiative could feed into town planning schemes reviews, would be important for engagement of people living in towns and could be linked to feral control and fauna corridor projects in urban/peri-urban environments) <i>Law &amp; Policy :: Policies &amp; Regulations</i></p>	-
<p>Develop and implement communications and engagement strategy (Demonstrating multiple benefits of programs to the landholders and community) : (Communications and engagement strategy. e.g. fox baiting programs that benefit both stock farmers and native fauna, e.g. development of eco-tourism initiative - bicycle/walk track idea that links a number of CAP areas, offers opportunity for awareness raising and revenue generation for locals - "Connecting purpose, places and people") <i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Develop and implement long term funding strategy : (One of the first steps is to get together with a range of similarly minded groups to share common issues and opportunities) <i>External Capacity Building :: Conservation Finance</i></p>	-
<p>Develop landscape map which identifies key areas for implementation of all strategies : (This landscape-scale plan should have priorities for action built into it and take into account needs of key conservation targets (including nested targets) with regards functional connectivity) <i>Land/Water Protection :: Resource &amp; Habitat Protection</i></p>	-
<p>Develop optimum drainage strategy in a changing climate to reduce inundation and salinity effects : (Modifying drainage to benefit wetlands, perched water tables. There is a lot of data already - but needs to be pulled together and reviewed in the light of current thinking. Important sub-strategy is to retain annual freshwater on site - not in dams, but in soil) <i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Disseminate information on best hygiene practices, adopted by organisations and implemented : (South Coast NRM have recently released dieback protocols. There is also the DEC Green Card for dieback - 1.5 hour - about washdowns etc. - (Merredith Spencer) Murray Anning is taking part in this - free when conducted as a group) <i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Educate public about the importance of natural water flows : (Stephen Frost as possible case study, fields days, seek more information) <i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-



Strategy ( <i>Common Taxonomy</i> )	Threats Addressed
<p>Encourage an ecologically-friendly fire management regime (frequency, intensity etc.) that includes mosaic fire burning as appropriate : (Mosaic burning can keep strips of food and resources plus refugia. Local bridges need information in this regard. Tailor burns for different treatments. Recent work in Gnaragara by Wilson et al. (2010) &amp; Shedley (2007) can be used to provide some guidance)</p> <p><i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Encourage best practice farming methods to improve soil health : (e.g. "Don't guess - soil test" Soil health field days. Building soil biology. Other field days, brochures etc.)</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Identify and select dieback resistant species (and resistant provenances of susceptible species) for use in revegetation projects : (Would be less expensive than breeding. Selecting is time consuming - needs Kevin Collins or someone to spot resistant individuals/ populations)</p> <p><i>Species Management :: Species Re-Introduction</i></p>	-
<p>Implement integrated feral animal control program : (Post-fire feral management critical. Invasive species co-ordinator Matt Kennewell at SCNRM - is developing a broader plan. Co-ordinated baiting in March and feral Shoot - WICC Baiting not well taken up in areas with no sheep. Map areas in which good baiting currently occurring and identify where gaps are. WICC also supports Lake Muir Denbarker community feral pig eradication group (CFC +) Issue for Forestry sector to use 1080 on feral animal control - seek support from this group to assist support industry to carry on using 1080 - because of FSC guidelines - need specific approval. Cattle farmers have less incentive for feral animal control than sheep farmers - Climate Change shift to sheep?)</p> <p><i>Land/Water Management :: Invasive/Problematic Species Control</i></p>	-
<p>Implement post fire feral animal &amp; weed management : (Opportunity to intervene quickly against rabbits etc. - goes hand in hand with weed control as well)</p> <p><i>Land/Water Management :: Invasive/Problematic Species Control</i></p>	-
<p>Implement strategic weed control : (Weed control projects are already taking place - weeds of national significance (WONS), Bridal creeper, blackberry, gorse etc. There are also projects to tackle eastern states wattles and other weeds but would need ongoing funding to implement these projects on a large scale)</p> <p><i>Land/Water Management :: Invasive/Problematic Species Control</i></p>	-
<p>Increase habitat connectivity (through restoration and other methods) : (Number 1 strategy for climate change in DEC Threatened species report (Gillfillan et al. 2009). Work out what you are connecting for and design sub strategies appropriately. e.g. protect high value remnants (systems) &amp; species)</p> <p><i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-
<p>Increase public awareness of weed plants : (There is a need to increase the awareness of weeds to the broader community, including nurseries. There is information about agricultural weeds but more awareness is needed about environmental weeds - can it be built into legislation?- e.g. Shire can designate environmental weeds as pest weeds (poisonous plants). Another part of this strategy is encouraging alternatives to weedy plants for garden plants (FESA's fire safe plant list contains many weeds). Encourage discussions to address this issue with Matt Kinnewell - South Coast NRM regional plan for Sydney wattle (<i>A. longifolia</i>) + other resources. Road verge construction &amp; maintenance needs to be addressed - shires, main roads, pvt, can be a way of spreading weeds - need to address this issue. Also important to increasing public awareness about hygiene strategy for weeds. Vectors of weed seeds include machinery and travellers &amp; tourists can spread weeds country wide).</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-

Strategy ( <i>Common Taxonomy</i> )	Threats Addressed
<p>Investigate wallaby fences (ie allowing them through to decrease isolation &amp; improve landscape-scale movements) : (Wallabies can get through certain kinds of fences that are still effective for keeping stock out. Investigate which fences wallabies can get through and how (possibly using remote infra-red cameras) - investigate the possibility of using wire fencing and not ringlock fencing where appropriate)</p> <p><i>Species Management :: Species Management</i></p>	-
<p>Manage kangaroo numbers, exclude stock and implement rabbit controls</p> <p><i>Land/Water Management :: Invasive/Problematic Species Control</i></p>	-
<p>Obtain and disseminate current Marri canker findings from Centre of Excellence for Climate Change Woodland and Forest Health : (Prof. Giles Hardy (Centre of Excellence for Climate Change Woodland and Forest Health) has had a brief look at the problem on the south coast - need to get more information as to what is happening and how relevant these findings are for Lindsay Link. Marri canker is thought to be a secondary effect from poor ecosystem health - findings from Wandoo Recovery Project may be useful. Roadside clearing that includes area of Marri trees could lead to secondary infections)</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Promote the benefits of baiting for native fauna : (Linking outcomes; clear story about need for integrated controls; understand the opportunities and the real returns from action)</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Protect and restore dense understorey : (Improves native fauna survival (dense vegetation provides protection from predators such as foxes - e.g. Mt Barker Hill - bandicoots &amp; phascogales), improves ground cover which increases water infiltration (and reduces evaporation), which ameliorates some of the climate change effects)</p> <p><i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-
<p>Protect existing native vegetation : (By stock-exclusion fencing, buffering next to remnants, water management etc. Should also include alternative watering points to keep stock out of creeks, stock crossings etc.)</p> <p><i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Protect remnants from stock to reduce weed spread : (Prioritise protection of areas of remnant vegetation that are not weedy yet. This refers mainly to Granite outcrops and waterways, but affects a lot of other vegetation types as well NB: Relevant to how long the area has been disturbed for - need to get there before balance tips - Granite outcrops are very delicate in this regard. May be looking at stock management (crash grazing) in very weedy situation - extreme situation only)</p> <p><i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Provide extra nesting boxes and fire refugia : (This is for areas in which there is a lack of hollows (tree and ground). Need information from fauna surveys to feed into this - ie. where are the gaps, which fauna species, are hollows really the limiting factor)</p> <p><i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-
<p>Raise awareness of value of swamps, granite outcrops and other fire-sensitive ecosystems and the destructive impacts of fires : (Swamps should not burn, fires burn peat, loss lasts for ages, granite outcrops should have very long fire interval - risk from wildfire spread from adjacent vegetation systems needs to be reduced)</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-

Strategy ( <i>Common Taxonomy</i> )	Threats Addressed
<p>Raise community awareness of biodiversity values : (Positive messages for maintaining biodiversity (and other benefits such as carbon), e.g. Land for Wildlife and other programs to pass info on. Tapping into and disseminating hydrological information to wider audience. Sylvia Leighton (Land for Wildlife) to be invited to next community open days and information about Land for Wildlife to be disseminated to the community. Assess where LFW properties are located in the Lindesay Link area &amp; encourage those landholders to attend future LL CAP meetings)</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Rate adjustment for landowners willing to protect native vegetation : (Plantagenet is well forested - part of the Walpole Wilderness Area - Look at other shires - preserving for everyone. Needs a concerted approach by a number of groups including South Coast NRM - Department of Planning - suggestion of a Landuse Planning Forum - late 2012 - Gondwana Link)</p> <p><i>Law &amp; Policy :: Policies &amp; Regulations</i></p>	-
<p>Restore deep rooted vegetation (perennial pasture and native perennials) : (WICC involved as core business - 2 separate sub-strategies Balance between exploring maximising biodiversity outcomes and income streams on cleared agricultural land. Farmers a bit reluctant to plant more trees)</p> <p><i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Restore natural water flows where possible : (Grazing and biodiversity benefits. Fill drains and slowing water movements to restore wetland and other conservation target systems. DOW to advise and provide information)</p> <p><i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-
<p>Retain annual rainfall on site : (Involved - WICC &amp; farm production groups, Department of Agriculture. Driver - WICC, also Evergraze, Evergreen, Dept of Ag. Priority - high - timing - started with perennial pasture - needs to be more defined. Restore natural annual inundation processes - not all bad - opportunity for later - summer crops etc. - Euc occidentalis, Casuarina obesa - use all freshwater on site)</p> <p><i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Stock exclusion and rabbit &amp; pig control as part of restoration</p> <p><i>Land/Water Management :: Site/Area Management</i></p>	-
<p>Supply information on ecological aspects of fire to farmers, public, shires, local fire brigades etc : (Weeds burn more - more burning means more weeds - vicious cycle - can be seen along roadsides)</p> <p><i>Education &amp; Awareness :: Awareness &amp; Communications</i></p>	-
<p>Support for increased fauna &amp; flora protection through enhanced law enforcement : (Name and shame those landholders who are not doing the right thing? Problems with lack of support for evidence from neighbours with regards policing &amp; enforcement)</p> <p><i>Law &amp; Policy :: Compliance &amp; Enforcement</i></p>	-
<p>Survey Black Gloved Wallabies to determine current status &amp; distribution : (Undertake community survey as per Gillamii centre. Camera - traps - future co-ordinated survey work. Black Gloved Wallaby to act as surrogate for other fauna)</p> <p><i>Species Management :: Species Management</i></p>	-
<p>Survey Honey Possums to determine current status &amp; distribution : (Undertake survey of key areas using cameras &amp; traps)</p> <p><i>Species Management :: Species Management</i></p>	-
<p>Update Lindesay Link Phytosphthora map : (First step - validate existing 2008 dieback layer. Not feasible at this stage to roll out detailed dieback mapping as been done for the hygiene report for Mondurup reserve - general costs \$30 - 40 / ha for the interpretation and report - Great Southern Bio Logic was the company)</p> <p><i>Land/Water Management :: Habitat &amp; Natural Process Restoration</i></p>	-

## Viability Summary

Conservation Targets		Landscape Context		Condition		Size		Viability Rank
		Grade	Weight	Grade	Weight	Grade	Weight	
1	Albany Blackbutt & banksia woodlands	-	1.0	Fair	1.0	-	1.0	Fair
2	Black-gloved wallabies	-	1.0	-	1.0	Poor	1.0	Poor
3	Granite outcrops & ridges	-	1.0	Good	1.0	-	1.0	Good
4	Honey possums	-	1.0	Fair	1.0	Fair	1.0	Fair
5	Jarrah-Marri forests	-	1.0	Fair	1.0	Fair	1.0	Fair
6	Karri & Wandoo outliers	-	1.0	Fair	1.0	-	1.0	Fair
7	Wetlands including rivers & creeks	-	1.0	Fair	1.0	-	1.0	Fair
<b>Project Biodiversity Health Rank</b>								<b>Fair</b>

## Threat Summary

Project-specific Threats (Common Taxonomy *)	Albany Blackbutt & banksia woodlands	Black-gloved wallabies	Granite outcrops & ridges	Honey possums	Jarrah-Marri forests	Karri & Wandoo outliers	Wetlands including rivers & creeks	Overall Threat Rank
Feral animals (cats, feral dogs, foxes) ( <i>Invasive Non-Native/Alien Species</i> )	Medium	Very High	Medium	Very High	High	Medium	Medium	Very High
Grazing (stock & roos, rabbits, pigs) (Understorey loss) ( <i>Other Ecosystem Modifications</i> )	High	High	High	High	High	Very High	High	Very High
Historical clearing & drainage causing altered hydrology (inundation & salinity) ( <i>Dams &amp; Water Management/Use</i> )	High	Low	-	Medium	Very High	High	High	Very High
Dieback (Phytophthora, marri canker) ( <i>Invasive Non-Native/Alien Species</i> )	High	Low	Medium	High	High	Low	Low	High
Weeds ( <i>Invasive Non-Native/Alien Species</i> )	Low	Low	Medium	Low	Medium	Medium	Very High	High
Climate change ( <i>Habitat Shifting &amp; Alteration</i> )	Medium	Medium	Medium	Medium	Medium	High	High	High
Land management practices causing excess nutrients in systems ( <i>Livestock Farming &amp; Ranching</i> )	Medium	Low	Low	Medium	Low	High	High	High
Fire ( <i>Fire &amp; Fire Suppression</i> )	Medium	Low	Low	High	Medium	High	High	High

Project-specific Threats (Common Taxonomy *)	Albany Blackbutt & banksia woodlands	Black-gloved wallabies	Granite outcrops & ridges	Honey possums	Jarrah-Marri forests	Karri & Wandoo outliers	Wetlands including rivers & creeks	Overall Threat Rank
Clearing causing habitat fragmentation (lack of connectivity) (Other Ecosystem Modifications)	Medium	High	Low	Medium	Medium	High	High	High
Lack of funding to implement strategies as on-ground actions (Undefined)	-	-	-	-	-	-	-	-
Lack of awareness by landholders and the broader community as to the value of biodiversity (Undefined)	-	-	-	-	-	-	-	-
Lack of engagement in practical conservation actions by the community (Undefined)	-	-	-	-	-	-	-	-
Lack of funding for monitoring (Undefined)	-	-	-	-	-	-	-	-
<b>Threat Status for Targets and Project</b>	<b>High</b>	<b>High</b>	<b>Medium</b>	<b>Very High</b>	<b>Very High</b>	<b>Very High</b>	<b>Very High</b>	<b>Very High</b>

## Action Plan

**Objective:** 80% of Hay River protected from livestock and other threats by 2014 and 60% of tributaries & wetlands protected from livestock and other threats by 2020 : (Currently as at June 2012, only two landholders are holding up the process of completing stock exclusion fencing along the river) (Target = Wetlands including rivers & creeks)

**Objective:** Ensure that 90% of key granite outcrop ecosystems are protected using appropriate management by 2016. : (Some granite outcrops are already under grazing systems - we are dealing with the intact i.e. salvageable systems here) (Target = Granite outcrops & ridges)

**Objective:** Identify, engage with landholders and map all key Albany Blackbutt areas by 2013 to implement key management actions by 2015. : (Management plans and actions are needed (e.g. fencing & revegetation) - some of the areas are in conservation reserves and need management plans developed) (Target = Albany Blackbutt & banksia woodlands)

**Objective:** Identify, engage with landholders and map all key Wandoo & Karri outliers by 2013 so as to implement key management actions by 2015. : (Management actions include fencing & revegetation for understorey replacement and connectivity) (Target = Karri & Wandoo outliers)

**Objective:** Improve status of and connectivity for black gloved wallabies by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (In particular increasing understorey, connectivity of bush and integrated feral animal control) (Target = Black-gloved wallabies)

**Objective:** Improve status of and connectivity for honey possums by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (It is suspected that integrated feral animal control is one of the key strategies needed) (Target = Honey possums)

**Objective:** To ensure no net loss of area of Jarrah-Marri forest during the period 2013-2020 and the condition of remnants (structure & composition) is measurably improving during this period : (Use vegetation condition rating such as the Keighery/Kasehagen scale or Vegmachine to monitor) (Target = Jarrah-Marri forests)

## All Monitoring Indicators

Methods	Objectives	Key Indicator References by Target (w/Current Indicator Measurement)	Threat References by Target (w/Current Indicator Measurement)
<b>Indicator:</b>			
<b>Age classes present</b>			
<ul style="list-style-type: none"> <li>Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.</li> </ul>	<ul style="list-style-type: none"> <li>To ensure no net loss of area of Jarrah-Marri forest during the period 2013-2020 and the condition of remnants (structure &amp; composition) is measurably improving during this period : (Use vegetation condition rating such as the Keighery/Kasehagen scale or Vegmachine to monitor) (Target = Jarrah-Marri forests)</li> </ul>	<b>Jarrah-Marri forests</b> <ul style="list-style-type: none"> <li>Condition: Structure &amp; composition</li> </ul>	
<b>Indicator:</b>			
<b>Area/size &amp; accessibility</b>			
<ul style="list-style-type: none"> <li>Use appropriate Beard vegetation layers with vegetation associations as baseline, and determine appropriate cut-offs of size thresholds for key fauna (e.g. 30, 100, 500 ha) and gaps between patches (e.g. 100m, 500m &amp; 1000m) from the literature</li> </ul>	<ul style="list-style-type: none"> <li>Improve status of and connectivity for black gloved wallabies by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (In particular increasing understorey, connectivity of bush and integrated feral animal control) (Target = Black-gloved wallabies)</li> </ul>	<b>Black-gloved wallabies</b> <ul style="list-style-type: none"> <li>Size: Habitat suitability and extent</li> </ul>	
<b>Indicator:</b>			
<b>Composition &amp; density of habitat</b>			
<ul style="list-style-type: none"> <li>Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.</li> </ul>	<ul style="list-style-type: none"> <li>Improve status of and connectivity for black gloved wallabies by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (In particular increasing understorey, connectivity of bush and integrated feral animal control) (Target = Black-gloved wallabies)</li> </ul>	<b>Black-gloved wallabies</b> <ul style="list-style-type: none"> <li>Size: Habitat suitability and extent</li> </ul>	
<b>Indicator:</b>			
<b>Continual flower and nectar throughout the year</b>			
<ul style="list-style-type: none"> <li>Condition rating &amp; flora species lists from flora survey</li> </ul>	<ul style="list-style-type: none"> <li>Improve status of and connectivity for honey possums by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (It is suspected that integrated feral animal control is one of the key strategies needed) (Target = Honey possums)</li> </ul>	<b>Honey possums</b> <ul style="list-style-type: none"> <li>Condition: Diversity of Proteaceous plus other communities</li> </ul>	
<b>Indicator:</b>			
<b>critical area (ha) and linkage</b>			
<ul style="list-style-type: none"> <li>Use appropriate Beard vegetation layers with vegetation associations as baseline, and determine appropriate cut-offs of size thresholds for key fauna (e.g. 30, 100, 500 ha) and gaps between patches (e.g. 100m, 500m &amp; 1000m) from the literature</li> </ul>	<ul style="list-style-type: none"> <li>Improve status of and connectivity for honey possums by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (It is suspected that integrated feral animal control is one of the key strategies needed) (Target = Honey possums)</li> </ul>	<b>Honey possums</b> <ul style="list-style-type: none"> <li>Condition: Habitat quality, size and connectivity</li> </ul>	
<b>Indicator:</b>			
<b>Foreshore condition</b>			
<ul style="list-style-type: none"> <li>Foreshore Condition Assessment. (Pen Scott Methodology). Baselines have already been established for large sections of the Hay River which can be used as comparisons for future monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>80% of Hay River protected from livestock and other threats by 2014 and 60% of tributaries &amp; wetlands protected from livestock and other threats by 2020 : (Currently as at June 2012, only two landholders are holding up the process of completing stock exclusion fencing along the river) (Target = Wetlands including rivers &amp; creeks)</li> </ul>	<b>Wetlands including rivers &amp; creeks</b> <ul style="list-style-type: none"> <li>Condition: Hydrological regime</li> </ul>	
<b>Indicator:</b>			
<b>Habitat occupancy</b>			



Methods	Objectives	Key Indicator References by Target (w/Current Indicator Measurement)	Threat References by Target (w/Current Indicator Measurement)
<ul style="list-style-type: none"> <li>Use the % of suitable habitat occupied method developed by Giffillan (2010) for Black Gloved Wallabies in the FitzStirling</li> </ul>	<ul style="list-style-type: none"> <li>Improve status of and connectivity for black gloved wallabies by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (In particular increasing understorey, connectivity of bush and integrated feral animal control) (Target = Black-gloved wallabies)</li> </ul>	<b>Black-gloved wallabies</b> <ul style="list-style-type: none"> <li>Size: Abundance</li> </ul>	
<b>Indicator:</b> <b>Health of Eucalyptus staeri trees</b>			
<ul style="list-style-type: none"> <li>% of trees in different crown condition category</li> </ul>	<ul style="list-style-type: none"> <li>Identify, engage with landholders and map all key Albany Blackbutt areas by 2013 to implement key management actions by 2015. : (Management plans and actions are needed (e.g. fencing &amp; revegetation) - some of the areas are in conservation reserves and need management plans developed) (Target = Albany Blackbutt &amp; banksia woodlands)</li> </ul>	<b>Albany Blackbutt &amp; banksia woodlands</b> <ul style="list-style-type: none"> <li>Condition: Hydrological balance</li> </ul>	
<b>Indicator:</b> <b>Organic matter</b>			
<ul style="list-style-type: none"> <li>Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.</li> </ul>	<ul style="list-style-type: none"> <li>Identify, engage with landholders and map all key Wandoo &amp; Karri outliers by 2013 so as to implement key management actions by 2015. : (Management actions include fencing &amp; revegetation for understorey replacement and connectivity) (Target = Karri &amp; Wandoo outliers)</li> </ul>	<b>Karri &amp; Wandoo outliers</b> <ul style="list-style-type: none"> <li>Condition: Sponge (Water holding capacity)</li> </ul>	
<b>Indicator:</b> <b>Population size &amp; health</b>			
<ul style="list-style-type: none"> <li>Use the % of suitable habitat occupied method developed by Giffillan (2010) for Black Gloved Wallabies in the FitzStirling</li> </ul>	<ul style="list-style-type: none"> <li>Improve status of and connectivity for honey possums by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (It is suspected that integrated feral animal control is one of the key strategies needed) (Target = Honey possums)</li> </ul>	<b>Honey possums</b> <ul style="list-style-type: none"> <li>Size: Viable population of honey possums</li> </ul>	
<b>Indicator:</b> <b>Representative species (number and density)</b>			
<ul style="list-style-type: none"> <li>Number and % of representative species in different age classes</li> </ul>	<ul style="list-style-type: none"> <li>Identify, engage with landholders and map all key Albany Blackbutt areas by 2013 to implement key management actions by 2015. : (Management plans and actions are needed (e.g. fencing &amp; revegetation) - some of the areas are in conservation reserves and need management plans developed) (Target = Albany Blackbutt &amp; banksia woodlands)</li> </ul>	<b>Albany Blackbutt &amp; banksia woodlands</b> <ul style="list-style-type: none"> <li>Condition: Condition of understorey</li> </ul>	
<b>Indicator:</b> <b>Size of remnants and patchiness</b>			
<ul style="list-style-type: none"> <li>Use appropriate Beard vegetation layers with vegetation associations as baseline, and determine appropriate cut-offs of size thresholds for key fauna (e.g. 30, 100, 500 ha) and gaps between patches (e.g. 100m, 500m &amp; 1000m) from the literature</li> </ul>	<ul style="list-style-type: none"> <li>To ensure no net loss of area of Jarrah-Marri forest during the period 2013-2020 and the condition of remnants (structure &amp; composition) is measurably improving during this period : (Use vegetation condition rating such as the Keighery/Kasehagen scale or Vegmachine to monitor) (Target = Jarrah-Marri forests)</li> </ul>	<b>Jarrah-Marri forests</b> <ul style="list-style-type: none"> <li>Size: Size and distribution of remnants</li> </ul>	
<b>Indicator:</b> <b>Species diversity/richness</b>			
<ul style="list-style-type: none"> <li>Condition rating &amp; flora species lists from flora survey</li> </ul>	<ul style="list-style-type: none"> <li>To ensure no net loss of area of Jarrah-Marri forest during the period 2013-2020 and the condition of remnants (structure &amp; composition) is measurably improving during this period : (Use vegetation condition rating such as the Keighery/Kasehagen scale or Vegmachine to monitor) (Target = Jarrah-Marri forests)</li> </ul>	<b>Jarrah-Marri forests</b> <ul style="list-style-type: none"> <li>Condition: Structure &amp; composition</li> </ul>	

Methods	Objectives	Key Indicator References by Target (w/Current Indicator Measurement)	Threat References by Target (w/Current Indicator Measurement)
Indicator: <b>Structural and functional diversity</b>			
<ul style="list-style-type: none"> <li>Condition rating &amp; flora species lists from flora survey</li> </ul>	<ul style="list-style-type: none"> <li>Identify, engage with landholders and map all key Wandoo &amp; Karri outliers by 2013 so as to implement key management actions by 2015. : (Management actions include fencing &amp; revegetation for understorey replacement and connectivity) (Target = Karri &amp; Wandoo outliers)</li> </ul>	<b>Karri &amp; Wandoo outliers</b> <ul style="list-style-type: none"> <li>Condition: Structure and functional integrity</li> </ul>	
Indicator: <b>Suite of representative flora</b>			
<ul style="list-style-type: none"> <li>Spring flora surveys with orchid experts to document representative species of orchids on granite outcrops to be used as a baseline for future monitoring work</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that 90% of key granite outcrop ecosystems are protected using appropriate management by 2016. : (Some granite outcrops are already under grazing systems - we are dealing with the intact i.e. salvageable systems here) (Target = Granite outcrops &amp; ridges)</li> </ul>	<b>Granite outcrops &amp; ridges</b> <ul style="list-style-type: none"> <li>Condition: Hydrology</li> </ul>	
Indicator: <b>Vegetation diversity</b>			
<ul style="list-style-type: none"> <li>Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that 90% of key granite outcrop ecosystems are protected using appropriate management by 2016. : (Some granite outcrops are already under grazing systems - we are dealing with the intact i.e. salvageable systems here) (Target = Granite outcrops &amp; ridges)</li> </ul>	<b>Granite outcrops &amp; ridges</b> <ul style="list-style-type: none"> <li>Condition: Hydrology</li> </ul>	
Indicator: <b>Water quality</b>			
<ul style="list-style-type: none"> <li>Ausrivas indices to be used as well as another indicators such as the invertebrate species suggested by Cook et. al. (2008). There are 22 existing sites on the Hay River (Cook et. al. 2008) measured in June - Sep 2007 which can be used as baselines and measured at regular intervals (e.g. 5 years)</li> </ul>	<ul style="list-style-type: none"> <li>80% of Hay River protected from livestock and other threats by 2014 and 60% of tributaries &amp; wetlands protected from livestock and other threats by 2020 : (Currently as at June 2012, only two landholders are holding up the process of completing stock exclusion fencing along the river) (Target = Wetlands including rivers &amp; creeks)</li> </ul>	<b>Wetlands including rivers &amp; creeks</b> <ul style="list-style-type: none"> <li>Condition: Hydrological regime</li> </ul>	

## Project Resources

There is not enough information to produce this report.

## Assessment of Target Viability

Conservation Target	Key Attribute (Category)	Indicator	Current Indicator Measurement	Rating Comments: (Poor, Fair Good Very Good)	Current Rating and Date	Desired Rating and Date
Albany Blackbutt & banksia woodlands	Condition of understorey <sup>1</sup> (Condition )	Representative species (number and density)	% of representative species present - flora survey rating	<b>Poor:</b> little understorey <b>Fair:</b> some understorey <b>Good:</b> good understorey <b>Very Good:</b> excellent understorey	Good	Good
Albany Blackbutt & banksia woodlands	Hydrological balance <sup>2</sup> (Condition )	Health of Eucalyptus staeri trees <sup>3</sup>	Number of dead trees (% of trees in different crown condition category)	<b>Poor:</b> >30% alive <b>Fair:</b> 30-60% alive <b>Good:</b> 60-90% alive <b>Very Good:</b> >90 % alive	Fair	Fair
Black-gloved wallabies	Abundance <sup>4</sup> (Size )	Habitat occupancy <sup>5</sup>	% of suitable habitats occupied	<b>Poor:</b> <20% <b>Fair:</b> 21-50% <b>Good:</b> 51-79% <b>Very Good:</b> >80%	Poor	Good
Black-gloved wallabies	Habitat suitability and extent <sup>6</sup> (Size )	Area/size & accessibility <sup>7</sup>	Patch size (ha) & distribution and connectivity based on size of gaps between remnant vegetation patches	<b>Poor:</b> Remnants small < 30 ha, far apart > 500 m <b>Fair:</b> Remnants 30 - 100 ha, not very well connected, 200 - 500m apart <b>Good:</b> Remnants 100 - 500 ha, reasonably well connected, 100 - 200m apart <b>Very Good:</b> Remnant s > 500 ha, well connected < 100m apart	Fair	Fair
Black-gloved wallabies	Habitat suitability and extent <sup>8</sup> (Size )	Composition & density of habitat <sup>9</sup>	Kaesehagen bush condition scale	<b>Poor:</b> Very Good - Excellent (VG) (4) (Kaesehagen, 1994) <b>Fair:</b> Fair - Good (G) (3) (Kaesehagen, 1994) <b>Good:</b> Poor (P) (2) (Kaesehagen, 1994) <b>Very Good:</b> Degraded (D) (1) (Kaesehagen, 1994)	Fair <sup>10</sup>	Fair
Granite outcrops & ridges	Hydrology <sup>11</sup> (Condition )	Vegetation diversity <sup>12</sup>	Keighery (1994) or similar condition rating but tailored for granite outcrops	<b>Poor:</b> few vegetation layers present, little leaf layer <b>Fair:</b> some vegetation layers present, leaf litter present <b>Good:</b> most vegetation layers present, some leaf litter <b>Very Good:</b> all vegetation layers present, lots of leaf litter	Good	Good
Granite outcrops & ridges	Hydrology (Condition )	Suite of representative flora <sup>13</sup>	No and abundance of representative flora species	<b>Poor:</b> < 25% of representative orchid species <b>Fair:</b> between 25-50% of representative orchid species <b>Good:</b> between 50 - 75% of representative orchid species <b>Very Good:</b> > 75% representative orchid species	Fair	Fair
Honey possums	Diversity of Proteaceous plus other communities (Condition )	Continual flower and nectar throughout the year <sup>14</sup>	Condition rating & flora species lists from flora survey	<b>Poor:</b> tbd <b>Fair:</b> tbd <b>Good:</b> tbd <b>Very Good:</b> tbd	Fair	Good

Conservation Target	Key Attribute (Category)	Indicator	Current Indicator Measurement	Rating Comments: (Poor, Fair Good Very Good)	Current Rating and Date	Desired Rating and Date
Honey possums	Habitat quality, size and connectivity (Condition)	critical area (ha) and linkage <sup>15</sup>	Aerial extent and connectivity index	<b>Poor:</b> TBD <b>Fair:</b> TBD (e.g. Mondurup Reserve) <b>Good:</b> TBD (e.g. Narrikup Reserve) <b>Very Good:</b> TBD	Fair <sup>16</sup>	Good
Honey possums	Viable population of honey possums (Size)	Population size & health	Integrated trapping and health survey with experts	<b>Poor:</b> Too few individuals for viable populations <b>Fair:</b> A few viable populations <b>Good:</b> Some viable populations <b>Very Good:</b> Many viable populations	Fair	Fair
Jarrah-Marri forests	Structure & composition <sup>17</sup> (Condition)	Age classes present <sup>18</sup>	Condition rating score based on Keighery (1994) or similar	<b>Poor:</b> one or none <b>Fair:</b> some <b>Good:</b> more than some <b>Very Good:</b> all present	Fair <sup>19</sup>	Good
Jarrah-Marri forests	Structure & composition <sup>20</sup> (Condition)	Species diversity/richness <sup>21</sup>	No. of key/representative species	<b>Poor:</b> Few native, lots of weeds <b>Fair:</b> A few more <b>Good:</b> Quite a few <b>Very Good:</b> Lots of natives, no weeds	Fair	Good <sup>22</sup>
Jarrah-Marri forests	Size and distribution of remnants <sup>23</sup> (Size)	Size of remnants and patchiness	Fragmentation index using GIS	<b>Poor:</b> Small remnants not well connected <b>Fair:</b> Medium sized remnants, moderately connected <b>Good:</b> Large remnants, well connected <b>Very Good:</b> Very large remnants, well connected	Fair <sup>24</sup>	Fair
Karri & Wandoo outliers	Sponge (Water holding capacity) <sup>25</sup> (Condition)	Organic matter	Density of native understorey	<b>Poor:</b> low organic matter <b>Fair:</b> some organic matter (TBD) <b>Good:</b> high organic matter <b>Very Good:</b> very high organic matter	Fair	Fair
Karri & Wandoo outliers	Structure and functional integrity <sup>26</sup> (Condition)	Structural and functional diversity	Keighery vegetation condition scale or similar	<b>Poor:</b> low diversity <b>Fair:</b> - <b>Good:</b> - <b>Very Good:</b> High diversity	Fair	Fair
Wetlands including rivers & creeks	Hydrological regime <sup>27</sup> (Condition)	Water quality <sup>28</sup>	Standard physical, chemical & biological indices	<b>Poor:</b> poor water quality <b>Fair:</b> fair water quality <b>Good:</b> good water quality <b>Very Good:</b> very good water quality	Fair Sep 25, 2007	Good
Wetlands including rivers & creeks	Hydrological regime <sup>29</sup> (Condition)	Foreshore condition	% of River in Pen-Scott Categories (A,B,C,D)	<b>Poor:</b> Majority D Grade <b>Fair:</b> Majority C Grade <b>Good:</b> Majority B Grade <b>Very Good:</b> Majority A Grade	Fair <sup>30</sup> Jul 25, 2007	Good

**COMMENTS:**

1. Kunzea ericifolia, Melaleuca thymoides, Taxandria parviceps, Desmocladius fascicularis
2. Health of trees as an indicator of hydrological balance - if the hydrological balance is out, waterlogging will cause tree deaths - However - deaths could be caused by a number of other factors. This indicator is probably more practical for the groups monitoring plan
3. These values need to be reviewed with some observations at known sites that can be used as benchmarks of different quality with regards tree health. Another more refined measurement such as crown decline may be a more useful measurement to employ Also need to look at issues such as recruitment.
4. Refer to Sandra Gilfillan's work from the FitzStirling.
5. Taken from Sandra Gilfillan's research in the FitzStirling area as reported in the Functional Landscape Plan for the FitzStirling area by Deegan & Sanders (2011) where the actual % of occupancy was 37%
6. Connectivity / fragmentation measures Threats include too large a gap, roadways and fences (wallaby gates required in key areas) - ringlock versus plain wire - different design GIS fragmentation examination -eg. where are the patches less than 100 ha and gaps >500 m

7. Roughly based on literature, needs to be verified with more data collection and input from experts.
8. Density of understorey
9. Use Kaesehagen (1994) categories or similar
10. These measurements need to be linked to the area size & accessibility
11. Might need to also include some measure of litter accumulation (see GWJ's paper for Mt Lindesay etc)
12. Use Kaesehagen Vegetation Condition Scale
13. Orchid species are suggested, but may be augmented by other species that are susceptible to disturbance (e.g. disease, water etc.) such as representative tree species
14. current declining trend
15. Current declining trend, could use infra cameras for monitoring as less invasive than trapping
16. Dense understorey is important, safe passage between patches important - 25 ha for breeding area
17. This relates mostly to trees but could be applied to shrubs as well. It would be good to investigate to what extent VegMachine can be used to measure quality of patches - by getting benchmark sites and ground truthing.
18. Might need to come up with a representative set of sites
19. Need to do GIS analysis to assist with mapping this conservation target. Could also be tenure related, related to fencing (Lynne Heppel estimates that about 60% of larger remnants are fenced)
20. Species and relative abundance
21. Native plants and weeds - might be two tiers of measurement
22. Add to the habitat/site assessment suite of indicators
23. Was called "patch number & size" new name during synthesis by BH 23 May 2012
24. Look at the work done by Julian Neville for Gondwana Link
25. This refers to both on top of and in the soil (Leaf litter and A & B horizons)
26. This is based on Karri Forest composition
27. Standard measurements, i.e. salinity, turbidity etc, Includes a measure of water volume, ground and surface water levels, Department of Water has gauging stations at a number of waterways, -water volumes in wetlands tricky to measure (how useful would this be?), -some wetlands have been drained in the past
28. Need to extract data from existing reports, e.g. Cook et al. (2008) - raw data & data from Upper Hay Catchment Plan (Heppel, 2007)
29. Lots of information done previously - use to measure baseline and update in future
30. Need to look at actual numbers to ensure that this rating is correct and what the percentages are in different foreshore condition categories. Check original measurement dates.

## Strategy Effectiveness

**Objective:** 80% of Hay River protected from livestock and other threats by 2014 and 60% of tributaries & wetlands protected from livestock and other threats by 2020 : (Currently as at June 2012, only two landholders are holding up the process of completing stock exclusion fencing along the river) (Target = Wetlands including rivers & creeks)

**Percent Complete: 0%**

**Indicator:** Foreshore condition

**Methods:**

1. Foreshore Condition Assessment. (Pen Scott Methodology). Baselines have already been established for large sections of the Hay River which can be used as comparisons for future monitoring.

**Measurement Report:**

Measure	Date	Source	Trend	Comments
% of River in Pen-Scott Categories (A,B,C,D)	Jul 25, 2007	Expert Knowledge	Mild Increase	Need to look at actual numbers to ensure that this rating is correct and what the percentages are in different foreshore condition categories. Check original measurement dates.

**Indicator:** Water quality

**Methods:**

1. Ausrivas indices to be used as well as another indicators such as the invertebrate species suggested by Cook et. al. (2008). There are 22 existing sites on the Hay River (Cook et. al. 2008) measured in June - Sep 2007 which can be used as baselines and measured at regular intervals (e.g, 5 years)

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Standard physical, chemical & biological indices	Sep 25, 2007	Intensive Assessment	Mild Increase	

**Objective:** Ensure that 90% of key granite outcrop ecosystems are protected using appropriate management by 2016. : (Some granite outcrops are already under grazing systems - we are dealing with the intact i.e. salvageable systems here) (Target = Granite outcrops & ridges)

**Percent Complete: 0%**

**Indicator:** Suite of representative flora

**Methods:**

1. Spring flora surveys with orchid experts to document representative species of orchids on granite outcrops to be used as a baseline for future monitoring work

**Measurement Report:**

Measure	Date	Source	Trend	Comments
No and abundance of representative flora species	-	Rough Guess	Mild Decrease	

**Indicator:** Vegetation diversity

**Methods:**

1. Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.

**Measurement Report:**

Measure	Date	Source	Trend	Comments
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Keighery (1994) or similar condition rating but tailored for granite outcrops	-	Expert Knowledge	Flat	
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**Objective:** Identify, engage with landholders and map all key Albany Blackbutt areas by 2013 to implement key management actions by 2015. : (Management plans and actions are needed (e.g. fencing & revegetation) - some of the areas are in conservation reserves and need management plans developed) (Target = Albany Blackbutt & banksia woodlands) **Percent Complete: 0%**

**Indicator:** Health of Eucalyptus staeri trees

**Methods:**

1. % of trees in different crown condition category

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Number of dead trees (% of trees in different crown condition category)	-	Rough Guess	Mild Decrease	

**Indicator:** Representative species (number and density)

**Methods:**

1. Number and % of representative species in different age classes

**Measurement Report:**

Measure	Date	Source	Trend	Comments
% of representative species present - flora survey rating	-	Not Specified	Mild Decrease	

**Objective:** Identify, engage with landholders and map all key Wandoo & Karri outliers by 2013 so as to implement key management actions by 2015. : (Management actions include fencing & revegetation for understorey replacement and connectivity) (Target = Karri & Wandoo outliers) **Percent Complete: 0%**

**Indicator:** Organic matter

**Methods:**

1. Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Density of native understorey	-	Rough Guess	Flat	

**Indicator:** Structural and functional diversity

**Methods:**

1. Condition rating & flora species lists from flora survey

**Measurement Report:**

Measure	Date	Source	Trend	Comments
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Keighery vegetation condition scale or similar	-	Rough Guess	Flat	
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**Objective:** Improve status of and connectivity for black gloved wallabies by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (In particular increasing understorey, connectivity of bush and integrated feral animal control) (Target = Black-gloved wallabies)

**Percent Complete: 0%**

**Indicator:** Area/size & accessibility

**Methods:**

1. Use appropriate Beard vegetation layers with vegetation associations as baseline, and determine appropriate cut-offs of size thresholds for key fauna (e.g. 30, 100, 500 ha) and gaps between patches (e.g. 100m, 500m & 1000m) from the literature

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Patch size (ha) & distribution and connectivity based on size of gaps between remnant vegetation patches	-	Rough Guess	Flat	

**Indicator:** Composition & density of habitat

**Methods:**

1. Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Kaesehagen bush condition scale	-	Expert Knowledge	Flat	These measurements need to be linked to the area size & accessibility

**Indicator:** Habitat occupancy

**Methods:**

1. Use the % of suitable habitat occupied method developed by Gilfillan (2010) for Black Gloved Wallabies in the FitzStirling

**Measurement Report:**

Measure	Date	Source	Trend	Comments
% of suitable habitats occupied	-	Rough Guess	Mild Decrease	

**Objective:** Improve status of and connectivity for honey possums by 2020 through undertaking a baseline survey in key areas by 2013 and implementing key management actions by 2014. : (It is suspected that integrated feral animal control is one of the key strategies needed) (Target = Honey possums)

**Percent Complete: 0%**

**Indicator:** Continual flower and nectar throughout the year

**Methods:**

1. Condition rating & flora species lists from flora survey

**Measurement Report:**

Measure	Date	Source	Trend	Comments

Condition rating & flora species lists from flora survey	-	Expert Knowledge	Mild Decrease	
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**Indicator:** critical area (ha) and linkage

**Methods:**

1. Use appropriate Beard vegetation layers with vegetation associations as baseline, and determine appropriate cut-offs of size thresholds for key fauna (e.g. 30, 100, 500 ha) and gaps between patches (e.g. 100m, 500m & 1000m) from the literature

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Aerial extent and connectivity index	-	Rough Guess	Strong Decrease	Dense understorey is important, safe passage between patches important - 25 ha for breeding area

**Indicator:** Population size & health

**Methods:**

1. Use the % of suitable habitat occupied method developed by Gilfillan (2010) for Black Gloved Wallabies in the FitzStirling

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Integrated trapping and health survey with experts	-	Rough Guess	Mild Decrease	

**Objective:** To ensure no net loss of area of Jarrah-Marri forest during the period 2013-2020 and the condition of remnants (structure & composition) is measurably improving during this period : (Use vegetation condition rating such as the Keighery/Kasehagen scale or Vegmachine to monitor) (Target = Jarrah-Marri forests)

**Percent Complete: 0%**

**Indicator:** Age classes present

**Methods:**

1. Vegetation Condition: The Bushland Condition Scale (Kaesehagen 1994) is utilised to estimate composition and density of vegetation and it is suggested that photo-point monitoring be used as well.

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Condition rating score based on Keighery (1994) or similar	-	Rough Guess	Mild Decrease	Need to do GIS analysis to assist with mapping this conservation target. Could also be tenure related, related to fencing (Lynne Heppel estimates that about 60% of larger remnants are fenced)

**Indicator:** Size of remnants and patchiness

**Methods:**

1. Use appropriate Beard vegetation layers with vegetation associations as baseline, and determine appropriate cut-offs of size thresholds for key fauna (e.g. 30, 100, 500 ha) and gaps between patches (e.g. 100m, 500m & 1000m) from the literature

**Measurement Report:**

Measure	Date	Source	Trend	Comments
Fragmentation index using GIS	-	Rough Guess	Flat	Look at the work done by Julian Neville for Gondwana Link

**Indicator:** Species diversity/richness

**Methods:**

1. Condition rating & flora species lists from flora survey

**Measurement Report:**

Measure	Date	Source	Trend	Comments
No. of key/representative species	-	Rough Guess	Mild Decrease	

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