

Lepidosperma gibsonii

Recovery Plan



Revision 0

MGX & EHPL

June 2014

FORWARD

Recovery plans are developed within the framework laid down in Department of Environment and Conservation Policy Statements Nos. 44 and 50 (CALM 1992, 1994), and the Australian Government Department of Environment (DEWHA 2008a). Recovery plans outline the recovery actions that are required to address threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, so enhancing the recovery process.

The objectives of the plan will be planned for attainment. The provision of funds necessary to implement actions are subject to budgetary and other constraints affecting parties involved, as well as the need to address other business priorities.

Information in this recovery plan was accurate at June 2014.

Cover photograph: *Lepidosperma gibsonii*. Photograph: Kiera Foster (Parks and Wildlife).

Disclaimer: This Recovery Plan has been developed to meet Ministerial Statement 753 to the requirements of Minister for the Environment. This Plan provides updates information and material contained in the approved Interim Recovery Plan No 283, however it is noted that this Recovery Plan is yet to be formally reviewed by the Department of Parks and Wildlife and the Environmental Protection Authority.

Mount Gibson Mining and Extension Hill Pty Ltd and its employees do not guarantee that this publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence that may arise from you relying on any information in this publication.



Source: BGPA (2010)

ABBREVIATIONS

BGPA	Botanic Gardens and Parks Authority
BIF	Banded Ironstone Formation
CALM	Department of Conservation and Land Management, Western Australia (changed to Department of Environment and Conservation in July 2006)
DoE	Commonwealth Department of the Environment (formerly DSEWPaC)
DEC	Department of Environment and Conservation, Western Australia (changed to Department of Parks and Wildlife in July 2013)
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts (changed to DSEWPaC on 14 September 2010)
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (changed to DoE on 18 September 2013, formerly DEWHA)
Parks and Wildlife	Department of Parks and Wildlife, Western Australia (formerly DEC)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EHPL	Extension Hill Pty Ltd
DFES	Department of Fire and Emergency Services
GDTFRT	Geraldton District Threatened Flora Recovery Team
GNHwy	Great Northern Highway
IBRA	Interim Biogeographical Regionalisation for Australia
IUCN	International Union for Conservation of Nature
MGIOIP	Mount Gibson Iron Ore Mine and Infrastructure Project
MGM	Mount Gibson Mining Limited
NAN	Nuts About Natives
SCB	Species and Communities Branch, Parks and Wildlife
TPFL	Threatened and Priority Flora Database
UWA	The University of Western Australia
WA	Western Australia

Summary

Species:	<i>Lepidosperma gibsonii</i>	Common name:	none
Family:	Cyperaceae	Flowering period:	August to December (development); April to May (final development-pollen dispersal)
IBRA Regions:	Avon Wheatbelt	IBRA Subregions:	Avon Wheatbelt P1
Shire:	Yalgoo, Perenjori	NRM region:	Rangelands NRM – Murchison subregion, Northern Agricultural Catchment Council
DEC Region:	Midwest	DEC District:	Geraldton
		Recovery team:	Geraldton District Threatened Flora Recovery Team (GDTFRT)

Current status of taxon:

- Western Australia Wildlife Conservation Act 1950: Schedule 1, Extant and considered likely to become extinct or rare: ranked as Vulnerable D2 (using IUCN criteria)

This Plan identifies the following matters stipulated in MS753 Condition 7-3 items 1 to 6:

TABLE OF CONTENTS

1	INTRODUCTION	8
1.1.	PURPOSE AND BACKGROUND	8
1.2	THE TAXON.....	9
1.2.1	Description.....	9
1.2.2	Conservation Status.....	9
1.2.3	Biology and ecology.....	10
1.2.4	Habitat and distribution	10
1.3	POPULATION RECENT HISTORY.....	11
1.3.1	Abundance and distribution	11
1.3.2	Population size	14
1.3.3	Initial information on population genetics.....	14
1.3.4	Population areas of occupancy and extent of occurrence	14
2	HABITAT CRITICAL TO SURVIVAL OF THE PLANT SPECIES	16
3	THREATENING PROCESSES.....	20
3.1	RECOGNISED POTENTIAL THREATENING PROCESSES.....	20
3.1.1	Mining and infrastructure development (MGIOIP)	20
3.1.2	Mining activities (secondary threats)	20
3.1.3	Natural extent of habitat.....	20
3.1.4	Weed populations	20
3.1.5	Fire.....	21
3.1.6	Drought.....	21
3.1.7	Grazing.....	21
3.1.8	Climate change	21
4	OBJECTIVE AND RECOVERY CRITERIA	22
4.1	OBJECTIVE OF THE PLAN	22
4.2	RECOVERY CRITERIA.....	22
4.3	ROLES AND RESPONSIBILITIES OF PARTIES.....	23
5	MANAGEMENT ACTIONS FOR RECOVERY	25
5.1	Outcomes from Implementation of the Interim Recovery Plan actions.....	25
5.1.1	Research to date.....	25

5.1.2	Managing the secondary threats of mining	25
5.1.3	Fire Management	26
5.1.4	Grazing pressure.....	26
5.1.5	Plant condition monitoring.....	26
5.1.6	Plant demographic monitoring.....	27
5.1.7	Translocation trials	27
5.1.8	Establishing seed/germplasm collections	28
5.1.9	Surveys and reporting new occurrences of <i>L. gibsonii</i>	28
5.1.10	Review IUCN ranking of the species and need for a full Recovery Plan.....	29
5.2	Management actions for Recovery.....	29
5.2.1	Implement plant condition monitoring program	29
5.2.2	Implement Fire Management Strategy	30
5.2.3	Manage risks from Secondary threats of mining	30
5.2.4	Manage the risk of grazing on <i>L. gibsonii</i>	31
5.2.5	Maintain and use seed/germplasm collections.....	31
5.2.6	Plant translocation and population restoration planning.....	32
5.2.7	Report existing and any new occurrences of <i>L. gibsonii</i>	33
5.2.8	Promote awareness of <i>L. gibsonii</i>	33
5.2.9	Coordinate recovery actions and liaise with stakeholders.....	34
5.2.10	Review assigned conservation status of the species.....	34
5.3	Further research to understand certain ecological processes.....	35
6	PLAN IMPLEMENTATION AND EVALUATION	37
7	REFERENCES	38
8	ATTACHMENT 1 – SUPPORTING TECHNICAL INFORMATION	40
	A1.1. History, nomenclature and taxonomic relationships	40
	A1.2. Illustrations and/or further information.....	40
	A1.3. Further details on species biology and ecology.....	40
	A.3.1. International obligations	49
	A.3.2. Role and interest of Aboriginal groups.....	49
	A.3.3. Potential social and economic effects	49
	A.3.4. Guide for Decision Makers	50

LIST OF TABLES

Table 2.1 Summary of population records 18

Table 4.1 Classes and criteria for assessing the recovery plan 23

LIST OF FIGURES

Figure 1: Distribution of *Lepidosperma gibsonii* in the Mt Gibson Ranges and surrounds..... 13

Figure 2: Model outputs showing mapped probabilities of plant presence 15

1 INTRODUCTION

1.1. PURPOSE AND BACKGROUND

Ministerial Statement 753 (**MS753**) authorises the implementation of the Mount Gibson Iron Ore Mine and Infrastructure Project (**MGIOIP**), being the proposal to mine and price iron ore from Extension Hill and Extension Hill North, within the Mount Gibson Ranges, construct a pipeline to transport the magnetite slurry to Geraldton Port, and construct infrastructure at the port to strip the ore from the slurry for export.

MGM and EHPL are both proponents for the purposes of MS753.

This *Lepidosperma gibsonii* full recovery plan has been prepared to meet condition 7-3 of MS753 and to be consistent with the “Recovery Plan Guidelines for Nationally Listed Threatened Species and Ecological Communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*” (published on the Commonwealth Department of Environment website).

The primary objective of this plan is to maintain, and ultimately improve, the conservation status of *L. gibsonii* such that its conservation status is more secure in the Mt Gibson area.

The development and preparation of this plan and the management actions within has been guided by the outcomes to date of the implementation of the *Lepidosperma gibsonii* Research Plan and *Lepidosperma gibsonii* Interim Recovery Plan. The *Lepidosperma gibsonii* Research Plan and the *Lepidosperma gibsonii* Interim Recovery Plan were developed and implemented pursuant to conditions 7-1, 7-2, 7-4 and 7-5 of MS753. A summary of the outcomes of the Research and Interim Recovery Plan is provided by way of background in sections 1.2, 2 and 5.1 of this plan.

When this plan was prepared, some information continuing from the implementation of the *Darwinia masonii* Interim Recovery Plan was not available to MGM and EPHL and therefore could not be incorporated to inform this recovery plan. This includes outputs from recent research initiatives and specific methodologies of previous research conducted by BGPA; and tasks underway by various parties requiring completion in the near future. MGM and EHPL will review this recovery plan in light of this outstanding information once it becomes available in accordance with the tasks assigned in Parks & Wildlife (2014).

MS753 includes several conditions which regulate the implementation of the MGIOIP in a manner that will manage the effects of the MGIOIP on *Lepidosperma gibsonii*. For example, condition 8 (conservation of significant flora and communities), condition 9 (weeds) and condition 10 (bushfires). This plan does not repeat those obligations, but is intended to work alongside those obligations (and particularly the management plans that operate under those conditions) to meet the objectives of this plan.

The Table below outlines where this plan addresses the matters stipulated by condition 7-3 of MS753.

MS753 Condition	Key Plan Elements	Section of the Plan
7-3(1)	<i>Habitats which are critical to the survival of the species</i> <i>Actions needed to protect those habitats</i>	Section 2; Table 2.1; Figure 1; Figure 2 Section 5.2
7-3(2)	<i>Threats to the species and areas and populations under threat</i>	Section 3
7-3(3)	<i>Objectives to be achieved</i>	Section 4

MS753 Condition	Key Plan Elements	Section of the Plan
7-3(4)	<i>Criteria against which achievement of the objectives is to be measured</i>	Section 4
7-3(5)	<i>Management actions based on the outcomes of the implementation of the Research Plan and Interim Recovery Plan that will remediate the impacts of the project and provide for a net improvement on the pre-mining status of the species</i>	Section 5.2
7-3(6)	<i>Further research required into the management or recovery of the species</i>	Section 5.3

The Recovery Plan has been developed using the structure and addresses the matters outlined in the Recovery Plan Guidelines for Nationally Listed Threatened Species and Ecological Communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (**Attachment 4**).

1.2 THE TAXON

1.2.1 Description

Lepidosperma gibsonii is a fine-leaved herb (sedge), to 0.6 m high. Its characteristics are as follows:

Culms terete, scarcely finely ribbed, pale green, fully erect, culms 0.32 - 0.51 x 0.32 - 0.51 millimetres (mm), to 35 - 45 centimetres (cm) tall. Rhizome compact. Leaves angular, distinctly diamond-shaped, pale green, compressed, 0.43 x 0.40 mm, 35 – 45 cm high. Bracts pale tan, glabrous. Base cross-hatched. Inflorescence simple or with one small branch at the base, loose-linear, 32 - 51 mm long, 2.5 - 3.5 mm wide. Inflorescence bract 10.0 - 39.1 mm long. Scales 6-8, broadly triangular, white, 0.45 - 0.47 mm long. Seeds 1.25 - 1.40 x 0.87 - 0.89 mm, cream, becoming mottled brown with age, smooth, and no ribs. Inner floral bract 2.01 x 0.94 mm, opaque sides grading to rusty red keel. Style base caducous. Style 1.29 mm to branches which are 0.55 mm long. Anthers not seen. Anther filaments 2.01 mm long (Meissner and Caruso, 2006).

Lepidosperma gibsonii was initially thought to be taxonomically most closely related to *L. ferricola* (formerly *Lepidosperma* sp. Mt Jackson (L. Mattiske 193-2/572)), which was recorded from Mt Jackson during surveys of the Portman Iron Ore Ltd Kooyanobbing Expansion Project in 2001. The taxonomic status of *L. gibsonii* has been investigated by Botanic Gardens and Parks Authority (BGPA) as part of a research programme funded by Mount Gibson Mining (MGM) and Extension Hill Pty Ltd (EHPL). Results now indicate that *L. gibsonii* has been found to be more closely related to *L. costale* (and related entities) than to *L. ferricola*. There are clear differences in stem cross-section and seed morphology between *L. costale* and *L. gibsonii*. *Lepidosperma gibsonii* is superficially similar to *L. ferricola*.

1.2.2 Conservation Status

Lepidosperma gibsonii is specially protected under the Western Australian *Wildlife Conservation Act 1950*. It was listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950* [as *Lepidosperma* sp. Mt Gibson (R. Meissner & Y. Caruso 3)] on 12 December 2006, and on 22nd January 2008 it was listed under its current name. It is currently ranked as Vulnerable D2 under the International Union for Conservation of Nature (IUCN) criteria due to it being known at the time of ranking from one location (14 populations, one genetic population) with a plausible future threat that could change its ranking.

The species is not currently listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2.3 Biology and ecology

Although the known distribution of *L. gibsonii* appears to be restricted, it demonstrates traits of strong ecological resilience namely:

1. It is a re-sprouting species and therefore capable of surviving fire and grazing to a greater extent than a seeder species;
2. *Lepidosperma* as a genus that is well known to be highly resistant to root pathogens, particularly *Phytophthora*. It would be expected that *L. gibsonii* would have a similar resistance and would therefore be unlikely to be directly impacted by the root rot fungi;
3. The species demonstrates vigorous subsoil rhizome sprouting indicating that the plant can respond to seasonal moisture and is probably capable of producing a shoot to flower in one year; and
4. Clump size and branching patterns indicate that individual clumps are long lived, likely for multiple decades and potentially longer.

Overall the species is probably long-lived, resilient to fire and grazing, and disease tolerant. Initial research by BGPA suggest that the species is water rather than nutrient limited, with rapid growth rates in standard soil mixes indicating that the substrate may be less important than water harvesting attributes (BGPA, 2010).

Lepidosperma gibsonii flowering to seed production occurs over an 18 month period. Flower development starts in late winter to early spring and then fall dormant over summer until May-June when the flowers' mature and release their pollen. *Lepidosperma gibsonii* are wind pollinated and therefore has a high outcrossing rate (i.e. a multilocus outcrossing rate of 91.7%) compared to selfing. Seeds mature in the same year and are released over a two week window around mid-October (BGPA, 2010).

As the rainfall in the region is unreliable, *L. gibsonii* is likely to respond opportunistically (at least with vegetative growth) to rainfall events (i.e. tropical cyclonic summer rainfall events and southern winter cold fronts).

1.2.4 Habitat and distribution

Lepidosperma gibsonii appears to be restricted to the mid-west region of Western Australia where it occurs in the vicinity of the Mt Gibson Ranges, which are located approximately 80 kilometres (km) northeast of Wubin and 350 km north east of Perth. Within the Mt Gibson Ranges, *L. gibsonii* prefers steep slopes or gullies that provide increased water availability during rainfall events. The populations occurring outside of the Ranges are associated with low granite outcrops or breakaways and loamy flats in close proximity to the breakaways. In the majority of locations from where *L. gibsonii* has been recorded, the soils range from skeletal on the upper slopes often in association with the margins of larger areas of exposed ironstone, Banded Ironstone Formation (BIF) or granitic outcropping to deeper, sandy loams on the side slopes and gully floor. The geographical extremes of the populations are less than 8 km apart, thus making the species a restricted and narrow endemic.

Lepidosperma gibsonii has been recorded from a number of vegetation communities including three thicket and one heath community (Bennett, 2000) on BIF in the Mt Gibson Ranges, and low woodland and thicket communities for the populations associated with granite breakaways. *Lepidosperma gibsonii* is associated with the following vegetation communities on the Mt Gibson Ranges (Bennett, 2000):

- T1 Dense Thicket of mixed species dominated by *Acacia* species, *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Calycopeplus paucifolius* and *Melaleuca nematophylla* over Low Shrubland in jaspilite rocks and pockets of loam.

- T3 Dense Thicket dominated by *Acacia assimilis*, *Allocasuarina acutivalvis* subsp. *prinsepiana* and *Melaleuca nematophylla* over Low Shrubland of *Hemigenia* sp. Paynes Find and *Hibbertia crassifolia* in loam pockets in jaspilite rocks.
- T6 Thicket of *Acacia acuararia* and *Acacia stowardii* over Low Shrubland of mixed species with large numbers of *Darwinia masonii* in loam with abundant rocks on the surface.
- HS1 Low Heath of *Ptilotus obovatus* with emergent shrubs of *Acacia stowardii* and *Calycopeplus paucifolius* over Herbs in loamy clay large amongst large boulders.
- Emu proof fence sub-population Low Woodland of *Eucalyptus kochii* subsp. *plenissima*, *Eucalyptus kochii* subsp. *horistes* over Tall Open Scrub dominated by *Allocasuarina acutivalvis*, *Acacia aneura*, *Micromyrtus clavata* and *Acacia acuminata* on clayey loamy soil.
- Sub-populations C and D *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Melaleuca uncinata*, *Acacia assimilis* subsp. *assimilis*, and *Melaleuca nematophylla*.
- Sub-population E Low Open Woodland of *Eucalyptus leptopoda* subsp. *arctata* with occasional *Allocasuarina acutivalvis* subsp. *prinsepiana* over a Tall Open Woodland *Melaleuca uncinata* and *Acacia aneura* var. *aneura* over a Tall Scrubland dominated by *Acacia masliniana* over a Low Shrubland dominated by *Micromyrtus clavata* and *Thryptomene cuspidata* over a Very Open Herbland of *Ecdeiocolea monostachya* and *Hyalosperma glutinosum* subsp. *glutinosum*.
- Sub-population F *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Melaleuca uncinata*, *Acacia assimilis* subsp. *assimilis*, and *Melaleuca nematophylla*.

1.3 POPULATION RECENT HISTORY

1.3.1 Abundance and distribution

Parks and Wildlife have collated the data from numerous surveys and identified 13 “populations” of *L. gibsonii* (as listed in Table 1).

A comprehensive survey was undertaken in 2006 (ATA Environmental, 2006) to determine the population size, distribution and age spectrum of *L. gibsonii* populations within the Mt Gibson Ranges. At that time in 2006, eight discrete populations of *L. gibsonii* were recorded from the slopes of the Mt Gibson Ranges, with a total population of 17,618 plants (ATA Environmental, 2006). In 2007 and 2008, a further six ‘populations’ were located increasing the total population to 45,013 plants. Five of the six additional populations occurred on or were associated with granite outcrops and breakaways outside the Mt Gibson Ranges (Coffey Environments, 2008a, b). The sixth population was located within the Mt Gibson Ranges, to the south of Mt Gibson South (Figure 1).

Areas with similar geology (BIF or chert) and vegetation to that at the Mt Gibson Ranges were surveyed by ATA Environmental (2006) but no additional populations of the species were located. Areas surveyed during the targeted survey included banded iron formation and granite hills within a 20 km radius of Mt Gibson including Mt Singleton, Yandhanoo Hill, the old Bonnie Mine and other smaller unnamed BIF hills in the area. In addition a helicopter based Rapid Habitat Assessment was undertaken of approximately 10,000 m² area bounded by Mt Gibson, Windamurra, Yalgoo and Koolanooka. The Rapid Habitat Assessment focused on 30 BIF and granite hills within the area (ATA Environmental, 2006).

MGM and EHPL initially had Ministerial approval to take approximately 8,201 plants for a mining and infrastructure development project. An addendum approval dated 20 February 2008 (Permit to Take 70b-0809) allowed for the taking of an additional 700 plants associated with the Great Northern Highway re-

alignment, with the total approval to take representing 19.8% (8,900 plants) of the known population (45,013 plants) as at June 2008. To date, approximately 819 plants have been taken under this permit, with approximately 520 plants removed from the Great Northern Highway deviation footprint, and approximately 299 plants removed from the hematite mine footprint.

In addition, genetic studies now estimate the current population size of *L. gibsonii* to be 1.25 times greater than the current census due to multiple genetic individuals within some clumps. In order to get accurate estimates of the size of the population, genetic sampling of all clumps would be required to accurately determine the number of individuals.

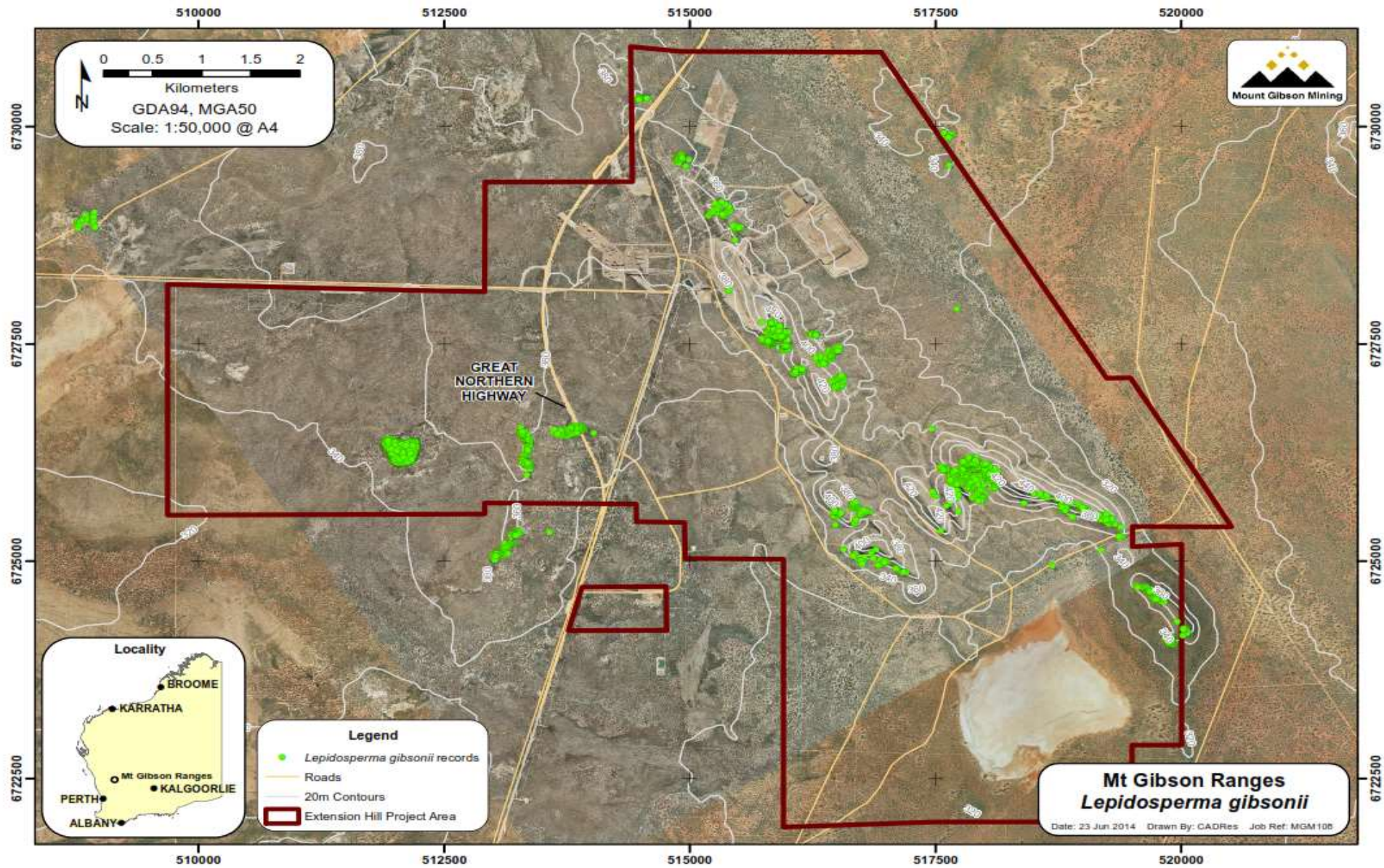


Figure 1: Distribution of *Lepidosperma gibsonii* in the Mt Gibson Ranges and surrounds

1.3.2 Population size

Using data from the most recent and accurate records (Table 2-1), the size of the *L. gibsonii* population is now conservatively estimated to comprise 58,800 mature plants. This takes into consideration that approximately 819 whole plants have been removed. The most comprehensive data for many populations range in accuracy, and most of it is eight years old, so the present size of the population may differ. Note that the size of the population when the Interim Recovery Plan was prepared in 2008 comprised 45,013 mature plants (DEC, 2008), which means that the current data available indicates that the known population size has increased by over 30% since 2008.

Approximately 39% of the estimated population (i.e. 22,900 of 58,800 plants) are from slopes and gullies within the Mt Gibson Ranges. Of the balance of the population, the majority (i.e. 35,900 plants) are associated with breakaways and granite outcrops within 4 km of the Ranges, and occurring in six discrete groups.

1.3.3 Initial information on population genetics

A preliminary study undertaken by BGPA (2006) focused on genetic variations of *L. gibsonii* using standard population genetic statistics. The study found high genetic variation within the eight discrete *L. gibsonii* populations located within the Mt Gibson Ranges. The observed microsatellite variation was uniformly distributed over the range of the species, therefore the populations in the Mt Gibson Ranges were considered as a single provenance unit for *L. gibsonii* (BGPA, 2006).

Further genetic studies have since confirmed that there is low genetic structuring between populations of *L. gibsonii* with 96% of variation within populations and 4% between populations. Pairwise tests, however, show that there are some barriers to complete gene flow across the Mt Gibson Ranges (BGPA, p6, 2010). The sub-population on “Mt Gibson Saddle” is genetically isolated from nearly all remaining populations. Possible explanations include inbreeding in small populations, physical isolation, or a strong selection at one or more linked loci (BGPA, 2010).

A study to determine genetic diversity in *L. gibsonii* involved comparisons with populations belonging to the *L. costale* complex (BGPA, 2010). Measures of heterozygosity and fixation index of the two species showed comparable genetic diversity, which, given the low sample size, was in contrast to expected evidence of population bottlenecks and inbreeding. BGPA (2010) suggest gene flow is high over the scale of these populations or that the current small populations are relicts of past populations.

1.3.4 Population areas of occupancy and extent of occurrence

The area of occupancy of *L. gibsonii* is illustrated in **Figure 1**. BGPA (2010) modelled outputs showing probabilities of presence (blue = low, red = high) for *L. gibsonii* as shown in **Figure 2**. BGPA’s modelling of the distribution of *L. gibsonii* against spatially mapped data identified localities for possible *L. gibsonii* translocation sites (see **Figure 2**). The modelling predicted *L. gibsonii* to occur with a greater than 90% likelihood of presence in many small areas and a detailed pattern of presence probabilities outside of these areas of greatest likelihood (BGPA, 2010). *Lepidosperma gibsonii* is already known to occupy many of the areas that it is most strongly predicted to occupy, and the environmental variables used were considered to be good predictors of suitable abiotic habitat.

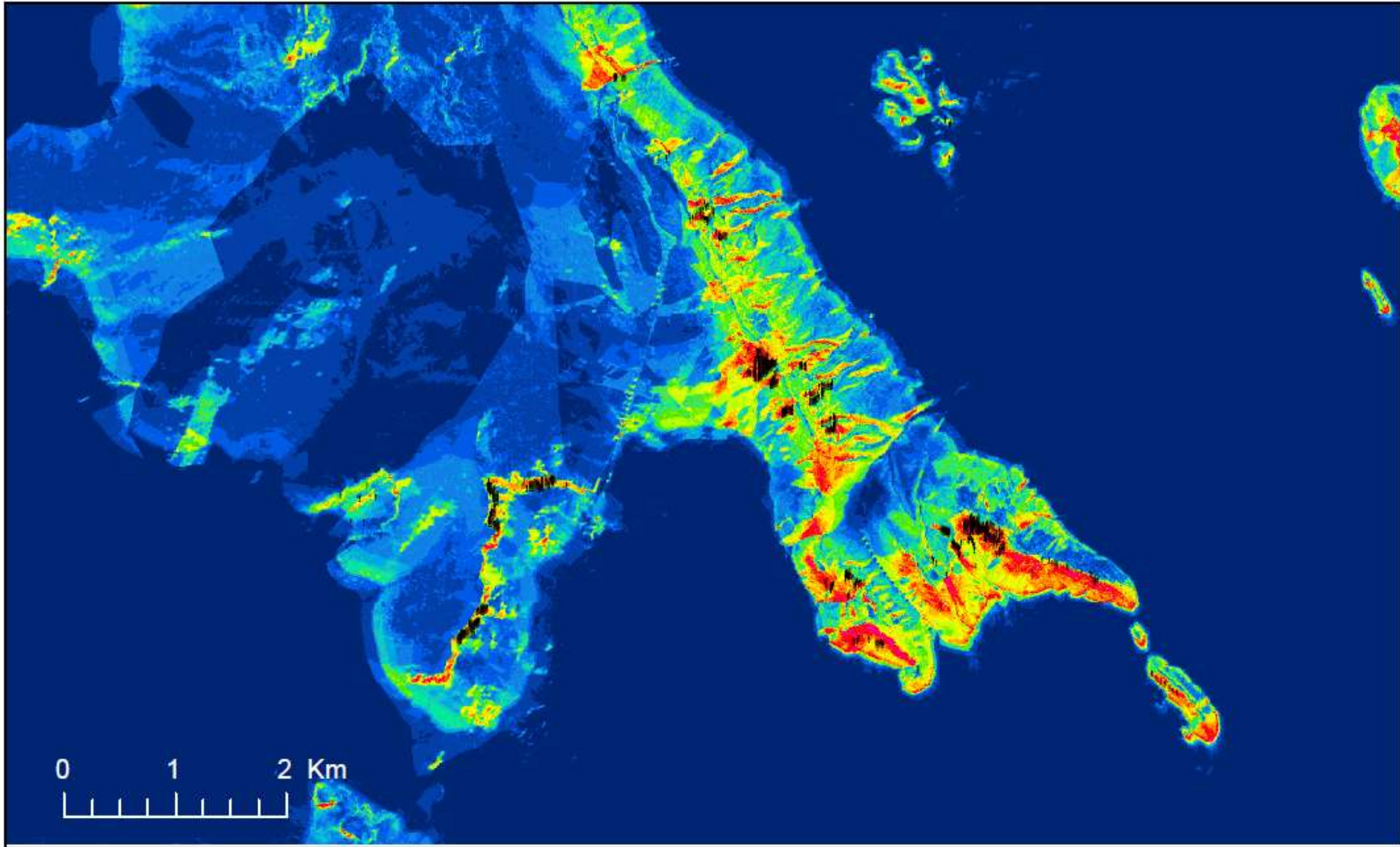


Figure 2: Model outputs showing mapped probabilities of plant presence

2 HABITAT CRITICAL TO SURVIVAL OF THE PLANT SPECIES

This taxon is listed as Vulnerable D2 under the World Conservation Union (IUCN 2001) Red List. As a result of its IUCN conservation status, emphasis is placed on the known habitat which is critical to the survival of the plant species, as well as, any successfully rehabilitated populations.

Within the Mt Gibson Ranges, *L. gibsonii* prefers steep slopes or gullies that provide increased water availability during rainfall events. The populations occurring outside of the Ranges are associated with low granite outcrops or breakaways and loamy flats in close proximity to the breakaways. In the majority of locations from where *L. gibsonii* has been recorded, the soils range from skeletal on the upper slopes often in association with the margins of larger areas of exposed ironstone, Banded Ironstone Formation (BIF) or granitic outcropping to deeper, sandy loams on the side slopes and gully floor. *Lepidosperma gibsonii* has been recorded from a number of vegetation communities including three thicket and one heath community (Bennett, 2000; Section 1.2.4).

Research conducted by BGPA (2010) further refined and characterised suitable habitat. BGPA (2010) broadly defined the habitat requirements and found that suitable habitat that could be critical to the long term health and survival of *L. gibsonii* was more extensive than the currently known areas of occupancy. The model considered geology from the Mt Gibson Iron Deposit Geological Plan, fire history using satellite and air photo imagery (1969 to 2007), and solar radiation receipt, aspect, slope, curvature and elevation using a 1 m interval contour map (BGPA 2010). Winter 2 pm solar radiation (< 0.4 w.m-2.hr-1) contributed 40% of the models prediction with slope (> 15o) and elevation (380 – 440 m) making up the remainder of the contribution. These factors have been found to accurately model the areas in which *L. gibsonii* are known to occur. These areas are shown in **Figure 2**.

These qualities and characteristics of habitats may need continuing assessment to determine spatial locations within the landscape and relationships to other flora species to better define those elements that define critical habitat for the recovery of *L. gibsonii*. Substrate types on which the plant species is predicted and known to occur is well characterised (BGPA, 2010). For instance, other nearby lands on which *L. gibsonii* is not currently present - for reasons such as overgrazing - might have supported the species in the past and may be suitable for future recovery actions such as translocations. Translocation trials will continue to assist in determining whether additional areas of similar habitat are considered suitable for recovery of the species.

Note that Parks and Wildlife's Policy Statement 29 (CALM, 1995) refers to the translocation of threatened flora.

Habitat critical to the survival of *L. gibsonii* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), and additional areas of similar habitat that may contain undiscovered populations of the species or otherwise be suitable for future translocations.

Furthermore, in relation to **Figure 2**, BGPA (2010) reported that:

- *Lepidosperma gibsonii* is already known to occupy many of the areas that it is most strongly predicted to occupy; and,
- most of the remaining highly predicted areas will also contain populations if they were to be surveyed.

In relation to critical habitat, BGPA (2010) concluded:

- that factors limiting the distribution of *L. gibsonii* are described by the environmental variables modelled;
- potential restoration and translocation areas for *L. gibsonii* need to be in areas of low solar radiation and areas able to maintain higher soil moisture levels than the landscape average; and,
- that restoration trials should include treatments addressing uncertainties – i.e. shade and moisture for *L. gibsonii*.

Table 2.1 Summary of population records

TPFL Pop No.	IRP Pop No.	Date of first database record (database)	Broad location description	Take status	WA Herbarium Sheet No	Quadrat monitoring site	Date of most accurate monitoring record (method)	Numbers recorded	Comment
1A, 1B	6	26/02/2006 (TPFL)	Iron Hill East	Not taken			26/02/2006 (estimate)	675	No herbarium specimen Last census in 2006
2A	4	26/02/2006 (WA Herb, TPFL)	Iron Hill Middle	Not taken	PERTH 07523092	L20, L22	26/02/2006 (estimate)	265	Last census in 2006
2B	5	26/02/2006 (TPFL)	Iron Hill South	Not taken	NONE	L18, L19	26/02/2006 (estimate)	118	Last census in 2006
3A ²	2	15/09/2005 (WA Herb)	Extension Hill	Part will be taken – mining activities	PERTH 07745974 PERTH 07543867 PERTH 07245343 PERTH 07245351	L16, L17	26/02/2006 (estimate)	7,424	Last census in 2006
3B	3	26/02/2006 (TPFL)	Extension Hill South	Not taken		L26	26/02/2006 (estimate)	4,307	No herbarium specimen Last census in 2006
4A ²	1	26/02/2006 (TPFL)	Extension Hill North	Will be taken - mining activities	NONE		26/02/2006 (estimate)	777	No herbarium specimen Last census in 2006
4B	Not listed	12/02/2008 (TPFL)	Extension Hill North	Will be taken - mining activities	NONE		12/02/2008 (broad estimate) 14/08/2013 (partial)	1,000 91	No herbarium specimen Low quality census in 2008, and limited census in 2013
5A, 5B, 5C	7	26/02/2006 (TPFL)	Mt Gibson (north end)	Not taken	NONE	L23, L24	26/02/2006 (estimate)	3,617	No herbarium specimen Last census in 2006
6	8	24/02/2006 (WA Herb)	Mt Gibson (south end)	Not taken	PERTH 07523084 PERTH 07523068		26/02/2006 (estimate)	435	Last census in 2006
7	9	13/02/2008 (TPFL)	Mt Gibson South	Not taken	NONE		13/02/2008 (estimate)	4,384	No herbarium specimen Last census in 2008
8	10	13/02/2008 (TPFL)	Emu Proof Fence	Not taken	NONE	L25	13/02/2008 (estimate)	160	No herbarium specimen Last census in 2008
9 ¹	Not listed?	12/02/2008 (TPFL)	Northern Junction old and new GNHwy	Partially taken for GNHwy realignment	NONE		12/02/2008 (broad estimate)	1,000-10,000	No herbarium specimen Low quality census in 2008
10	12	02/01/2008 (WA Herb, TPFL)	Population D (Coffey Environments, 2008a; 2008b)	Not taken	PERTH 07887116		02/01/2008 (estimate)	3,244	Last census in 2008
11	14	12/02/2008 (TPFL)	Population F (Coffey Environments, 2008b)	Not taken	PERTH 07887310		12/02/2008 (estimate)	10,352	Last census in 2008
12A	11	02/01/2008 (WA Herb, TPFL)	Population C (Coffey Environments, 2008a; 2008b)	Not taken	PERTH 07887108 PERTH 07887388		02/01/2008 (estimate)	5,225	Last census in 2008
12B ¹	13	02/01/2008 (WA Herb, TPFL)	Population E (Coffey Environments, 2008a; 2008b)	Partially taken for GNHwy realignment	PERTH 07887353 PERTH 07887361		02/01/2008 (estimate)	4,030	Last census in 2008, and limited census in 2103

TPFL Pop No.	IRP Pop No.	Date of first database record (database)	Broad location description	Take status	WA Herbarium Sheet No	Quadrat monitoring site	Date of most accurate monitoring record (method)	Numbers recorded	Comment
NEW subpop.	Not listed	24/09/2013 (WA Herb, TPFL)	E of old GNHwy, ~200m south of turnoff to MGM Accommodation Village	Not taken	PERTH 08503524		24/09/2013 (Partial survey, low quality)	362	Low quality partial census in 2013
NEW subpop.	Not listed	24/09/2013 (WA Herb, TPFL)	W of old GNHwy, ~200m south of turnoff to MGM Accommodation Village	Not taken	PERTH 08503532		24/09/2013 (Partial survey, low quality)	11,550	Low quality partial census in 2013
NEW pop	Not listed	02/01/2008 (WA Herb)	Populations A and B (Coffey Environments, 2008a)	Not taken	PERTH 07887124 PERTH 07887345		02/01/2008	Pop A - 290 Pop B - 451	This is a new TPFL population. Last census in 2008

¹ These populations have been partially taken. Approximately 520 plants have been removed for the GN Hwy realignment, which infers that the combined number of plants remaining at these populations may range between 4,510 and 13,510.

² These populations have been partially taken. Approximately 299 plants have been removed for the hematite mine, which infers that the combined number of plants remaining at these populations may be 7,902.

³ Plants related to past translocation trials are not recorded in the above table. These may account for in the order of 200 plants.

3 THREATENING PROCESSES

Specimens within *L. gibsonii*'s current geographic range may be subjected to the following identified threats. Anthropogenic threats have mitigations and controls that may be readily applied; but less so for natural stressors such as natural fire; drought and effects from drying climates. Failure to address significant threatening processes listed below may contribute to uncontrolled declines in distribution and abundance of the species.

3.1 RECOGNISED POTENTIAL THREATENING PROCESSES

Potentially threatening processes may have effects at different times and in different parts of the species range during its lifecycle. MGM and EHPL have direct influence over managing key threatening processes stated in sections 3.1.1, 3.1.2, 3.1.4 and 3.1.5.

3.1.1 Mining and infrastructure development (MGIOP)

Approximately 39% of the known *L. gibsonii* population records are from ironstone formations which are also prospective for iron ore. The current MGIOMIP approval will result in approximately 8,900 adult plants of *L. gibsonii* being taken, which represents approximately 19.8 % of the population known as of June 2008.

If future mining and exploration operations are proposed and approved by government (as approved proposal(s)), then they may have the potential to clear *L. gibsonii* during ground disturbance. Any such impacts will need to be assessed and approved in the normal government approval processes, which provides opportunity to regulate the proposal through the conditions imposed on the approval. Ground disturbance may be mitigated by restoration activities; surveys to increase the knowledge about species abundance, area of occupancy and/or extent of occurrence; land rehabilitation; and, translocation programs.

3.1.2 Mining activities (secondary threats)

It is possible that populations at Extension Hill South, Emu Proof Fence and Iron Hill North may be at some risk from secondary effects of mining (DEC, 2008) because they are adjacent to the mining operations. Possible secondary threats include dust, inadvertent disturbance such as cracking of rock faces, negative effects on pollinator activity arising from habitat disturbance, and other potential effects on reproductive biology that may be shown to lead to a decline in plant recruitment rates.

To address this potential threat, plant health and emissions monitoring is used to indicate effects and further adaptive management actions may be applied as needed. Additionally, further management of this threat, if found to occur, may be through restoration activity, such as land rehabilitation and translocation programs for the species.

3.1.3 Natural extent of habitat

Lepidosperma gibsonii appears to be restricted to slopes and gullies of major hills that comprise the 6 km long Mt Gibson Ranges, as well as granite breakaways and outcrops in the general vicinity of the Ranges. The known area of occupancy and likely extent of occurrence of the species are depicted in Figures 1 and 2, respectively.

3.1.4 Weed populations

No significant weed populations had been observed at the time of the publication of the Interim Recovery Plan (Parks and Wildlife, 2008). Weeds, should they proliferate in the future, may be a potential threat to habitats that support *L. gibsonii*.

3.1.5 Fire

Lepidosperma gibsonii recruitment from long-lived soil seedbanks occurs following a fire (BGPA, 2010). No evidence for inter-fire recruitment has been observed. Approximately 50% of adult *L. gibsonii* survive and regenerate following a fire (BGPA, 2010). The threat of fire alone will unlikely result in negative impacts to the species because some adults will survive and there will likely be a proliferation of seedling recruitment. However, a period of drought following a fire and during the seedling establishment phase may result in a significant reduction in abundance of this species.

Fire will help the species to proliferate as long as there is sufficient rainfall in the following years to ensure seedlings grow and establish as adults.

3.1.6 Drought

Seed production in *L. gibsonii* is very much dependent on sufficient rainfall in consecutive years given that flower development occurs in one year and fruit and seed development occur in the following year. BGPA (2010) estimates a rainfall requirement of 65 - 110% of the average. Historical periods of low rainfall resulting in no seed production by this species are estimated to vary from two to 49 years. Therefore, *L. gibsonii* requires suitable conditions over two consecutive growing seasons (i.e. sufficient soil moisture) in order to complete one reproductive cycle (BGPA, 2010). This makes it more vulnerable to the impacts of drought compared to most other plant species which complete their reproductive cycles within one year. Drought conditions may therefore impact the reproductive ability of *L. gibsonii* in the short term.

Comparative studies by BGPA (2010) on *L. gibsonii* and related species demonstrate that the target taxa do not possess unique capacity to function or use water at lower levels of water availability. *Lepidosperma gibsonii* was shown to respond to declining soil moisture levels by increasing root growth at the expense of an energy investment in leaves and shoots, and appear to persist over the arid summer period by closing down plant function and maintaining a dormant state through to the winter period.

3.1.7 Grazing

Lepidosperma gibsonii is susceptible to herbivory by rabbits or goats, although plants often show significant recovery (BGPA 2010). The impact of herbivory on survival rates is unknown. The greatest impact to the plants' is likely to be a reduction in reproductive output, which can be reduced to zero seed production as a result of grazing.

A scale insect (Hemiptera: Coccoidea), yet to be identified, has been observed on *L. gibsonii* culms. The insect is likely a parasite that feeds on the plants sap. This may affect the plant by reducing its growth rate and photosynthesis.

In addition, a rust fungus (yet to be identified) has been observed growing on *L. gibsonii*, although no significant impact to the plants has been observed (BGPA, 2010). The effects may be evident when the plants are under stress by other vectors (e.g. drought, grazing).

3.1.8 Climate change

Based on the potential effect of low rainfall or drought events on seed production, there may be implications for the long term viability of the species if climate change results in increased drying or a greater frequency of dry years in the region (BGPA, 2010). Given the increased effect of drought conditions on this species, there may also be implications for seed production and ultimately seed bank size and recruitment capacity of populations of the taxon if climate change results in increased drying or a greater frequency of dry years in the region.

4 OBJECTIVE AND RECOVERY CRITERIA

4.1 OBJECTIVE OF THE PLAN

This plan guides the recovery of *L. gibsonii* for the life of the MGIOIP. Its overall objective is to maintain or improve the conservation status of *L. gibsonii* such that its conservation status is more secure in the Mt Gibson area.

MGM and EHPL will implement the management actions set out in section 5.2 of this plan with a view to making a contribution (along with the work being done and to be done by government departments, tenure holders and others) to achievement of the objective of this plan.

The plan will be implemented through:

- adoption and implementation of specified management actions,
- identifying habitats critical to the long term survival of the species,
- applying relevant mitigations to known threats to the species,
- promotion of research that supports the management or recovery of the species; and,
- assessment against the specified recovery criteria,

The Recovery Plan has been developed using the structure and addresses the matters outlined in the Recovery Plan Guidelines for Nationally Listed Threatened Species and Ecological Communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Attachment 4).

4.2 RECOVERY CRITERIA

Five levels of recovery are defined in Table 3 to measure progress towards achievement of the objective of this Recovery Plan. The criteria presented are based on 1. Plant abundance, 2. Plant distribution or its area of occupancy, and 3. IUCN category.

This Recovery Plan will be meeting its objective if any classes of “Yellow” or above are attained.

If the Criteria for Caution (“Amber” light) are met while the MGIOIP is operating, MGM and EHPL will review this Recovery Plan, and its associated management actions.

In the event of a significant fire event, it is expected that population numbers will initially decrease due to death. However, it is anticipated that the population will then increase in time to a number greater than the pre fire population due to abundance of seedlings, but will eventually resume similar to status to the pre-fire population abundance. The timeframe will be taken into account when conducting a post fire population census to avoid over- or under-estimating the recovery success or failure. Prolonged periods of drought may also result in unavoidable reduction in population abundance and/or areas of occupancy. Should either of these distinct natural events occur the ex situ conservation material might be used to aid species recovery should natural processes not account for its recovery.

Table 4.1 Classes and criteria for assessing the recovery plan

Criteria for excellence – Class “Blue light”
The conservation status of the species improves on the status set out on page 8 of this plan; and “Green light” status
Criteria for success – Class “Green Light”
The abundance of plants in areas outside of approved Proposal(s) shows a statistical trend of a significant increase over the Plan’s term; the extent of the population increases by 25% or more above the number of adults described in Table 2.1; and “Yellow” light status
Criteria for status quo – Class “Yellow light”
The abundance of plants in areas outside of approved Proposal(s) remains stable# (that is equal to the number of adults in Table 2.1); and, The conservation category of the species remains at the status set out on page viii of this plan.
Criteria for caution – Class “Amber light”
The abundance of mature plants in the population has statistically decreased by more than 30% below the census number of adults in Table 2.1; or, There is a statistical trend showing at least a 30% reduction in the known area of occupancy of the species.
Criteria for failure – Class “Red light”
The conservation status meets IUCN criteria for listing at a higher threat category than the status set out on page 8 of this plan.

Stable means ‘original population total abundance (ATA, 2004) plus or minus fifteen percent’. Current insight is that population numbers may vary over periods of years, so it is expected to naturally vary within the term of this Plan.

Should classes yellow or above in Table 4.1 not be met against stated criteria, the management actions and tasks of this recovery plan will be reviewed and revised in accordance with condition 7-7.

4.3 ROLES AND RESPONSIBILITIES OF PARTIES

Implementation of the plan will rely on the management actions and responsibilities of a number of key parties who interact in the recovery of the species through collaboration of some management actions.

MGM and EHPL

The proponents of the Mount Gibson Iron Ore Mine and Infrastructure Project have a responsibility to undertake (or to engage suitably qualified consultants to undertake) the specified management actions relevant to the species on the mining tenements and to manage the threats stated to be associated with implementation of the Project. The proponents will be partly responsible for implementation of a number of recovery actions as specified in section 5.2.

Because of established interactions with parties based on Interim Recovery Plan No 283, MGM and EHPL anticipate collaborative contributions that can be made as follows.

Parks and Wildlife

The Department of Parks and Wildlife (Parks and Wildlife) is responsible for administration and enforcement of the *Wildlife Conservation Act 1950*, and the *Conservation and Land Management Act 1984* and undertake a range of activities in relation to identifying, conserving and protecting threatened flora and fauna. Parks and Wildlife may adopt responsibility for implementation of a number of recovery actions as specified in section 5.2 and 5.3, including monitoring of the implementation and performance of the Plan itself.

Department of Environment

The Department of Environment (DoE) is responsible for administration and enforcement of the *Environment Protection and Biodiversity Conservation Act 1999*. The DoE will liaise with the local Parks and Wildlife in Geraldton and the WA Environmental Protection Authority to assess the suitability of the Recovery Plan.

Botanic Gardens and Parks Authority (BGPA)

BGPA was contracted to MGM and EHPL to undertake research into the species as per the Conservation and Restoration Research Proposal for *Darwinia masonii* and *Lepidosperma gibsonii*.

Geraldton District Threatened Flora Recovery Team (GDTFRT)

The role of the GDTFRT, which is a non-statutory association of stakeholders committed to the recovery of threatened species, is to support in coordinating the recovery of threatened flora in the DEC Geraldton District. The GDTFRT may play a role in implementing certain recovery actions where possible.

5 MANAGEMENT ACTIONS FOR RECOVERY

5.1 OUTCOMES FROM IMPLEMENTATION OF THE INTERIM RECOVERY PLAN ACTIONS

This section describes some of the key outcomes of the management actions previously adopted under the Interim Recovery Plan (no. 283). Past and existing management actions are examined and assessed here as to inform the future management actions set out in this Recovery Plan in **Section 5.2**.

A Conservation Officer at Parks and Wildlife was employed in August 2013 in accordance with the requirements of Offset 4 of Condition 16 of Ministerial Statement 753. Among other roles, this officer has the responsibility to assist with “the development and implementation of the interim and full recovery plans; and, coordinating the managing of threatening processes in relation to *L. gibsonii*”.

5.1.1 Research to date

After the issue of Ministerial Statement 753, EHPL and MGM funded a three year research programme which was undertaken by BGPA on *L. gibsonii* to facilitate the continued survival and improvement in the conservation status of *L. gibsonii* over time to assist the development of a recovery plan for the species. The research programme addressed the objectives of Condition 7.1 of Ministerial Statement 753. That past research was into the:

- conservation genetics;
- population demography;
- breeding biology;
- population viability analysis;
- environmental interactions and plant health;
- restoration and translocation; and,
- *ex situ* conservation.

Work was completed and submitted by BGPA to MGM and EHPL in October 2010 in the form of a report entitled “*Darwinia masonii* and *Lepidosperma gibsonii* Conservation and Restoration Research. An integrated research program into the *ex situ* and *in situ* conservation, restoration and translocation requirements of *Darwinia masonii* and *Lepidosperma gibsonii* May 2007 – June 2010”. The major findings and recommendations of this research have been incorporated into the relevant sections of this recovery plan.

A research project investigating soil plant atmosphere interactions and their influence on mine waste cover system performance is underway. Earthworks and plot preparation was completed in June 2014. Among other objectives, this research will investigate how topsoil thickness (comprised of a 2:1 waste rock: topsoil mix) and rooting depth influence the physiological performance of the taxa in the project. It is anticipated that *L. gibsonii* will be used as one of the species in the trials pending Parks and Wildlife approval (J Sackmann 2014, pers. comm., 28 January).

Further targeted research topics are considered in Section 5.3.

5.1.2 Managing the secondary threats of mining

Management by MGM and EHPL of the non-mining areas occurs on the tenements generally but specifically in areas that include the *L. gibsonii* population. This management framework has developed in consultation with other parties to the Plans and is consistent with environmental legislation and regulatory framework including Department of Environmental Regulation.

An Environmental Management Plan (EMP) was developed using a risk based approach to ensure significant environmental factors were protected from potential threats with a high inherent risk rating. The EMP and associated procedures (used for operational risk management) detail management actions aimed to minimise emissions and secondary threats (i.e. inadvertent disturbance, excessive dust deposition, fire impact, altered hydrology and weed invasion) from mining on *L. gibsonii*. Mitigation actions identified to reduce threats with a high inherent risk rating to an acceptable residual risk rating include, but are not limited to, the following:

- weed management procedures;
- dust management procedures;
- fire management procedures (Section 5.1.3);
- feral animal management procedures (Section 5.1.4); and
- staff inductions and training.

The EMP also included the requirements to audit its implementation and conduct plant condition monitoring of sensitive receptors (i.e. *L. gibsonii*; Section 5.1.5) to ensure management procedures were implemented and effective in managing risk.

The EMP was approved in accordance with requirements of Ministerial Statement 753, and is currently being implemented. The EMP and associated procedures operate in areas under the control of MGM or EHPL, generally defined by the active mining area and the broader mining tenements.

5.1.3 Fire Management

An Environmental Management Plan (MGM and EHPL, 2008) and Fire Management Procedures have been developed and presently adopted and used by MGM at the minesite to date. Fire management actions have been aimed at reducing the risk of unplanned fires resulting from mining activities, and included:

- no smoking within 10 metres of bushland rules;
- hot work permit system;
- dangerous goods handling and storage practises;
- housekeeping practices and regular inspections to prevent build-up of rubbish or flammable materials;
- training of emergency response personnel in firefighting;
- procurement of site based firefighting equipment;
- vehicle maintenance safety checks to reduce fire hazards,
- fire suppression systems on selected plant and equipment;
- regular fire break maintenance; and
- liaison with neighbours and DFES with regard to bushfires (MGM and EHPL, 2013b).

5.1.4 Grazing pressure

The number of goats on pastoral leases has been reduced in recent years as a result of economic, and environmental reasons. The impacts of grazing have been assessed based on significantly lower numbers of goats on the tenements in comparison to historical grazing pressures. Grazing by introduced animals (goats and rabbits) has been assessed as part of plant condition monitoring of *L. gibsonii*.

5.1.5 Plant condition monitoring

Since 2007, the condition of plants in the population of *L. gibsonii* has been monitored annually to detect indirect effects of mining. Parameters monitored are plant height; reproductive status; plant condition; basal diameter and seedling recruitment and attrition. The 2012 monitoring survey was conducted late (in April

2013) at plots which have been part of the condition monitoring program since its inception. A total of 611 plants were included in the 2012 annual monitoring program in April 2013 (MGM and EHPL, 2013). Because of drought conditions, some of these were dead and some could not be relocated, which resulted in a total of 391 plants which were scored, up from 366 in 2011.

Additional monitoring plots were established in the subsequent survey, conducted in November 2013, to ensure the target numbers were met. A total of 920 plants were scored (794 of these were alive) (J Sackmann 2014, pers. comm., 11 February 2014).

Ambient dust monitoring was undertaken by MGM on a monthly basis in permanent quadrats to assess dust deposition on *L. gibsonii*. Ten dust deposition gauges are monitored in the locality of the Mt Gibson Ranges. The standard used is 4 g/m²/month (ATA Environmental *et al.*, 2008a).

TPFL population 3A, closest to the mine on Extension Hill (reported to agencies as plot L16) was monitored monthly by MGM to assess any changes in condition prior to evidence of acute stress or mortality. TPFL population 2A (L20) and 2B (L18) on Iron Hill Middle and South respectively, and TPFL population 5 (L23 and L24) on Mt Gibson, are monitored for comparative purposes during the monthly condition monitoring program. At each plot, a photograph is taken, and plants are given a health score. Observations recorded at the plots include evidence of grazing and weeds. Visual inspection at TPFL population 3A, closest to the mine on Extension Hill plot was also undertaken weekly by MGM. At this plot, a photograph was taken, and plants given a health score. Observations recorded at these plots include evidence of grazing and weed invasion.

MGM and EHPL are conditioned by Ministerial Statement 753 to undertake such plant monitoring. Statistical analysis and reporting of plant condition might now be done in the near future once several years of data are held from the post-development period.

5.1.6 Plant demographic monitoring

BGPA (2010) recommended ongoing annual collection of demographic data from plants in permanently marked plots where individual plants should be tagged and measured. Additional variables recommended for collection were: survival, recruitment (new plants tagged and recorded as found), health, herbivory, infructescence production, seed production, and growth of seedlings and smaller plants. These permanently marked plots are currently established.

5.1.7 Translocation trials

BGPA (2010) described biotic and abiotic environments and habitat requirements for *L. gibsonii* and used a species distribution model to identify localities for possible *L. gibsonii* translocation sites (see Sections 1.1.4 and 1.1.5). They concluded that of the environmental parameters interrogated by distribution modelling for *L. gibsonii*, low solar radiation, areas maintaining higher than average moisture content on slopes and hilltops, and rocky or gravel substrates were ideal habitat for translocation. *Lepidosperma gibsonii* is already known to occupy many of the areas that it is most strongly predicted to occupy. BGPA (2010) concluded that the modelling predicted the distribution of *L. gibsonii* well, and the environmental variables used were good predictors of suitable abiotic habitat (refer to Figure 2).

Translocation trials (780 plants; 65 per plot; 195 plants/ treatment) confirmed this conclusion with the greatest success occurring on rocky or gravel substrates versus sand or clay substrates (BGPA 2010). Rocky soils also demonstrated a greater ability to receive and hold a greater volume of water following a rainfall event in comparison to non-rocky soils. Nine months after planting, *L. gibsonii* survival and establishment was limited to those sites with gravel (approximately 70% survival) and rocky substrates (approximately 50% survival).

Further research was recommended to investigate variation of composition of rock and gravel substrates, and varying degrees of soil depth and rockiness. Other parameters, such as soil geochemistry and regolith may also be critical for the long-term viability of any re-established or translocated plants.

5.1.8 Establishing seed/germplasm collections

Collections of seed and germplasm have been reported by BGPA (2010). Batches of 1000 filled seeds have been deposited at three conservation seed storage facilities. Information relating to the current status and location of seed which was collected has been requested from MGM and EHPL.

Lepidosperma gibsonii is able to be successfully initiated into cultivation, and a stock of 187 genotypes from the Extension Hill mine footprint are stored in cultivation at Nuts About Natives (NAN), a specialist native plant nursery. Cuttings were collected (under DRF collection permits held by EHPL and BGPA) from 250 genotypes of *L. gibsonii* from within the mine footprint on Extension Hill and transported to NAN in October 2008. After 3 months, 44% of the total cuttings (815 cuttings) from 75% of the genotypes (187 different genotypes) had successfully initiated. A few of these genotypes have been lost since the last recording and 174 genotypes remain in stock in 2014 (B Croxford 2014, pers. comm., 10 June).

The intention of the germplasm collection was to create and maintain clones of *L. gibsonii* genotypes as tube stock in two collections, with three clones of each genotype in each collection. However, some clones have not grown well and it has been necessary to pot up and maintain plants as new cuttings have not always been successful or numbers are low (B Croxford 2014, pers. comm., 27 January). The plants and clones are kept on unshaded external benches, regularly monitored, and watered at moderate intervals. The genotypes are subcultured annually from the parent stock. At present, clones in excess of those required for maintenance of the genotypes are disposed.

In vitro culture, with root initiation from stem tissue and embryo extraction has been achieved with multiple genotypes (BGPA, 2010). These culture lines can be maintained over the short to medium term. However, cryostorage is an option for longer term storage if required.

5.1.9 Surveys and reporting new occurrences of *L. gibsonii*

One new population and two new subpopulations of *L. gibsonii* have been recorded since publication of the Interim Recovery Plan in 2008 (DEC, 2008). These are described further here:

- A new group was recorded west of the Extension Hill Mine Site in the vicinity of Wanarra Road. This is located west along Wanarra Road from its junction with the Great Northern Highway. This population corresponds to populations A and B referred to by Coffey Environments (2008a). Collections made from populations A and B were reported as being *Lepidosperma* aff. *costale* by Coffey Environments but subsequent review of specimens collected during the survey at populations A and B and subsequently lodged with the Western Australian Herbarium revealed that they were identified as *L. gibsonii*.
- TPFL population 4A was first recorded on Extension Hill North on 12 February 2008. This population was broadly estimated to consist of 1,000 clumps at that time. It has not been fully surveyed since. It falls within the area of the MGIOMIP approval under Ministerial Statement 753.
- A new subpopulation of *L. gibsonii* was recorded on both sides of the old Great Northern Highway alignment, approximately 200 m south of the turn off to the MGM's Extension Hill Village by Parks and Wildlife and MGM on 24 September 2013. This population was estimated to comprise approximately 11,912 clumps in a low quality partial survey, and needs to be re-surveyed.

The status of the population and its records are shown in Table 2.1.

5.1.10 Review IUCN ranking of the species and need for a full Recovery Plan

Parks and Wildlife have reviewed the relevance and effectiveness of the Interim Recovery Plan in the *L. gibsonii* Review Paper (Parks and Wildlife, 2014). *Lepidosperma gibsonii* currently has a World Conservation Union (IUCN, 2001) Red List Category of Vulnerable (VU) under criterion D2. The ranking of the taxon is currently under review by Parks and Wildlife and that review is expected to be completed by 30 June 2014.

MGM and EHPL have incorporated the information from the *L. gibsonii* Review Paper (Parks & Wildlife 2014) as well as from other sources into this Recovery Plan, with a review scheduled for completion by 30 June 2015.

5.2 MANAGEMENT ACTIONS FOR RECOVERY

This section describes the management actions that MGM and EHPL will undertake to meet condition 7-3 of MS753. They have been informed by the outcomes of the research and the interim recovery plans implemented to date (as summarised in Section 5.1).

MGM and EHPL are required to manage secondary threats from mining and threats of fire to the species through the conditions that apply to the MGIOIP under MS753. The management actions below will be undertaken alongside those obligations that already apply under MS753.

MGM and EHPL will consult with and seek advice from Parks and Wildlife and other entities during implementation of the management actions for the species. MGM and EHPL will also seek assistance from the officer at Parks and Wildlife that it is funding (as set out in the schedule of MS753) to assist with implementation and review of this recovery plan and to coordinate management of threatening processes for the species.

Budget allocations relating to management actions are listed in **Attachment 2**.

Parks and Wildlife have informed MGM and EHPL that as part of their broader conservation objectives, they will:

- coordinate recovery actions for the species that are occurring more broadly (and independently of MGM and EHPL) and liaise with all stakeholders.
- summarise the achievements and progression of all recovery actions for and include a report in an annual reports to Parks and Wildlife's Corporate Executive and funding bodies.
- promote awareness of *L.gibsonii*.
- provide assistance to MGM and EPHL as requested.

These above actions are not actions that are the direct or sole responsibility of MGM and EHPL. Sections **5.2.9 – 5.2.10** outline management actions and responsibilities assigned to parties other than only MGM and EHPL. The proponents take responsibility for implementing those actions in Sections **5.2.1-5.2.8**.

5.2.1 Implement plant condition monitoring program

MGM and EHPL will implement a program for *L. gibsonii* condition monitoring as described in Section 5.1.5.

The condition of *L. gibsonii* will be monitored for potential effects from dust deposition and possible weed invasions, and other threats such as grazing. A representative subset of approximately 920 individual plants will be monitored in detail annually between September and November. In addition, monitoring will be undertaken on a monthly basis in permanent quadrats containing plants to assess dust deposition on the

surface of *L. gibsonii*. Plants in quadrats closest to the mine (e.g. Extension Hill South) will be monitored monthly to assess condition prior to acute stress or mortality. Plants in quadrats located further away from the mine will be inspected quarterly. The monitoring results will be used to guide subsequent management of the species on the mining tenements.

Tasks would include:

- On-going monitoring of tagged plants in established plots (refer to MGM and EHPL 2013; Annual Compliance Report). A representative subset of 920 individual plants will continue to be monitored in detail on an annual basis.
- Collect data on key monitoring measures include: survival, recruitment (new plants should be tagged and recorded as found), health, herbivory, infructescence production, appearance of new seedlings, and growth of young plants.

MGM and EHPL are conditioned by Ministerial Statement 753 to undertake such plant monitoring. The monitoring framework will continue for at least the next three years. Statistical analysis and reporting of plant condition will be done when four years of data has been collected (2015). That analysis of data from the condition monitoring program will be used to inform any further recovery actions in this Plan and guide management of the species in relation to potential threats beyond 2017.

Adaptive management, if required, will draw on mitigations to reduce indirect effects on plant health.

Action: Undertake condition monitoring

Timing: Quarterly and annually, as described above

Commencement date: 2014 and ongoing

Completion date: Life of MGIOIP

5.2.2 Implement Fire Management Strategy

Lepidosperma gibsonii is a re-sprouting species and therefore capable of surviving fire and grazing to a greater extent than a seeder species. Frequent fires (combined with drought conditions) represent the greatest threat to the medium to long term survival of the species.

MGM and EPHL are required to manage secondary threats from mining and threats of fire to *L.gibsonii* through the conditions that apply to the MGIOIP under MS753. The management actions below will be undertaken alongside those obligations that already apply under MS753.

Commencement date: 2014

Completion date: Life of MGIOIP

5.2.3 Manage risks from Secondary threats of mining

The size and condition of the *L. gibsonii* population may be affected by secondary threats including excessive dust deposition, introduction or spread of weeds, unauthorized access causing ground disturbance and altered hydrology. MGM and EPHL are required to manage secondary threats from mining and threats of fire to the species through the conditions that apply to the MGIOIP under MS753. The management actions below will be undertaken alongside those obligations that already apply under MS753.

Commencement date: 2014

Completion date: Life of MGIOIP

5.2.4 Manage the risk of grazing on *L. gibsonii*

Grazing effects by introduced animals (goats and rabbits) will continue to be assessed as part of monitoring the condition of *L. gibsonii* (see Section 5.2.2). BGPA (2010) recommended that populations of goats and rabbits are managed, and herbivory by macropods on *L. gibsonii* are monitored too (BGPA, 2010).

Generally, to date, minor grazing pressure has been observed although in some areas, this has been significant. In the event that grazing pressure significantly affects the health of many plants or sub-populations, introduced animals may need to be controlled through trapping, baiting, poisoning, shooting, exclusion fencing and other means.

Management of grazing pressure will also benefit the broader ecological communities of the Mt Gibson Range.

Tasks would include:

- Monitor effects of grazing on the condition of *L. gibsonii* (Section 5.2.1);
- If significant impacts to *L. gibsonii* populations are observed then consider the implementation of goat and/or rabbit control programs.

Action: If the plant condition monitoring referred to in section 5.2.1 demonstrates that grazing is having an adverse impact on the plant population on the mining tenements, MGM and EHPL will implement an appropriate feral animal control program within the Mt Gibson Area.

Commencement date: 2014

Completion date: Life of MGIOP

5.2.5 Maintain and use seed/germplasm collections

Seed/germplasm collections with a broad genetic base should be made available for on-going *ex situ* conservation and for future use in restoration programs. Seed banking and germplasm strategies provide long-term security for identified genotypes and back-up collection. Seed will be provided to Parks and Wildlife to be stored at the Parks and Wildlife Threatened Flora Seed Centre.

In vitro culture and cryostorage are options for long-term storage of key clonal germplasm if required (BGPA, 2010). *In vitro* culture has successfully been achieved for this species (BGPA, 2010). This may be a necessary option if the IUCN status deteriorates as a result of the identified threats in Section 3.

However, in the short-medium term, propagation of live *L. gibsonii* plant material from wild collections and nursery stock may pose a cost-effective approach for storage, as well as production of new plants for restoration purposes. Maintenance of the *L. gibsonii* germplasm collection, particularly from those plants which have been cleared for the MGIOMIP footprint, should continue until such a time as viable plants are re-established from these collections. Multiple (>100) genotypes of live plants should be maintained, monitored and supplemented in the mid-west region to represent each of the groups cleared during mining activities.

A review of the seed held in storage, its quality, and the groups from which it originates, is necessary. Collection of seed from groups which do not have representations of seed, or seed of good quality, will be necessary with the aim of maintaining an adequate supply of seed in storage for each of the groups of *L. gibsonii*.

Tasks may include:

- Collate and annually check records of retained seed stock in storage (2015).

- One-off test of retained seed stock in storage (2016).
- Targeted seasonal collection of seeds from key Mt Gibson Ranges groups (mid-November) including those which do not have seed representation (late Spring 2015-2016).
- Propagation of live *L. gibsonii* plants from wild collection seedstock (2017-2018).
- Provision of nominated seed samples to Parks and Wildlife (2015-2016).

Action: Maintain adequate seed/ germplasm collections

Commencement date: 2015

Completion date: Life of MGIOIP

5.2.6 Plant translocation and population restoration planning

The critical habitat for the survival of *L. gibsonii* may also include additional nearby occurrences of similar habitat that do not currently support the species but may have done so in the past and may be suitable for future translocation. The modelled habitat (Figure 2) and recorded groups of plants has increased the known areas of occurrence and abundance of the population. Direct or extensive plant translocations may not be necessary in the medium to long term. In preparation, should the plant population show trends of decline, further trials may be required to conserve the species.

Restoration planning should consider the scaled production of *L. gibsonii* seedlings via germination of methods such as:

- fresh or stored seed involves physical manipulation of small seeds for seed coat nicking or removal;
- heat shock treatment (100°C for five minutes);
- seed burial which resulted in physical degradation of the seed coat, as well as, environmental (seasonal temperature and moisture) cuing; and
- smoke treatments.

All of these treatments have been shown to improve germination percentage, however, the best results were obtained from removing the seed coat and then subjecting the seeds to a heat shock treatment, which resulted in 60% germination. Further research is required to specifically identify the right combination of dormancy breaking treatments for the seed of this species.

Should *L. gibsonii* seed become a more viable restoration source, as a result of further investigations into its germinability, allowance must be made for the likely ultimate rate of seed germination, difficulty of collection and the potential rate (in time and money) of developing seedlings from seed.

The effort and budget invested in such tasks as below would only be triggered by a reduction against the criteria in Section 4 describing key metrics of the plant population.

Tasks may include:

- Prepare species restoration strategy and program (2014 - 2015).
- Collect seed and use *ex situ* materials for translocation programs (2015 – 2016).
- Monitor the survival and establishment of plants remaining from preliminary translocation trials (2015).
- Waste landform rehabilitation trials: Assessment rock and gravel substrates with varying composition, degrees of soil depth and rockiness and other growing media to support growth of *L. gibsonii* will determine the suitability of this species for more extensive waste landform rehabilitation programs (2015 – 2017).

Actions:

- The currently proposed management actions are comprised of the set of tasks above. The sequence of the timing of each task is also specified.
- Review the use and application in species recovery outcomes.

Timing: 2014 – 2017 initially

Commencement date: November 2014

Completion date: life of MGIOIP

5.2.7 Report existing and any new occurrences of *L. gibsonii*

Note these interests that may be the domain of parties other than MGM and EHPL:

- *Lepidosperma gibsonii* does not have representative specimens held by the WA Herbarium from across its range. Parks and Wildlife will consider that specimens of these sub-populations are to be collected and lodged with the WA Herbarium.
- There are plans by Parks and Wildlife to survey areas of potential habitat for the presence of *L. gibsonii* during the seasonal flowering period. Any surveyed areas will be recorded and the presence or absence of the species will be documented to increase survey efficiency and reduce the chance of duplicate surveys. Where possible, the GDTFRT and volunteers from the local community shall be involved in surveys, supervised by Parks and Wildlife staff.

A full population census may be required if there is evidence that the population abundance had decreased or was decreasing dramatically in a short period of time resulting in the recovery criteria dropping to the “Amber” category. Refer to Table 4.1 for guidance on criteria that would determine a significant change in plant abundance.

A future census would need to use a reliable reproducible methodology with the aim to provide an update of the total plant counts, boundary and structure (proportions of mature, juvenile, seedling and dead individuals) of each recorded occurrence. The lead responsibility for completing any census would be MGM and EHPL should the population decline occur on mining tenements in accordance with criteria (Table 4-1).

Specific tasks for MGM and EHPL would be:

- Any new *L. gibsonii* specimens or groups that may be located through opportunistic surveys will be reported in accordance with the Threatened and Priority Flora Report Form to Parks and Wildlife.
- If the population is estimated at ‘Amber light’ (or lower class), conduct plant population census within one year at a rate of every five years; otherwise every ten years.

Action: Continue to investigate the occurrence of *L. gibsonii* and report any new occurrences to Parks and Wildlife.

Commencement date: 2014

Completion date: Life of MGIOIP

5.2.8 Promote awareness of *L. gibsonii*

The status of *L. gibsonii* and measures to manage risk and threats to the species will be promoted to staff at the MGIOMIP. The significance of the species will continue to be communicated to personnel working at and around the mine site (i.e. environmental induction).

Note that Parks and Wildlife may lead on matters of species awareness for external extension.

Actions:

1. Promote need for protection through poster displays and local print and electronic media; and
2. Continue environmental inductions.

Commencement date: 2014

Completion date: Life of MGIOIP

5.2.9 Coordinate recovery actions and liaise with stakeholders

MGM and EHPL will continue to liaise with stakeholders in relation to requirements of MS753 for the Mt Gibson Iron Ore Mine and Infrastructure Project. Parks and Wildlife has indicated its oversight of species recovery actions.

Parks & Wildlife tasks may include:

- Coordinate recovery actions, liaise with stakeholders and provide an annual review report.
- Summary of achievements and progression of recovery actions will be included in recovery team annual reports to Parks and Wildlife's Corporate Executive and funding bodies.

Actions:

- Coordinate recovery actions, and liaise with stakeholders.
- Provide an annual review report on the species including guidance on research and its directions.

Responsibility: Parks and Wildlife

Commencement date: on adoption of the Recovery Plan

Completion date: annually for the Species Review Paper over the life of Recovery Plan

5.2.10 Review assigned conservation status of the species

The IUCN category of the species is currently 'Vulnerable' and it will be reviewed during the term of the Recovery Plan.

Actions:

1. Review the conservation status of the species; and every 5 years thereafter.

Responsibility: Parks and Wildlife

Timing: 2015

Commencement date: 2015

Completion date: for life of Recovery Plan

5.3 FURTHER RESEARCH TO UNDERSTAND CERTAIN ECOLOGICAL PROCESSES

There are emerging research outcomes about certain biological processes and ecophysiological interactions that may contribute to recovery of the species in some way. These processes and interactions may be important over the course of the Recovery Plan. Given the extensive research investment and knowledge gained from this, on-going nascent factors need to be prioritised in order to deliver effective management for recovery of the species. It is recommended that such research tasks and actions commence after the Parks and Wildlife 2015 Annual Review Paper is written to collate the most recent findings and information gaps from the completion of the Interim Recovery Plan and all preceding works.

Tasks may include:

Seed bank demography

Investigate by desktop assessment and reporting:

- Soil seed bank, phenology, genetic analysis of breeding systems and seed dispersal.
- Seed production susceptibility to drought and climate change including risks on fecundity, seed production and any changes to plant demographic monitoring.

Environmental interactions and plant health

- Investigate key biotic and abiotic associations for habitat and revegetation, key aspects of ecophysiology, and tools to monitor plant growth and health.
- Perform manipulative experiments of substrates using mine waste components or other available and appropriate materials.

Restoration and translocation techniques

- Report into the use of seed as preferred restoration source (because of the drawbacks of greenstock).
- Determine if *L. gibsonii* seed would germinate from 2007 collected samples.
- Seed tested for viability using non-destructive x-ray screening.
- Translocation trial methodologies will assist in:
 - determining whether or not additional areas of similar habitat are suitable for growing *L. gibsonii*, and
 - rehabilitation of areas disturbed by mining. The survival and management of the plants remaining from the preliminary past planting trials of *L. gibsonii* on the four differing field soil substrates should continue to be monitored.

Fire regime

- Conduct an experiment designed using fire in unburnt habitat where *L. gibsonii* is present and also areas where it is not recorded but where the habitat is suitable (portions of South Mt Gibson South for example). Determine if fire can be carried out to rejuvenate populations and determine if *L. gibsonii* is present in the soil stored seedbank.

Ex-situ conservation methods

- Conduct a comparative evaluation of the effectiveness of off-site conservation collections (living, cryogenic and seed banking) held at the Kings Park Seed Technology Centre, Kings Park Science laboratory and the Parks and Wildlife Threatened Flora Seed Centre.

Action: Prioritise the above tasks and implement according to resourcing and budget considerations over a three year period.

Responsibility: MGM and EHPL, in association with Parks and Wildlife and scientific research agencies

Commencement date:	2016
Completion date:	2018

6 PLAN IMPLEMENTATION AND EVALUATION

MGM and EHPL will review this plan:

- after results of the Parks and Wildlife annual report (2015) become available and justifies need for a review;
- if Criteria for Caution (“Amber” light) are met while the MGIOIP is operating; and
- if directed to do so by the CEO of the EPA in accordance with condition 7-7 of MS753.

This plan will continue to apply unless and until the Minister for Environment approves a revised plan under condition 7-3 of MS753.

The plan may be evaluated upon submission to the requirements of WA Minister for the Environment by Environmental Protection Authority and Parks and Wildlife. The Commonwealth Department of Environment may evaluate the Recovery Plan.

MGM and EHPL will review the management actions based on available data that enables the ‘recovery criteria’ to be assessed and for that assessment to occur. In addition to annual reporting by proponents and by Parks and Wildlife on progress and evaluation against the criteria, the plan will be reviewed following five years of implementation.

7 REFERENCES

- ATA Environmental, GHD Pty Ltd, Maunsell Australia Pty Ltd, Mount Gibson Mining Limited, Extension Hill Pty Ltd (2008a). Extension Hill & Extension Hill North Environmental Management Plan, Management Plan prepared for Mount Gibson Mining Limited and Extension Hill Pty Ltd.
- Bennett Environmental Consulting Pty Ltd. (2000). Flora and Vegetation of Mt Gibson. Private report prepared for MGI.
- Botanic Gardens and Parks Authority (BGPA) (2005a). Research Benchmarks for Conservation of *Lepidosperma gibsonii* at Mt Gibson: Stage 1. Unpublished Report.
- Botanic Gardens and Parks Authority (2005b). Conservation Biology and Restoration Ecology of *Lepidosperma gibsonii* at Mt Gibson. Stage 2 Program: Six monthly summary, December 2005. Unpublished Paper.
- Botanic Gardens and Parks Authority (BGPA) (2008) Conservation and Restoration Research Proposal *Darwinia masonii* and *Lepidosperma gibsonii*: An integrated research program into ex situ and in situ conservation, restoration and translocation of *Darwinia masonii* and *Lepidosperma gibsonii*. 2007-2010 Version 2 April 2008.
- Botanic Gardens and Parks Authority (BGPA) (2010). *Darwinia masonii* and *Lepidosperma gibsonii* Conservation and Restoration Research. An integrated research program into the *ex situ* and *in situ* conservation, restoration and translocation requirements of *Darwinia masonii* and *Lepidosperma gibsonii* May 2007 – June 2010. Unpublished report prepared by Botanic Gardens and Parks Authority (Kings Park and Botanic Garden) for Mount Gibson Mining Limited and Extension Hill Pty Ltd, Perth, WA.
- Brown, A., Thomson-Dans, C. and Marchant, N. (eds). (1998). Western Australia's Threatened Flora. Department of Conservation and Land Management, Western Australia.
- Coffey Environments, Maunsell Australia Pty Ltd and GHD Pty Ltd (2008). Mt Gibson Iron Ore Mine and Infrastructure Project – Extension Hill & Extension Hill North Environmental Management Plan (Rev 2). [Online]. WA: Mount Gibson Mining Limited, Extension Hill Environmental Documentation. Viewed 19 December 2013. <<http://www.mtgibsoniron.com.au/wp-content/uploads/2012/12/Extension-Hill-Environmental-Management-Plan-Rev-2.pdf>>
- Department of Conservation and Land Management (1992), Policy statement No. 44 Wildlife Management Programs, Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1994), Policy statement No. 50 Setting priorities for the conservation of Western Australia's threatened flora and fauna, Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1995). Policy Statement No. 29 Translocation of Threatened Flora and Fauna, Department of Conservation and Land Management, Perth.
- Department of Conservation and Land Management (1999). Draft Policy Statement Number 9: Conserving Threatened Species and Ecological Communities. In preparation.
- DEC (2008). *Lepidosperma gibsonii* Interim Recovery Plan 2008-2012. Interim Recovery Plan No. 283. DEC, WA.

- Gardner, C.A. (1964). *Contributions Florae Australiae Occidentalis* 13. *Journal of the Royal Society of Western Australia* 47: 54-64.
- Government Gazette, Western Australia (2008). *Government Gazette Part 1: Conservation CO302, Wildlife Conservation Act, 1950, Wildlife Conservation (Rare Flora) Notice 2008*, pp 185-191, 22 January 2008.
- IUCN Standards and Petitions Subcommittee. (2011). *Guidelines for Using the IUCN Red List Categories and Criteria. Version 9.0*. Prepared by the Standards and Petitions Subcommittee. Downloadable from <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>.
- Landcare Services (2007). Report on the collection of *Darwinia masonii* (DRF) and *Lepidosperma gibsonii* (DRF) seed. Unpublished report prepared by Landcare Services for Mount Gibson Mining Limited and Extension Hill Pty Ltd, Perth, WA, December 2007.
- MGM & EHPL (2013a). *Annual Environmental Report – Mt Gibson Iron Ore Mine and Infrastructure Project October 2012 – September 2013*. Unpublished report prepared by MGM & EHPL, WA.
- Patrick, S.J. (2001). *Declared Rare or Poorly Known Flora in the Geraldton District*. [Online]. *Wildlife Management Program No 26*. Department of Conservation and Land Management, Western Australia.
- Parks and Wildlife (2014). *Lepidosperma gibsonii* Review Paper. Unpublished report prepared by Department of Parks and Wildlife, Geraldton.
- Vallee, L., Hogbin T., Monks L., Makinson B., Matthes M. And Rossetto M. (2004) *Guidelines for the Translocation of Threatened Australian Plants. Second Edition*. The Australian Network for Plant Conservation. Canberra, Australia.
- Western Australian Herbarium (1998–) *FloraBase – The Western Australian Flora*. Department of Parks and Wildlife. <http://florabase.dpaw.wa.gov.au/>
- World Conservation Union (2001). *IUCN Red List Categories: Version 3.1*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

Personal communication references

- M. Barrett Research Scientist (Conservation Genetics), Kings Park and Botanic Garden, West Perth, Western Australia
- B. Croxford Proprietor, Nuts About Natives, Karnup, Western Australia
- J. Sackmann Senior Environmental Engineer, Mount Gibson Mining Ltd – Extension Hill Operations, Western Australia

8 ATTACHMENT 1 – SUPPORTING TECHNICAL INFORMATION

A1.1. History, nomenclature and taxonomic relationships

Lepidosperma gibsonii is a species that was recognised as such in January 2006 (Barrett, 2007). The species was not represented by any specimen in the Western Australian Herbarium, and was recognised after Russell Barrett from Botanic Gardens and Parks Authority (BGPA) carried out a preliminary study of unsorted *Lepidosperma* specimens and found that there are many more taxa of *Lepidosperma* than have previously been recognised. Consequently, funding was made available to BGPA from MGM and EHPL to examine patterns of genetic variation within *L. gibsonii* (formerly *Lepidosperma* sp. Mt Gibson (R. Meissner & Y. Caruso 3)) as part of a preliminary study to provide some fundamental information on which the effects of removal of plants could be evaluated.

Lepidosperma gibsonii is most closely related to nearby populations of *L. costale* (BGPA, p5, 2010).

A1.2. Illustrations and/or further information

Barrett, R.L. (2007). New Species of *Lepidosperma* (Cyperaceae) Associated with Banded Ironstone in Southern Western Australia. *Nuytsia* 17:37-60.

Barrett, R. L. (2013). Ecological importance of sedges: a survey of the Australasian Cyperaceae genus *Lepidosperma*. *Annals of Botany* 111: 499-529.

BGPA (2010). *Darwinia masonii* and *Lepidosperma gibsonii* Conservation and Restoration Research. An integrated research program into the *ex situ* and *in situ* conservation, restoration and translocation requirements of *Darwinia masonii* and *Lepidosperma gibsonii* May 2007 – June 2010. Unpublished report prepared by Botanic Gardens and Parks Authority (Kings Park and Botanic Garden) for Mount Gibson Mining Limited and Extension Hill Pty Ltd, Perth, WA.

Meissner, R. and Caruso, Y. (2008) Flora and Vegetation of Banded Iron Formations of the Yilgarn Craton: Mt Gibson and surrounding area. *Conservation Science WA* 7, 105-120.

Western Australian Herbarium (1998–) *FloraBase – The Western Australian Flora*. Department of Parks and Wildlife. <http://florabase.dpaw.wa.gov.au/>

A1.3. Further details on species biology and ecology

Population demography

Lepidosperma gibsonii individuals recruit from long-lived soil-stored seedbanks in a single post-fire cohort. There is no particular evidence for inter-fire recruitment. Plants are long-lived (perhaps to ca. 100 years) and about half of plants exposed to fire appear to survive and resprout (BGPA, 2010)

Growth

Plant size data and known population ages suggest that *L. gibsonii* basal diameter growth averages 2 – 2.5 mm per year for seedlings and adults. Surveys of tagged plants identified mean negative growth rates between 2007 and 2010, possibly reflecting growth conditions in these years (BGPA, 2010).

Fecundity

Reproduction commences in *L. gibsonii* seedlings as young as six years, but increases in terms of proportion of plants flowering, and flowers per plant as plant size increases (BGPA, 2010).

Recruitment

Post-fire *L. gibsonii* recruitment averaged 4.2 seedlings produced per pre-fire adult, but approximately 75% did not survive to two years of age. Mortality among 4-6 year old seedlings averaged 3% per year (BGPA, 2010).

Seed production and seed biology

Lepidosperma gibsonii reproduction takes place over multiple years, with inflorescence production occurring in one year and flowering and fruit ripening occurring in the next (BGPA, 2010). *Lepidosperma gibsonii* seed production is limited by a requirement for sufficient rainfall in consecutive years (BGPA, p70, 2010). The amount of this rainfall is unknown but appears to lie in the range of 65 - 110% of the average. Applying these thresholds to the Ninghan rainfall record suggests that the frequency of *L. gibsonii* reproduction may vary between 60% and 22% of years, with likely historic runs of no seed production varying from 2 to 49 years.

Pollination is via wind. If seed is produced, the period for which ripe seed can be collected from *L. gibsonii* plants is brief (one to two weeks in mid October) as good seeds fall soon after ripening (BGPA, 2010).

Seed of *L. gibsonii* is thought to be abiotically dispersed by gravity or flowing water (BGPA, 2010). It has no apparent external dispersal adaptations, and a small experiment offering fruits to captive seed dispersing ants from Extension Hill did not result in fruits being removed. Comprehensive seed dispersal studies were not possible as insufficient seed was available for them.

Tracking seed dispersal was difficult because of these abiotic dispersal vectors, small seed size and poor seed production. BGPA (2010) conducted an experiment which mapped the actual dispersal distance by assignment of the genotypes of 200 seedlings within the boundary of the May 2009 experimental fire to their source plants.

Seed germination and dormancy

Lepidosperma gibsonii recruits in a single cohort post fire from the soil-stored seedbank as discussed previously in this section, but preliminary results from BGPA's (2010) seed bank trial indicated that *L. gibsonii* has complex germination and dormancy strategies. These results indicated requirements for physical degradation of the seed coat, environmental (seasonal temperature and moisture) cuing, with smoke acting as an additional cue. Smoke alone does not break the dormancy of *L. gibsonii*. The seed bank trial was designed to run for up to five years and was established in 2009, so BGPA were only able to report on the results from the first six months of the trial. After six months burial, only those *L. gibsonii* seed which were treated with heat (100°C for 10 minutes) germinated, and the rate was low – 8 % for seeds treated with smoke water and 4.8 % for seeds treated with water. The germination rate appeared to show signs that it would continue to steadily increase with the length of time of seed burial as there was no germination of seeds which hadn't been buried, and a small percentage germinated (with the same treatments) at three months.

The preliminary results of the seed bank trial were corroborated by data from experiments where the seed coat of *L. gibsonii* was manually removed and heat treated. Tissue culture of embryos extracted and treated to 100°C for 10 minutes had the highest germination rate (60 %; BGPA, 2010).

Environmental adaptations

Lepidosperma gibsonii shares with co-occurring species the drought avoiding strategy of closing down transpiration and photosynthetic function to enter a period of physiological dormancy through summer drought with the capacity to restore tissues when rainfall occurs and the soils become wet (BGPA, 2010).

Roots of *L. gibsonii* have a capacity to enter large cracks, pores and fissures in regolith and may achieve considerable root depths (perhaps to >10m), but the species did not show root growth adaptations that were significantly different from close relatives from non-Banded Iron Formation habitats (BGPA, 2010).

Biotic interactions

Grazing by goats and rabbits was recorded repeatedly at localised sites (BGPA, 2010) which were all on lower slopes or not on slopes. At least half of the leaves or scapes were grazed on 16% of all *L. gibsonii* plants surveyed, and over 20% were recorded having been grazed. BGPA reported that the evidence for an impact of herbivory on survival rates is unclear as significant recovery was recorded for plants experiencing herbivory. However, repeated herbivory which was recorded has an impact on reproductive output. Plants which are 100% grazed had no reproductive output.

A scale insect (unidentified Hemiptera: Coccoidea) has been recorded on the culms of *L. gibsonii* (BGPA, 2010). The parasitic, sap-sucking nature of this insect may significantly affect growth rate and reproductive capacity in populations where it was prevalent (e.g. Emu Proof Fence TPFL 8).

An unidentified rust fungus was recorded in small numbers (1-5 culms per clump) on *L. gibsonii* plants of most populations (BGPA, 2010). It is considered a minor parasite of *L. gibsonii*, but its significance may be more marked in poor seasons or if infection rates increase.

Five species of smut fungi (four *Moreaua*, one *Heterotolyposporium*) which have been observed in populations of *L. costale sens. lat.* in the Midwest have not yet been observed on *L. gibsonii*. *Lepidosperma* smuts are systemic and destroy all florets within an inflorescence when they are abundant.

Abiotic associations

BGPA (2010) used two approaches to determine the environmental associations of *L. gibsonii*: An analysis of site factors at demographic and physiological monitoring plots; and, modelling of species distributions against spatially mapped environmental data. The environmental parameters interrogated by the modelling were geology, short term fire history (since 1968), solar radiation receipt, aspect, slope, curvature and elevation. They concluded that of the environmental parameters interrogated by distribution modelling for *L. gibsonii*, winter 2 pm solar radiation (below), elevation and slope were the principal environmental parameters predicting the distribution of *L. gibsonii*. These were followed by geology, aspect and fire history since 1969. When considered alone, areas with less than 0.4 w/m²/hr winter 2pm solar radiation receipt had an 80% probability of presence of *L. gibsonii*.

The modelling predicted *L. gibsonii* to occur with a >90% likelihood of presence in many small areas and a detailed pattern of presence probabilities outside of these areas of greatest likelihood (BGPA, 2010). *Lepidosperma gibsonii* is already known to occupy many of the areas that it is most strongly predicted to occupy, and BGPA postulated that most of the remaining highly predicted areas will also contain populations if they were to be surveyed. It is interesting to note that the modelling also predicted suitable habitat for *L. gibsonii* on Yandanhoo Hill to the east of the Mt Gibson Ranges. BGPA (2010) concluded the environmental variables used are the factors limiting suitability of the abiotic habitat. Also discussed in the context of the abiotic associations was soil moisture, although this was not a variable which was modelled. Low solar radiation receipt is one factor which contributes to increased soil moisture. Soil type and depth to rock also affect soil moisture, and these may also be important abiotic factors affecting the distribution of *L. gibsonii*.

In situ planting methods using separated clumps of *L. gibsonii* were trialled by BGPA (2010) at Mt Gibson on four differing field soil substrates. These were on the deep red loam/clay plains east of Extension Hill (clay), white-yellow sands of sandplains west of Extension Hill (sand), and gravelly and rocky loams of the north Extension Hill slope and ridge (BIF gravel and BIF rock respectively). *Lepidosperma gibsonii* survival after nine months of planting was successful in sites with BIF rock and BIF gravel substrate, and less than 10% of

the plants persisted with limited vigour at the sand and clay sites. In contrast, there was approximately 70% survival on the BIF gravelly loam and 50% survival on the BIF rocky loam. Both sites had significantly higher Organic Carbon (%) and Total Nitrogen (%) than the clay and sand sites. The BIF rock and BIF gravel sites had slower soil drying curves than the sand and clay sites. *L. gibsonii* is not currently known from sandy or clayey sites like those selected for the restoration trial, and perhaps the factors contributing to the lack of success of the clumps planted provides some explanation for this. BGPA (2010) concluded that sites with BIF rock and BIF gravel are suitable for translocations, and texture, gravel/rock content, patterns of moisture content and Total Nitrogen may be the most critical soil properties to consider in site selection.

Fire

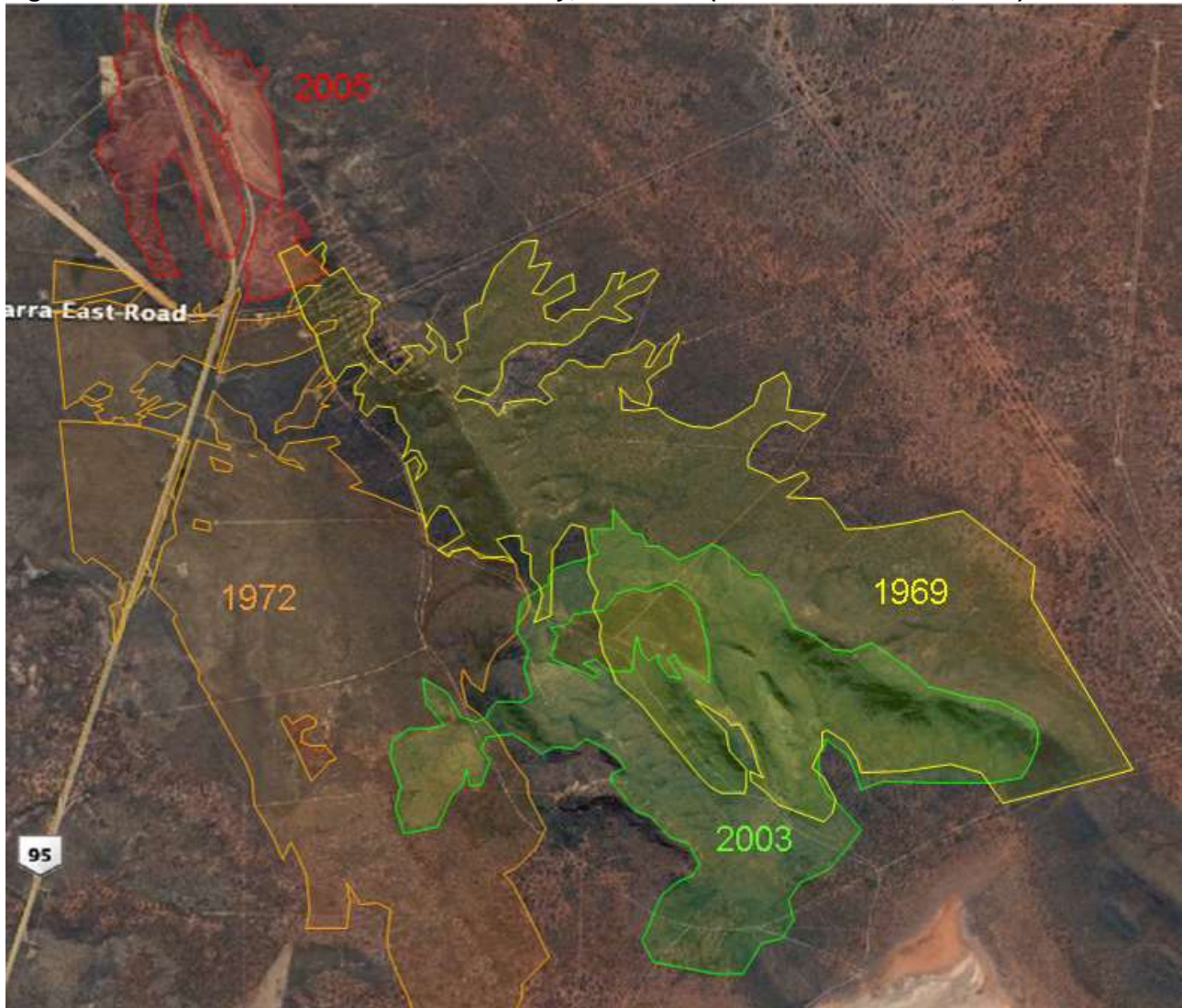
BGPA research (2010) indicates that *L. gibsonii* is a long-lived re-sprouting species, and approximately 50% of adult *L. gibsonii* plants are killed in a fire. Recruitment occurs after fire in a single cohort from long-lived soil-stored seedbanks and seedlings take at least six years to reach reproductive maturity. This research also found no evidence of inter-fire recruitment. Fire management, particularly management of fire frequency, is essential in optimising the ongoing conservation of *L. gibsonii*.

BGPA (2010) reported that the best model of fire history since the mid 1960's (Figure 10) describes just four major fires on the Mt Gibson range and several others nearby. Scars for the two recent fires are clearly visible on images dating from 2004 and 2005, and these can be accurately dated from Sentinel to 7-10th February 2003 and from personal communications to December 2005. The two previous fires are attributed to 1972 and 1969 are visible on high resolution images up to the present, and dating back to 1972. Evidence supporting the dates of these fires include their absence from the 1968 photo, presence in 1972 and relative freshness apparent in the two fire scars in the 1972 and 1974 images (Figure 9). While it is recognised that this dating may be imprecise, variation of a year or two is relatively insignificant relative to the subsequent 40 years of growth of plants subsequently. In fact only one of these fires appears to have burnt surveyed populations of *L. gibsonii*, although the 1972 fire may have burnt populations of *L. gibsonii* to the west of the Mt Gibson range.

BGPA (2010) also reported that population structure of *L. gibsonii* indicates that individuals recruit in a single cohort post-fire, with no evidence for inter-fire recruitment observed. That older populations were evenly structured may suggest infrequent inter-fire recruitment, but are more likely to indicate varying growth rate and the coalescence and splitting of clumps through time. Furthermore, the studies found:

- Evidence from population structure suggesting a mean basal diameter growth rate of 2 – 2.5 mm per year for seedlings and adults.
- Extrapolating growth rates from population structure suggests that the oldest populations studied (“Emu Fence”) may have last burnt early in the 20th century, perhaps around 1910.
- Post-fire recruitment was higher, with an average of 4.2 seedlings produced per pre-fire adult.

Figure A.1: Mt Gibson-Extension Hill fire history; 1968-2010 (sourced from BGPA, 2010)



***Ex situ* Plant Tissue**

Techniques for the successful propagation of *L. gibsonii* have been proven at both BGPA and an independent specialist nursery and involve greenstock production from cuttings (BGPA, 2010). Propagation of live *L. gibsonii* plant material from wild collections and nursery stock is likely pose the most cost-effective approach for the short-medium term storage and production of plants for restoration purposes, but the drawbacks of the use of greenstock should be taken into consideration and managed. The number of genotypes remaining from TPFL population 4A is low at 24, while 150 remain from TPFL 3A. Both of these populations will be taken as they are within the approved disturbance area under Ministerial Statement 753, however, desktop data review indicates that the proportion of plants taken to date from both of these populations is low. Multiple (>100) genotypes of live plants (BGPA, 2010) should be maintained, monitored and supplemented to represent each of the populations (TPFL 4A and 3A) cleared during mining activities under Ministerial Statement 753. Maintenance of the germplasm collection, particularly of the populations of *L. gibsonii* which have been cleared for the MGIOIP footprint, should continue until such a time as viable populations are re-established from these collections.

Table A1. Genotypes of *L. gibsonii* maintained at NAN

TPFL population number	Number of genotypes collected (October 2008)	Number of genotypes remaining (June 2014)	Current status of natural population	Future status of natural population
TPFL 4A (Extension Hill North)	33	24	Aerial photography and historical survey records indicate proportion of plants taken is low	Within approved disturbance area under Ministerial Statement 753. Will be taken.
TPFL 3A (Extension Hill)	217	150	Aerial photography and historical survey records indicate proportion of plants taken is low	Within approved disturbance area under Ministerial Statement 753. Will be taken.

While propagation of live plant material from wild collections and nursery stock are likely the most cost effective approach for the short-medium term storage and production of plants for restoration purposes, BPGA (2010) recommended continuing investigation into the use of seed as a restoration source because of drawbacks of greenstock. Drawbacks to the use of clones for population restoration were outlined by BGPA, and include:

- Infrastructure, resource and time demands (pots, potting media, glasshouse bench space, irrigation, pest management, time and expertise to establish cuttings, plant out etc.);
- Selection in propagation can lead to a loss of genetic diversity and capacity;
- Increasing the numbers of genotypes collected and established (beyond the low hundreds) may be possible, but with diminishing returns in terms of required effort; and
- Translocation of large and/or unbalanced numbers of genetic clones means that some genotypes may become grossly over-represented in restoration, which should aim to replicate source levels of genetic diversity.

Should *L. gibsonii* seed become a more viable restoration source as a result further investigations into its germinability, allowance must be made for the likely ultimate rate of seed germination, difficulty of collection and the potential rate (in time and money) of developing seedlings from seed.

Lepidosperma gibsonii reproduction takes place over multiple years, with inflorescence production occurring in one year and flowering and fruit ripening occurring in the next. If *L. gibsonii* seed is produced, the optimal time for which ripe seed can be collected from *L. gibsonii* plants is brief (one to two weeks in mid-October) as good seeds fall soon after ripening (BGPA, 2010).

Seed was collected from the southern slopes of Extension Hill in rock fissures on banded ironstone by Russell Barrett on 19 May 2006 (L Sweedman 2014, pers. comm., 6 June). Details of the quantities and viability of the seed, which is stored at the WA Seed Technology Centre at Kings Park and the Millenium Seed Bank, are provided in Table A2. The seed at the MSB remains WA property and is stored as a duplicate only. No *Lepidosperma gibsonii* seed is currently stored at Parks and Wildlife's Threatened Flora Seed Centre (A Crawford 2013, pers. comm., 30 October).

Table A2. Details of *Lepidosperma* seed collections held by Kings Park's WA Seed Technology Centre and the Millenium Seed Bank

Location	Accession	Collection date	Location	TPFL Pop	Seeds/fruit in storage	Viability (%)
WASTC	20110360	19/06/2006	Extension Hill South	3A	1204 seed	60%

Location	Accession	Collection date	Location	TPFL Pop	Seeds/fruit in storage	Viability (%)
MSB	?20110360	19/06/2006	Extension Hill South	3A	1678 seed	60 %

Landcare Services (2007) carried out seed collection over 5 days within the MGIOIP footprint in December 2007 as part of a salvage operation to collect the maximum amount of seed material prior to clearing of vegetation for mining activities and determine the most efficient way to salvage seed from *Lepidosperma gibsonii*. Little seed was available on the plants at the time of collection, and it was collected from the plants and vacuumed from within plant clumps (Table A4), and cut tests on a portion of the seeds which were collected appeared to be non-viable. They also collected organic material, localised “organic dams”, and soil from under and around the plants (Table A3). They recommended that a pot trial of this material be conducted to determine if *L. gibsonii* seed would germinate from collected samples, and the use of the remainder of the seed collected from the plants be tested for viability using non-destructive x-ray screening.

The seed and topsoil of *L. gibsonii* collected by Landcare in December 2007 is stored along with *Darwinia masonii* seed and topsoil, collected at the same time, in four 55 L containers (Landcare Services, 2009). The seed and material is stored at a constant temperature controlled (19°C) seed storage facility in Bassendean.

Table A3. Details of *L. gibsonii* bulk sampled collections made during Landcare Holdings (2007) salvage operation held by Landcare Holdings in Bassendean

Code	Collection date	Location	Material <2mm (g)	Nature of material	Collection method
Group 1, Bag 1	Dec-07	unknown	2,928	Leaf litter	Collected manually with trowels and brushes.
Group 1, Bag 2	Dec-07	unknown	456	Leaf litter	Collected manually with trowels and brushes.
Group 1, Bag 3	Dec-07	unknown	122	Leaf litter	Collected manually with trowels and brushes.
Group 1, Bag 4	Dec-07	unknown	1,434	Leaf litter	Collected manually with trowels and brushes.
Group 2, Bag 1	Dec-07	unknown	5,132	Surface material, contains leaf litter	Collected by hand with trowels.
Group 2, Bag 2	Dec-07	unknown	11,375	Surface material, contains leaf litter	Collected by hand with trowels.
Group 2, Bag 3	Dec-07	unknown	2,314	Surface material, contains leaf litter	Collected by hand with trowels.
Group 2, Bag 4	Dec-07	unknown	1,320	Surface material, contains leaf litter	Collected by hand with trowels.
Group 2, Bag 5	Dec-07	unknown	3,280	Surface material, contains leaf litter	Collected by hand with trowels.
Group 3, Bag 1	Dec-07	unknown	2,188	Surface material to 2 cm	Collected by hand with trowels.
Group 3, Bag 1	Dec-07	unknown	5,432	Surface material to 2 cm	Collected by hand with trowels.
Group 4, Bag 1	Dec-07	unknown	1,676	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 2	Dec-07	unknown	410	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 3	Dec-07	unknown	464	Topsoil, detritus and surface organic material	12V vacuum

Code	Collection date	Location	Material <2mm (g)	Nature of material	Collection method
Group 4, Bag 4	Dec-07	unknown	492	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 5	Dec-07	unknown	196	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 6	Dec-07	unknown	64	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 7	Dec-07	unknown	114	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 8	Dec-07	unknown	62	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 9	Dec-07	unknown	3,176	Topsoil, detritus and surface organic material	12V vacuum
Group 4, Bag 10	Dec-07	unknown	2,072	Topsoil, detritus and surface organic material	12V vacuum

Table A4. Details of *Lepidosperma gibsonii* seed collections from 2007 held by Landcare Holdings in Bassendean

Code	Collection date	Location	TPFL Pop	Amount of seed (g)	Collection notes
L1	Dec-07	Northern	4A	4.6	Hand collected from plant
L2	Dec-07	Northern	4A	2.7	Hand collected from plant
L3	Dec-07	Southern	3A	4.9	Hand collected from plant
L4	Dec-07	Southern	3A	0.6	Hand collected from plant
L5	Dec-07	Southern	3A	0.2	Hand collected from plant
L6	Dec-07	Southern	3A	Approximately 100 seeds	Hand collected from plant
L7	Dec-07	Southern	3A	3.1	Hand collected from plant
*L8	Dec-07	Southern	3A	1	12V vacuum from plant
*L9	Dec-07	Northern	4A	2	Hand collected from plant
*L10	Dec-07	Northern	4A	2.5	12V vacuum from plant
*L11	Dec-07	Northern	4A	44.5	12V vacuum from plant
*L12	Dec-07	Northern	4A	2.7	12V vacuum from plant
*L13	Dec-07	Northern	4A	1,262	Stihl 27 CC vacuum from plant
L14	Dec-07	Mt Gibson	?5/6	0.1	Hand collected from plant

* No seed in sieved material

ATTACHMENT 2 – MANAGEMENT ACTION ESTIMATES

Action item	Responsibility	Cost Estimate (per annum unless stated otherwise)
5.2.1. Program for <i>L. gibsonii</i> condition monitoring	MGX/EHPL	MGX/EHPL site operational budgets
5.2.2. Implement fire management	MGX/EHPL	MGX/EHPL site operational budgets
5.2.3. Manage risks from secondary threats of mining	MGX/EHPL	MGX/EHPL site operational budgets
5.2.4. Manage effects of grazing on <i>L. gibsonii</i>	MGX/EHPL	MGX/EHPL site operational budgets
5.2.5. Maintain and use seed/germplasm collection	MGX/EHPL	\$7,500
5.2.6. Plant translocation and population restoration	MGX/EHPL	\$25,000 per annum (2015-17); MGX/EHPL site operational budgets
5.2.7. Report existing and any new occurrences of plants	MGX/EHPL	MGX/EHPL site operational budgets
5.2.8. Promote awareness	MGX/EHPL	MGX/EHPL site operational budgets
5.2.9. Coordinate recovery actions, liaise with stakeholders	-	MGX and EHPL fund \$110,000 for officer position for this species and <i>D. masonii</i>
5.2.10. Review assigned conservation status	-	
5.3. Further Research	MGX/EHPL	\$20,000 per annum (2016-18)

ATTACHMENT 3 – SUPPLEMENTARY INFORMATION

A.3.1. International obligations

This plan is intended to be consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and assist in implementing Australia's responsibilities under that Convention. The species is not listed:

- under Appendix II in the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES), nor
- under International Union on Conservation of Nature (2012) Red List.

This plan is not known to adversely affect Australia's obligations under any other international agreements.

A.3.2. Role and interest of Aboriginal groups

There is one Native Title claim over the Mt Gibson area (the Badimia People WC96/98, registered) which is the area that includes the habitat and potential habitat of *L. gibsonii*. In agreements with MGM and EHPL, the claimant group has recorded a general interest in the environment and natural history of the area. There are registered ethnographic and / or archaeological sites which are of cultural significance within the known habitat of *L. gibsonii*.

MGM and EHPL has undertaken regular consultation through stakeholder meetings, including in the period of the Interim Recovery Plan and during the preparation of this Recovery Plan. The joint proponents will continue to consult with Aboriginal groups in the region identified in this plan and consider their role and interests in its implementation. Input and involvement will be welcome from Aboriginal groups of standing that have an active interest in areas that *L. gibsonii* occurs, and their involvement in recovery team representation may be sought.

The works of Tehnas (2010) should be referenced to obtain information of the existence and status of aboriginal heritage sites and regional ethnography.

The Aboriginal Heritage Sites Register, maintained by the Department of Aboriginal Affairs, will be used to identify significant sites near recorded and any new plant population. However, not all potential heritage sites are listed on the Register, and on-going liaison will be maintained with local Aboriginal community representatives.

A.3.3. Potential social and economic effects

The implementation of this Recovery Plan will have some impact through MGM and EHPL funding the development and implementation of certain management actions in this plan. The Plan does not and should not enhance or impede entitlements or restrictions that derive from other existing operating approvals or new applications. That is, proponents for particular land uses, such as mining, may be required through statutory assessments to demonstrate that they will not have a significant impact on *L. gibsonii* and that the future risks of detrimental effects can be adequately mitigated. Such requirements would be in place irrespective of this plan, because of environmental legislation, and this plan would provide guidance for the adoption of management actions and their implementation.

A.3.4. Guide for Decision Makers

Preceding sections of this Plan provide details of current and possible future threats to the species. Any further development in the vicinity of existing or potential habitat would require further assessment under established referral and/or environmental assessment mechanisms of State and Commonwealth governments.

The *L.gibsonii* population is known to occur across a variety of land tenures including pastoral leases, Crown Reserve (Reserve 17367), unallocated Crown land, mining leases and native title areas. Based on the current records and known area of occurrence (Figure 1), interests potentially affected by, or involved in the implementation of this recovery plan include:

- MGM, EHPL, Pindiddy Aboriginal Corporation (Ninghan Station), Australian Wildlife Conservancy (Mt Gibson Station) and the Badimia People.

Interests of others may be potentially affected by this plan. Further details are provided in Attachment 3. In most cases, no undue impediment or restriction on current land use is apparent or likely to arise because of this recovery plan. Landholders and land management agencies may be affected through statutory planning and approval processes outside this plan when seeking to alter the landscape or undertake actions that may cause certain detrimental effects on *L. gibsonii*.

Permission has been, or will be, sought from the managers and those with entitlements to lands where *L. gibsonii* occurs or may occur before recovery actions are undertaken on any such land.

Recovery actions implemented to maintain the quality and occurrence of the habitat of *L. gibsonii* will also support vegetation and habitat in which it is located and supports the Declared Rare Flora (DRF) taxon *Darwinia masonii* and other priority flora. Fauna species may also benefit where recovery actions improve their habitat. No negative effects of the recovery actions for the species have been identified, however, should they be, they should be allied with those of extant taxa.

ATTACHMENT 4 – GUIDELINES

The Recovery Plan has been developed using the structure and addresses the matters outlined in the “Recovery Plan Guidelines for Nationally Listed Threatened Species and Ecological Communities” under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Recovery Plan Guidelines). The following table is a condensed version of the Department of the Environment’s compliance checklist:

Requirements of the Recovery Plan Guidelines	Section of this Plan
1. Consultation with relevant departments	Consultation with relevant government departments and Decision Making Authorities has been on-going since MGIOIP was Referred under the EPBC and EP Acts. Since that time, on-going consultation has occurred in the development and implementation of the IRP, through the funding of a Parks and Wildlife officer positions, and through the development of this Recovery Plan.
2. Consultation with other stakeholders	Consultation with scientists and specialists has also occurred during the MGIOIP development, approvals and operations with regard to <i>L. gibsonii</i> . Section 5
3. Public consultation	The Public Environmental Review document was made available for public comment and the IRP is publically available. This Recovery Plan will also undergo a 3 month advertisement period to encourage feedback from the public.
4. Objects of the Act	Objects a-c: The <i>Lepidosperma gibsonii</i> Recovery Plan Object d: Consultation (as above (1), Attachment 3) Object e: International responsibilities (Attachment 3) Objects f & g: The role and interests of indigenous people (Attachment 3)
5. International agreements	Attachment 3
6. Indigenous People	Attachment 3
7. Social and economic impacts	Attachment 3
8. Efficient and effective use of resources	Section 5.1; Attachment 2
9. Species listed as threatened (EPBC Act)	<i>Lepidosperma gibsonii</i> is not currently listed under the EPBC Act.
10. Taxonomic or common names used	The taxonomic name, <i>Lepidosperma gibsonii</i> , is used throughout the document.
11. Distribution of the species	Section 1.2.3
12. Population(s)	Section 1.3
13. Define habitat critical to survival	Section 1.2.3, Section 2
14. Description of habitat - spatial	Section 2

Requirements of the Recovery Plan Guidelines	Section of this Plan
15. Threats	Section 3
16. Areas affected by threats	Section 3
17. Population(s) under pressure of survival	Section 3, Section 1.2.3
18. Recovery objectives	Section 4.1
19. Measurable criteria	Section 4.2
20. Evaluation of performance	Section 6, Section 4.3
21. On-ground actions	Section 5
22. Cost	Attachment 2
23. Management practices	Section 5
24. Biodiversity benefits/impacts	Section 5
25. Affected interests	Attachment 3
26. Social and economic benefits/impacts	Attachment 3