INTERIM RECOVERY PLAN NO. 383

Monsoon vine thickets on the coastal sand dunes of the Dampier Peninsula

2018 – 2023

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

Science and Conservation Service

February 2018

Foreword

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Parks and Wildlife (now Biodiversity, Conservation and Attractions) Corporate Policy Statement No. 35 (DPaW 2015*a*) and Corporate Guideline No. 35 (DPaW 2015*b*). Corporate Policy Statement No. 35 states that the department will prepare recovery plans or conservation advices that document the conservation requirements, recovery or management actions and information requirements of threatened species and ecological communities (TECs), identify threatening processes impacting threatened species or TECs, and implement programs to mitigate the threats. Interim recovery plans outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened species or ecological communities, and begin the recovery process.

While the Department of Biodiversity, Conservation and Attractions (DBCA) is committed to ensuring that threatened ecological communities are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs, there is no statutory requirement to implement recovery actions identified in this plan. This plan identifies responsibilities for specific actions and largely refers to the department initiating and guiding actions. However, the implementation of recovery actions by the Department of Biodiversity, Conservation and Attractions or any other organisation will be done within the context of regional and statewide priorities and technical and resource capacity. The provision of funds identified in this plan is dependent on budgetary and other constraints affecting the Department of Biodiversity, Conservation and Attractions, as well as the need to address other priorities.

This plan was given regional approval on 13 June 2017 and was approved by the Executive Director of Science and Conservation on 20 February 2018. This plan will operate from February 2018 to January 2023 but will remain in force until withdrawn or replaced following a review of the need for further recovery actions, and whether a revised plan needs to be prepared.

Information in this IRP was accurate at August 2017.

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CITATION

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CONTENTS

SUMMARY

Name: Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula (hereafter termed 'vine thickets').

Description
The vine thickets of the Dampier Peninsula are a very distinctive type of rainforest in the Kimberley region. This type of vine thicket is confined to the Peninsula between Broome and Derby, along with the coastal dune formations on which it occurs.

The community occurs as semi-deciduous vine thicket on leeward slopes of coastal sand dunes on the Dampier Peninsula. Many occurrences include scattered discrete vine thicket patches located in swales throughout the dune system and are likely to be indicators of the movement of the dune system over time. The community generally occurs on deep dune sands with a dark superficial grey organic layer, with a surface layer of moist leaf litter, but it can occur on other substrates due to other influences.

Vine thickets occur as discrete areas of dense vegetation and can occur as a stand of a few trees or as larger patches. The 90 known occurrences vary in size from about 0.3 ha up to 507 ha, with a mean size of about 33 ha. They can occur as clumps or narrow linear stands (Black *et al*. 2010). There are about 2,887 ha of the vine thickets currently mapped on the Department of Biodiversity, Conservation and Attractions Threatened Ecological Community (TEC) Database.

The vine thicket community contains many plants with fleshy fruits that provide important food sources for fauna such as agile wallabies, bats, bower-birds and fruit-doves. They are also an important traditional resource for Indigenous people.

DBCA Region: Kimberley

DBCA District: West Kimberley

Local Government: Shire of Broome

IBRA Subregions: Dampierland DL1 Fitzroy Trough subregion and DL2 Pindanland subregion

Current Status
Ranked as Vulnerable in Western Australia in 2001, and ranked Endangered in February 2013 under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Habitat Characteristics
This vine thicket community is largely restricted to the east and west coastlines of the Dampier Peninsula associated with Holocene and Pleistocene dune systems. Due to rainfall, frugivore distribution and fire history, occassional relictual fragments occur throughout surrounding woodlands.

The vine thicket occurrences are dependent on rainfall, hydrology and high humidity levels. Rainfall in the northern end of the Peninsula is between about 700-750mm per annum, and in the southern end of the range of the community it is about 600m. Many occurrences are known to occur adjacent to or on groundwater springs or shallow aquifers, described as permanent soakage by Kenneally *et al*. (1991), and so some level of dependence on groundwater can be assumed. A concentration of water flow into the shallow recharge zones at the base of the dune systems is believed to support the community.

The high humidity and heavy fogs along the coast and the wet season rains also help the community to survive long dry periods. The moisture and humidity are accentuated by the dense and protective shady canopy and support the ecosystems' role as a biological refuge. The humidity is also thought to assist in protecting the community from fires.

Benefits to other species/ecological communities

One declared rare flora taxon, one Priority 2, two Priority 3, and one Priority 4 flora taxa occur in vine thicket occurrences (Biota Environmental Services 2009a). *Parsonsia kimberleyensis,* a Kimberley endemic, is only known from the vine thicket TEC (Environs Kimberley 2010). An additional TEC, three Priority 1 and two Priority 3 ecological communities also occur adjacent to or close to the vine thicket TEC near Broome. Actions such as general improvements in land management practices applied to the vine thicket TEC areas, including fire management and weed control, will assist in the conservation of nearby threatened and priority flora and communities.

A bird listed as endangered under the EPBC Act and as P4 in WA, and one Schedule 4, one Priority 2, two Priority 4 fauna, and two Commonwealth migratory fauna species have also been located in the vine thicket occurrences or similar assemblages (Biota Environmental Services 2009b). Other migratory birds are also known to seasonally utilise the vine thickets. An endemic reptile species is known from within the vine thickets TEC (Bardi Jawi Rangers, personal communication). Recovery actions implemented to improve the quality or security of the vine thicket community are likely to improve the status of all native species within the community, including the significant species noted above.

Role and interests of Indigenous people

Many vine thicket occurrences contain sites that are of Aboriginal significance and many are also managed by indigeous people (refer Appendix 1, 3). The close involvement of Indigenous people is crucial to the implementation of recovery under this plan, and this is identified in recovery actions.

Interim recovery plan objective

To conserve the ecological and conservation values of the vine thicket community, by:

- ensuring the permanent protection and conservation of self-sustaining representative areas of key occurrences identified in this plan;
- attaining conservation management of self-sustaining representative key areas of each of the identified vine thicket clusters;
- minimising the loss and maximising the conservation of all remaining occurrences as far as possible, including recovering degraded occurrences where it is cost effective and practical to do so.

Criteria for success:

- an increase in the number of key self-sustaining areas of the vine thicket community as identified in this plan that are managed for conservation and/or with conservation included in their purpose (including Indigenous Protected Areas, and reserves that are jointly managed between the Conservation and Parks Commission and the Aboriginal Native Title Holder in accordance with the *Conservation and Land Management 1984 Act* (CALM Act); or
- an increase in the number of identified vine thicket cluster groups for which representative areas have conservation management in place; or
- an increase in the number of occurrences of the vine thicket community for which formal strategies are in place to minimise loss and maximise conservation (such as formal weed or fire management strategies in place and being implemented).

Criteria for failure:

- complete loss of any identified cluster group; or

- complete loss or degradation (to degraded condition or poorer) of any key areas of the vine thicket community as identified in this plan; or
- failure to develop and implement formal strategies to manage key threats such as weed invasion, or inappropriate fire or hydrologic regimes.

Summary of Recovery Actions

Liaise with stakeholders	Design and conduct research
Complete on-ground surveys	Investigate controlled tourism, manage access
Continue to monitor	Map habitat critical to survival
Identify and implement appropriate fire regime	Develop management guidelines
Monitor and control major weeds	Monitor and manage feral and exotic animals
Report and control high threat weeds	Apply planning and impact assessment processes
Investigate hydrological processes	Consider climate change issues
Seek tenure that provides for conservation management	Report on outcomes
Protect critical habitats and species	

1. BACKGROUND

1.1 History, defining characteristics of the community, and conservation significance

The two recognised types of rainforests - tropical and temperate, both occur in Australia. Tropical rainforests occur near the equator in areas of consistently high temperatures. These are dense, damp forests on nutrient-poor soils. Tropical rainforests are generally millions of years old.

Temperate rainforests, such as the vine thickets of the Dampier Peninsula, are much younger in geological time than tropical rainforests. They are generally less than 10,000 years old (McKenzie 1991), cover a lot less area than tropical rainforests, and soils are much more nutrient-rich.

The Australian rainforests have been described as small seasonally sparse, 'raingreen' patches in gullies, scree-slopes and rugged terrain. They have the highest degree of biotic interdependence of any terrestrial community, and are still recognised as fragmentary associations derived from the original rainforest community (McKenzie 1991). McKenzie (1991) states that it is likely a variety of issues probably support the high species richness including disturbance, stability, species' reproductive biology, heterogeneity of the habitat, evolutionary time and predation pressure. The many layers within rainforests provide a suite of habitats.

Over the last million years the extent of tropical rainforests has altered continuously with variations in climate. The extent of rainforests is much greater than it was at the beginning of the Holocene – about 10,000 years ago. Australian rainforests are believed to contain species of Gondwanan and Laurasian origin (McKenzie 1991). Rainforests have continued to expand into areas previously occupied by drier associations as climate has continued to get wetter during the Holocene. Australia's dry 'monsoonal' rainforests are part of a group of this type that occur in areas with a dry season throughout Australasia. This type is characterised by presence of many vagile (mobile) cosmopolitan genera and largely deciduous tree canopy.

This vine thicket community is a type of rainforest ecosystem that occurs in discrete patches along the Dampier Peninsula in the south-western portion of the Kimberley region. These are the southernmost occurrences of rainforest (dry monsoon forest) in Western Australia. This diverse community occurs on dunal back slopes, and in swales between dunes and sometimes also on unconsolidated coastal Holocene landforms (Black *et al.* 2010). The western coastline occurrences are on the downwind (leeward, eastern) sides of quaternary slopes of coastal dunes formed in the last 2 million years - the Quaternary period. The eastern occurrences have a more varied geomorphology including a higher incidence of Pleistocene dune systems (those formed between 2 million and 10,000 years ago), headlands and rocky slopes, in addition to Holocene dunes.

Vine thickets are recorded from the western seaboard near Broome townsite in the south to the tip of the peninsula at One Arm Point in the north, however, anectodal evidence indicates small patches may occur at Cape Villaret, about 40 km south west of Broome (L. Beames personal communication). The eastern peninsula coastline occurrences are known to extend as far south as Foul Point.

Kenneally *et al.* (1991) note that rainforest patches contribute a considerable proportion of the floristic diversity of the Kimberley Region. They recorded the vine thickets covered only 0.05% of the land area but contained 24% of the total number of flowering plant species known in the region. They also noted that a large proportion of the plant species recorded in rainforest patches did not occur outside rainforests despite suitable habitat.

Kenneally *et al.* (1991) note that many of the rainforest trees have fleshy fruits or other types that are adapted for dispersal by bats, birds, mammals, wind and water. Rainforest should therefore be able to be established in additional areas of suitable habitat, and there
that the vine thicket vegetation on the Dampier Peninsula was distinct from other Kimberley rainforest should be considerable pollen transfer between patches. The inter-dependence of species may mean that component species need to migrate in unison (McKenzie 1991), and this may limit the distances that they can migrate. The vine thicket community probably occurs in its current habitats due to being afforded some protection from the elements, particularly fire, provided overall climate is appropriate.

The Kimberley Rainforests Australia survey (McKenzie *et al*. 1991) determined assemblages in the region through statistical analysis of plant species composition. The study included data from four rainforest sites on the Dampier Peninsula. These four sites were distinguished as a separate floristic group in the 18 Group level analysis of perennial plant species data. The vine thickets were termed 'Patch Group 6' and classified together on the basis of similarities of the perennial plant species. Kenneally *et al*. (1991) named the community 'Western Kimberley Holocene dune sand patches' and noted that they differed from other groups through the absence of many of the tree and large shrub species that characterised other rainforest groups in other parts of the Kimberley (eg. *Vitex acuminata, Ganophyllum falcatum, Albizia lebbeck, Elaeodendron melanocarpa*, *Adansonia gregorii, Glycosmis* sp.*, Strychnos* sp. and *Micromelum* sp.). The authors also note that although the rainforest sites as a group were generally low in annuals, they recorded 20 annuals in site 29/2 (Occurrence 3 - Vine 03, refer Appendix 3, and 6). They attributed this to increased numbers of annuals in rainforest patches with open canopies or with large glades. The vine thickets of the Dampier Peninsula were on the margins of the sites sampled by McKenzie *et al*. (1991) as well as the margin of rainforest distribution in the south western Kimberley.

Ninety occurrences of this vine thicket community have been located between Broome and One Arm Point and are recorded on the TEC database (Appendix 1). Although the original data that distinguished the vine thickets as having a unique composition was collected for McKenzie *et al*. (1991), most of the data about the location and composition of the vine thickets were gained from approximately three years' dry-season survey of the Dampier Peninsula by the then Department of Conservation and Land Management in liaison with Broome Botanical Society, Aboriginal communities, Traditional Owners, and outstation residents, between 1999 and 2002 (Black *et al*. 2010). They focussed on perennial evergreen and semi-deciduous trees, shrubs and vines, but herbs were also noted when evident.

There have been a series of additional surveys that have also contributed data about the location, status and composition of the community. The survey work has resulted in the characterisation of the vine thickets in terms of composition, threats, location and boundaries. These data are stored on the TEC database at Department of Biodiversity, Conservation and Attractions, Kensington.

Black *et al.* (2010) note that about 25% of the plant species they recorded in the vine thickets were mostly or completely confined to the community. They found that the most common plant families encountered in their surveys of the vine thickets were Fabaceae (21 species), Poaceae (14), Myrtaceae (11), Apocynaceae (seven), Malvaceae (six), with the most common genera being *Acacia* (six species), *Corymbia* (four), *Amyema* (three) and *Capparis* (three).

Black *et al*. (2010) state the following (the term patch is generally equivalent to occurrence in this plan): "Several tree and tall shrub species were common to most monsoon thickets. The trees were: Marool or blackberry tree (*Terminalia petiolaris* - 57 patches), currant or coffee fruit (*Grewia breviflora* - 56 patches), Goonj (*Celtis philippensis* - 55 patches), ebony wood (*Diospyros humilis* - 50 patches), mangarr (*Sersalisia sericea* - 48 patches), mistletoe tree (*Exocarpos latifolius* - 46 patches), mamajen (*Mimusops elengi* - 47 patches), bauhinia or jigal tree (*Bauhinia cunninghamii* - 43 patches), and

helicopter tree (*Gyrocarpus americanus* subsp. *pachyphyllus* - 43 patches). Common tall shrubs included: snowball bush (*Flueggea virosa* subsp. *melanthesoides* - 49 patches), along with *Croton habrophyllus* (44 patches) and broad-winged hop bush (*Dodonea platyptera* - 44 patches). The most common climbers were crabs eye bean (*Abrus precatorius* - 54 patches), bush caper (*Capparis lasiantha* - 45 patches), snake vine (*Tinaspora smilacina* - 44 patches), *Jasminum didymium* (42 patches), *Caesalpinia major* (37 patches), and oyster-catcher bill (*Tylophora cinerascens* - 35 patches).

While most patches were dominated by a mix of several different tree species that varied in height, a few patches were dominated by a single tree species at a uniform height, and had little to no understorey of shrubs. Any ground layer was sparse in healthy patches. Twenty three percent of the native perennial plant species present comprise generally inconspicuous vine species." Appendix 6 provides a list of plant taxa recorded in the vine thicket community, taken from the TEC database.

The trees *Ficus virens* (banyan fig) and *Syzygium eucalyptoides* subsp. *bleeseri* (wild apple) occur in a significant occurrence of vine thickets between Quandong and James Price Point. Some species also occur as localised populations in the community, including *Cupaniopsis anacardioides* at Chile Creek and *Diospyros maritima* near Emeriau Point.

The vine thickets support high species richness and this provides important habitat for fauna including the agile wallaby, rose crowned fruit-dove, flying foxes and great bowerbirds.

There are approximately 2,887 hectares in 90 occurrences of the community recorded on Biodiversity, Conservation and Attractions' TEC database. The average area of occurrences is about 33ha. There are several small additional occurrences that have been located but not yet mapped, generally due to access issues.

Of the area of the community mapped on the TEC database at the time of writing of this plan (note that some tenure categories overlap):

- About 1147 ha (~40%) occurs on Indigenous managed lands
- About 159 ha (~5%) occurs on pastoral stations (Note: some pastoral stations are also managed by Indigenous groups)
- About 1,028 ha (~36%) occurs on Unallocated Crown Lands (UCL) – unspecified land managers/usage.
- About 264 ha (~9%) occurs on land vested with the Shire of Broome; including Minyirr Coastal Park (Vine 01)
- About 302ha (~11%) occurs on private freehold land
- About 0.8ha (~0.03%) occurs on road reserves.

About 3% of the total area occurs in a reserve managed for conservation in Minyirr Coastal Park in the town of Broome. Vegetation in the Coulomb Point Nature Reserve includes a mix of vine thicket and pindan flora and is considered transitional between the two vegetation types (Black *et al.* 2005) and has therefore not been included in current mapping of the vine thicket TEC. Minyirr Coastal Park is the most degraded vine thicket occurrence and has been impacted by recreational use, off-site impacts such as hydrological change from adjacent urban developments and other impacts associated with its urban location (Black *et al.* 2005). Neither of the two reserve areas represent the true character of the Dampier Peninsula's vine thickets.

The vine thickets on the Dampier Peninsula are of great significance to Aboriginal people. The thickets contain many traditional food sources and medicine, water and significant sites. Many occurrences contain culturally sensitive law-grounds with restricted access protocols (Black *et al.* 2010) but there has not yet been a comprehensive investigation into the cultural values, protocols and traditional management for this ecosystem. Much traditional ecological knowledge about the management and

protection of vine thickets is held in a series of languages and cultural groups, including Bardi Jawi, Nyul Nyul, Djabera Djabera, Jabirr Jabirr, Goolarabooloo and Yawuru (Environs Kimberley 2009).

The vine thicket community is currently ranked Vulnerable in Western Australia and Endangered under the EPBC Act.

1.2 Biological and ecological characteristics

Flora

The main tree species include (from Black 2005; Environs Kimberley 2010): *Celtis philippinensis, Diospyros ferrea* var. *humilis, Ficus virens, Melaleuca cajuputi, Melaleuca dealbata, Melaleuca viridiflora, Mimusops elengi, Sersalicia sericea* and *Terminalia petiolaris.* Shrub species in the understorey include: *Croton tomentellus, Dodonaea platyptera, Exocarpos latifolius, Pandanus spiralis, Plumbago zeylanica* and *Santalum lanceolatum.* Vine species include *Abrus precatorius, Adenia heterophylla, Caesalpinia major, Gymnanthera nitida, Jacquemontia paniculata, Tylophora cinerascens* and *Tinospora smilacina*. *Lophostemon grandiflora* often occurs in the wettest areas behind sand dunes as part of the vine thicket stand and occurs as a forest similar to the occurrence of *Melaleuca* sp. within vine thickets. *Capparis lasiantha* is a common sprawling vine found within most vine thicket occurrences, while *Capparis sepiaria* is a regular feature in most northern vine thicket patches. Black *et al*. (2010) state that flora species in the vine thicket community comprise 23% of the species known to occur on the Dampier Peninsula.

Black *et al*. (2010) state "Flora confined to localised populations (i.e. a small number of patches) included: the climber *Secamone timoriensis* (one patch), the Kimberley endemic shrub *Helicteres rhynchocarpa* (two patches), the annual climber potato vine *Operculina aequisepala* (two patches), the small tree *Clerodendrum floribundum* var. *ovatum* (three patches), the climber *Capparis jacobsii* (four patches), the small tree *Pittosporum moluccanum* (two vine thicket patches plus one transitional patch of vegetation, and vegetation adjacent to a vine thicket), the shrub musk-scented plant *Hypoestes floribunda* var. *varia* (four patches), and the climber *Opilia amentacea* (four patches), the small tree Tuckeroo *(Cupaniopsis anacardioides* - eight patches), the shrub *Luvunga monophylla* (eight patches), and the tree wing-leaf whitewood (*Atalaya variifolia* - eight patches)."

Vine thickets provide a good food source for many fauna during the dry season, and the vegetation, with its dense canopy and large fruiting trees provides a particular refuge, habitat and nesting sites for many birds and reptiles. Species in the vine thickets that have edible fruits and berries include Mangarr *(Sersalisia sericea*), Joongoon *(Mimusops elengi*), Australian Ebony *(Diospyros ferrea*), Marool or blackberry *(Terminalia petiolaris*) and banyan fig *(Ficus virens*). These fruits are important food resources for flying foxes and rose-crowned fruit-doves that then distribute seeds to maintain the pockets of vine thickets.

Birds

Birds believed to utilise the vine thickets include rose crowned fruit-dove (*Ptilinopus regina),* and the great bower bird *(Ptilonorhynchus nuchalis)*, broad-billed flycatcher, red-crowned pigeon and mangrove golden whistler (Kenneally *et al.* 1996; Johnston and Burbidge 1991; Biota Environmental Services 2010b). Dollar birds (an insectivore), honeyeaters, and channel billed cuckoos (frugivore) reportedly feed on the spatially variable and seasonally complementary fruit, nectar and habitat resources in the stands of vine thickets (Environs Kimberley 2009; D. Dureau[1] personal communication). This is similar to the ecology of vine thickets in the Northern Territory, where birds have been shown to track fruit resources with variations in fruit availability (Bach and Price 1999). Price

[1] Mr Dave Dureau: Broome Botanical Society

(2004) indicates that the conservation of frugivorous birds and of the plants whose seeds they disperse will require the protection of networks of rainforest patches. A breeding group of Gouldian finch (*Erythrura gouldiae*) was recorded in the vine thickets (Department of Water and Environmental Regulation (DWER) 2017)).

Bats

The role of birds as frugivores in vine thickets is complemented by a number of species of bats. From Northern Territory studies (Bach and Price 1999) bats also seasonally rely upon vine thicket and adjacent or neighbouring complementary habitats for year-round survival. The authors examined the diet of black flying foxes and found that it consisted of fruit from the rainforest patches in the wet season and flowers from other habitats (*Eucalyptus* savannah, *Grevillea* heath and *Melaleuca* forest) at other times of the year. The protection of alternative roosting sites and the succession of seasonal feeding sites for these fruigivores is critical for maintenance of the vine thicket ecological processes, species diversity and survival of the ecosystem functionality. Bach and Price (1999) emphasised that genetic diversity was not related to rainforest patch size, but was maintained as a result of effective seed dispersal between rainforest patch networks.

At least 15 bat species were recorded by McKenzie (1991) as utilising complementary mangrove and paperbark plant communities. Bats are typically seasonal in their use of complementary habitats and a detailed investigation of the use of Dampier Peninsula monsoon vine thickets by bat species has not yet been conducted.

Mammals

There are few records of mammalian fauna in the vine thickets, however, the important role of the black flying fox (*Pteropus alecto)*, as both a pollinator and seed disperser for species such as *Syzygium* spp. is noted in Palmer *et al*. (2000). McKenzie (1991) recorded agile wallaby (*Macropus agilis)* as utilising vine thicket areas. Similarly, species such as northern brush-tailed possum (*Trichosurus arnhemensis)* and water rat (*Hydromys chrysogaster)* are recorded as using the often adjacent and complementary mangrove communities and are highly likely to utilise vine thickets for habitat and available fruit and flowers.

Other species that have been recorded on the peninsula in complementary or adjacent ecosystems and have (had) the potential to periodically use/used vine thickets for habitat or refuge include sugar glider (*Petaurus breviceps* - bollanga), greater bilby (*Macrotis lagotis)*, golden bandicoot (*Isoodon auratus)*, northern planigale (*Planigale maculata)*, golden-backed tree-rat *(Mesembriomys macrurus),* western chestnut mouse *(Pseudomys nanus)* and the dingo (*Canis familiaris dingo)*.

Ecological characteristics

The following characterisations of the vine thickets were noted by McKenzie *et al.* (1991) for four vine thicket occurrences ('patches') on the Dampier Peninsula:

- Average canopy height - 8.2m.
- Average perennial plant species richness - 30.7 species
- Average bird species richness - 12.75 species per patch, with a total of 24 species recorded in the four patches surveyed.
- Average total species richness (birds, snails and plants) - 48.5 species
- Six species of land snail recorded
- Soils were all Quaternary sands, dark grey, dark greyish brown, or reddish brown
- Average litter depth - 7.4cm
- Average soil pH - 7.91

- The annual mean temperature for the three northern sites was 27.4^{o}C and for the southern site was 26.7 ^{o}C
- The annual average rainfall for the three northern sites - 736mm, and for the southern site - 580mm.
- The impact of fire when surveyed in 1987-1989 was recorded as severe throughout, or severe on the edges of the patches.
- Average distance to the coast - 150m.

Black *et al*. (2010) summarizes the variation of Dampier Peninsula vine thickets as follows;

"Dendrogram classification of thickets by perennial plant species, and of perennial plant species by co-occurrence in the same thicket patches, showed some spatial associations and trends. Based on similarity of perennial plant species assemblages, coastal thickets were subdivided into four main patch groups (referred to as B, C, D and E). Vine thicket patch groups largely corresponded with the clustered patch distributions, albeit with some outliers.

Group C is the largest patch group. This group occurs at the far northern end of Dampier Peninsula above the 750 mm per annum rainfall zone, and includes the most species-rich patches. Patches in this group extend across coastal dune systems onto red pindan soil plains in the lee of dunes. Most were characterised by several co-dominant evergreen tree species, often at a range of heights relative to each other within the patch. Group E patches are interspersed among Group C patches in the north and most occur entirely within extensive coastal dune systems that are either very broad or very high (one patch occurs on a headland). Group E patches tended to be dominated by a single tall evergreen tree species. Group D patches occur on the mid-west coast between Cape Baskerville and Baldwin Creek. Group D patches have the narrowest range of species, comprising mainly core rainforest plants. Group B patches occur at and towards the southern end of the distribution of thickets on each of the west and east coasts of the Peninsula. In comparison with the other patch groups, Group B patches are situated on low dunes and other relatively exposed locations, are depauperate in evergreen trees, and have a more open shrubby structure."

Maintenance of key self-sustaining areas of these identified cluster groups is recommended as a focus for conservation management in this plan. In this context, self-sustaining areas are natural areas that can maintain their characteristic diversity of major functional biotic groups, productivity, and rates of biochemical cycling over the normal cycle of disturbance events that might impact the area, without the need for major management intervention (adapted from Chapin III *et al*. 1996).

Black *et al*. (2010) note that topography and soil are probably important in determining the floristic classifications of the vine thicket occurrences, with the larger dune formations towards the north of the peninsula providing suitable conditions for a greater species diversity and vegetation structure. In particular factors such as dune formation and height, and different soil types are likely determinants. They also noted that some vine thicket vegetation was recorded on rock outcrops, but that it looked quite different and grouped separately from the floristic associations of occurrences on coastal land forms.

McKenzie *et al*. (1991) surmise that differences between the species composition of the rainforest groups could be related to responses to environmental factors, such as rainfall and substrate. They note that rainforest only occurs in the drier areas in fire refugia with favourable hydrological conditions, and that none were recorded in areas where rainfall was less than 580mm. The Broome occurrence of the vine thickets occurs near this rainfall isohyet and is therefore the patch that occurred in the lowest rainfall zone of all those studied by McKenzie *et al*. (1991). McKenzie *et al*. (1991) state

that species richness correlated with rainfall and higher levels of soil phosphorus, but that richness declined with increased annual temperature range.

The vine thickets are believed to function as a network ecosystem (Environs Kimberley 2010; Black *et al*. 2010). That is, the migration of fruit-eating animals, including birds, bats and mammals, ensures dispersal of seeds and fauna and therefore helps to maintain the isolated patches of the vine thickets and their associated plant and animal communities.

Research in the Northern Territory indicates that monsoon vine thicket species re-colonize areas that remain unburnt for long periods. This reinvasion process is generally concentrated around existing savannah trees due to the deposition of seeds by roosting bats and birds (Fensham and Butler 2004) and the process has been observed in vine thickets on the Dampier Peninsula (L. Beames personal communication).

1.3 Geology and Hydrology

Red sands ('pindan soils') cover most of the Dampier Peninsula. Yellow-grey sands occur on the northern end of the Peninsula where rainfall is higher. Wind blown red sands have formed weak dunes throughout the Peninsula and may be a remnant of a more arid era when the Great Sandy Desert expanded (Kenneally *et al*. 1996). The superficial formations of the Peninsula are dominated by red pindan soils, but immature soils on sandy Pleistocene dunes, clayey tidal creek sediments and recent sandy Holocene dunes have also formed in the area. Pindan soils are of wind blown or alluvial origin and consist of red clayey sands that contain abundant iron-oxides. The 1:500,000 CSIRO soil and landform mapping indicates that the areas in which the vine thickets occur consists of "sand plain with longitudinal sand dunes, some active drainage ways – chief soils are red earthy sands", and "plains with minor sandstone residues with extensive rock outcrop, chief soils neutral red earths."

The vine thickets mainly occur on leeward slopes and swales and occasionally exposed dune crests. Many occurrences extend into the red pindan soils on the inland portions of the dunes. Landforms occupied by the vine thickets include beach fronts, sand-spit headlands, low cliffs above mangrove lined creeks, storm ridges within intertidal flats, and red soil gullies inland of coastal cliffs (Black *et al*. 2010). The soils in the Holocene dunes where the community occurs are deep coastal dunes, generally white but can be pink, with a thin humus layer.

There is typically very low relief across the Dampier Peninsula that results in sheet flooding across most of the area. Low elevation in the northern part of the Peninsula has resulted in the development of broad drainage valleys and seasonal swamps near Beagle and Pender Bays (Kenneally *et al*. 1996). The habitats of the vine thickets possess little surface drainage, are dominated by sheet runoff, and are generally a very simple environment of gently sloping surfaces, often internally draining.

Rainfall in the northern end of the Peninsula is between about 700-750mm per annum, and in the southern end of the range of the community it is about 600m. At the far southern, more arid end of their range near Broome, the vine thickets are replaced by savanna.

Where the vine thickets occur in the southern portion of the Dampier Peninsula, site drainage is from east to west; in the northern portion groundwater flow is generally from south to north, and the eastern portion it is from west to east. There are no permanent rivers or creeks in the habitat of the vine thickets, and minor drainage lines flow after rain. After rains, water accumulates behind the first sand dune system at the coast, in the habitat of the vine thickets (Environs Kimberley 2010).

A micro-climate is created behind the dune systems, where the cooler air is thought to become trapped, interacting with the warm moist coastal breeze resulting in a higher level of precipitation from

fog and dew concentrated along the coastal strips. It is believed that the high humidity and heavy fogs along the coast, and the wet season rains, also help the community to survive the long dry periods. The moisture and humidity are accentuated by the dense and protective shady canopy and support the ecosystems' role as a biological refuge. The humidity is also thought to assist in protecting the community from fires.

The Department of Water and Environmental Regulation completed a study of groundwater dependent ecosystems on the Dampier Peninsula between Pender Bay and Waterbank in August 2017 (DWER 2017). The study showed that there were few signs that groundwater resources were being impacted by current use except in some sub-areas of the Broome groundwater area. The report states that as at 2012 increased salinity in Town Water Reserve indicated that upper limits of abstraction may have been reached.

The study included four locations within the vine thicket TEC (vine 64, vine 62a, and two sites in vine 72). The groundwater was found to be two to four metres below ground level. These water levels indicate that trees species will be accessing shallow groundwater from the regional aquifer. All occurrences in the study were found to be accessing older water from the Broome Sandstone aquifer that was forced up over the near-coastal saltwater interface, and not water derived from recent rainfall (DWER 2017).

The preliminary probability map that was developed by DWER (2017) indicates that all occurrences of the vine thicket TEC that occurred within their study area are likely to be groundwater dependent. Many vine thicket occurrences are also situated adjacent to, or on ground water springs or shallow aquifers described as permanent soakage by Kenneally *et al.* (1991) in which case they will be highly or entirely groundwater dependant. Aboriginal people culturally identify vine thickets as a place for water sites, containing jila, (living water, groundwater). Many species such as *albay* (fig), *manbung* (Pandanus) and *mutgarr* (paperbark) are closely associated with and adjacent to vine thickets and are known to indicate that fresh water is close to the surface.

1.4 Threatening processes

Clearing and Development

Rainforest vegetation in general is particularly vulnerable to disturbance. Most of the vine thicket occurrences are small or very narrow and linear and have high edge to area ratios (Black *et al*. 2010). At the time of their surveys in the early 2000s, Black *et al.* (2010) estimated about 95% of the vine thickets remained, however, clearing is a relatively new and escalating threat. Current or potential clearing of vine thicket occurrences is associated with ongoing development in Broome, the recent rapid establishment of Aboriginal outstations and ecotourism ventures, clearing for building and track construction, and recent proposals for industrial development on the coast of the peninsula.

Residential areas are expanding in Broome and the Aboriginal settlements of Beagle Bay, Lombadina-Djarindjin and One Arm Point, and vine thicket patches in their vicinity may be potentially affected by infrastructure expansion unless the issue is considered in planning processes. An additional occurrence near the town of Broome in Hidden Valley (Occurrence 8) has been subject to development plans in recent history, although it was also planned as a cultural site likely to be part of a coastal park. Environmental approvals were provided in 2015 for a Liquified Natural Gas (LNG) precinct at James Price Point (Occurrence 62).

Where tracks have been established with heavy equipment such as graders, the pindan soils erode rapidly and water tends to flow along the tracks, ultimately creating major erosion channels. Tracks established only by vehicle movement do not tend to erode in this way as the soil structure can be

maintained. A project to upgrade the 196 km Broome to Cape Leveque Road and ancillary roads to an all-weather raised gravel standard or sealed road will increase vehicle traffic, economic development and tourism pressures on the Dampier Peninsula, and this will have the potential to increase impacts to the vine thickets associated with increased runoff, erosion and visitor pressure.

The focus of environmental impact assessment should be to avoid and minimise future impacts to key occurrences of the vine thicket community such that remaining areas are self-sustaining, and to ensure that key areas of each cluster group are protected and conserved. An additional focus should be to ensure that loss of other remaining occurrences of the community is minimised and conservation is maximised.

Altered fire regimes

Local Aboriginal people have commented that healthy vine thickets did not 'want to burn' due to the cool microclimate under the closed canopy and the lack of a significant ground storey to provide fuel (Black *et al.* 2010). Aboriginal people took care to keep fire out of the vine thickets because of the valuable food resources they contain (Kenneally *et al*. 1996). Black *et al*. (2010) noted that a freehold landowner had successfully prevented late season bush fires and that these vine thickets were in exceptionally good condition.

Traditional burning practices involved lighting small fires in appropriate seasons that resulted in patchworks of new growth and maximised ecosystem diversity. These practices avoided the late dry-season bush fires that have greatly increased since European settlement. Late dry season bush fires burn hot and cover vast areas and are considered to be a key threatening process influencing the vine thickets. The frequent intense fires threaten the integrity of the vine thickets through impacting on species diversity, encouraging weed invasion and encroachment of Pindan vegetation. Recovery of the vine thicket assemblages following fire is likely to be slow as many species are fire-sensitive and much of the soil seedbank is likely to be destroyed by fire (Environs Kimberley 2010). Frequency of fire in the surrounding landscape is thought to be the most critical factor in controlling rainforest boundaries (Bowman 2000), with re-emergence of vine thicket vegetation into the surrounding woodlands only occurring where areas have been subject to much less frequent fire.

Occurrences afforded some protection from rocky outcrops, steep sided gullies, or the ocean are likely to be burnt less frequently and McKenzie *et al*. (1991) noted that rainforest patches throughout the Kimberley region are restricted to the same 'fire-proof' refugia as other tropical rainforests in Australia. Therefore, actual appropriate habitat for the vine thickets may be considerably more extensive than their current distribution indicates. In the absence of fire it is possible that occurrences may increase in size. Where hot, late season fires have occurred frequently, the vine thickets on the Dampier Peninsula have retreated from the edges and are colonised by the surrounding woodlands (T. Willing[2], D. Dureau personal communication). Black *et al*. (2010) state that repeated hot fires in vegetation that occurs adjacent to the vine thickets may cause occurrences to decline in size over time. As part of the West Kimberley Nature Project (WKNP), Environs Kimberley has worked with a number of on-ground groups to identify practical monitoring and assessment tools to assist with fire management applications including measurements of fire risk and impacts, and vine thicket emergence and retreat.

In 2010-2013, a study of fire frequency and biodiversity in the vine thickets using remote sensing data correlated with on ground measurements was coordinated by Environs Kimberley. The study indicated that about 70% of the total area of the vine thickets burnt between 2000-2010 (Fisher *et al.* 2013). They found a median of 4.5 fires per 'patch', and inter-fire intervals of 1-3 years in 71.4% of patches in 1989-2010. Sixty eight percent of all fires were found to have occurred during the late dry season.

[2] Mr Tim Willing: Broome Botanical Society

Remote sensing data indicated a trend of vegetation decline associated with fire, with 20% of the area of the vine thickets experiencing declining cover between 1991 and 2012 (Fisher *et al.* 2013). These figures were considered likely to be an underestimate as remote sensing data used to determine fire occurrence was found to only capture canopy fire impacts, and not smaller burns in the understorey (Fisher *et al.* 2013). These data have implications for the future ecological function of the vine thickets as the vegetation will retreat rapidly as a consequence of hot fires.

Little is known of the fire regime required to maintain species composition. An experimental approach to fire, with a general reduction in late season hot fires, in conjunction with a carefully designed monitoring regime that provides quantitative data about the effects of fire on the vine thickets is recommended in this plan.

Cattle and other disturbances, such as vehicles, exacerbate the impacts of fire as they open up the canopy. This in turn then allows annual and exotic grasses to invade, and these increase the fire risk and intensity of fire, producing a self perpetuating threat to the vine thickets. Research also indicates that with a subsequent decrease in fire frequency the occurrences can recover and allow rainforest species to recolonise, or infiltrate into adjacent sclerophyll vegetation if there is suitable adjacent habitat (McKenzie *et al.* 1991).

Weed invasion

Weed invasion is an increasing threat to the vine thickets, and as mentioned above, is exacerbated by disturbances such as fires and grazing which in turn, can predispose areas to further weed invasion. The structure of the vine thickets is generally a dense tree canopy, providing a generally damp and shady habitat. When in good condition the community generally lacks grass cover and can include a thick layer of leaf litter and a sparse layer of medium sized fruiting shrubs. Buffel grass and other grassy weeds are penetrating the vine thickets along tracks and access points and have been spread by feral cattle, donkeys, pigs, and human access tracks. As visitation increases on the Peninsula, the threat posed by weed invasion is likely to increase. Furthemore, particular parts of Occurrence 1 in Minyirr Park near the town of Broome have increased sediment deposited from adjacent residential development, which is also implicated in serious weed invasion.

Many of the major weed species that are invading the vine thickets were historically pastoral or horticultural species that are now spreading into native bushland. Weeds have been recorded in just under 60% of vine thicket occurrences (see Appendix 4). *Passiflora foetida* var. *hispida* (passion vine) and *Cenchrus* spp. (including *Cenchrus ciliaris* - buffel grass, *C. setiger* and *C. biflorus*) were noted to be the most common weeds, with passion vine occurring in about 40% of occurrences and *Cenchrus* spp. in about 30% of occurrences. Buffel grass is a common weed on the northern Dampier Peninsula. Grassy weeds such as these dry out in the late dry season and greatly increase flammability of the vine thickets. The species regenerate rapidly, and greatly increase both the fire risk and intensity of fire, thereby increasing weed invasion. *Macroptilium atropurpureum* (siratro) is another significant and increasing weed in the vine thickets, and also contributes to the fuel load where it occurs in the community. Tree weeds, including neem trees (*Azadirachta indica*) and coffee bush *(Leucaena leucocephala),* spread from old settlements and can displace native trees and form impenetrable thickets.

The occurrence closest to Broome (Occurrence 1) has suffered major infestations of vine species that can smother tree canopies, including siratro and *Merremia aegyptia* (hairy morning glory).

Environs Kimberley (2010) states the following:
"Weeds recorded within and surrounding vine thicket vegetation on the Dampier Peninsula include the following high threat species (L. Beames personal communication):

- coffee bush — *Leucaena leucocephala*
- buffel grass — *Cenchrus ciliaris*
- morning glory — *Ipomoea quamoclit*
- lantana — *Lantana camara* — **WONS/Declared Weed**
- white convolvulus creeper — *Merremia dissecta*
- hairy Merremia — *Merremia aegyptia*
- bellyache bush — *Jatropha gossyipifolia* — **Declared Weed**
- mint weed — *Hyptis suaveolens*
- Gallon's curse — *Cenchrus biflorus*
- neem — *Azadirachta indica*
- siratro — *Macroptilium atropurpureum*
- passion vine — *Passiflora foetida*

Cryptostegia madagascariensis (rubber vine), a significant weed, has not been found as a naturalised plant, but there is a high possibility of occurrence of this species due to localised community plantings.

Secondary weed species recorded:

- Darwin pea — *Clitoria ternatea*
- caltrop — *Tribulus terrestris*
- snakeweed — *Stachytarpheta cayennensis*
- pie melon — *Citrullus lanatus*
- vinca — *Vinca major*
- rubber tree — *Calotropis procera*
- kapok — *Aerva javanica*
- coral vine — *Antigonon leptopus."*

Black *et al*. (2010) state that the highest priority weed to target for vine thicket conservation is the vine siratro (*Macroptilium atropurpureum*), which currently occurs at Broome (Occurrence 1), James Price Point (Occurrence 62), and in two occurrences near One Arm Point. New infestations are a higher priority than those in the already degraded occurrence close to the town of Broome.

Recommendations from Black *et al*. (2010) state that other high priority weeds are: *Clitoria ternatea* at Broome and One Arm Point; *Merremia dissecta* at Broome and Quandong Point; *Leucaena leucocephala* at James Price Point and north of Quandong Point; *Azadirachta indica*; *Cryptostegia madagascariensis* recorded in Lombadina-Djarindjin; *Hyptis suaveolens* at Broome and in and near One Arm Point; and yellow poinciana (*Peltophorum pterocarpum)* at Broome. *Maroptilium atropurpureum*, *Passiflora foetida, Jatropha gossypiifolia*, *Azadirachta indica, Leucaena leucocephala*, *Clitoria ternatea*, *Hyptis suaveolens* and garden–derived rubber vine are also priorities at Lombadina, Djarindjin and One Arm Point. Black *et al*. (2010) state that *Cenchrus ciliaris, C. setiger, and C. biflorus* that occur at various locations are medium priorities for control.

Hydrological change

There is potential for groundwater abstraction to impact the vine thickets, in particular, greater abstraction of groundwater for domestic and industrial use has the potential to impact the community due to drawdown. Some developments proposed for the Peninsula involve groundwater abstraction, and have potential for saltwater intrusion, interface up-coning and subsequent impacts to groundwater dependent ecosystems. Increased infiltration and re-directed or increased runoff, from urban or industrial sites, also have the ability to impact by causing shifts in the location of available water, including occasional surface water, groundwater rise and water logging of vegetation. Groundwater contamination due to pollution events or runoff from industrial, agricultural or residential areas can also create impacts to vine thickets as a result of unacceptable water quality.

Pre-development documentation of natural flow regimes, natural water quality and determination of water and solute balances for the vine thickets will provide a baseline for assessing likely impacts and monitoring post-development change. A better understanding of the tolerances of the vine thickets to changes in hydrology, and threshold levels is also crucial for impact assessment.

The water opportunity map in DWER (2017) indicates that there is restricted opportunity for water abstraction in areas of the vine thicket TEC within the study boundary. There are likely to be extra management considerations if there are abstraction proposals in these areas.

The focus of environmental impact assessment for developments with potential to impact on the vine thicket community should be to avoid and minimise future hydrological impacts to key occurrences such that remaining areas are self-sustaining, and to ensure that representative areas of each cluster group retain natural hydrologic processes. An additional focus should be to ensure that adverse hydrological impacts to other remaining occurrences of the community are minimised.

Alterations in flow regimes or water quality can cause impacts at other sites in proximity. For example in Broome, road construction and residential developments are impacting on the hydrology of the adjacent occurrence (Occurrence 1), and Manari Road impacts on the edges of Occurrences 62 and 63. Impacts are primarily through an influx of sediment, nutrients, weed infestations, and an increase in flooding. Increasing flooding can result in changes to species composition, such as loss of helicopter trees, *Gyrocarpus americanus* (Black *et al*. 2010). *Triodia* species are also sensitive to flooding (T. Willing personal communication). More recent subdivisions, such as Januburu, have more water sensitive urban design that is intended to reduce excess nutrients and other possible pollutants in stormwater entering surrounding bushland and waterways. However, there is still a substantial amount of run-off, soil erosion and weed spread observed from the drainage system (L. Beames personal communication). Black *et al*. (2010) also note stormwater runoff redirected from roads was having a significant impact on Occurrence 62 at James Price Point at the time of their surveys.

Grazing and Feral Animals

Populations of un-managed cattle, donkeys, pigs and possibly horses that occur on the Peninsula are a major threat to the vine thickets (Environs Kimberley 2009). These animals damage canopy-forming plants, open the canopy and result in erosion and weed invasion that can subsequently result in more damaging fires. Plant species that are grazed by these animals are less likely to continue to propagate successfully. Pastoral activity has declined on the Peninsula and much of the land has been destocked in recent years. Most of the area is now Aboriginal Reserves and unallocated Crown land; however mechanical damage of plants and the soil surface by un-managed cattle is still significant in some occurrences of the vine thickets.

The impact of grazing has not been quantified through monitoring, however 'widespread and severe' cattle damage was noted in three occurrences surveyed for McKenzie *et al.* (1991) and as 'localised and severe' in one occurrence. Impacts of unmanaged cattle were recorded in 24 (39%) of the 62 occurrences surveyed in the early 2000s (Black *et al*. 2010). Occurrence 63 near Quandong Point was previously stocked with cattle, but has now been destocked.

Signs of feral pigs were noted at two occurrences by Black *et al*. (2010).

Black rats have previously been noted in vine thickets (McKenzie 1991) and have the potential to compete with native species for fruit and habitat resources.

Feral cat tracks have been observed frequently in dune systems that are part of and on the outskirts of vine thickets (L. Beames personal communication). Feral cats may have an impact on the bird, small reptile and mammal populations inhabiting vine thickets.

Wild dogs are often reported near outstations and tip points and are likely to have some impact on remaining reptile and mammal fauna inhabiting vine thickets (L. Beames personal communication).

Recreational Activities

The vine thickets are very popular shady areas for camping, and despite some work implemented by Goolarabooloo people and the Kimberley Land Council, the vine thickets on Waterbank Station (Occurrence 63 in particular) are under intense pressure from tourism, camping and fires (Environs Kimberley 2009). Many other occurrences remote from the town of Broome, such as Quandong Point and Middle Lagoon (Occurrences 63, 75), are subject to intense pressure from tourist visitation including vehicle impacts, weed invasion, clearing for camping, and increased fires.

The vine thicket community provides good shade and the occurrences are therefore a popular place for camping. Visitation and impacts associated with use of vine thickets for camping and four wheel driving such as soil compaction, fire wood collection, increased fire frequency, rubbish dumping and increased weed spread have the potential to increase. For example, James Price Point (Occurrence 62) and Quandong Point (Occurrence 63) have been popular recreational and camping sites located 60-70 km north of Broome. These sites are subject to high visitor numbers and the associated impacts of the visitation, including too frequent fire and damage by four wheel drives. The upgrade and realignment of the road from Broome to Cape Leveque is expected to increase the visitation, with an accompanying rise in tourism pressures, traffic, and infrastructure development on the Dampier Peninsula.

Increased mobility for locals and tourists is already having detrimental impacts on vine thickets close to popular fishing and camping spots. Occurrence 75 at Middle Lagoon has been part of a restoration project by Nyul Nyul Rangers with Environs Kimberley, designed to limit the extent of four wheel drive damage and vandalism on this small but significant vine thicket area.

Rubbish dumping, sometimes associated with weed invasion was noted as a threat at three occurrences of the vine thickets by Black *et al.* (2010). Soil erosion and forest product harvesting were also noted as minor threats to the community.

Climate Change

Some of the potential impacts expected as a consequence of climate change may be a threat to the vine thickets. Coastal locations may be susceptible to storm surge, cyclone damage and inundation by rising sea levels and saltwater intrusion into freshwater aquifers upon which the ecosystem is likely to have some dependency. Increase in the frequency of cyclones is predicted and this could increase flooding in the vine thickets. In addition, the tolerance of particular species to changes that may occur in association with climate change, including changes in rainfall and temperatures, is generally unknown. If biota that are significant in dispersing seeds and cross pollinating species are impacted by climate change, then this may also directly impact the vine thickets.

The naturally fragmented state of vine thickets can result in them being highly vulnerable to disturbance. Small and highly fragmented rainforest areas, such as the Dampier Peninsula vine thickets, are particularly susceptible to rapid changes or destruction in the face of threatening processes (Environs Kimberley 2010). Climate change presents a serious threat to vine thickets as it could exacerbate atered fire regimes and weed invasion (Williams 2009).

Black *et al.* (2010) state that as many vine thicket patches as possible should be reserved, managed and protected for conservation to help increase their resilience from the impacts of climate change. The continuing viability of the community will depend on maintaining the ecosystem's connectivity through species migration and the conservation of the network of occurrences and dispersal pathways. It will also be important to maintain the quality of adjacent habitat to support this connectivity. Black *et al.* (2010) note that the vine thickets will be particularly important as refuges in the face of changing climatic conditions as they will be a potential source of foundation species.

A well managed reserve system would also act as a buffer to stochastic events. The management of other threatening processes, such as increased weed invasion or fire frequency that may be exacerbated by climate change, is a crucial part of increasing resilience to this potential threat. Fire management over the wider peninsula area in particular will need to be coordinated with land managers, communities, inter-agency programs and other stakeholders to ensure that the most ecologically, spatially and seasonally appropriate regime is implemented.

The minimisation of the impact of other threats is probably the most important aspect of increasing the resilience of the vine thicket community in the face of climate change. Managing a drying climate as a threatening process in itself is, however, outside the scope of this interim recovery plan.

Dune Movement

The vine thickets can be covered by natural movement of coastal dunes through natural coastal processes. This 'natural threat' to the vine thicket occurrences can be exacerbated through destabilisation of dunes by removal or damage to vegetation. Black *et al.* (2010) recorded patch 28 (Occurrence 65) as an example of significant dune movement, and noted that some trees were buried up to the middle of their trunk in pink sand. Shifting sand dunes are also covering some areas of vine thickets near Hunter Creek (Occurrence 32) and possibly a site south west of Swan Point, Karrakatta Bay (Occurrence 38) (Harding *et al.* 2009).

1.5 Evaluation of the Plan's Performance

DBCA, in conjunction with the West Kimberley Threatened Flora and Communities Recovery Team, will evaluate the performance of this interim recovery plan. The plan will be reviewed within five years of its completion and the need for a new or updated plan will be evaluated.

1.6 Conservation status

The monsoon vine thickets on the coastal sand dunes of Dampier Peninsula were endorsed as vulnerable by the Western Australian Minister for Environment in 2001, and listed as endangered under the EPBC Act in 2013.

2.0 IRP OBJECTIVE AND CRITERIA

Objective:
To conserve the ecological and conservation values of the vine thicket community, by:

- ensuring the permanent protection and conservation of self-sustaining representative areas of key occurrences identified in this plan;
- attaining conservation management of self-sustaining representative key areas of each of the identified vine thicket clusters; and
- minimising the loss and maximising the conservation of all remaining occurrences as far as possible, including recovering degraded occurrences where it is cost effective and practical to do so.

Criteria for success:

- an increase in the number of key self-sustaining areas of the vine thicket community as identified in this plan that are managed for conservation and/or with conservation included in their purpose (including Indigenous Protected Areas, and reserves that are jointly managed between the Conservation and Parks Commission and the Aboriginal Native Title Holder in accordance with the CALM Act); or
- an increase in the number of identified vine thicket cluster groups for which representative areas have conservation management in place; or
- an increase in the number of occurrences of the vine thicket community for which formal strategies are in place to minimise loss and maximise conservation (such as formal weed or fire management strategies in place and being implemented).

Criteria for failure:

- complete loss of any identified cluster group; or
- complete loss or degradation (to degraded condition or poorer) of any key areas of the vine thicket community as identified in this plan; or
- failure to develop and implement formal strategies to manage key threats such as weed invasion, or inappropriate fire or hydrologic regimes.

2.1 Habitat critical to the survival of the community, and important occurrences

Much of the interdunal swale area behind the primary coastal dunes between Broome and Cape Leveque may be considered potential habitat for this vine thicket community. Protection from fire, and an appropriate hydrologic regime in particular, may be major determinants for the occurrence of the community in this habitat.

Although in recent geological history the community may have covered less area, and there may have been less occurrences, the importance of individual patches to the overall maintenance of the 'interacting ecosystem' as a whole is not known. It is therefore not possible to specify which occurrences might be more important than others in the continued existence of the community, and far greater detailed ecological information will be required before this might be determined.

Black *et al*. (2010) recommend the protection of all *Ficus virens* trees (banyan, albay or strangler fig), *Canarium australianum* (jalgir), *Terminalia petiolaris* (marool or blackberry), and hybrids with *T. ferdinandiana* (red gubinge, barragool or gariling) on the Dampier Peninsula, as they produce copious fruit and therefore have a strategic importance in maintaining the viability of vine thickets. It has also been suggested that conservation of *Parinari nonda* (nonda plum) is important for the same reason (D. Dureau personal communication). The maintenance of many fauna, including fruit-eating birds, bats and mammals and their implied status as dispersal agents for the seeds of many vine thicket plant species is also an important consideration.

Woodlands, mangroves and other adjacent ecological communities are likely to play a significant complementary role in the provision of food and habitat resources for mobile frugivores (Black *et al*. 2010). Species such as bats have been shown to seasonally rely upon monsoon vine thicket and adjacent or neighbouring complementary habitats for year-round survival (Bach and Price 1999). These complementary ecosystems provide alternative roosting sites and a succession of seasonal feeding sites for mobile frugivores and are believed to be critical for maintenance of monsoon vine thicket ecological processes, species diversity and survival of the ecosystem's functionality (Environs Kimberley 2010). Maintenance of vine thicket connectivity is therefore also dependent on the maintenance of the quality of complementary linking habitats.

Black *et al.* (2010) indicate that a series of occurrences are a priority for conservation as a consequence of large size, vegetation structure, significant flora, species richness, and representation of the floristic groups they identified. This is further discussed in recommended actions. Protection and conservation of key self-sustaining examples of these high priority areas of the vine thicket community are a focus for conservation management in actions recommended in this plan.

The DWER (2017) study indicated the importance of groundwater levels for maintenance of the vine thicket TEC. Groundwater quality is also likely to be important for the TEC. Further information is required in relation to hydrology in order to define critical habitat.

2.2 Benefits to other species/ecological communities

The declared rare flora taxon *Seringia exastia* occurs near a small vine thicket occurrence near the Broome Port. Four priority flora were located in the vine thickets (Occurrences 62 and 73) or allied assemblages at James Price Point. These are *Gomphrena pusilla* (priority 2), *Eriachne semiciliata* (priority 3), *Polymeria distigma* (priority 3) and *Pittosporum moluccanum* (priority 4) (Biota Environmental Services 2010a). *Pittosporum moluccanum* is only known in WA from four occurrences of the vine thickets on the Dampier Peninsula and the Maret and Berthier Islands.

Parsonsia kimberleyensis (priority 1) is only known from three occurrences of vine thickets - near Bulgin and Hunters Creek – Occurrences 31, 32, 33.

Actions such as general improvements in land management practices applied to the vine thicket TEC areas, including fire management and weed control, will assist in the conservation of nearby threatened and priority flora and communities, such as *Corymbia paractia* (priority 1) which is found in areas close to the vine thicket community.

The following occur adjacent or close to the vine thicket TEC, particularly near Broome:

- Species-rich faunal community of the intertidal mudflats of Roebuck Bay (vulnerable ranked TEC),
- Relict dune system dominated by extensive stands of Minyjuru (Mangarr) *Sersalisia sericea* (P1)
- Dwarf pindan heath of Broome Coast (P1)
- *Corymbia paractia* community on dunes (P1)
- Vegetation Association 73 (Grasslands, short bunch grass savanna, grass; salt water grassland (*Sporobolus virginicus*) (P3)
- Vegetation Association 67 (Grasslands, tall bunch grass savanna, sparse low tree; ribbon grass and paperbarks) (P3)

The greater bilby (Schedule 1), Peregrine falcon (*Falco peregrinus* – Schedule 4), Dampierland burrowing snake (*Simoselaps minimus* - priority 2), bush stone curlew (*Burhinus grallarius* - priority 4), *Leristra separandra* (priority 4 skink), rainbow bee-eater (*Merops ornatus* - Commonwealth migratory species), white-bellied sea eagle (*Haliaeetus leucogaster* – Commonwealth migratory species) occur in the vine thicket occurrences or similar assemblages at James Price Point (Biota Environmental Services 2010b). Dampierland limbless slider (*Lerista apoda)* is an endemic species for which all 31 records are from the Dampier Peninsula (Naturemap accessed 17.01.11). It is recorded as inhabiting sand dune transition zones (Wilson and Swan 2003) and the species has been observed within the vine thickets (Bardi Jawi Rangers personal communication). A breeding group of Gouldian finch (*Erythrura gouldiae:* priority 4 in WA and endanagered under EPBC Act) has been recorded in a vine thicket (DWER 2017).

Actions aimed at conserving the occurrences of vine thickets that contain these taxa will also assist in helping to maintain component species.

2.3 International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that convention. The community is not listed under any specific international treaty, however, and therefore this interim recovery plan does not affect Australia's obligations under any other international agreements.

2.4 Role and interests of Aboriginal people

Many occurrences of vine thickets are on land subject to native title and managed by Aboriginal groups, so the involvement of Aboriginal people in the planning and management for the vine thickets is crucial. Many of the vine thicket areas are also located in significant law grounds.

The vine thicket community provides seasonal fruits, yams, carving timber and other valuable resources for Aboriginal people on the Dampier Peninsula. For example, *Gyrocarpus americanus* can be used to make shields and *Cassytha* species were used for fishing nets and shoes.

There are a number of Aboriginal small business operations that include harvesting of some bush fruits and medicines for use in saleable products, for example Gubinge, a species often occurring on the edge of vine thickets is harvested by a number of Aboriginal owned and operated businesses for sale in the food, nutritional and cosmetic industries. It is important that any commercial harvesting strikes a balance with allowing emerging sustainable economies to be further developed whilst also ensuring the ecosystem is not compromised by unsustainable levels of harvest.

Indigenous Protected Areas (IPAs), under the Australian federal government's IPA programme are voluntary agreements where Traditional Owners decide to enter into an agreement to manage a part or whole of their land or sea and other important cultural places and resources. Declaring an IPA on particular country, such as in vine thickets, results in that area being considered part of Australia's network of protected areas (Department of the Environment and Heritage 2006). An IPA has been established with Bardi Jawi Traditional Owners on the northern Dampier Peninsula.

3.0 RECOVERY ACTIONS

Recovery actions implemented to date

The Kimberley Rainforests Australia survey and analysis of data from 95 rainforest sites across the Kimberley included assessments of four vine thicket sites on the Dampier Peninsula (McKenzie *et al.* 1991).

Broome Botanical Society and staff from the then Department of Conservation and Land Management undertook a three year survey of the vine thickets in likely habitat on the Dampier Peninsula from 2000-2002. Environs Kimberley provided funding support for completion of the report (Black *et al.* 2010). Over 70 occurrences were described and mapped, and threats recorded including major weed infestations, clearing and inappropriate fire regimes. Data collected were entered into the Biodiversity, Conservation and Attractions corporate TEC database. A plain English version of the Black *et al.* 2010 report was later produced and distributed through the West Kimberley Nature Project (WKNP - see below) (Bellfield *et al.* 2012).

In 2007, the Northern Rangelands Steering Committee supported the WEED Project (Weed Education Eradication Delivery) coordinated by Environs Kimberley working in partnership with Department of

Biodiversity, Conservation and Attractions in implementing the 'The Dampier Peninsula Vine Thicket Project'. On-ground work in the vine thickets was undertaken by Aboriginal Ranger Groups facilitated by the Kimberley Land Council, including Bardi Jawi Rangers, the Society for Kimberley Indigenous Plants and Animals (SKIPA) and Environs Kimberley staff. The Goolarabooloo Association and Beagle Bay (now Nyul Nyul) Rangers were also involved. Weeds were surveyed in 11 occurrences. Seven occurrences were subject to follow up weed control activities including a combination of small-scale intensive weed control sites, surveys and control of isolated outbreaks, including Djoodoon, Chile Creek, Lombadina, One Arm Point School and Goorrnganggoon, Kooljamon and Marrgoon. The project resulted in community-driven momentum for the protection and management of vine thickets and weed management, awareness raising, production of community information materials and propagation of native plants for restoration (Environs Kimberley 2009).

As part of the Commonwealth-funded Resource Condition Monitoring Project in 2008-2009, two monitoring protocols were developed for the vine thicket community. Both of these are available on the Biodiversity, Conservation and Attractions website. They provide information and procedures for monitoring the effectiveness of weed control work in occurrences of the vine thickets (Harding *et al*. 2009), and information and procedures for monitoring the extent of occurrences of the vine thickets (Harding 2009).

Rubibi Aboriginal Land, Heritage and Development Council commissioned a comprehensive survey and report on the environmental weeds of Minyirr Coastal Park (Black *et al*. 2010). Activities included weed removal. SKIPA, Biodiversity, Conservation and Attractions and Yawuru rangers have an ongoing program of revegetation and rehabilitation works in Minyirr Park with the vine thickets being target areas for ongoing weed control. Yawuru rangers are also upgrading walk trails to protect values including the vine thickets in the park. In addition, Nyambu Buru Yawuru (NBY - the Prescribed Body Corporate (PBC) for Yawuru) developed a green army project with SKIPA and Biodiversity, Conservation and Attractions for weed work in Minyirr Park to protect the vine thickets. Fire planning is also underway through Yawuru rangers for Minyirr Park and other reserves near Broome, to help protect the vine thickets.

Biodiversity, Conservation and Attractions staff and volunteers from Broome Botanical Society worked with Aboriginal Ranger groups and Environs Kimberley in February 2010, and September 2015 to survey a selection of the vine thickets to collect updated information about boundaries, composition, threats, and current on-ground management by Traditional Owners. Data were also collected about additional previously unknown vine thicket occurrences, and these have been added to the Biodiversity, Conservation and Attractions database. Environs Kimberley also worked with Yawuru Country Managers and Nyul Nyul rangers to collect additional survey and mapping data for previously unrecorded vine thicket occurrences.

Environs Kimberley took the lead role in a major vine thicket conservation project from 2009-2013. The WKNP, managed by Environs Kimberley and funded through Caring for our Country via Rangelands NRM WA, supported the Bardi Jawi and Nyul Nyul Rangers in developing and implementing a series of projects to conserve and manage the vine thickets. The Aboriginal Ranger groups are guided by their PBCs and facilitated by the the Kimberley Land Council (KLC). The Aboriginal Rangers completed threat management, such as weed control, fire management and protection and access management in the habitat of the vine thickets. Some traditional knowledge was recorded and developed into management signs and materials and a community publication 'Plant Stories' produced. Groups consulted and supporting the WKNP and its predecessors, include Biodiversity, Conservation and Attractions, Traditional Owner groups, the KLC, and Kimberley Training Institute. The management of the vine thickets continues to form an important part of both ranger groups' workplans, including KPIs within the Bardi Jawi Indigenous Protected Area plan of management.

With additional funding through State NRM, the WKNP incorporated the Fire and Biodiversity Project. With support from the Bardi Jawi and Nyul Nyul Ranger groups, KLC, University of WA, Biodiversity, Conservation and Attractions and others, the Environs Kimberley WKNP engaged Fisher Research consultancy to identify biological indicators and design monitoring protocols to assess vine thicket health. These protocols were developed in conjunction with on-ground ranger partners and SKIPA and will be useful to groups managing vine thickets beyond the WKNP. This project component included research into the impacts of fire, fire history and vegetation cover change within the vine thicket TEC (Beames 2013).

The completed study (Fisher *et al*. 2013) determined the fire history for 70 occurrences of vine thickets. Landsat imagery was utilised to examine the relationships between fire history, including seasonality and area burnt, and vegetation canopy changes and vegetation structural measurements in the middle and edges of the vine thicket occurrences, and the adjacent pindan woodlands. The impacts of fire on the vine thickets was found to be far greater than previously estimated, having profound consequences for the ecological function, viability and cultural integrity of the entire Dampier Peninsula vine thicket ecosystem network. A plain English publication was produced to examine the findings of the WKNP with regards to the vine thickets (Environs Kimberley 2013) and two papers were produced (Fisher *et al*. 2014, Fisher *et al* 2013).

With the endorsement of several Aboriginal groups, in 2009 Environs Kimberley's Community Weed Project Officer submitted the first nomination of a series of iterations for the vine thickets to be listed under the EPBC Act. In March 2013, the Monsoon Vine Thickets on the Dampier Peninsula was listed as Endangered under the EPBC Act.

Environs Kimberley is continuing on with the Kimberley Nature Project (KNP). This involves continuing to work with ranger groups to manage weeds, fire, feral fauna and rare fauna, in addition to managing and further documenting the vine thickets. The project brings together traditional ecological knowledge, scientific monitoring, and management of natural and cultural areas. Environs Kimberley and Biodiversity, Conservation and Attractions Yaruwu rangers also surveyed and mapped a series of new occurrences of vine thickets in 2013. The project included prioritising management works and coordinating fee-for-service burning and weeding work with other planned activities. Environs Kimberley is also working with Bardi Jawi Oorany rangers to undertake seed collection and propagation activities through their co-joined state NRM funded project (Bardi Jawi Oorany Nursery/EK Kimberley regional seedbank) as well as collaborating in seed collection, weed control and revegetation projects with this and other Dampier Peninsula groups (Nyul Nyul rangers, Nyul Nyul women rangers, Yawuru country managers, Goolarabooloo community).

Environs Kimberley is also working with SKIPA and ranger groups to develop a vine thicket plant identification resource that can be adapted for different language groups and regions.

Eleven Green Army projects that have Aboriginal groups as partners were funded in December 2015 through the Australian Government. They include activities to improve the management and protection of vine thickets. An additional project that will benefit the vine thickets was funded through the Australian Government 20 Million Trees program in December 2015. Environs Kimberley also has funding through Rangelands NRM WA to undertake work with the vine thickets that commenced November 2015, and is completing work with funds from the National Landcare Programme that has some vine thicket components.

A West Kimberley Threatened Flora and Ecological Communities Recovery Team was established in February 2016, and considers recovery activities in the vine thickets.

A hydrological study in the central portion of the range of the vine thicket TEC was completed in August 2017 (DWER 2017).

Recommended Recovery Actions

Note**:** The responsible agency is frequently listed as the relevant Biodiversity, Conservation and Attractions District. This refers largely to initiating and guiding actions. In general, however, the relevant departmental District, and the Recovery Team, have the primary responsibility for securing resources for recovery actions (with consideration for resourcing limits and other high priority conservation work).

An overarching principle of this plan is that for recommended actions, the highest priority areas of the vine thickets will be determined and this ranking will be used as a guide to focus conservation efforts. A secondary focus will be the conservation of other areas of the vine thicket community wherever it is possible and practical to do so.

1 Liaise with stakeholders to implement recovery

Almost all occurrences of the community are managed by authorities other than Biodiversity, Conservation and Attractions, or are privately owned. Therefore, the involvement of Aboriginal land managers, Shire of Broome, local community groups and industry in the recovery of the community is essential to the recovery process. In particular, most occurrences are on Aboriginal-managed lands (the relevant Aboriginal groups as listed in Appendix 1 are essential to recovery of the community). The West Kimberley Threatened Flora and Communities Recovery Team was established to help coordinate recovery actions for TECs and declared rare flora in the region and this provides an avenue for stakeholder liaison.

A program of community liaison and education to increase awareness of the significance and conservation management requirements of vine thickets will continue to be developed. This will also need to include information about potential legal implications for activities impacting on vine thickets. The involvement of the Recovery Team, Aboriginal rangers and natural and cultural heritage officers would be required.

The distribution of the vine thickets posters and web-based information should be continued. Signage in public areas targeting general visitors and Aboriginal people identifying the significance of the community and other biodiversity values at sites open to public access should be expanded. This includes information about fire issues, weeds, access and trampling, feral animals and dog walking. Signs on Aboriginal land should be in local languages and in English.

General publications and articles recently released include Black *et al*. (2010), McGilvray (2008), English (2010), Docherty and Williams (2009), Bellfield *et al*. (2012) and Beames (2013). A variety of websites, including those hosted by SKIPA and Environs Kimberley, also contain information about the vine thicket community. Articles and publications should continue to be developed and distributed.

To help prevent accidental destruction of the community and gain public support for its conservation, information about the community will continue to be provided by local Biodiversity, Conservation and Attractions staff to stakeholders including landholders, and managers of land containing the community. This would include information from the TEC database, and maps indicating the location of the community.

Local Biodiversity, Conservation and Attractions staff will ensure regular liaison with landowners and managers of land containing the community to ensure the TEC information is up to date.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District, Species and Communities Branch (SCB)) in consultation with land owners and managers
Cost: $20,000 pa
Completion date: Ongoing

2 Complete on-ground surveys for occurrences

Aerial photographs should be used to identify other potential monsoon vine thicket occurrences. In addition, those potential locations identified by Broome Botanical Society in 2001 and 2002 (Black *et al.* 2010) should be investigated with more up to date mapping software and subsequent ground-truthing.

Botanical and condition survey should be completed for occurrences that remain un-surveyed. This includes occurrences in the town of One Arm Point, Tooey Creek, Weedong, Christmas Island, Broome Airport, and at Hidden Valley.

Patches of rainforest have also been recorded at Cape Villaret about 45 km south west of Broome, at Sunday Island on the far north-east Dampier Peninsula, and on Coronation Island; however, it is not known if the assemblages are similar to those in the vine thickets on the remainder of Dampier Peninsula (L. Beames, M. Lyons[3] personal communication).

Black *et al.* (2010) state that their surveys of Occurrences 1, 8, 47, 48, 62 and 63 were brief. These occurrences should be subject to more detailed surveys, where this has not yet been completed.

On-ground survey data are required for Occurrences 5, 8, 11, 14, 34, 40, 41 and 42. Occurrence 90 near Tappers Inlet has been surveyed but has not been mapped.

These surveys will require close liaison with Traditional Owners, including seeking permission and ensuring that cultural access protocols are adhered to. Surveys should be conducted in both the wet and dry seasons to determine the full suite of native and weed species present.

Data collected should include that outlined on the TEC Report Form located on the web (refer https://www.dpaw.wa.gov.au/plants-and-animals/monitoring/96-standards/140-standard-report-forms?showall=&start=2). The condition of each occurrence should be recorded including vegetation structure in relation to tree size, number of large mature trees especially fruit bearing trees, canopy cover and health and the depth of leaf litter. Condition classes will also need to incorporate the fire history and the abundance of major weed species. These general parameters for data collection should be based on Casson *et al*. (2010), a manual specifically developed for vegetation monitoring in Western Australia.

The relative diversity of species will help to provide information about ecosystem function as species composition changes along the coast according to location, size and shape of occurrences. Composition will also be affected by species migration pathways and the condition and composition of adjacent vegetation. The level of canopy cover and leaf litter are important determinants of condition and integrity of occurrences, as the level of shading and resource availability in a healthy canopy will help prevent weed invasion. Large canopy trees are key indicators of condition and are indicative of longer intervals between hot destructive bush fires.

Condition classes should also acknowledge the cultural importance of the vine thickets and of specific sites and that work should be undertaken with Traditional Owners to identify priority areas, culturally

[3] Mr Michael Lyons: Science and Conservation, Biodiversity, Conservation and Attractions

sensitive areas and ecological indicators of the vegetation health and condition (Environs Kimberley 2009).

Ideally detailed fauna surveys will be undertaken as part of the TEC surveys, however, opportunistic data should be collected and compiled wherever possible.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District, SCB) in consultation with relevant land owners and managers
Cost: $30,000 in Year 3
Completion date: Ongoing

3 Continue to monitor, and improve extent, composition and boundary data

Harding (2009) states that the original Dampier Peninsula vine thickets boundaries were mapped using aerial photography, topographic maps and site specific surveys, and that some of the original boundaries were inaccurate when overlaid on new aerial photography. To date many of the occurrences have been manually mapped, mapped with a GPS using unknown datum, or mapped using aerial photographs. All occurrences should be remapped using current datum with a GPS to increase accuracy. Accurate GPS mapping of community boundaries has commenced and a spatial database using ArcGIS has been developed. Extent and boundary information will continue to be updated on the TEC database.

A program to monitor the condition and extent of vine thicket patches will be developed in response to current and new management regimes, with a maximum interval of five years between monitoring events. Remote sensing data can be used to determine general changes to vegetation condition. The use of these techniques was being investigated at the time of writing of this plan. The technique is likely to be able to provide a good general overview of the changes in integrity of vine thicket occurrences as a consequence of impacts, including increased fire frequency that opens up the canopy. Ideally these data will then be ground-truthed wherever possible to ensure that results acquired from remote sensing accurately reflect on-ground change in vegetation condition rank.

The boundaries of vine thickets mapped by Harding (2009) will be refined, and the expansion or contraction of the boundaries of vine thickets will be investigated over time, through further 'ground-truthing' survey work and the use of spatially rectified digital aerial photographs. This is of particular importance for vine thickets and transitional vegetation in and adjacent to the towns of Broome, One Arm Point and Lombadina-Djarindjin (Harding 2009).

Where intensive management actions are to be implemented in the community, detailed monitoring programs that will determine the effects of management actions will be established. Results will be fed into an adaptive management framework to ensure continuous improvement in knowledge, understanding and management of the vine thicket community. Occurrence 3 (Yakka country) is considered to be in excellent condition and subject to few threats and may be useful as a reference site for condition.

The highest priority sites requiring comprehensive monitoring will be determined based on those identified as key sites for conservation, those subject to major management programs, or subject to significant change caused by other factors. This ranking will be used as a guide to focus monitoring efforts. An additional secondary focus should be to ensure that basic monitoring data, such as remote sensing, is collected at least every five years for other occurrences.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District), in consultation with relevant land owners and managers

Cost: $50,000 every fifth year
Completion date: Ongoing

4 Identify and implement an appropriate fire regime

Black *et al*. (2010) recommends that an integrated community-based fire management program should be developed for the Dampier Peninsula. The involvement of Traditional Owners and owners of freehold land in implementing any changes to fire regimes on their land is crucial. According to Black *et al.* (2010) residents of outstations should have fire units and be responsible for fire control on country.

Fisher *et al.* (2013) indicated a trend of vegetation decline associated with fire, with 20% of the area of the vine thickets area experiencing declining cover between 1991 and 2012. There is a need for research into an appropriate fire regime for the community and to determine the implications of findings for management. The inter-fire intervals of occurrences of the vine thickets will be determined from remote sensing data wherever possible, and a fire history map developed from this.

A strategic approach to fire should ideally be applied on the Dampier Peninsula with appropriate fire management sought for the vine thickets through management of fire at a landscape scale. This will involve seeking to reduce fire frequency, reduce the incidence of intense late dry-season fires, and increase application of smaller-scale cooler burns earlier in the season. As frequency of fire in the surrounding landscape is likely to be the most critical factor in controlling rainforest boundaries, fire management of the TEC will need to be part of a larger landscape scale process. Rangelands NRM is seeking to implement improved fire management across the landscape.

Access management is also an important part of fire management in the vine thickets. Unrestricted access appears to be associated with increased frequency of intense late season fires. Ways and means of reducing the frequency of intense fire, such as the practicality of restricting access to parts of areas including Quandong Point that have already suffered major decline in vegetation integrity through frequent intense fires, will be investigated. A program of information and education through signage and other means to inform visitors about the impact of fire on the environment should also be implemented.

Fire should be excluded in the short term in Occurrence 63 as the site has suffered catastrophic impacts from intense fire recently. This should be coupled with control of the prolific weed buffel grass, which is promoting the intensity and spread of the fire in this area. Fire regimes in some occurrences, for example Occurrence 3b (north of Cape Borda), appear to be entirely appropriate in maintaining plant community structure and composition, and the current fire regime in such occurrences should be maintained. The exclusion of hot fires in Occurrence 3b may be partly through its location in a protective landscape in a steep sided humid gully.

Occurrences of vine thickets that are most at risk from fire damage should be identified. Occurrences that are most accessible, such as Occurrence 1 near Broome, are likely to be most at risk of fire damage due to increased risk around urbanised areas. Severe fire damage was noted in 2010 in surveys in Occurrence 63 (Quandong Point) about 35 km north of Broome, with tree deaths and almost total replacement of understorey species with weeds.

The highest priority areas for fire management will be determined based on those occurrences identified as key sites for conservation (see actions 3.9 and 3.10), and those subject to highly inappropriate fire regimes. This ranking will be used as a guide to focus fire management efforts. An additional secondary focus should be to ensure that impacts of inappropriate fire regimes on other remaining occurrences of the community is minimised wherever it is possible and practical to do so.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District), Department of Fire and Emergency Services, land owners and managers, in consultation with all stakeholders
Cost: $40,000 pa
Completion date: Ongoing

5 Monitor and control priority weeds; restore where necessary

Black *et al*. (2010) noted high priority vine thicket areas for weed control occur in settlements and town sites, particularly at One Arm Point, Lombadina-Djarindjin and Broome.

Aboriginal ranger groups are already implementing weed control, fire protection and management, seed collection, access management and restoration with Environs Kimberley and this should continue to be encouraged and supported. Biodiversity, Conservation and Attractions also implements similar types of on-ground management actions for locations near Broome.

Most of the weeds that pose the greatest threat to each occurrence are listed in Appendix 2. Weed populations need to be accurately mapped and appropriate herbicides or other methods of weed control determined, where this has not already been done. Control of major weeds in the community will require continued and possibly increased efforts on major weed infestations. Effort will also be required to prevent incursions of new weeds and unwanted introductions.

Tracks through many occurrences of the community facilitate weed invasion to varying extents and these sites should be priority areas for weed control. Replanting with local native species may be necessary if areas are no longer capable of regenerating following weed control. Only seed from the same occurrence should be used for rehabilitation and no seed from other areas should be introduced into occurrences. Piles of weed-contaminated soil in any occurrences should be removed and the areas replanted.

Harding *et al.* (2009) state that weed mapping and control has occurred in five occurrences of the vine thickets (Occurrences 10, 12, 41, 43 and 62). It is recommended that these occurrences should be re-monitored at one year, two years and five years after the initial weed control work, and that additional monitoring should be prior to and after any changes in land management, such as weed control or an alteration to the fire regime.

Harding *et al.* (2009) established a series of line-intercept transects where weed control work had been undertaken and in equivalent control sites. All species were recorded along the transects so that all compositional changes could also be recorded, and this proved to be an extremely accurate and quantitative method for determining compositional changes.

The highest priority areas for weed control will be determined from information about key sites for conservation of the vine thicket community (see actions 3.9 and 3.10), and priority infestations that occur in them (including Appendix 2 and section 1.4 above). This ranking will be used as a guide to focus control efforts. An additional secondary focus should be to ensure that impacts of weed invasion on other remaining occurrences of the community are minimised through weed control and restoration wherever it is possible and practical to do so.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District), land owners and managers
Cost: $30,000 pa for weed control; rehabilitation requirements - to be determined
Completion date: Ongoing

6 Report new outbreaks of high threat weeds; prevent new incursions

Land managers, community members, tourists and other stakeholders should be informed through educational materials and workshops about how to prevent, identify and report new weed incursions.

When an incursion of a new or high threat weed is reported and confirmed, land managers should be encouraged and where possible assisted to control and eradicate the weed before it becomes an intensive or costly problem. People with appropriate skill levels will be required to advise and support the control and assessment aspect of the program.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District) in consultation with land owners and managers
Cost: $10,000 pa
Completion date: Ongoing

7 Investigate hydrological processes; incorporate findings into planning and management

DWER (2017) provided some information about groundwater levels and dependence in four locations of the vine thicket TEC. The report also mapped all areas of the TEC within their study area as being within areas that have restricted opportunity for water development. This map should be utilised to guide environmental impact assessment for development proposals involving water abstraction near the TEC in areas covered by the DWER (2017) study.

There is evidence of hydrological change through increased inundation occurring in Occurrence 1 in the Broome townsite. An urgent effort is required to document natural flow regimes, water quality and determine water/solute balances for the vine thickets prior to development occurring within or in close proximity to occurrences. This will enable a baseline to be established and provide the ability to judge the likely severity of future impacts. A better understanding of the tolerances to change, and hydrologic thresholds for the community is also crucial.

Bores are planned to be established in areas subject to major development in the Broome townsite near vine thicket occurrences in the near future. Monitoring bores should also be placed to elucidate natural hydrologic processes in areas remote from potential impacts of development to serve as 'control' sites.

Bore data will need to be compiled and analysed over time, and may indicate the need for remedial actions, such as the creation of drainage management within Occurrence 1 adjacent to a residential area to prevent flooding of the vine thickets.

The highest priorities for hydrological investigations will be determined from areas identified as key sites for conservation of the vine thicket community and areas that are subject to current or future proposals with potential to impact hydrologic processes in the community.

The findings from hydrological investigation should be incorporated into planning and management processes such as town planning schemes. This will help ensure that housing, outstation and other developments have minimal impact on surface and groundwater levels and quality that are considered important for the health of vine thicket vegetation.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District), and Department of Water and Environmental Protection in consultation with land managers and owners.

Cost: $100,000 to establish bores, $50,000 pa for ongoing monitoring network of bores

Completion date: Ongoing

8 Seek tenure that provides for conservation management of representative areas of important occurrences of the vine thickets

Formal agreements that allow for greater security in conservation management include:

- Reserves with conservation included in the purpose
- Indigenous Protected Areas
- Nature conservation covenants.

Private land managed under an agreed management plan can also represent an improved level of management commitment for conservation outcomes. Management plans should be designed to include protection and active management to conserve the composition and function of the vine thickets.

Black *et al*. (2010) states that previously proposed conservation reserves should be declared and appropriate conservation management implemented.

Black *et al*. (2010) note that the proposed Borda Nature Reserve contains six occurrences of vine thickets (Occurrences 3, 6, 7, 19, 20, 48), two of which are particularly large (3, 7). The reserve was proposed in 1983. Other proposed reserves are the proposed Cygnet Bay Nature Reserve (15805 ha – encompasses eight occurrences: 2, 28, 29, 30, 39, 44, 45, 46), and the proposed Reserve for Conservation and Aboriginal Heritage (Waterbank - 92234 ha – encompassing two Occurrences 62, 63).

The recently proposed Leveque Conservation Park just north of Thomas Bay (Department of Planning and Western Australian Planning Commission (WAPC) 2015) includes up to five occurrences of the vine thickets (Occurrences 4, 5, 11, 12, 41) and the proposed Lake Louisa Conservation Park near Disaster Bay on the eastern side of the Peninsula includes an occurrence of the vine thickets (Occurrence 66).

The Bardi Jawi IPA was established in 2013 encompassing 45 occurrences in the northern portion of the Dampier Peninsula north of Pender Bay.

The following is adapted from Black *et al.* (2005, 2010). They recommend adding to the proposed conservation reserve system and/or managing vine thickets for conservation based on the following principles. The essence of these principles is supported and has been utilised in this plan:

- vine thicket patches should be protected and conserved in areas under tenure suitable for management for conservation plus a 500 m buffer zone extending into adjacent vegetation. Areas managed for conservation should extend to the low tide line to include mangroves and tidal mudflats, as much of the Dampier Peninsula's species richness comes from species dependent on these littoral areas
- critical clusters of vine thicket patches should be conserved in secure tenure to maintain connectivity
- any areas declared as nature reserves should remain available for Aboriginal usage for traditional purposes, such as ceremonial use of sacred sites.

In addition, priority areas for vine thicket conservation as discussed by Black *et al*. (2005, 2010) are:

- the cluster of ten vine thicket patches on coastal dune formations between Cape Baskerville and Baldwin Creek (Occurrences 40, 22, 21, 23, 9, 25, 24, 26, 27, 62, on Aboriginal Reserve 22615 (Beagle Bay lands), UCL and other Crown reserves. The protected area should encompass all of Baldwin Creek including its mangroves and tidal mudflats to the low tide line, Bunda Bunda Spring and the intertidal mudflats of Carnot Bay, the rock outcrops King Peaks and Carnot Peaks, and interspersed woodlands. This could be accomplished by drawing a circle of 15 km in radius around Occurrence 23;
- the cluster of four vine thicket patches from East Sandy Point to Cliff Point (Occurrences 67, 68, 69, 70) on Crown Reserve 1012 (Beagle Bay lands). A circle with a radius of about 7 km from the southern end of occurrence 70, would include Tappers Inlet in the conservation area;
- the whole of the northern end of Dampier Peninsula as this includes all the most northern vine thicket occurrences (the most species-rich) in a tight cluster along the coastline, along with a substantial area of intervening habitats including: (i) vine thickets on Lombadina Grazing Lease from just south of Chile Creek then north through Lombadina-Djarindjin to Kooljaman (Occurrences 10, 47, 71, 15, 5, 12, 11, 41 and; (ii) vine thickets on Aboriginal Reserve 20927 (One Arm Point lands) from Kooljaman (Occurrence 4) northeast to Swan Point (Occurrence 35), and south through One Arm Point (Occurrence 43) to Gallen (Occurrence 53) and Millagoon (Occurrence 59). This includes three patches on freehold land; and
- occurrence at Quandong Downs (Occurrence 63).

Key self-sustaining examples of these high priority areas of the vine thicket community are recommmended as a focus for conservation management in this plan (note: Appendix 5 provides a key to patch numbers vs occurrence numbers and also states special conservation values).

Extensive Commonwealth programs operate in northern Australia, and given the listing of large areas of the West Kimberley as a National Heritage Area and the prevalence of IPAs in the vicinity of the vine thicket TEC, Commonwealth funding is crucial to achieving priority actions in this plan. The Commonwealth funds IPAs, and also provides funds for Aboriginal Ranger Programs that contribute to conserving specific occurrences of the vine thicket TEC.

Liaison with owners and managers regarding conservation management is crucial for vine thickets on freehold land in oyster and pearl license areas.

Only a few areas of the vine thicket community are owned privately. If management for conservation of vine thickets on private land seems unlikely, and areas containing occurrences of the community become available, Biodiversity, Conservation and Attractions will seek resources and negotiate to acquire occurrences and adequate buffer areas.

Responsibility:	Biodiversity, Conservation and Attractions (Land Unit, Kimberley Region) in consultation with land owners and managers
Cost:	Opportunities to be sought through potential Indigenous Land Use Agreements, offsets or covenants. Market price for acquisitions – to be determined.
Completion date:	When opportunities arise.

9 Protect critical habitats and species

In addition to areas identified in the action above, areas identified as high priority for conservation based on composition and structure according to Black *et al*. (2010) include Occurrences 2, 6, 7, 9, 10, 15, 17, 18, 22, 24, 27, 29, 32, 43, 46, 47, 50, 53, 54, 55, 56, 58, 62, 64, 65, 67, and 72.

The protection of all *Ficus virens* trees, *Canarium australianum*, *Terminalia petiolaris*, and hybrids of *T. petiolaris* and *Terminalia latipes* subsp. *psilocarpa* on the Dampier Peninsula is recommended. Wherever possible, the protection of a 250m radius around these species is also advocated by Black *et al.* (2010). These four species may be found scattered throughout the landscape where they provide alternative food sources and act as stepping-stones for fauna travelling between vine thicket occurrences. The planting of these trees in towns is also to be encouraged.

Fauna critical to survival of vine thickets also needs to be protected. Flying fox roost sites on the Dampier Peninsula should be identified and protected. Studies in the Northern Territory recommend including roosts within reserves and buffering them within a 500 m radius (Black *et al*. 2010).

Guidelines for protecting and maintaining vine thicket viability and complementary habitats in the Northern Territory as noted in Bach and Price (2005) are likely to be especially relevant to the Dampier Peninsula vine thicket ecosystem and should be further investigated and adapted for use in this area. The recommendations included: maintain all existing rainforest patches, maintain the vegetation within 500m of each patch, maintain considerable areas of all habitats that provide significant flower resources, protect all known black flying fox roost sites, never destroy a *Ficus virens* tree, manage the rainforest accordingly with respect to specific threats (feral animals, weeds or fire).

Given the unique nature of each occurrence, any occurrence regardless of size can be a significant food source and habitat for frugivores at various times of the year. It is therefore essential to conserve the existing diversity of rainforest types on the Dampier Peninsula (Harding 2009). Means of protection may include fencing, realigning or closing tracks and utilising environmental impact assessment processes to minimise impacts on important species or sites.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District) in consultation with land owners and managers
Cost: To be determined
Completion date: Ongoing

10 Design and conduct research that builds knowledge about ecosystem processes and informs management.

Research will be designed to increase understanding of the community to assist in future management decisions. Research should include:

- Investigations into the ecology of frugivorous fauna - birds, reptiles and mammals, and their role in seed dispersal in the vine thickets. Gaining an understanding of this ecological process and the complementary roles of adjacent habitats and resource provision for mobile frugivorous species will have major implications for conservation management.
- Investigating the complementary roles of vine thicket, savanna, mangroves and other habitats in the provision of resources for mobile frugivorous species on Dampier Peninsula.
- Survey for flying fox roost sites, and frugivorous bird species on Dampier Peninsula.
- Investigation of Aboriginal knowledge in relation to vine thickets. Relevant knowledge includes vine thicket values, uses, and ecology.
- Experiment with inter-fire interval and monitor effects. Fire-sensitive species may require at least twice the juvenile period between burns to sustain them and this should be investigated (Burrows *et al*. 2008). Experiments are required with dry versus wet season fires. Anecdotal evidence indicates the need to increase the inter-fire interval and ensure cool burns rather than intense late season fires. Traditional burning methods should be investigated.
- Investigating the use of drainage lines in/on cliffs, in coastal dunes where floods are occurring following development (Occurrence 1).

- Research availability of bushtucker in vine thickets and means of protecting them whilst facilitating commercialisation of particular species.
- Investigating genetic variation within and between vine thickets. The vine thicket ecosystem is likely to have compromised genetic diversity in a number of smaller patches isolated from sufficient frugivorous migration (Environs Kimberley 2010).
- There are very few data about land snails in the vine thickets, and this group should also be a focus for studies.
- Taxonomic studies of *Capparis jacobsii* on Dampier Peninsula to determine its conservation status.
- Investigating insect damage in infected trees and understorey species.

The highest priority areas of research will be determined based on information requirements for management of areas identified as key sites for conservation of the vine thicket community, and potential risk of adverse impacts associated with lack of these data. This ranking will be used as a guide to focus research efforts. A secondary focus will be to ensure that research programs are designed to provide information to minimise adverse risk to other remaining occurrences of the community wherever possible and practical.

Support from academic and cooperative partnerships should be sought for conducting research and to incorporate findings into on-ground planning and works. Findings wil be incorporated into reviews of management plans wherever applicable.

Responsibility:	Biodiversity, Conservation and Attractions (Science and Conservation, SCB, Threatened Flora Seed Centre, West Kimberley District; Botanic Gardens and Parks Authority), in consultation with land owners and managers; partnering with universities, the KLC and community groups
Cost:	$40,000 pa
Completion date:	Ongoing

11 Investigate controlled tourism, manage recreational access and reduce potential for littering and weed spread

Black *et al.* (2010) note that most vine thickets should be protected from high rates of recreational access, especially vehicles, as the habitat is very vulnerable to disturbance.

Fencing or other barriers may be required to help prevent degradation where occurrences are being significantly grazed, are in areas with high visitation, or where the vine thickets have been exposed to increased access through development. Occurrences will be ranked for priority for the need for fencing or other means of access control such as bollards, gates and signage.

Vehicular access other than on existing tracks should be avoided in all occurrences of the vine thickets, however, the general public should have the opportunity to walk in some occurrences. Information and educational signs should be created in English and in local Aboriginal languages. Vine thicket patches, including reserved areas need to continue to be available for traditional Aboriginal purposes, such as collection of bush tucker and ceremonial use of cultural sites.

A standard and associated guideline for access track construction needs to be established and promoted to prevent further land degradation on the Dampier Peninsula and in the vine thickets in particular. Specifically, unformed access tracks should not be graded or bulldozed, rather their construction should include driving over or removal and slashing of vegetation where necessary, such that soil surfaces remain intact and tracks do not become deeply eroded. Blade-down clearing for track construction is unnecessary and is not ecologically sustainable, and unlike discrete bush tracks, detracts from the wilderness experience. Additionally, building tracks up with imported soils, gravel or

similar can cause changes to water movement and result in significant erosion with deep furrows being created.

A plan for ecologically sustainable management of tourism and recreational impacts on vine thickets and surrounding vegetation should be designed and implemented (Black 2005). Areas that are identified as high use or tourist-use areas should be subject to a number of measures to limit weed spread, irresponsible use of fire and littering. It will be important to work with land-managers and stakeholders to identify the best ways to manage these issues at alternative sites including use of effective signage, bin provision, wash-down areas, community workshops and site-adapted awareness and education material.

On Aboriginal lands the potential for tourism programs integrated with conservation management that highlight the significance of vine thickets and for guided walks with Aboriginal rangers and/or other knowledgeable local people should be investigated.

The collection of firewood is resulting in damage to vegetation in and near occurrence 72. The feasibility of providing firewood to visitors should be investigated.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District) in consultation with land owners and managers
Cost: $10,000 pa
Completion date: Ongoing

13 Map habitat critical to survival

Although the boundary of the vine thicket occurrences have mostly been mapped, areas that are crucial to continued integrity of the community will include some complementary ecosystems and adjacent vegetation that links occurrences, such as migration pathways for fauna, and vegetation that seasonally sustains frugivores. This community is likely to have a level of groundwater dependence, so habitat critical to survival will also include groundwater catchment zones that will need to be protected to ensure maintenance of the hydrological processes in the community. These areas will need to be described and mapped.

The highest priority areas for mapping of habitat critical to survival will be determined based on areas identified as key sites for conservation of the vine thicket community and potential risk associated with lack of this information. This ranking will be used as a guide to focus mapping efforts. A secondary focus will be to ensure that habitat critical to survival is mapped wherever possible and practical to minimise adverse risk to other remaining occurrences of the community

If additional occurrences are located, then this habitat will also be determined and mapped for these locations.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District, SCB) in consultation with land owners and managers
Cost: $30,000
Completion date: Year 3

14 Develop management guidelines

If site-based management guidelines that would help manage occurrences of the vine thicket community are not being prepared or implemented by current land managers, Biodiversity, Conservation and Attractions will seek involvement in the cooperative preparation of plans for

occurrences that include management considerations as listed in this plan. Where required, such guidelines should also include consideration of the need for sustainable tourism management, and ecologically sustainable timber harvesting from vine thickets, including monitoring and regulation, and replanting and plantation establishment as necessary.

The highest priorities for development of management guidelines will be determined based on areas identified as key sites for conservation of the vine thicket community, and areas subject to major current or future land management programs. A secondary focus will be to ensure that management guidelines are developed wherever possible and practical for other remaining occurrences of the community.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District, SCB) in consultation with land owners and managers
Cost: $30,000 every 3rd year for plan development
Completion date: As required

15 Monitor and manage feral and exotic animals including unmanaged cattle, horses, donkeys and cats

Domestic and feral or exotic animals should be excluded from vine thickets wherever possible.

Signs of unmanaged cattle were noted in recent surveys of Occurrences 3c, 62 and 63. Cattle have the potential to cause major damage in the vine thickets. When incursions are identified, unmanaged cattle should be fenced out or, where appropriate, destroyed.

Donkeys are an additional and potentially problematic feral herbivore that exist in and around the Beagle Bay area. If monitoring indicates an increasing impact of this species within local vine thicket occurrences, the Department of Primary Indistries and Regional Development should be contacted about on ground control to be undertaken with the local community. Horses have particularly been noted around Yawuru country.

Feral cats are an increasing threat to small lizards, mammals and birds that utilise vine thicket areas. Feral cat activity should be included in vine thicket site monitoring and where high levels of activity are recorded, control should be implemented. All managed sites will need to include some level of feral cat monitoring and control. Fauna monitoring should be conducted at intensive control sites to establish the impact of feral cats on the vine thicket fauna assemblage.

The highest priority areas for control of feral and exotic animals will be determined based on areas identified as key sites for conservation of the vine thicket community, from knowledge of distribution of these introduced fauna, and the level of risk they pose to the vine thicket community. This ranking will be used as a guide to focus control efforts. A secondary focus will be to ensure that programs to control feral and exotic animals are implemented wherever possible and practical to minimise adverse impacts of these fauna on other remaining occurrences of the community.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District) in consultation with land owners and managers
Cost: $10,000 pa
Completion date: Ongoing

16 Apply planning and environmental impact assessment processes

A strategic land use planning document that covers the Peninsula seeks to ensure that all future development proposals are subject to appropriate planning procedures (Department of Planning and Western Australian Planning Commission 2015). The plan also refers to proposed Nature Reserve and Conservation Investigation Areas. The stated objective in that section of the document is: 'Without limiting the operation of relevant other legislation, facilitate conservation of cultural heritage, environmental and landscape assets of the Dampier Peninsula that are demonstrated to have local, regional, state, national or international significance'. A strategy pertinent to achieving that objective is to 'Represent the vegetation of the Peninsula in secure conservation reserves, in particular areas of known special values such as vine thickets and mound springs.' Conservation reserves are defined as nature reserves, national parks, conservation parks and marine conservation reserves under the *Conservation and Land Management Act 1984*. These reserve categories largely align with the intent of the International Union for the Conservation of Nature's category I to IV conservation reserves (protected areas established as strict nature reserves and wilderness areas, national parks, protected areas for natural monuments or features, and habitat/species management areas), and do not include IPAs.

Black *et al*. (2010) outline specific actions to undertake further investigations with regard to Coulomb Point Nature Reserve, Borda, Leveque and Cygnet Bay, and Dampier Peninsula Coastal Park proposals.

Environmental impact assessment processes should be utilised to minimise impacts to vine thicket occurrences, including consideration of secondary impacts such as hydrology, loss of patch type representation, loss of integrity of occurrences, loss of connectivity, the impacts of increased access and access tracks, and weed invasion. Primary and secondary impacts should be carefully considered in proposals for residential areas adjacent to Occurrence 1, industrial areas, outstation or ecotourism venture development or expansion, and any other planned developments.

Outcomes to be sought through impact assessment processes should be to seek to avoid and minimise impacts to occurrences of the vine thickets, and to ensure that key examples of each cluster group are protected and conserved. An additional focus should be to ensure that loss of other remaining occurrences of the community is minimised and conservation is maximised.

If funds become available for management of the vine thicket community as a condition of development impacts, they should be utilised to assist in implementing recovery actions for priority areas of the community as identified in this plan.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District, SCB) in consultation with land owners and managers
Cost: $10,000 pa
Completion date: Ongoing

17 Consider climate change issues in management and incorporate into conservation targets and management planning

Resilience of the vine thickets in the face of climate change should be maximised through the maintenance of existing large areas of vegetation in areas that have tenure that is compatible with, and are managed for conservation, and through maintaining or increasing their connectivity. The management of other threatening processes such as increased weed invasion or fire frequency that may be exacerbated by climate change will be a crucial part of maximising resilience.

The impacts of storm surge, cyclone damage, inundation from rising sea levels and salt water incursion into freshwater aquifers should be monitored over time. The potential impacts of climate change on

biota that are significant in dispersing seeds and cross pollinating species will be part of other actions listed in this plan.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District, SCB) in consultation with land owners and managers
Cost: $10,000 pa for additional monitoring
Completion date: Ongoing

18 Report on outcomes of management strategies and adapt recovery actions in response

Reporting should be part of annual reports for Biodiversity, Conservation and Attractions' Corporate Executive prepared by the West Kimberley Threatened Flora and Communities Recovery Team. A final report will be presented and distributed to stakeholders as part of the review of this plan. The interim recovery plan will be updated at the end of the ten year term, if deemed necessary.

Responsibility: Biodiversity, Conservation and Attractions (West Kimberley District)
Cost: $5,000 pa
Completion date: Ongoing

Table 1: Summary of costs for each recovery action

Recovery Action	Year 1	Year 2	Year 3	Year 4	Year 5
Liaise with stakeholders	20,000	20,000	20,000	20,000	20,000
Complete on-ground surveys			30,000		
Continue to monitor		50,000			
Identify and implement appropriate fire regime	40,000	40,000	40,000	40,000	40,000
Monitor and control priority weeds	30,000	30,000	30,000	30,000	30,000
Report; control high threat weeds	10,000	10,000	10,000	10,000	10,000
Investigate hydrological processes	100,000	50,000	50,000	50,000	50,000
Seek tenure providing for conservation management of important occurrences	TBD	TBD	TBD	TBD	TBD
Protect critical habitats and species	TBD	TBD	TBD	TBD	TBD
Design and conduct research	40,000	40,000	40,000	40,000	40,000
Investigate controlled tourism, manage access	10,000	10,000	10,000	10,000	10,000
Map habitat critical to survival			30,000		
Develop management guidelines	30,000			30,000	
Monitor and manage feral and exotic animals	10,000	10,000	10,000	10,000	10,000
Apply planning and impact assessment processes	10,000	10,000	10,000	10,000	10,000
Consider climate change issues	10,000	10,000	10,000	10,000	10,000
Report on outcomes	5,000	5,000	5,000	5,000	5,000
Total	**315,000**	**285,000**	**295,000**	**265,000**	**235,000**

Total of all costs over five years: $1,395,000

4. REFERENCES

Bach, C. and Price O. (1999). Fruit resources, frugivore movements and landscape scale conservation in monsoon rainforests of northern Australia, In: Gorman, J., Pethram and Vigilante, T. 12th Annual conference of the Australasian Wildlife Management Society, Darwin, 1-3 Dec 1999.

Bach, C. and Price, O. (2005). Fruit resources and landscape scale conservation in monsoon rainforests of Northern Australia. *Wildlife Research* 33(6) Pg.521–528.

Beames, L. (2013). Valuable & Endangered. Working Together to Understand and Manage Threats to Monsoon Vine Thickets of the Dampier Peninsual. A Summary of Key Findings. Environs Kimberley, West Kimberley Nature Project 2011-2013.

Beames, L., Roe, J, and Fisher, J. (2010). Working together to manage a threatened ecologicalcommunity in the Kimberley: Dampier Peninsula monsoon vine thickets, Western Australia. Paper presented at Ecological Society of Australia meeting 6-10 December 2010, Canberra, ACT.

Bellfield, A., Beames, L., Black, S. (2012) Valuable and threatened, Monsoon Vine Thickets of the Dampier Peninsula. A Summary of Key Findings from The Broome Botanical Society. Environs Kimberley, Broome.

Black, S.J., Willing, T., and Dureau, D.M. (In press). The coastal vine thickets of Dampier Peninsula, West Kimberley 2000 - 2002. Broome Botanical Society, Centre for Management of Arid Environments, and Department of Conservation and Land Management. Perth, Western Australia.

Black, S. (2005) Draft recommendations extracted from 'Black S.J., Willing T., and Dureau D.M. (In press). The coastal vine thickets of Dampier Peninsula, West Kimberley 2000 - 2002. Broome Botanical Society, Centre for Management of Arid Environments, and Department of Conservation and Land Management. Perth, Western Australia.'

Black, S.J., Willing, T. and Dureau, D.M. (2010). A comprehensive survey of the flora, extent and condition of vine thickets on coastal sand dunes of Dampier Peninsula, West Kimberley 2000-2002. Final report September 2010. Broome Botanical Society (Inc.). Broome, Western Australia.

Biota Environmental Services (2009a). A Vegetation and Flora Survey of James Price Point: West Season 2009. Biota Environmental Sciences. Report prepared for Department of State Development.

Biota Environmental Services (2009b). James Price Point Terrestrial Fauna Survey: Wet Season 2009. Report prepared for Department of State Development. Perth, Western Australia.

Bowman, D.M.J.S. (2000) *Australian rainforests, islands of green in a land of fire*. Cambridge University Press, Cambridge.

Burrows, N.D., Wardell-Johnson, G., and Ward, B. (2008). Post-fire juvenile periods of plants in south-west Australian forests and implications for fire management. *Journal of the Royal Society of Western Australia*. 91: 163-174.

Casson, N, Downes, S., and Harris, A. (2009). Native Vegetation Condition Assessment and Monitoring Manual for Western Australia. Version 1 Draft report produced by the Department of Parks and Wildlife for the Australian Government Department of Environment, Water, Heritage and the Arts.

Chapin III, S.F., Torn, M.S, and Tateno, M. (1996). Principles of Ecosystem Sustainability. *The American Naturalist*. 148: 1016-1037.

Department of Parks and Wildlife (2015*a*). Corporate Policy Statement No. 35 Conserving Threatened Species and Ecological Communities. Perth, Western Australia.

Department of Parks and Wildlife (2015*b*). Corporate Guideline No. 35 Listing and Recovery of Threatened Species and Ecological Communities. Perth, Western Australia.

Department of Planning and West Australian Planning Commission (2015). Dampier Peninsula Planning Strategy. WAPC, Perth.

Department of the Environment and Heritage (2006). Indigenous Protected Areas. Indigenous Australians Caring for Country. Australian Government.

Department of Water and Environmental Regulation (2017). Groundwater-dependent ecosystems of the Dampier Peninsula. Royalties for Regions groundwater investigation. Environmental water report series Report no. 29. August 2017.

Docherty, P. and Williams, L (2009). Monsoon Vine Thickets Factsheet. A Threatened Ecological Community in the west Kimberley. The Dampier Peninsula Vine Thicket Project. Environs Kimberley, Rangelands NRM and Parks and Wildlife.

English, V. (2010). Developing a Recovery Plan for rainforest patches with local communities. WATSNU. Species and Communities Branch newsletter for threatened species and ecological communities conservation.

Environs Kimberley (2009). Threatened Ecological Community Nomination Form - for listing or changing the status of an ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Environs Kimberley (2010) Threatened Ecological Community Nomination Form - for listing or changing the status of an ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Environs Kimberley(2013). Valuable & Endangered. Working Together to Understand and Manage Threats to Monsoon Vine Thickets of the Dampier Peninsula. A Summary of Key Findings. Environs Kimberley West Kimberley Nature Project 2011 – 2013. Environs Kimberley, Broome.

Fensham R.J. and Butler D.W. (2004). The spatial pattern of dry rainforest colonising unburnt Eucalyptus savanna. *Austral Ecology* 29, 121-128.

Fisher, J. and Beames, L. and Rangers, B. and Rangers, N. and Majer, J. and Heterick, B. (2014). Using ants to monitor changes within and surrounding the endangered Monsoon Vine Thickets of the tropical Dampier Peninsula, north Western Australia. *Forest Ecology and Management*. 318: pp. 78-90.

Fisher, J., Beames, L., van Dongen, R., Delaney, J., Bardi Jawi Rangers, Nyul Nyul Rangers (2013). Fire history and vegetation change in threatened Monsoon Vine Thickets of northern Western Australia: applying culturally informed science. Draft manuscsript. University of Western Australia, Nedlands.

Harding, C. (2009). Monitoring of the extent of Dampier Peninsula Vine Thickets Threatened Ecological Community. Version 1.0 (June 2009). Prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project.

Harding, C., McGilvray, A., and Beames, L. (2009). Monitoring the Effectiveness of Weed Control in Dampier Peninsula Vine Thickets Threatened Ecological Community. Version 1.0 (October 2009). Prepared for Significant Native Species and Ecological Communities – Resource Condition Monitoring Project.

Johnstone, R.E. and Burbidge, A.H (1991). The avifauna of Kimberley rainforests. Chapter 17 in *Kimberley Rainforests Australia*, edited by McKenzie, N.L., Johnston, R.B., and Kendrick, P.G. Surrey Beatty & Sons in Association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment. Chipping Norton, NSW.

Keighery, B.J. (1994). Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of Western Australia (Inc.), Nedlands, Western Australia.

Kenneally, K. F., Choules Edinger, D., Willing, T. (1996). *Broome and Beyond. Plants and People of the Dampier Peninsula, Kimberley, Western Australia.* Department of Conservation and Land Management.

Kenneally, K.F., Keighery, G.J. and Hyland, B.P.M (1991). Floristics and phytogeography of Kimberley rainforests, Western Australia. Chapter 6 in *Kimberley Rainforests Australia*, edited by McKenzie, N.L., Johnston, R.B., and Kendrick, P.G. Surrey Beatty & Sons in Association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment. Chipping Norton, NSW.

McGilvray, A. (2008). Taking Weed Action in Dampier Peninsula's Vulnerable Vine Thickets. WATSNU. Species and Communities Branch newsletter for Threatened Species and Ecological Communities conservation.

McKenzie (1991). An ecological survey of tropical rainforests in Western Australia: background and methods. Chapter 1 in: McKenzie, N.L., Johnston, R.B., and Kendrick, P.G (eds) (1991). *Kimberley Rainforests Australia*. Surrey Beatty & Sons in Association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment. Chipping Norton, NSW.

McKenzie, N.L., Johnston, R.B., and Kendrick, P.G (eds) (1991). *Kimberley Rainforests Australia*. Surrey Beatty & Sons in Association with the Department of Conservation and Land Management and Department of Arts, Heritage and Environment. Chipping Norton, NSW.

National Native Title Tribunal (2017). http://www.nntt.gov.au/assistance/Geospatial/Pages/Maps.aspx. Data dated August 2017.

Naturemap (2011). Mapping Western Australia's biodiversity. Department of Biodiversity, Conservation and Attractions website http://naturemap.dbca.wa.gov.au/default.aspx. Accessed 16 February 2011.

Palmer, C., Price, O., and Bach, C. (2000). Foraging ecology of the black flying fox (Pteropus alecto) in the seasonal tropics of the Northern Territory, Australia, *Wildlife Research* Vol 27. Pg 169-178.

Price, O.F. (2004). Indirect evidence that frugivorous birds track fluctuating fruit resources among rainforest patches in the Northern Territory, Australia. *Austral Ecology*. 29: 137-144.

Smith, M. (2017). Declared Rare and Priority Flora List for Western Australia. Department of Parks and Wildlife, Perth.

Vogwill, R.I.J, (2003). Hydrogeology and Aspects of the Environmental Geology of the Broome Area Western Australia, PhD Thesis, Curtin University, Western Australia.

Williams, L. (2009). Address to House of Rpresentatives Standing Committee on Climate Change, Water, Environment and the Arts: Climate change and environmental impacts on coastal communities. 27 August 2009. http://parlinfo.aph.gov.au/parlInfo/download/committees/commrep/12351/toc_pdf/7076-1.pdf;fileType%3Dapplication%2Fpdf (accessed 15 February 2010).

Williams, L. (2010) A *Unique Ecosystem Network*. *The Threatened Dampier Peninsula Vine Thicket System*. A Question of Balance. 2SER 107.3 Real Radio. www.aqob.com.au/details.php?p_id=576&seo=A_unique_ecosystem_network&listid=422&menuid=category_id_22&submenuid=categorylist_id_422 (accessed 15 February 2011).

Wilson, S. and Swan, G. (2008). *A Complete Guide to Reptiles of Australia*. Second Edition. New Hollland Publishers (Australia) Pty Ltd. Sydney, Australia.

APPENDIX 1 LOCATION AND SIZE OF OCCURRENCES

(from TEC database, see also location map at Appendix 4)

Occ No.	Estmd area	Details of location	Land manager	Stated land use (where known)	Native title application /determination (National Native Title Tribunal 30 September 2016)
1	76.57	Cable Beach, Broome (Minyirr Coastal Park)	Nyambu Buru Yawuru (NBY) and Shire of Broome	Conservation	Edarrbur (Rubibi, Yawuru)
			Shire of Broome		Edarrbur (Rubibi, Yawuru)
			Shire of Broome	D, P, R, BF, C**	Edarrbur (Rubibi, Yawuru)
2a	4.58	S side Cygnet Bay, NE Dampier Peninsula (29/1 in McKenzie *et al.* 1991)			Bardi Jawi
3a	5.35	N of Cape Borda, NW Dampier Peninsula (29/2 in McKenzie *et al.* 1991), 'Yakka Thickets'.			Bardi Jawi
4	15.57	~ 1 km SE of Kooljaman at Cape Leveque (29/3 in McKenzie *et al.* 1991).	The Aboriginal Affairs Planning Authority	Use and benefits Aboriginal inhabitants	Bardi Jawi
5	43.51	NW of Gregory Well	Shire of Broome	Private freehold use	Bardi Jawi
6a	53.15	N of Cape Borda, NW Dampier Peninsula			Bardi Jawi
6b		N of Cape Borda, NW Dampier Peninsula			Bardi Jawi
7a, b, c, d, e	127.70	N of Cape Borda, NW Dampier Peninsula. Northern most Cape Borda patch, just S of Gilbut Ck.			Bardi Jawi
8	52.04	Bilingurr Hidden Valley, N end Cable Beach Broome	Joint Shire of Broome and NBY	Consn and recn	darrbur (Rubibi, Yawuru)
9	12.42	Red Bluff; SW of helipad	The Aboriginal Affairs Planning Authority	AR	Binbunbur
10a, b	35.33	S of Chile Creek	DoP leasee	Private uses	Bardi Jawi
11	12.31	SSW of Cape Leveque lighthouse	DoP leasee	Private uses	Bardi Jawi
12	11.57	NW of Gregory Well	DoP leasee	Private uses	Bardi Jawi
13	9.61	Bullock Camp, E of Gallen Well, N of Cygnet Bay	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
14	7.24	NE Skeleton Point	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
15	47.99	S of Gregory Well	DoP leasee	Private uses	Bardi Jawi
				Proposed roadway	
16	3.31	SW of helipad at Red Bluff	The Aboriginal Affairs Planning Authority (Dept Indigenous	AR	Bindunbur

			Affairs)		
17	87.45	SW of One Arm Point	Private landholder	Private freehold use	Bardi Jawi
		Dampier Peninsula	DoP (lease)		Bardi Jawi
18	19.35	WSW of One Arm Point	Private landholder	Private freehold use	Bardi Jawi
		Dampier Peninsula	Private landholder	Private freehold use	Bardi Jawi
19	6.88	S of Gilbut Creek and N of VT7, Cape Borda			Bardi Jawi
20a, b	9.97	NW of Pender outstation, Cape Borda			Bardi Jawi
21	15.69	Mundud community outstation, NE of Van Tuyn Point, N of Carnot Bay	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
22a, b	14.12	Near Smirnoff Beach (S of Mundud Community Outstation) N of Carnot Bay	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
23	2.31	SW of helipad at Red Bluff between Carnot Bay and Baldwin Creek. 'Red Block'.	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
24a, b	6.47	ENE of helipad at Red Bluff (S of Baldwin Ck)	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
25	25.84	E of Red Bluff helipad to SW of Baldwin Ck	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
26	12.18	ENE of Helipad at Red Bluff, SW of upper Baldwin Ck	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
27a, b	31.23	Upper Baldwin Ck, ENE of helipad at Red Bluff	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	AR	Bindunbur
28a, b	6.74	Cunningham Point			Bardi Jawi
29a, b	16.82	S of Carlisle Head and NNW of Amatangoora Point			Bardi Jawi
30	3.53	SSW of Deepwater Point, NE Dampier Peninsula			Bardi Jawi

31	0.88	E Hunter Ck, middle occ, N Dampier Peninsula	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
32a, b	46.89	E Hunter Ck, N occ, N Dampier Peninsula	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
33a, b, c	15.17	E Hunter Ck, S occ, N Dampier Peninsula	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
vine34	31.66	ESE of Cape Leveque lighthouse W of upper Hunter Ck	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
		Dampier Peninsula	Ardyaloon (Dept Indigenous Affairs)		Bardi Jawi
35a, b	50.55	Immediately SW of Swan Point, Karrakatta Bay	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
36	0.31	SW of Swan Point, Karrakatta Bay, NE Dampier Peninsula	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
37	0.64	SW of Swan Point, Karrakatta Bay, NE Dampier Peninsula	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
38a, b	52.94	SW of Swan Point, Karrakatta Bay	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
		Dampier Peninsula	Private landholder	Private freehold use	Bardi Jawi
39	53.52	Willie Pt, Cygnet Bay			Bardi Jawi
40	16.36	Smirnoff beach S, N of Carnot Bay	The Aboriginal Affairs Planning Authority	AR	Bindunbur
41	43.21	N of Gnamagun Well			Bardi Jawi
42	10.90	NE of One Arm Point	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
43	161.66	One Arm Point town	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
44a, b	9.72	E point between Rumbul Bay to the S and Cygnet Bay to the N			Bardi Jawi
45	25.03	S of Willie Point (S of Lurugun)			Bardi Jawi
46a, b	62.67	SSW of Willie Point, Cygnet Bay (Lurugun)			Bardi Jawi
47	17.71	SW of Chile Creek	DoP leasee	Private use	Bardi Jawi
48	38.13	Tjarbormai Ck, E of Packer Island and Lombadina Creek			Bardi Jawi
49	14.68	Island in mudflats NW of Elephant Point, Cygnet Bay	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
50	5.30	ESE of Gallen Well. Middle on S coast of Skeleton Point Peninsula, N Cygnet Bay.	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
51	12.21	W occ on S coast of Skeleton Point Peninsula, SE of Gallen Well	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
52	8.52	S of Skeleton Point	Ardyaloon (Dept	AR	Bardi Jawi

			Indigenous Affairs)		
53	113.86	SSE of Gallen Well	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
54a, b	19.44	West of Talboys Point, Karrakatta Bay	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
55	12.89	N of Easton Point, between Karrakatta Bay and Curlew Bay	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
56	12.87	N Catamaran Bay,	Private landholder and leasee	Private use	Bardi Jawi
57	57.66	S of Catamaran Bay	Leasee	Private use	Bardi Jawi
58	31.19	Behind bay between Gallen and Brown's (Cygnet Bay) Pearl Farm	Ardyaloon (Dept Indigenous Affairs)	AR	Bardi Jawi
59a, b	38.27	Milligan/Djaradjung	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	Use and benefits Aboriginal inhabitants	Bardi Jawi
60	4.42	South west of Elephant Point	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	Use and benefits Aboriginal inhabitants	Bardi Jawi
61	8.81	W of Elephant Point	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	Use and benefits Aboriginal inhabitants	Bardi Jawi
62	507.58	Waterbank. From James Price Point to just north of Quandong Beach			Goolarabooloo
63 (vine 64)	93.44	Beach between Barred Creek and Quandong (Rurrjaman)			Goolarabooloo
64 (vine 65)	56.39	Midarlon: Dunes SE of Kooljaman at Cape Leveque	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	Use and benefits Aboriginal inhabitants	Bardi Jawi
65 (Vine 67a)	1.32	E of Cliff Point (N of Beagle Bay inlet)	The Aboriginal Affairs Planning Authority (Aboriginal Lands Trust)	Use and benefits Aboriginal inhabitants	Bindunbur
66 (vine 66)	3.46	Maddarr: SSE of Foul Point	The Aboriginal Affairs Planning Authority (Dept Indigenous Affairs)	Use and benefits Aboriginal inhabitants	Bindunbur

67 (vine 68)	15.62	E Sandy Point near mouth of Yallet Creek,N shore of Beagle Bay inlet	The Aboriginal Affairs Planning Authority (Aboriginal Lands Trust)	Use and benefits Aboriginal inhabitants	Bindunbur
68 (vine 69)	12.06	ESE of Cliff Point, N shore of Beagle Bay	The Aboriginal Affairs Planning Authority (Aboriginal Lands Trust)	Use and benefits Aboriginal inhabitants	Bindunbur
69 (vine 70)	21.90	SE of Cliff Point, N shore of Beagle Bay	The Aboriginal Affairs Planning Authority (Aboriginal Lands Trust)	Use and benefits Aboriginal inhabitants	Bindunbur
70 (vine 71)	29.35	Lombadina-Djarindjin townsite	Shire of Broome		Bardi Jawi
			Aboriginal Land Trust	AR	Bardi Jawi
71 (vine 02b)	8.42	S side of Cygnet Bay, NE Dampier Peninsula (Patch 29/1 in McKenzie *et al*. 1991)			Bardi Jawi
72 (vine 03b,c)	153.95	N of Cape Borda, NW Dampier Peninsula (patch 29/2 McKenzie *et al*. 1991)	Leasee	Pastoral	Bardi Jawi
73 (JPP nth)	0.82	Waterbank. N of James Price Point, in creekline	Shire of Broome	Public road	Goolarabooloo
74 (Murphey Ck)	3.03	South of vine68	Aboriginal Land Trust	Use and benefits Aboriginal inhabitants	Bindunbur
75 (middle Lagoon)	11.28	Middle Lagoon, NW Dampier Peninsula	Aboriginal Land Trust	Use and benefits Aboriginal inhabitants	Bindunbur
76 (vine 67b)	10.54	E of Cliff Point (N of Beagle Bay inlet)	The Aboriginal Affairs Planning Authority (Aboriginal Lands Trust)	Use and benefits Aboriginal inhabitants	Bindunbur
77	0.79	E of Cliff Point (N of Beagle Bay inlet)	The Aboriginal Affairs	Use and benefits	Bindunbur

(vine 67c)			Planning Authority (Aboriginal Lands Trust)	Aboriginal inhabitants	
78 (BPen 01)	19.96	Kavite Rd Broome townsite.	Yawuru Native Title Holders Aboriginal Corporation (NBY), Shire of Broome and Broome Port Authority	Conservation, recreation, use and benefit of aboriginal inhabitants Harbour Purposes, House	Edarrbur (Rubibi Yawuru)
79 (BPen 02)	88.4	Port Drive Broome townsite	- Yaruwu Native Title Holders Aboriginal Corporation (NBY) Broome Port Authority, Shire of Broome	Conservation, recreation, use and benefit of aboriginal inhabitants. Conservation, culture, recreation Golf, public recreation, golf course, sewerage treatment works Quarry, pistol club, resort,	Edarrbur (Rubibi Yawuru)
80 (Perp Hd01)	31.7	North of Beagle Bay townsite (Chimney Rocks/Perpendicular Head)	Aboriginal Land Trust	Use and benefits Aboriginal inhabitants	Bindunbur
81 (Map Bch0 1)	12.5	North of Beagle Bay townsite (North Head/Mercedes Cove)	Aboriginal Land Trust	Use and benefits Aboriginal inhabitants	Bindunbur
82 (Bilun gurr0 1)	About 3.7ha? Not Mapped	South end Lullfitz Drive, Broome townsite, East side of Pleistocene dune, east of Hidden Valley	Yarawu Native Title Holders Aboriginal Corporation (Nyambu Buru Yawuru or NBY)	Use and benefits Aboriginal inhabitants	Edarrbur (Rubibi Yawuru)
83 (Broo meM VT01)	Not mapped	South of junction of Lullfitz and Fairway Drv Broome	Yawuru Native Title Holders Aboriginal Corporation	Native title exists in parts of the determination area	Edarrbur (Rubibi Yawuru)
84 (sister sYalla d)	18.1	North west of Beagle Bay community	Aboriginal Affairs Planning Authority.	Use and benefits Aboriginal inhabitants	Bindunbur
85 (Carn	16.8	Near mouth of Carnot Bay creek, south west of Beagle Bay	Aboriginal Affairs Planning Authority	Use and benefits Aboriginal inhabitants	Bindunbur

otMVT1)					
86 (CarnotMVT2)	8.4	Near mouth of Carnot Bay creek, south west of Beagle Bay	Aboriginal Affairs Planning Authority	Use and benefits Aboriginal inhabitants	Bindunbur
87 (NNpeaks)	2.1	South west of King Peaks	Aboriginal Affairs Planning Authority Shire of Broome	Use and benefits Aboriginal inhabitants Infrastructure/Pubic Use	Bindunbur
88 (MidlleLagoonSW)	1.0	South of Middle Lagoon, near Neem Creek	Aboriginal Affairs Planning Authority.	Use and benefits Aboriginal inhabitants	Bindunbur
89 (Surf01)	0.4	North of Broome townsite	Shire of Broome	Drainage, Parking, Recreation, Beach Facility, Club, Shop	Edarrbur (Rubibi Yawuru)
90 (Tappers01)	Not mapped	Tappers Inlet	Aboriginal Affairs Planning Authority.	Use and benefits Aboriginal inhabitants	Bindunbur

Occurrences are listed in order as they occur in the TEC database

* Department of Planning / Western Australian Planning Commission

** D=drainage, P=parking, R=recreation, BF=beach facility, C=club, AR= Aboriginal Reserve

***Unallocated Crown Land

APPENDIX 2: THREATS

Occ. #	**Issues / current and future threats**	**Major Weeds (TEC database, Black *et al.* 2010, Environs Kimberley personal communication)**	**Condition, other comments** (vegetation condition is based on Keighery (1994) condition scales)
1	Historical impacts of stock Weed invasion Storm water runoff and flooding Trampling Inappropriate fire regime Climate change	*Antigonon leptopus* *Azadirachta indica* *Aerva javanica* *Carica papaya* *Cenchrus biflorus* *Cenchrus echinatus* *Cenchrus ciliaris* *Cenchrus setiger* *Chloris virgata* *Clitoria ternatea* *Delonix regia* *Hyptis suaveolens* *Jatropha gossypifolia* *Khaya senegalensis* *Leucaena leucocephala* *Macroptilium atropurpureum* *Merremia aegyptia* *Merremia dissecta* *Passiflora foetida var. hispida* *Peltophorum pterocarpum* *Stylosanthes hamata*	Black *et al.* (2010) described this as the most degraded patch of all. Recorded as Good condition on Keighery (1994) condition scales. Ground truthing required to clarify boundary between Occurrences 1 and 2.
2	Impacts of stock Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Azadirachta indica* *Cenchrus ciliaris* *Leucaena leucocephala* *Passiflora foetida* var. *hispida*	Good, but some new incursion of weeds. Boundary mapping needs checking - landward side of the dune system.
3	Impacts of stock Inappropriate fire regime Clearing Weed invasion Climate change (Cattle tracks, lots of feral pig signs (recorded by S. Black in 2001))	*Cenchrus biflorus*	Very good
4	Impacts of stock Inappropriate fire regime Clearing Weed invasion Climate change	*Cenchrus ciliaris* *Passiflora foetida* var. *hispida* *Naturalised within vine thicket and on the degraded western strip near the airstrip surrounding the resort:* *Azadirachta indica* *Aerva javanica* *Cenchrus echinatus* *Cenchrus ciliaris* *Clitoria ternatea* *Gossypium hirsutum* *Hyptis suaveolens* *Leucaena leucocephala* *Macroptilium atropurpureum* *Ocimum basiliscum* *Merremia aegyptia* *Merremia dissecta* *Passiflora foetida* var. *hispida*	Good, some areas heavily impacted by fire and grass weeds.
5	-	-	
6	Impacts of stock Inappropriate fire regime Clearing	*Passiflora foetida* var. *hispida*	Excellent

	Weed invasion Climate change		
7	Innapropriate fire regime Small numbers of feral cattle Clearing Weed invasion Climate change	-	Excellent
8	Unofficial rubbish tip adjacent Development plans in recent history but planned as cultural site – most likely coastal park. Fire at wrong time greatest threat, old cattle and camel camp (mid 80s) Weed invasion Climate change Storm water runoff Trampling	*Azadirachta indica* *Cenchrus ciliaris* *Cenchrus biflorus* *Cenchrus setiger* *Delonix regia* *Leucaena leucocephala* *Macroptilium atropurpureum* *Merremia dissecta* *Physalis alkekengii* *Passiflora foetida var. hispida*	Excellent except degraded edge. Potentially the infestation from the Japanese garden rural properties – bird spread seeds.
9	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Cenchrus setiger* *Tribulus* sp. (Caltrop)	Excellent
10	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Cenchrus ciliaris* *Citrullus lanatus* *Stylosanthes hamata*	Excellent
11	-	-	
12	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	-	Excellent
13	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Cenchrus ciliaris* *Citrullus lanatus* *Passiflora foetida* var. *hispida*	85 % Cmpltly degraded 15 % Excellent
14	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Cenchrus ciliaris* *Citrullus lanatus* *Passiflora foetida* var. *hispida*	Good to degraded
15	Inappropriate fire regimes Minor impacts of cattle Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Excellent
16	Inappropriate fire regimes Minor impacts of cattle Clearing Weed invasion Climate change	-	Excellent
17	Clearing Weed invasion Cleared strip of vine thicket cleared to birdwood. Siratro. Inappropriate fire regime Impact of feral animals Climate change	*Cenchrus ciliaris* *Cenchrus setiger* *Macroptilium atropurpureum* *Passiflora foetida* var. *hispida* *Stylosanthes hamata*	10 % Cmpltly degraded 90 % Excellent
18	-	*Cenchrus ciliaris* *Hyptis suaveolens* *Macroptilium atropurpureum*	

19	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	-	Excellent
20	Inappropriate fire regimes Previous impacts of cattle Weed invasion Impact of feral animals Climate change Clearing Erosion	*Passiflora foetida* var. *hispida* *Tribulus sp.* (Caltrop)	Excellent
21	Inappropriate fire regimes Previous impacts of cattle Clearing Weed invasion Climate change	-	Excellent Hopping mouse tracks noted in sand as at Cape Bouda Vine thicket is a thin strip
22	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change Rubbish	*Cenchrus ciliaris*	Excellent *Acyranthes aspera* recorded in occurrence
23	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	-	Very good
24	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	-	Excellent
25	Inappropriate fire regimes Previous impacts of cattle Clearing Weed invasion Climate change	-	Excellent
26	Inappropriate fire regimes Previous impacts of cattle Clearing Weed invasion Climate change	-	Excellent
27	Inappropriate fire regimes Previous impacts of cattle Clearing Weed invasion Climate change	-	Excellent
28	Clearing and housing construction Inappropriate fire regime Weed invasion Impact of feral animals Climate change	*Passiflora foetida* var. *hispida*	Good 5 % Excellent 95 %
29	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Passiflora foetida* var. *hispida*	Excellent
30	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Very good
31	Impacts of feral pigs digging up	*Cenchrus setiger*	Good 5 %

	roots of plants at edge Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Very Good 95 %
32	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	-	Excellent
33	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	*Cenchrus setiger* *Hyptis suaveolens* *Passiflora foetida* var. *hispida*	Excellent
34	-	-	
35	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	-	Excellent
36	Sand dune encroachment Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	-	Excellent
37	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change Wind erosion	-	Excellent
38	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	-	Excellent
39	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	-	Excellent Wallaby tracks.
40	-	-	
41	-	-	
42	-	*Aerva javanica* *?Calotropis* sp. (rubber tree) *Cenchrus ciliaris* *Cenchrus setiger* *Clitoria ternatea* *Passiflora foetida* var. *hispida* *Stylosanthes hamata*	
43	Clearing and urban development Inappropriate fire regimes and disturbance due to recreational activities Presumed slightly modified due to altered fire regimes Weed invasion Disturbance due to recreational	*Azadirachta indica* *Aerva javanica* *Cenchrus echinatus* *Cenchrus ciliaris* *Cenchrus setiger* *Clitoria ternatea* *Delonix regia* *Hyptis suavolens*	Completely degraded 20 % Very Good 30 % Excellent 50 % Lawgrounds unsurveyed

	activities Storm water runoff	*Leucaena leucocephala* *Macroptilium atropurpureum* *Merremia dissecta* *Passiflora foetida* var. *hispida* *Stylosanthes hamata* *Stachytarpheta* sp. (snake weed) On sports oval (Adjacent): *Cenchrus ciliaris* *Merremia dissecta* *Macroptilium atropurpureum* *Hyptis suaveolens* *Tribulus terrestris* *Senna occidentalis* *Naturalised in town-site:* *Antigonon leptopus* *Calotropis procera* *Delonix regia* *Ipomoea quamoclit* *Lantana camara* *Tribulus* sp.	
44	Inappropriate fire regimes Dumping of rubbish Abandoned building Clearing Weed invasion Impact of feral animals Climate change	*Cenchrus setiger* *Stylosanthes hamata* *Trianthema portulacastrum* *Tridax procumbens*	Very Good
45	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	-	Excellent
46	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change and changed water levels	-	Excellent
47	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	-	Excellent
48	Mostly inappropriate fire regimes Some impacts of cattle past and present Clearing Weed invasion Climate change	*Cenchrus setiger*	Very Good
49	Occurrence on dune island surrounded by intertidal mudflats, appears protected from bush fire for long time Impact of feral animals Climate change Weed invasion	*Senna surattensis* subsp. *sulfurea*	Excellent
50	Inappropriate fire regimes Past impacts of cattle Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Excellent
51	Inappropriate fire regimes Past impacts of cattle Clearing	*Cenchrus setiger* *Passiflora foetida* var. *hispida*	Excellent

	Weed invasion Climate change		
52	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Cenchrus ciliaris* *Cenchrus setiger* *Passiflora foetida* var. *hispida*	Very Good
53	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Cenchrus ciliaris* *Passiflora foetida* var. *hispida*	Very Good
54	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Very Good
55	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	-	Excellent
56	Inappropriate fire regimes Possibly past impacts of cattle Weed invasion Vehicular damage	*Cenchrus setiger* *Passiflora foetida* var. *hispida* *Stylosanthes hamata*	Very Good A rare previously unrecorded plant possibly located here - data may be available in volunteer records.
57	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida* *Stylosanthes hamata*	Excellent
58	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion	*Passiflora foetida* var. *hispida*	Very Good
59	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Cenchrus ciliaris* *Cenchrus setiger* *Passiflora foetida* var. *hispida*	Excellent
60	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Azadirachta indica* *Cenchrus ciliaris* *Passiflora foetida* var. *hispida*	Excellent
61	Inappropriate fire regimes and possibly past impacts of cattle Clearing Weed invasion Climate change	*Azadirachta indica* *Cenchrus ciliaris* *Clitoria ternatea* *Merremia dissecta* *Passiflora foetida* var. *hispida* *Senna surattensis* subsp. *sulfurea*	Very Good
62	Weed invasion Recreational use Inappropriate fire regimes Possibly past impacts of cattle Potential industrial development – clearing for jetty access Camping and recreation Climate change Trampling Altered hydrology due to road construction Road widening – spreading	*Aerva javanica* *Cenchrus echinatus* *Cenchrus setiger* *Cenchrus biflorus* *Cenchrus ciliaris* *Hyptis suavolens* *Leucaena leucocephala* *Macroptilium atropurpureum* *Passiflora foetida* var. *hispida* *Trianthema portulacastrum* *Tribulus* sp. (Caltrop)	Very Good 30 % Excellent 70 %

	mintweed and buffel grass Stray cattle		
63	Weed invasion Impacts of receational use Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change Trampling Camping	*Aerva javanica* *Antigonon leptopus* *Arundo donax* (bamboo) *Azadirachta indica* *Cenchrus ciliaris* *Cenchrus setiger* *Clitoria ternatea* *Coccinia grandis* *Delonix regia* *Hyptis suavolens* *Leucaena leucocephala* *Macroptilium atropurpureum* *Mangifera indica* (mango) *Merremia aegyptia* *Merremia dissecta* *Ocimum basilcum* *Passiflora foetida* var. *hispida* *Stylosanthes hamata*	Excellent
64	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Aerva javanica* *Cenchrus ciliaris* *Cenchrus setiger* *Passiflora foetida* var. *hispida* *Passiflora foetida* *Parkinsonia* - possible previous (controlled) infestation	Very Good
65	Inappropriate fire regime Feral cattle Weed invasion	*Passiflora foetida* var. *hispida*	Cmpltly degraded 10 % Excellent 90 %
66	Inappropriate fire regime Clearing Weed invasion Impact of feral animals Climate change	*Trianthema portulacastrum* *Passiflora foetida* var. *hispida* *Azadirachta indica*	Excellent
67	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change Outstation development Recreation	*Cenchrus ciliaris* *Cenchrus biflorus* or *C. echinatus* *Passiflora foetida* var. *hispida* *Tribulus* sp. (Caltrop – large and small species)	Excellent
68	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Cenchrus ciliaris* *Cenchrus echinatus* *Passiflora foetida* var. *hispida* *Tribulus* sp.	Excellent *Achyranthes aspera* recorded.
69	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Azadirachta indica* *Passiflora foetida* var. *hispida* *Chenchrus ciliaris* *Tribulus* sp	Excellent
70	Inappropriate fire regimes Possibly past impacts of cattle Clearing Weed invasion Climate change	*Aerva javanica* *Cenchrus setiger* *Passiflora foetida* var. *hispida*	Excellent
71	Inappropriate fire regimes Weed invasion Clearing Impact of feral animals Climate change Trampling Vehicle access	*Aerva javanica* *Azadirachta indica* *Cenchrus biflorus* *Cenchrus ciliaris* *Cenchrus echinatus* *Cenchrus setiger* *Chloris virgata*	Good to degraded

		Clitoria ternatea *Hibiscus sabdariffa* *Hyptis suaveolens* *Jatropha gossypifolia* *Leucaena leucocephala* *Macroptilium atropurpureum* *Merremia aegyptia* *Merremia dissecta* *Passiflora foetida var. hispida* *Stachytarpheta cayennensis* *Stylosanthes hamata* Naturalised in town-site: *Delonix regia* Growing in town-site: *Cryptostegia madagasgariensis*	
72	Inappropriate fire regimes Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Excellent
73	Inappropriate fire regime Clearing Weed invasion Climate change	*Passiflora foetida* var. *hispida*	Very good
74	Inappropriate fire regimes Weed invasion Climate change Camping Rubbish dumping	*Cenchrus* sp. *Passiflora foetida* var. *hispida*	Good
75	Recreational impacts Weed invasion Inappropriate fire regime Climate change Sand dune erosion and movement Camping, Excessive 4WD tracks Rubbish dumping Vandalism of vegetation	*Cenchrus ciliaris* *Passiflora foetida* var. *hispida*	Good. Only occurrence of *Diospyros maritima* on the Dampier Peninsua
76	Inappropriate fire regime Weed invasion Past impacts of cattle	*Cenchrus biflorus* *Passiflora foetida* var. *hispida*	Excellent
77	Inappropriate fire regime Weed invasion Climate change	*Cenchrus ciliaris*	Good
78	Land clearing, weed invasion, Inappropriate fire regime, rubbish dumping, water contamination	*Aerva javanica* *Azadirachta indica* *Cenchrus biflorus* *Cenchrus ciliaris* *Cenchrus setiger* *Clitoria ternatea* *Cryptostegia madagascariensis* *Hyptis suaveolens* *Jatropha gossypiifolia* *Leucaena leucocephala* *Macroptilium atropurpureum* *Mangifera indica* *Merremia aegyptia* *Merremia dissecta* *Mimosa pigra* *Passiflora foetida* var. *hispida*	Good (65%) Very Good (35%)
79	Land clearing, weed invasion, inappropriate fire regime, rubbish dumping, water contamination	As for Occurrence 78	Completely degraded (10%) Degraded (25%) Good (30%) Very Good (20%) Excellent (15%)
80	Weed invasion, inappropriate fire	*Azadirachta indica*	Excellent (95%)

	regime, uncontrolled 4x4 access		Good (5%)
81	Weed invasion, inappropriate fire regime, uncontrolled 4x4 access	*Passiflora foetida* var. *hispida* *Tribulus terrestris*	Excellent (80%) Good (20%)
82	Hydrological change, rubbish dumping, weed invasion	*Aerva javanica* *Azadirachta indica* *Cenchrus ciliaris* *Calotropis procera* *Hyptis suaveolens* *Macroptilium atropurpureum* *Meremia dissecta* *Passiflora foetida* var. *hispida*	Very Good to Good condition
83	Survey incomplete	Unknown	Unknown
84	Weed invasion, inappropriate fire regime	*Passiflora foetida*	Excellent (10%) Very Good (90%)
85	Weed invasion, uncontrolled 4x4 access, too frequent hot fire, rubbish dumping	*Cenchrus ciliaris*	Excellent
86	Weed invasion, uncontrolled 4x4 access, too frequent hot fire, rubbish dumping	*Cenchrus ciliaris*	Excellent
87	Weed invasion, uncontrolled 4x4 access, too frequent hot fire	*Cenchrus ciliaris* *Passiflora foetida*	Excellent
88	Weed invasion, too frequent hot fire	*Cenchrus ciliaris* *Passiflora foetida*	Excellent
89	Land clearing, weed invasion,	*Azadirachta indica, Passiflora foetida,* *Leucaena leucocephala*	Excellent (50%) Very Good (50%)
90	Weed invasion, inappropriate fire	*Passiflora foetida*	Pristine (80%) Excellent (20%)

APPENDIX 3: SURVEY CURRENCY AND ABORIGINAL SITES

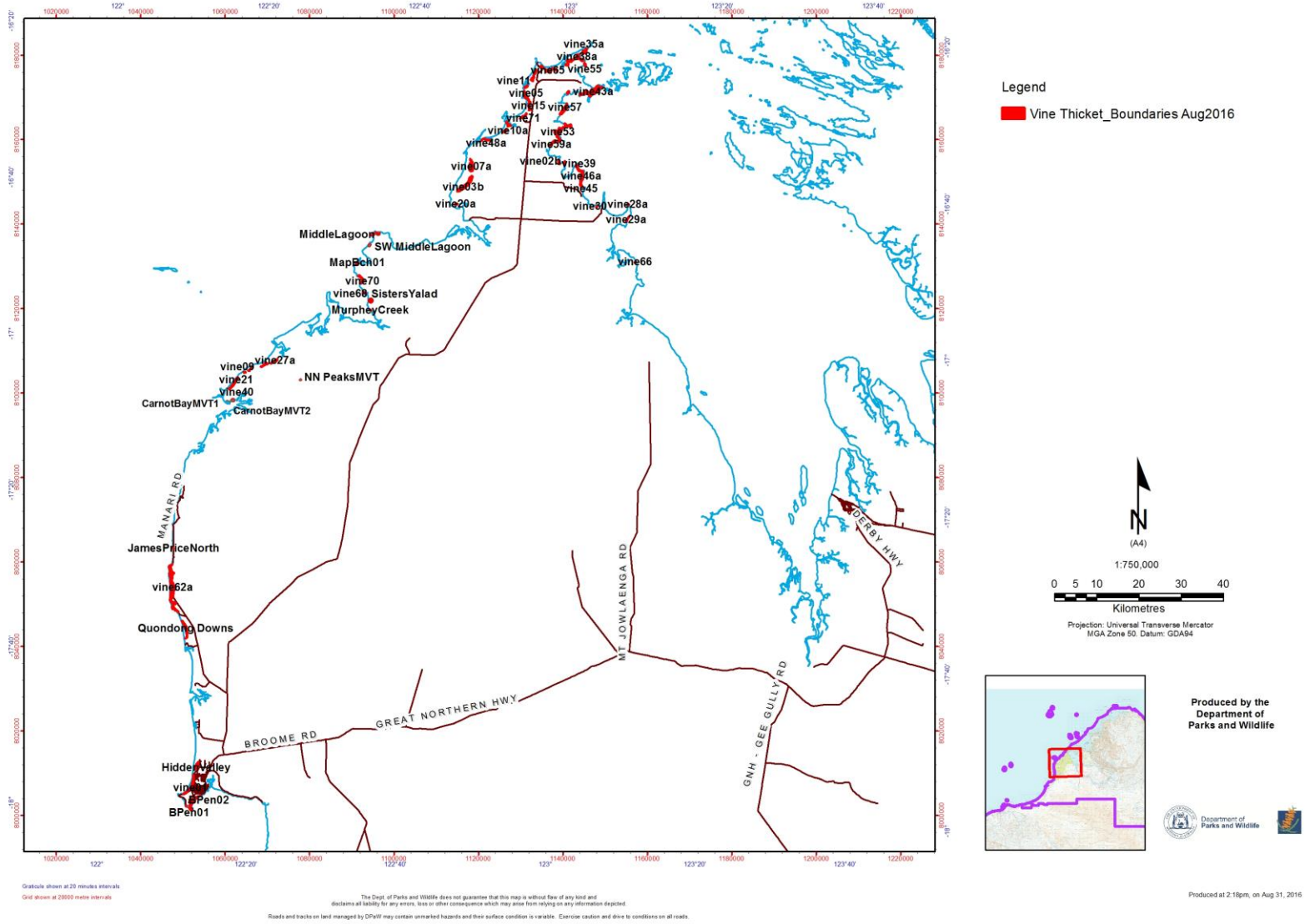
Occ. #	Date last surveyed (TEC database)	Surveys	Aboriginal significance (from Sites Register
1	02/2010	Kimberley Rainforest Survey (site WK01) TECs Outside SW A flora and vegetation survey of part of Broome coastline, Environmental weeds of Minyirr Coastal Park, Broome	Mythological, Artefacts / Scatter /Midden
2	13/08/2002	Kimberley Rainforest Survey (site 29/1) CALM & Broome Botanical Society	None identified
3	27/08/1999	Kimberley Rainforest Survey (site 29/2) Field survey, TECs and Ecosystems projects, CALM	Artefacts/Scatter
4	01/06/1987	Kimberley Rainforest Survey (site 29/4)	Artefacts / Scatter / Midden/significant sites
5	None		Man-made structures/Artefacts, Scatter / Midden
6	24/07/2003	Conserving TECs outside SW, West Kimberley District &	
7	23/07/2001		None registered
8	16/08/2008 02/2010	Flora and vegetation survey of part of Broome coastline Viewed from ridge only	Law ground and burial ground
9	17/07/2000	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
10	14/08/2008	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project Field reconnaissance Mapped part of boundary	Unidentified site
11	None		Man-made structures/Artefacts, Scatter / Midden
12	21/07/2000	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Unidentified site
13	21/07/2000	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Man-made structures/Artefacts, Scatter / Midden
14	None		None identified
15	25/08/2002	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Man-made structures/Artefacts, Scatter / Midden
16	24/10/2003	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
17	22/07/2000	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Ceremonial / Repository / Cache / Mythological
18	?2002 Cygnet Bay		Ceremonial / Repository / Cache / Mythological / Scatter
19	09/07/2008	Monitoring reconnaissance trip	None registered
20	25/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Adjacent to Artefacts/Scatter site
21	27/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
22	27/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
23	28/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
24	29/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
25	29/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
26	29/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered

27	29/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None registered
28	31/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Not specified
29	31/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	Not specified
30	31/07/2001	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project	None identified
31	08/07/2008	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project Monitoring reconnaissance trip	Artefacts / Scatter / Midden
32	08/07/2008	Monitoring reconnaissance trip Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Mythological / Ceremonial / Artefacts / Scatter
33	08/07/2008	Monitoring reconnaissance trip Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Not identified
34	None		Skeletal material/Burial, Man-Made Structure, Artefacts / Scatter, Midden
35	05/08/2001	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Mythological / Man-Made Structure, Artefacts / Scatter, Midden / Ceremonial
36	3/08/2008	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Midden / Scatter / Mythological / Fish Trap
37	13/08/2008	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Midden / Scatter / Mythological / Fish Trap
38	05/08/2001	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Ceremonial / Artefacts / Scatter / Mythological
39	06/08/2001	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Fish Trap / not specified
40	None		None registered
41	None		Artefacts / Scatter / Midden
42	None		Fish Trap / Ceremonial
43	06/09/2002	Conserving TECs outside the SW	Ceremonial / Repository / Cache / Mythological
44	13/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Not specified
45	14/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Not specified
46	4/08/2008	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project Mapped boundary	Not specified
47	16/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None registered
48	16/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None registered
49	18/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Man-made structures/Artefacts, Scatter / Midden
50	18/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Man-made structures/Artefacts, Scatter / Midden
51	18/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Man-made structures/Artefacts, Scatter / Midden . Fish Trap
52	19/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None identified
53	19/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Man-made structures/Artefacts, Scatter / Midden
54	21/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Midden / Scatter / Mytholgogical
55	21/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Fish Trap / Mythological
56	15/08/2008	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project Partial boundary and condition survey	Ceremonial / Repository / Cache / Mythological / Scatter

57	23/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Man-Made Structure / Artefacts Midden / Scatter
58	23/08/2003	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Man-Made Structure / Artefacts Midden / Scatter
59	24/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Skeletal material / Burial
60	24/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None identified
61	24/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None identified
62	02/2010	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project Biodiversity, Conservation and Attractions and Broome Botanical Society survey 2010	Mythological, Artefacts / Scatter, Midden / Scatter / Ceremonial Skeletal material/Burial / Fish Trap
63	02/09/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Mythological / Artefacts / Scatter / Midden
64	02/09/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	Mythological / scatter midden / artefacts
65	13/08/2008	Conserving TECs outside SW, West Kimberley District & Broome Botanical Society project Field reconnaissance Mapped occurrence using GPS	Skeletal material/Burial, Man-Made Structure, Artefacts / Scatter, Midden / Scatter
66	06/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None identified
67	02/2010	Briefly surveyed by Biodiversity, Conservation and Attractions, Nyul Nyul Rangers, Environs Kimberley and Broome Botanical Society 2010	Fish Trap, Artefacts / Scatter
68	02/2010	Briefly surveyed by Biodiversity, Conservation and Attractions, Nyul Nyul Rangers, Environs Kimberley and Broome Botanical Society 2010	Fish Trap
69	11/08/2002	Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None registered
70	11/08/2002	Conserving TECs outside the SW, West Kimberley District and Broome Botanical Society project	None registered
71	20/08/2002	McKenzie *et al* (1991) Kimberley Rainforest survey Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project	None registered
72	02/2010	McKenzie et al. (1991) -Kimberley Rainforest survey Conserving TECs outside the SW, West Kimberley District & Broome Botanical Society project Biodiversity, Conservation and Attractions and Broome Botanical Society survey	Artefacts / Scatter / Camp
73	02/2010	Biodiversity, Conservation and Attractions and Broome Botanical Society survey	Artefacts / Scatter, Midden / Scatter
74	02/2010	Biodiversity, Conservation and Attractions and Broome Botanical Society survey	Fish trap
75	02/2010	Biodiversity, Conservation and Attractions and Broome Botanical Society survey	Art, scatter, midden
76	02/2010	Conserving TECs outside the SW, West Kimberley District, Broome Botanical Society project Biodiversity, Conservation and Attractions and Broome Botanical Society survey	Fish Trap, artefacts, scatter
77	02/2010	Conserving TECs outside the SW, West Kimberley District, Broome Botanical Society project Biodiversity, Conservation and Attractions and Broome Botanical Society survey	None registered
78	26/03/2013	NBY, Environs Kimberley, SKIPA, Biodiversity, Conservation and Attractions	Artifacts/scatter, mythological, ceremonial, midden/scatter
79	26/03/2013	NBY, Environs Kimberley, SKIPA, Biodiversity, Conservation and Attractions	Artifacts/scatter, mythological, ceremonial, midden/scatter
80	11/9/2015	Nyul Nyul rangers, Environs Kimberley, Biodiversity, Conservation and Attractions	None registered
81	11/9/2015	Nyul Nyul rangers, Environs Kimberley, Biodiversity, Conservation	None registered

		and Attractions	
82	24/11/2014	Yawuru rangers, Broome Botanical Society, Environs Kimberley, Biodiversity, Conservation and Attractions	Skeletal material, burial
83	01/03/2015	Environs Kimberley, Broome Botanical Society project	Mythological
84	12/04/2016	Nyul Nyul Rangers	None registered
85	04/04/2016	Environs Kimberley, Nyul Nyul Rangers	None registered
86	04/04/2016	Environs Kimberley, Nyul Nyul Rangers	None registered
87	04/04/2016	Environs Kimberley, Nyul Nyul Rangers	None registered
88	06/04/2016	Environs Kimberley, Nyul Nyul Rangers.	None registered
89	19/07/2017	Environs Kimberley, Nyamba Buru Yawuru	Mythological
90	09/05/2017	Environs Kimberley,Nyul Nyul Rangers	None registered

APPENDIX 4: LOCATION OF OCCURRENCES



APPENDIX 5: KEY TO OCCURRENCE NAMES

Occ. # in TEC database	Site name/s in TEC database	Patch # in Black *et al.* (2010)	Patch group - Black *et al.* (2010)	Special conservation significance (Black *et al.* 2010)	Other names
Occ 1	vine01	patch 01	B		Minyirr Park
Occ 2	vine02a, b	patch 52, 61	C, B	Vine 02a is well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 3	vine03a, b, c	patch 20	D		Yakka thickets
Occ 4	vine04q	patch 69			Kooljamin
Occ 5	vine05	patch 66			
Occ 6	vine06a, b, 3a	patch 21	E	Unusual structure; high priority for conservation/ protection	
Occ 7	vine07a, b, c, d, e	patch 22	E	Large patch – high priority for conservation/ protection	
Occ 8	vine08	patch 02	B		Hidden valley
Occ 9	vine09	patch 10	D	Healthy well structured patch, significant flora species, good species rich representative of patch group D; high priority for conservation/ protection	Red Bluff
Occ 10	vine10a, b	patch 25	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	Chile Creek
Occ 11	vine11	patch 67			Gnamagun
Occ 12	vine12	patch 27	E		Gulumonon
Occ 13	vine13	patch 72			? Marrgoon/Bygnunn community
Occ 14	vine14	patch 63			
Occ 15	vine15	patch 26	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 16	vine16	Not mapped by Black *et al.* 2010			
Occ 17	vine17	patch 39	C	Large patch in good condition, well structured, significant flora species in and adjacent; high priority for conservation/ protection	
Occ 18	vine18	patch 40	C	Well structured, significant flora species in and adjacent; high priority for conservation/ protection	
Occ 19	vine19	patch 64			
Occ 20	vine20a, b	patch 19	D		
Occ 21	Vine21	patch 07	D		Mundud oustation
Occ 22	vine22a, b	patch 06	D	Significant flora species, good species rich representative of patch group D; high priority for conservation/ protection	
Occ 23	vine23	patch 08	B		Red Block
Occ 24	vine24a, b	patch 11	C	Unusual composition and adjacent trasitional vegetation, significant flora species; high priority for conservation/ protection	
Occ 25	vine25	patch 12	C		
Occ 26	vine26	patch 13	D		
Occ 27	vine27a, b	patch 14	D	Significant flora species; high priority for conservation/ protection	
Occ 28	vine28a, b	patch 58	B		Cunningham Point
Occ 29	vine29a, b	patch 59	B	Only well formed representative of patch group B in immediate area; high	

				priority for conservation/ protection	
Occ 30	vine30	patch 57	B		
Occ 31	vine31a, b	patch 31	C		
Occ 32	vine32a, b	patch 30	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	Hunter Creek
Occ 33	vine33a, b, c	patch 29	C		
Occ 34	vine34	patch 70			
Occ 35	vine35a, b	patch 32	C		
Occ 36	vine36	patch 33	E		
Occ 37	vine37	patch 34	E		
Occ 38	vine38a, b	patch 35	C		Karrakatta Bay
Occ 39	vine39	patch 54	C		
Occ 40	vine40	patch 09			
Occ 41	vine41	patch 68			
Occ 42	vine42	patch 38	C		
Occ 43	vine43a,b,c	patch 71	C	Large patch – high priority for conservation/ protection	One Arm Point
Occ 44	vine44a, b	patch 53	C		
Occ 45	vine45	patch 56	C		
Occ 46	vine46a, b	patch 55	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 47	vine47	patch 24	E	Representative of patch group E; possibly high priority for conservation/ protection	Byrugun scrub
Occ 48	vine48a, b	patch 23	C		Tjarbormai Ck
Occ 49	vine49	patch 48	C		
Occ 50	vine50	patch 45	E	Good representative of patch group E, significant flora species; high priority for conservation/ protection	
Occ 51	vine51	patch 46	C		
Occ 52	vine52	patch 44	C		
Occ 53	vine53	patch 47	C	Large patch, species rich; high priority for conservation/ protection	Gallen
Occ 54	vine54a, b	patch 36	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 55	vine55	patch 37	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 56	vine56	patch 41	C	Significant flora species in and adjacent; high priority for conservation/ protection	
Occ 57	vine57	patch 42	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 58	vine58	patch 43	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 59	vine59	patch 51	C		Milligoon/Djaradjung
Occ 60	vine60	patch 49	D		
Occ 61	vine61	patch 50	C		
Occ 62	vine62a, b, 63a, b, 72	patch 05, 04, 62	B	Large patch, significant flora species, species rich, good representative of patch group B; high priority for conservation/ protection	Waterbank/James Price Point
Occ 63	vine64	patch 03	B		Quandong Downs
Occ 64	vine65	patch 28	C	Well structured species rich representative of patch group C; high priority for conservation/ protection	
Occ 65	vine67a, b, c	patch 18	B	Good representative of patch group B, significant flora species, well	

				structured; high priority for conservation/ protection	
Occ 66	Vine 66	Not mapped by Black *et al.* 2010			
Occ 67	vine68	Patch 15	B	Good representative of patch group B, significant flora species, well structured; high priority for conservation/ protection	"Gubin" (Ronny Corpus' block)
Occ 68	vine69	patch 17	B		Yallert
Occ 69	Vine70	patch 16	B		
Occ 70	vine71	patch 65			Lombadina-Djarindjin
Occ 71	vine02b	patch 65			
Occ 72	vine03b, c	patch 20	D	Large patch – high priority for conservation/ protection	
Occ 73	JamesPriceNorth	Not mapped by Black *et al.* 2010			Waterbank
Occ 74	MurphyCreek	Not mapped by Black *et al.* 2010			
Occ 75	MiddleLagoon	Not mapped by Black *et al.* 2010			
Occ 76	vine67b	Not mapped as separate occurrence by Black *et al.* 2010			
Occ 77	vine 67c	Not mapped as separate occurrence by Black *et al.* 2010			
Occ 78	Bpen01	Not mapped by Black *et al.* 2010			
Occ 79	Bpen02	Not mapped by Black *et al.* 2010			
Occ 80	PerpHd01	Not mapped by Black *et al.* 2010			
Occ 81	MapBch01	Not mapped by Black *et al.* 2010			
Occ 82	Bilungurr	Not mapped by Black *et al.* 2010			
Occ 83	BroomeMVT01	Not mapped by Black *et al.* 2010			
Occ 84	SistersYallad	Not mapped by Black *et al.* 2010			
Occ 85	CarnotMVT1	Not mapped by Black *et al.* 2010			
Occ 86	CarnotMVT2	Not mapped by Black *et al.* 2010			
Occ 87	NNpeaks	Not mapped by Black *et al.* 2010			
Occ 88	MiddleLagoonSW	Not mapped by Black *et al.* 2010		Environs Kimberley, Nyul Nyul Rangers noted the substrate is sandstone. Has similar composition to other vine thicket ocurrences and is surrounded by pindan.	
Occ 89	Surf01	Not mapped by Black *et al.* 2010			
Occ 90	Tappers01	Not mapped by Black *et al.* 2010			

APPENDIX 6: VASCULAR PLANTS IN OCCURRENCES

(From TEC Database April 2015)

	Taxon		Taxon
	Abrus precatorius (Crabs Eyes)		*Glycosmis* sp.
	Abutilon andrewsianum		*Gomphrena* sp.
	Abutilon indicum (Indian Lantern Flower)		*Gossypium australe* (Native Cotton)
	Abutilon sp		*Grewia breviflora*
	Acacia bivenosa		*Grewia retusifolia* (Dog's Balls)
	Acacia colei		*Gymnanthera oblonga*
	Acacia monticola (Gawar)		*Gyrocarpus americanus* (Helicopter Tree)
	Acacia neurocarpa		*Gyrocarpus americanus* subsp. *pachyphyllus*
	Acacia platycarpa (Pindan Wattle)		*Hakea arborescens* (Common Hakea)
	Acacia tumida (Pindan Wattle)		*Hakea macrocarpa*
	Acacia wickhamii		*Hakea* sp
	Achyranthes aspera (Chaff Flower)		*Helicteres rhynchocarpa*
	Adansonia gregorii (Boab)		*Heliotropium* sp
	Adenia heterophylla		*Heteropogon contortus* (Bunch Speargrass)
	Adenia heterophylla subsp. *australis*		*Hibiscus austrinus*
	Adriana tomentosa (Bitter Bush)		*Hibiscus meraukensis* (Merauke Hibiscus)
*	*Aerva javanica* (Kapok Bush)		*Hibiscus* sp.
*	*Amaranthus hybridus* (Slim Amaranth)		*Hypoestes floribunda* (Bunu)
	Amaranthus sp.		*Hypoestes floribunda* var. *varia*
	Amyema benthamii	*	*Hyptis suaveolens* (Hyptis)
	Amyema bifurcata		*Ipomoea pes-caprae* subsp. *brasiliensis*
	Amyema sanguinea		*Ipomoea* sp.
	Asparagus racemosus		*Jacquemontia paniculata*
	Atalaya hemiglauca (Whitewood)		*Jasminum didymum*
	Atalaya variifolia (Wingleaf Whitewood)		*Jasminum molle*
*	*Azadirachta indica*	*	*Jatropha gossypifolia* (Bellyache Bush)
	Bauhinia cunninghamii	*	*Leucaena leucocephala* (Leucaena)
	Bauhinia sp		*Lophostemon grandiflorus*
	Boerhavia dominii		*Lophostemon grandiflorus* subsp. *grandiflorus*
	Boerhavia sp.		*Lophostemon grandiflorus* subsp. *riparius*
	Brachychiton diversifolius (Northern Kurrajong)		*Luvunga monophylla*
	Brachychiton diversifolius subsp. *diversifolius*		*Lysiana spathulata*
	Breynia cernua		*Lysiana spathulata* subsp. *spathulata*
	Bridelia tomentosa	*	*Macroptilium atropurpureum* (Purple Bean)
	Bulbostylis barbata	*	*Magnifera indica*
	Bulbostylis sp		*Mallotus nesophilus*
	Caesalpinia major		*Melaleuca alsophila*
	Caesalpinia sp		*Melaleuca dealbata* (Karnbor)
	Calandrinia strophiolata		*Melaleuca viridiflora* (Broadleaf Paperbark)
*	*Calotropis gigantea*	*	*Merremia dissecta*
	Calytrix exstipulata (Kimberley Heather)	*	Meremia aegyptia
	Canarium australianum (Jalkay)		*Microstachys chamaelea*
	Canavalia rosea (Wild Jack Bean)	*	Mimosa pigra
	Canavalia sp		*Mimusops elengi* (Walara)
	Capparis jacobsii		*Mukia maderaspatana*
	Capparis lasiantha (Split Jack)		*Myoporum montanum* (Native Myrtle)
	Capparis quiniflora		*Myoporum* sp
	Capparis sepiaria		*Operculina aequisepala*
*	*Carica* papaya (Pawpaw)		*Opilia amentacea*
	Carissa lanceolata (Conkerberry)		*Pandanus spiralis* (Screwpine)
	Cassytha capillaris		*Panicum decompositum* (Native Millet)
	Cassytha filiformis (Love Vine)		*Parinari nonda*
	Celtis australiensis	*	*Passiflora foetida* (Stinking Passion Flower)
	Celtis philippensis	*	*Passiflora foetida* var. *hispida*
	Celtis sp		*Pavetta kimberleyana*
*	*Cenchrus biflorus* (Gallon's Curse)		*Pavetta* sp
*	*Cenchrus ciliaris* (Buffel Grass)	*	*Peltophorum* pterocarpum (Yellow Poinciana)

	Cenchrus elymoides		*Persoonia acuminata*
*	*Cenchrus setiger* (Birdwood Grass)		*Persoonia falcata* (Wild Pear)
	Cenchrus sp		*Phyllanthus reticulatus*
*	*Chloris barbata* (Purpletop Chloris)		*Physalis* alkekengii (Chinese lantern)
	**Chloris virgata* (Feathertop Rhodes Grass)		*Pittosporum moluccanum*
	Chrysopogon pallidus (Ribbongrass)		*Planchonia careya* (Mangaloo)
	Cleome viscosa (Tickweed)		*Plumbago zeylanica* (Native Plumbago)
	Clerodendrum floribundum var. *ovatum*		*Polycarpaea longiflora*
	Clerodendrum sp		*Portulaca napiformis*
	Clerodendrum tomentosum		*Premna acuminata* (Ngalinginkal)
	Clerodendrum tomentosum var. *mollissima*		*Psoralea martinii*
*	*Clitoria ternatea*		*Psydrax pendulina*
	Corchorus pumilio		*Ptilotus exaltatus* var. *exaltatus* (Tall Mulla Mulla)
	Corchorus aestuans	*	*Pupalia lappacea*
	Corymbia bella		*Rulingia loxophylla*
	Corymbia dampieri		*Santalum lanceolatum* (Northern Sandalwood)
	Corymbia flavescens		*Sarcostemma sp.*
	Corymbia paractia		*Sarcostemma viminale*
	Corymbia polycarpa		*Sebastiania chamaelea*
	Crotalaria crispata (Kimberley Horse Poison)		*Secamone elliptica*
	Crotalaria cunninghamii (Green Birdflower)		*Senna costata*
	Crotalaria sp	*	*Senna occidentalis*
	Croton habrophyllus		*Senna surattensis* subsp. *sulfurea*
	**Cryptostegia madagascariensis*		*Sersalisia sericea* (Nangi)
	Cullen martinii		*Setaria apiculata* (Pigeon Grass)
	Cupaniopsis anacardioides (Tuckeroo)		*Setaria* sp.
	Cymbidium canaliculatum		*Sida hackettiana*
	Cymbopogon ambiguus (Scentgrass)		*Sida rohlenae* subsp. *occidentalis*
	Cymbopogon procerus (Lemon Grass)		*Sida* sp.
	Cymbopogon sp. (lemon scented grass)		*Solanum cunninghamii*
	Cynanchum carnosum		*Sorghum* sp.
	Cyperus bulbosus (Bush Onion)		*Spermacoce auriculata*
	Cyperus conicus		*Spinifex longifolius* (Beach Spinifex)
	Cyperus sp.		*Stackhousia* sp.
	Dendrophthoe acacioides subsp. *acacioides*	*	*Stylosanthes hamata* (Verano Stylo)
	Digitaria bicornis (Finger Grass)		*Syzygium eucalyptoides*
	Dioscorea bulbifera (Ganmanggu)		*Syzygium eucalyptoides* subsp. *bleeseri*
	Diospyros ferrea (Australian Ebony)		*Tacca leontopetaloides* (Gandungai)
	Diospyros humilis		*Tephromela* sp
	Diospyros maritima		*Tephrosia rosea* (Flinders River Poison)
	Diospyros rugosula		*Terminalia canescens* (Joolal)
	Dodonaea lanceolata (Pirrungu)		*Terminalia ferdinandiana* (Mador)
	Dodonaea platyptera		*Terminalia latipes*
	Ehretia saligna (False Cedar)		*Terminalia petioaris x ferdinandiana*
	Enneapogon pallidus (Conetop Nineawn)		*Terminalia petiolaris* (Masroorl)
	Enneapogon sp		*Thespesia populneoides* (Laba)
	Enneapogon sp.		*Tinospora smilacina* (Snakevine)
	Enteropogon dolichostachyus	*	*Trianthema portulacastrum* (Giant Pigweed)
	Eragrostis sp.	*	*Tribulus terrestris* (Caltrop)
	Erythroxylum ellipticum		*Trichodesma zeylanicum* (Camel Bush)
	Eucalyptus bella ms	*	*Tridax procumbens* (Tridax)
	Eucalyptus camaldulensis var. *obtusa* (Blunt-budded River Red Gum)		*Triodia bitextura*
	Eucalyptus tectifica (Darwin Box)		*Triodia microstachya*
*	*Euphorbia hirta* (Asthma Plant)		*Triodia pungens* (Soft Spinifex)
	Exocarpos latifolius (Broad-leaved Cherry)		*Triodia schinzii*
	Ficus aculeata		*Triodia* sp.
	Ficus opposita (Sandpaper Fig)		*Triumfetta* sp.
	Ficus platypoda (Native Fig)		*Tylophora cinerascens*
	Ficus virens (Albayi)		*Tylophora flexuosa*
	Fimbristylis sp.		*Ventilago viminalis* (Supplejack)
	Fioria vitifolia		*Vernonia cinerea* (Vernonia)

	Flagellaria indica (Gadji)		*Vigna vexillata* var. *angustifolia*
	Flueggea virosa		*Waltheria indica*
	Flueggea virosa subsp. *melanthesoides*		*Whiteochloa airoides*
	Gardenia pyriformis		*Wrightia saligna*
	Glycosmis sp.		*Zornia* sp.

Total = 246 species

* = Introduced

APPENDIX 7: STATUS OF FLORA TAXA

(Smith 2017)

Priority species
Species that maybe threatened or near threatened but are data deficient, have not yet been adequately surveyed to be listed under the Schedules of the Wildlife Conservation (Specially Protected Fauna) Notice or the Wildlife Conservation (Rare Flora) Notice, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

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

1: Priority One: Poorly-known species
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two: Poorly-known species
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three: Poorly-known species
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring
(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species
Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.