



Australian Government

Great Barrier Reef  
Marine Park Authority

# LADY ELLIOT ISLAND

ECOSYSTEM RESILIENCE PLAN



# LADY ELLIOT ISLAND

## ECOSYSTEM RESILIENCE PLAN

© Commonwealth of Australia (Great Barrier Reef Marine Park Authority) 2020

Published by the Great Barrier Reef Marine Park Authority

ISBN 9780648753100

This publication is licensed by the Commonwealth of Australia for use under a Creative Commons By Attribution 4.0 International licence with the exception of the Coat of Arms of the Commonwealth of Australia, the logo of the Great Barrier Reef Marine Park Authority, any other material protected by a trademark, content supplied by third parties, all illustrations, and photographs. For licence conditions see: <http://creativecommons.org/licenses/by/4.0>



While all efforts have been made to verify facts, the Great Barrier Reef Marine Park Authority takes no responsibility for the accuracy of information supplied in this publication.

**A catalogue record for this publication is available from the National Library of Australia**

### This publication should be cited as:

Great Barrier Reef Marine Park Authority 2020, *Lady Elliot Island Ecosystem Resilience Plan*, GBRMPA, Townsville.

### Project Team Members

Joy Brushe	<i>consultant botanist</i>
Jim Buck	<i>Lady Elliot Island Eco Resort</i>
Peter Gash	<i>Lady Elliot Island Eco Resort</i>
Chelsea Godson	<i>Lady Elliot Island Eco Resort</i>
Stephanie Lemm	<i>GBRMPA</i>
John Olds	<i>QPWS</i>

### Editor

Brigid Kerrigan	<i>GBRMPA</i>
-----------------	---------------

### Cover photography

Lady Elliot Island ©Nico Faramaz, Shutterstock

Surrounding reef ©Lady Elliot Island Eco Resort

Comments and questions regarding this document are welcome and should be addressed to:



**Australian Government**

**Great Barrier Reef  
Marine Park Authority**

### Great Barrier Reef Marine Park Authority

280 Flinders Street (PO Box 1379)  
Townsville QLD 4810, Australia

Phone (07) 4750 0700

Email [info@gbmpa.gov.au](mailto:info@gbmpa.gov.au)

[gbmpa.gov.au](http://gbmpa.gov.au)

# TABLE OF CONTENTS

List of Tables	4	7.4 Cultural Heritage Management Area	32
List of Figures	4	7.4.1 Cultural Heritage Management Area guidelines	32
Acknowledgements	5	7.4.2 Cultural Heritage Management Area implementation plan	33
Executive Summary	6	7.5 Airstrip	34
1.0 Introduction	8	7.5.1 Airstrip guidelines	34
2.0 Ecosystem Resilience Plan objectives – Phase 1	12	7.5.2 Airstrip implementation plan	34
3.0 Key strategies	13	7.6 Walking tracks	35
4.0 Management zones	14	7.6.1 Walking tracks guidelines	35
5.0 Pest plant management – guidelines	16	7.6.2 Walking tracks implementation plan	35
6.0 Establishing Capricorn Bunker Cay Regional Ecosystems	19	7.7 Composting and Waste Management Precincts	36
6.1 Coastal Zone	19	7.7.1 Composting and Waste Management Precincts guidelines	36
6.1.1 Coastal Zone guidelines	19	7.7.2 Composting and Waste Management Precincts implementation plan	36
6.1.2 Managing pest plants	20	8.0 Plant nursery and turf farms	36
6.1.3 Coastal Zone implementation plan	20	9.0 Increasing species richness and genetic diversity of native cay plant species	38
6.2 South-West Zone	21	10.0 Managing biosecurity	39
6.2.1 South-West Zone guidelines	21	10.1 Biosecurity guidelines	39
6.2.2 Managing pest plants	22	10.2 Biosecurity implementation plan	39
6.2.3 South-West Zone implementation plan	22	11.0 Fire management	40
6.3 North-West Zone	23	11.1 Guidelines for fire management	40
6.3.1 North-West Zone guidelines	23	11.2 Fire management implementation plan	40
6.3.2 Managing pest plants	24	12.0 Seabird and marine turtle habitat management	41
6.3.3 North-West Zone implementation plan	25	12.1 Guidelines – Seabird and turtle habitat management	41
6.4 North-East Zone	25	13.0 Pest animal species management	43
6.4.1 North-East Zone guidelines	25	13.1 Guidelines – Pest animal species management	43
6.4.2 Managing pest plants	26	13.2 Pest animal species management implementation plan	43
6.4.3 North-East Zone implementation plan	27	14.0 Monitoring	43
7.0 Management of vegetation in human use areas	28	14.1 Vegetation monitoring	43
7.1 Human use area – general management	28	14.1.1 Vegetation monitoring implementation plan	44
7.2 Buffer Zones	29	14.2 Soil condition monitoring	44
7.2.1 Managing pest plants	29	14.3 Seabird monitoring	44
7.2.2 Buffer Zone implementation plan	30		
7.3 Resort Precinct	30		
7.3.1 Resort Precinct guidelines	30		
7.3.2 Resort Precinct implementation plan	31		

14.3.1 Seabird monitoring implementation plan	44
14.4 Turtle monitoring	45
14.4.1 Turtle monitoring implementation plan	45
14.5 Invertebrate monitoring	45
14.5.1 Invertebrate monitoring implementation plan	45
14.6 Regular surveillance for pest fauna	46
14.6.1 Monitoring for pest fauna implementation plan	46
14.7 Monitoring of freshwater aquifers	46
14.8 Monitoring reef health	46
14.9 Aerial photography	46
15.0 Performance evaluation, reporting and Plan review	47
15.1 Reporting and Plan review	47
15.2 Performance evaluation	47
References	50
Appendix 1: Plant species for eradication	51
Appendix 2: List of native cay plant species recorded on LEI and recommended management	56
Appendix 3: Plant species suitable for use in landscaping	60
Appendix 4: The 19 Regional Ecosystems and plant species to be established across the four natural land use zones	64
Appendix 5: Habitat information for bird species commonly recorded on Lady Elliot Island	66
Appendix 6: Bird species list for Lady Elliot Island	69
Appendix 7: Recommended methods for use in weed removal, pest control, revegetation and monitoring	70
Appendix 8: Invertebrate species list for Lady Elliot Island	71

## LIST OF TABLES

Table 1: The 10 management zones. The relative size (ha) of each zone; and for each zone, the percentage of total island area. The area calculations are based on outputs from ARCMAP (Figure 2)	15
Table 2: Additional native cay plant species to be established on Lady Elliot Island	38
Table 3: Key performance criteria for each of the main objectives and outputs of the Plan	47

## LIST OF FIGURES

Figure 1: Example of a Lady Elliot Island revegetation work areas map specifying the works to be carried out in each of the areas in a specific year	12
Figure 2: Map of Lady Elliot Island showing relative location of the 10 management zones: four 'Natural Areas' and six 'Human Use Areas'	15
Figure 3: Current vegetation in the South-West Zone. The lantana ( <i>Lantana camara</i> ), pine trees ( <i>Araucaria spp.</i> ) and umbrella tree ( <i>Schefflera actinophylla</i> ) to be removed prior to pisonia ( <i>Pisonia grandis</i> ) planting (photograph J. Buck)	21
Figure 4: Dense cover of dwarf poinsettia ( <i>Euphorbia cyathophora</i> ) and lantana ( <i>Lantana camara</i> ) in the South – West Zone (photograph J. Brushe)	22
Figure 5: North-West Zone showing sandpaper fig ( <i>Ficus opposita</i> ) already well-established in this area growing among patches of lantana ( <i>Lantana camara</i> ) shrubs and dense ground cover of dwarf poinsettia ( <i>Euphorbia cyathophora</i> ) and other pest plants (photograph J. Brushe)	24
Figure 6: Dense cover of dwarf poinsettia ( <i>Euphorbia cyathophora</i> ) and morning glory ( <i>Ipomoea indica</i> ) in the North – East Zone (photograph J. Brushe)	26
Figure 7: <i>Agave</i> sp. and Moses in the cradle ( <i>Tradescantia spathacea</i> ) growing in garden waste at the end of a track pushed through the lantana in the South – West Zone (photograph J. Brushe)	29

# ACKNOWLEDGEMENTS

The development and implementation of the Lady Elliot Island (LEI) Ecosystem Resilience Plan (the Plan) would not have been possible without extensive input and support from a wide range of organisations and individuals.

In particular, we acknowledge the Great Barrier Reef Foundation and the Reef Islands Initiative (RII) program partners Lendlease, Fitzgerald Family Foundation, Lady Elliot Island Eco Resort, the Queensland Government, and Commonwealth Government for providing financial support for the implementation of this Plan. The RII program, which aims to establish a network of climate change refuges to protect critical habitats, will provide financial support to implement the Plan from 2018–19 to 2024–25.

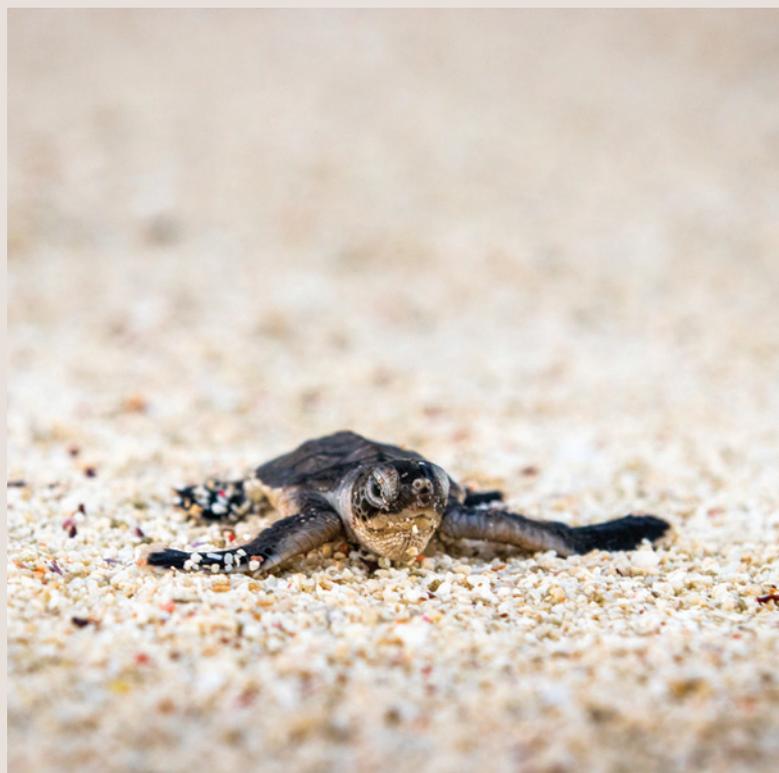
The Great Barrier Reef Marine Park Authority (the Authority) acknowledges the passion, commitment and expertise of Joy Brushe who was the key author of this Plan. Joy, with the assistance of Larry Brushe, has been instrumental in the restoration efforts on Lady Elliot Island over recent years and in revegetation efforts of other Capricorn Bunker cays. The success of revegetation works on Lady Elliot island to-date, would not have been achieved without the dedication and expertise of Jim and Annie Buck. Jim Buck (Environmental Management Officer, LEI Eco Resort) has led the on-ground planting and weed removal works, and Annie Buck's skills and knowledge of nursery systems, and growing of native cay species from seeds, has been pivotal to the successful establishment and operation of the nursery.

The Authority also acknowledges the significant contributions from the LEI Eco Resort (notably Peter Gash and Michael Kyle); John Olds (Queensland Parks and Wildlife Service, QPWS); the Queensland Herbarium; and the Curtis Island Offsets Program.

Our appreciation goes to John Meech (ex-QPWS and volunteer turtle researcher) for providing information on his pisonia planting program on LEI and propagation techniques for growing pisonia; Chris Burwell (Queensland Museum) for information on invertebrate data; Ben Geddes (QPWS) for logistical advice, advice on pest bird control measures and assistance with methods and costing of lantana control; Andrew McDougall (QPWS) for providing data and information on the bird species of LEI and comments on earlier drafts; Mark Hallam (Friends of the Cays volunteer and volunteer turtle researcher) for providing photographs and field data; Larry Brushe for his contributions to the Plan, assisting with field work and reviewing the Plan; Jim Buck for providing photographs and information, reviewing the Plan, and coordinating its

implementation; Steve Carter (Consultant, Environmental Dynamics) for his contributions as the communications person for LEI Eco Resort during the preparation of the Plan, for providing photographs and making comments on earlier drafts; and the student groups and volunteers that have assisted with weed removal and planting on LEI.

*The Great Barrier Reef Marine Park Authority acknowledges the continuing sea country management and custodianship of the Great Barrier Reef by Aboriginal and Torres Strait Islander Traditional Owners, whose rich cultures, heritage values, enduring connections, and shared efforts protect the Reef for future generations. The Great Barrier Reef Marine Park Authority further acknowledges the Port Curtis Coral Coast Traditional Owners of the sea country within lies LEI and their continuing connections to the land and sea country of this region. We pay respect to them, their cultures and their Elders, both past and present.*



Green turtle hatchling (*Chelonia mydas*). ©Lady Elliot Island Eco Resort



## EXECUTIVE SUMMARY

The Lady Elliot Island Ecosystem Resilience Plan (the Plan) is a two-phased action plan to increase the resilience of the terrestrial ecosystems of Lady Elliot Island (LEI) to the adverse impacts of climate change and other ecosystem stressors. Increasing resilience to climate change is best achieved by enhancing the integrity and natural ecosystem function by restoring the native cay vegetation communities, while balancing the ongoing needs of the LEI Eco Resort.

LEI is a highly modified cay. The cay has reduced topsoil and vegetation due to decades of major disturbance from guano mining, feral goats, and human habitation, and has considerably more introduced non-native plant species than any other Capricorn and Bunker cay.

Due to the relatively large size of the cay, the cay's elevation, the solid rock core on which the cay and reef are formed, and its geographical location at the southern end of the Great Barrier Reef, the cay is likely to be a long-term survivor of climate change compared to other cays.

LEI may provide alternative or interim habitats for seabirds, marine turtles and native cay vegetation as habitats are lost on other cays due to the impacts of climate change.

Although the fringing coral reef surrounding the cay is an integral part of LEI's ecology and biodiversity, this Plan is focused on the management of the terrestrial ecosystems of the cay.

*The goal of the Plan is to increase the resilience of the island to the adverse impacts of climate change by enhancing the native cay vegetation communities, maximising the breeding opportunities for important coastal birds, and marine turtle species, and minimising the impacts of introduced flora and fauna, while having regard to the ongoing operation of the LEI Eco Resort.*



Reef crest Lady Elliot Island. ©Lady Elliot Island Eco Resort

This will be achieved by implementing the following objectives:

- LEI supports pest-free, native cay vegetation communities that are representative of Capricorn and Bunker Cay Regional Ecosystems
- the Regional Ecosystems are improved and at benchmark condition
- the current diversity and abundance of desired nesting seabirds and other important birds is conserved and enhanced
- the nesting habitat for marine turtles is conserved and enhanced
- LEI supports increased diversity and area of suitable habitats to accommodate additional species, if habitats are lost on other cays due to climate change.

Most of the plant species contained within the proposed Regional Ecosystems are already present on the island, albeit in reduced abundance. In addition, vegetation diversity will be

increased by establishing other commonly-occurring native cay species representative of the Regional Ecosystems in the Capricorn Bunkers, which are currently not present on LEI.

The Plan is being implemented in two phases. Phase 1 (the first 10 years, starting 2018) focuses on establishing the cay Regional Ecosystems to a stage where they require minimal maintenance. Note that at the time of publication, the Plan was in the third year of implementation. Phase 2 will focus on ecosystem maintenance and ongoing management adaptation as the cay ecosystems mature and respond to changing climatic factors.

The Great Barrier Reef Foundation, through the RII program, is supporting the implementation of the Plan. The RII aims to establish a network of climate change refuges to protect critical habitats on Great Barrier Reef islands. LEI, due to its geographical location and in recognition of the significant restorative work already done by the Eco Resort and the managing agencies, has been identified as one of four key islands on the Reef to be funded through the RII.



Green turtle nesting (*Chelonia mydas*) in Coastal Zone. ©Lady Elliot Island Eco Resort

## 1.0 INTRODUCTION

LEI is a Commonwealth Island located in the southern end of the Great Barrier Reef Marine Park. The island is managed jointly through the Reef Joint Field Management Program by the Great Barrier Reef Marine Park Authority and Queensland Parks and Wildlife Service. The primary lease holders of the island are Reef Resort Management which operates the Lady Elliot Island Eco Resort.

The Great Barrier Reef Marine Park Authority takes a resilience-based approach to managing the Marine Park, which is adaptive and future-focused. Climate change has been identified as the greatest threat to the Great Barrier Reef region (Great Barrier Reef Marine Park Authority 2019a, 2019b). Island ecosystems within the Great Barrier Reef region face climate change-related threats such as more intense storms, tropical cyclones, droughts, flood events, and rising sea level.

Critical to helping the Reef cope better with the changing climate are actions that strengthen resilience, reduce

cumulative impacts, and protect and enhance habitats with carbon storage potential (Great Barrier Reef Marine Park Authority 2019b). The LEI Ecosystem Resilience Plan (the Plan) is part of the Great Barrier Reef Marine Park Authority's adaptive management approach to managing the Marine Park in the Great Barrier Reef region.

*The Plan aims to build resilience and future-proof the southern region cays to adverse impacts of stresses such as climate change, by establishing native cay vegetation communities that are representative of the southern region of the Reef. The restoration process will include the removal of pest flora and fauna that reduce the resilience of natural ecosystems.*

The development and proposed implementation of this Plan are consistent with the National Restoration Standards for the Practice of Ecological Restoration in Australia (Standards Reference Group SERA 2017).

The main objectives of this Plan:

- LEI supports pest-free, native cay vegetation communities that are representative of Capricorn and Bunker Cay Regional Ecosystems
- the Regional Ecosystems are improved and at benchmark condition
- the current diversity and abundance of desired nesting seabirds and other important birds is conserved and enhanced
- the nesting habitat for marine turtles is conserved and enhanced
- LEI supports increased diversity and area of suitable habitats to accommodate additional species, if habitats are lost on other cays due to climate change.

The following criteria and key attributes were considered in developing the strategies and methods to achieve the main objectives of this Plan:

- a) Understanding the factors that have contributed to the degradation and fragility of the cay:
  - the impact and extent of the devastation caused by removing the native vegetation and stripping the surface soil from the entire island during guano mining and grazing by goats
  - deliberate and accidental introduction of invasive pest plant species resulting from human habitation and utilisation of the island
  - the absence or poor biocondition of the natural terrestrial ecosystems on most of the island
  - a high diversity and abundance of introduced, non-cay plant species including numerous highly invasive pest plant species.
- b) The natural and cultural values that make LEI critical for conserving and protecting:
  - the intrinsic value of the island as an example of a shingle solitary cay and its location at the southern extremity of the Reef
  - the proximity of the island to the edge of the continental shelf and associated feeding grounds for oceanic seabirds
  - the proximity of LEI to larger, higher, and more stable islands that are likely to be more resilient to

climate change and more likely to become suitable refuges for many species (e.g. Fraser Island)

- the importance of the island as habitat for a high diversity of ground nesting seabirds and the likelihood that, at one time, the island was a nesting site for larger species of seabirds (i.e. frigate birds and boobies)
  - the provision of nesting habitat for endangered and vulnerable species of marine turtles
  - the role of natural cay vegetation in providing habitat requirements of all components of the natural cay ecosystems
  - (re) introduction of plant species of global conservation significance, such as pisonia forests
  - the presence of the Lady Elliot Island Lightstation managed under the *Lady Elliot Island Lightstation Heritage Management Plan* (GBRMPA 2012)
  - the need to further explore Traditional Owners' cultural values and connections with LEI.
- c) Replacement of current non-cay plant species with southern Great Barrier Reef natural cay plant species:
    - the likely impact of current reduced natural integrity on resilience to impacts of pest species, disease, climate change, and other stresses
    - native cay species present on other southern Great Barrier Reef cays have evolved over a long period of time, and will likely be more resilient to future extremes in climatic conditions than early successional non-native species
    - the advanced successional stage of much of the vegetation on the other southern Great Barrier Reef cays, which may improve its ability to survive extremes of climatic conditions
    - the importance of natural vegetation in helping to physically stabilise the cays
    - the biosecurity threat to other cays from invasive non-cay plant species on LEI
    - the likelihood that the current vegetation of LEI will not survive the predicted climate change
    - potential increased fire risk associated with the presence of some of the introduced non-cay plant species
    - current vegetation unlikely to provide long-term protection, resilience, soil development, and required habitat for cay-dependent species
    - natural cay vegetation unlikely to establish without prior removal of undesired species.

d) The operational constraints and challenges:

- unpredictable climatic regime including timing, frequency and intensity of cyclones, drought and rainfall
- the inherent vulnerability of the fragile shingle coral cay and reef ecosystems and the need to maintain resilience within the system
- a lack of information on 'original' vegetation communities, habitats, and species present prior to human disturbance on LEI
- dominance and extent of senescing coastal she-oak (*Casuarina equisetifolia*) originating from planted non-cay provenance
- the need to maintain effective biosecurity
- consideration of cultural heritage values including introduced plant species used in landscaping and ecological restoration
- the need to protect and provide interpretation of European artefacts 'discovered' during the clearing of pest plants
- difficulty in maintaining a regular weeding program without disturbing nesting birds
- potential threats of introduced ants to vegetation and nesting seabirds
- the need to manage the rate of restoration and minimise the immediate impacts that the restoration activities have on seabirds, turtles, and other fauna that utilise the island
- the need to balance the ecological restoration of the island while running a world-class eco resort including logistical and budget constraints and the availability of personnel and resources
- education of visitors during the implementation of the Plan and managing any negative perceptions
- a desire to minimise the use of herbicides (particularly non-organic) for pest plant control and eradication
- multiple agencies/stakeholders engaged in management and implementation
- ongoing stakeholder consultation and addressing stakeholder concerns.

e) The available knowledge base and experience to support decision-making:

- the availability of detailed and scientifically accurate ecological information on the vegetation communities of the Capricorn Bunker cays, including detailed

vegetation and Regional Ecosystem mapping, and detailed descriptions of the floristic composition and structure of these communities obtained from field survey data from replicate representative sites

- abundance of national and Queensland data and reports on the threats posed to natural ecosystems by invasive pest plants and the availability of scientifically prepared lists and classifications of invasive pest plants of concern
- spatial distribution, floristic composition and diversity, and successional processes that are characteristic of Capricorn Bunker cay communities
- recommendations from previous vegetation management, landscaping, and pest plant control plans
- uncertainty of the impacts of climate change on individual species, habitats, and locations; predicting how long before climate change impacts take effect; the extent to which individual species and habitats will be able to adapt to these changes; and, in a regional context, the importance of LEI as a climate change refuge

This Plan will contribute to relevant *Reef 2050 Long-Term Sustainability Plan* actions:

- MTR EHA3 – investigate, deliver, and support active localised restoration activities, as identified in the *Reef Blueprint for Resilience*
- MTR EHA6 – enhance natural vegetation communities on targeted Reef islands to enhance the resilience of the islands and adjoining coral reefs to climate change and other stressors.

The project will contribute to the 2020 target:

- EHT5 – condition and resilience indicators for islands are on a trajectory towards at least good condition at local, regional, and Reef-wide scales.

The project will contribute to the 2035 objectives:

- EHO2 – the Great Barrier Reef World Heritage Area retains its integrity and systems functions by maintaining and restoring the connectivity, resilience, and condition of marine and coastal ecosystems
- EHO3 – trends in the condition of key ecosystems are improved over each successive decade.

At the time of publication the *Reef 2050 Long-Term Sustainability Plan* actions, targets, and objectives were under review.



*Manta rays (Mobula alfredi) western reef edge Lady Elliot Island. ©Lady Elliot Island Eco Resort*

## 2.0 ECOSYSTEM RESILIENCE PLAN OBJECTIVES – PHASE 1

Phase 1 covers the first 10 years of the Plan’s implementation. Revegetation works guided by the initial drafts of this Plan were initiated in 2016–17. Annual Revegetation Work Plans direct the on-ground implementation of the Plan (Figure 1: an example of a revegetation work plan map from the 2016–17 work plan).

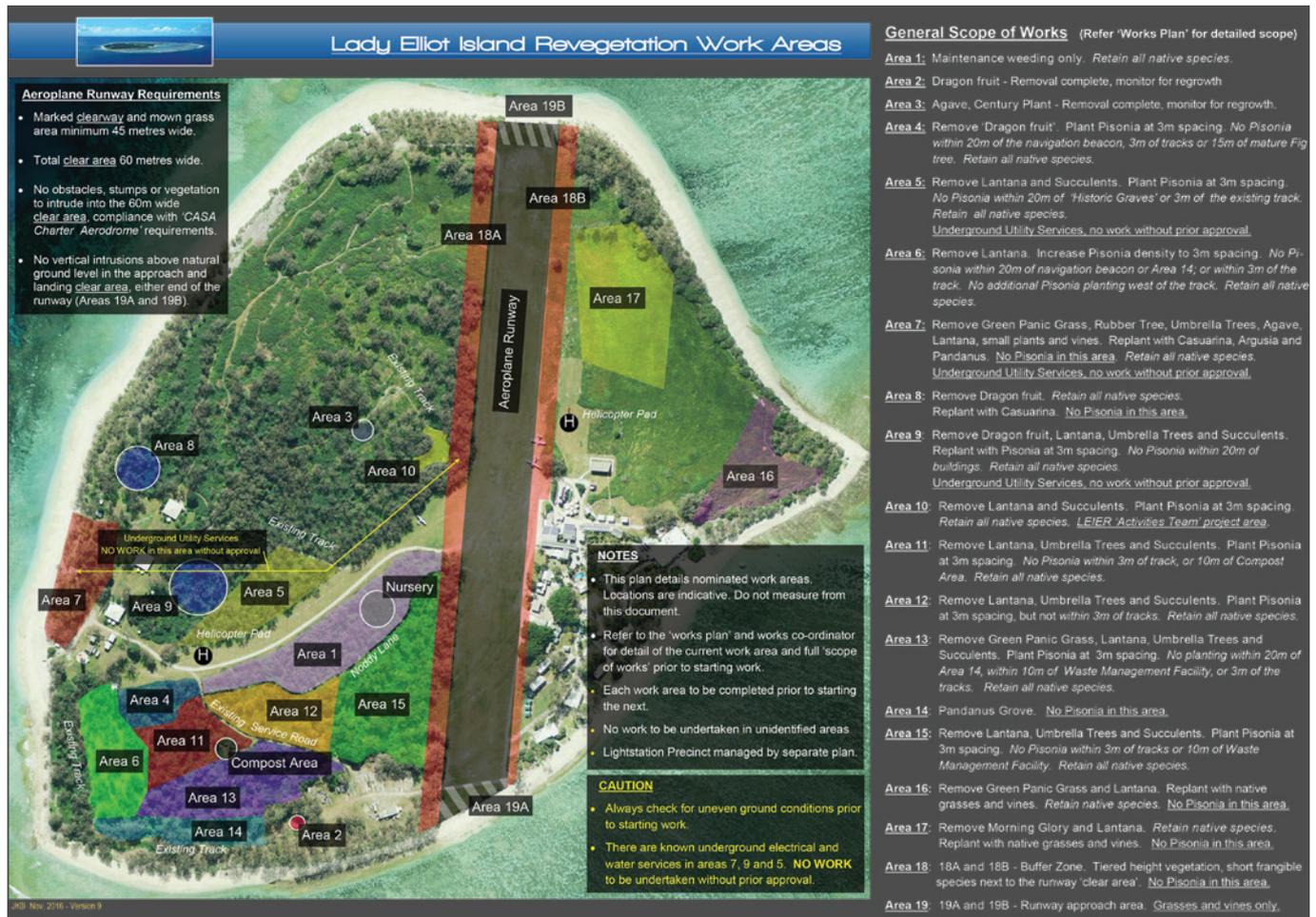


Figure 1: Example of a Lady Elliot Island revegetation work areas map specifying the works to be carried out in each of the areas in a specific year

Ecosystems during early stages of recovery can be highly dynamic. An important element of the Plan is reporting on and evaluating the results of each stage of restoration and adapting the Plan as required. The strategies, on-ground implementation plans, and restoration methods used in this Plan will be evaluated and used as a guide to develop similar plans for other islands (refer to Great Barrier Reef – Reef Islands Initiative).

Phase 1 objectives:

1. Maximise native cay plant species richness and genetic diversity by establishing suitable native Capricorn Bunker cay species sourced from a number of different Capricorn Bunker cays

2. Establish naturally functioning cay Regional Ecosystems (as described in Batianoff *et al.* 2012, Neldner *et al.* 2012) that require minimum maintenance within 10 years
3. Maximise the resilience of the ecosystems of the island to climate change and other disturbances by enhancing natural integrity
4. Manage vegetation within human use areas to maximise native cay plant species, minimise exotic species and minimise adverse impacts on adjacent natural areas and other cays, while meeting the requirements of the Cultural Heritage Management Plan

5. Maintain and enhance the current high diversity of birds and their habitats, particularly ground and arboreal nesting seabirds, shorebirds, coastal raptors, and silvereye (*Zosterops lateralis chlorocephalus*)
6. Maximise the extent of good condition nesting habitat for marine turtles

7. Maintain effective biosecurity
8. Ensure that Ecosystem Restoration provides for the continued operation of the LEI Eco Resort
9. Improve public appreciation of the value of southern Great Barrier Reef coral cay natural ecosystems.

### 3.0 KEY STRATEGIES

1. Adequate funding to ensure the effective implementation over the first 10 years
2. A project team for the LEI Plan to provide advice and guide implementation of the Plan. Include members from the Great Barrier Reef Marine Park Authority, Queensland Parks and Wildlife Service (QPWS) and the LEI Eco Resort
3. A full-time ecosystem management officer (EMO) based on LEI to oversee the implementation of the Plan. Duties of the EMO to include:
  - preparation of annual work plans agreed upon between Great Barrier Reef Marine Park Authority, QPWS, funding partners and the lessee, outlining actions, timelines and priorities
  - writing of progress reports
  - producing a source of appropriate pest-free planting material by:
    - establishing and managing nursery facilities
    - seed collection, taking cuttings, plant propagation, planting, care and maintenance of plants until established
  - pest plant control
  - establishing a volunteer program to assist with implementation of the Plan and ongoing longer-term maintenance of ecological restoration areas
  - engaging and supervising contractors, work experience students and volunteers, operational policy development including preparation of Standard Operating Procedures
  - updating the components of the LEI Environmental Management System that relate to the implementation of the Plan
  - participating in vegetation, bird and invertebrate monitoring, data compilation and reporting.
4. Existing experienced staff will assist with machinery operation and other aspects of Plan implementation
5. Additional person or persons may be required to assist with nursery duties, pest plant management and routine resort landscape maintenance
6. Utilise contractors as much as possible (depending on funding availability) to maintain momentum and logistical coordination
7. Coordinate tasks to ensure there are no direct impacts on seabirds during the breeding season (October to April). For example, avoid follow-up maintenance in bird nesting areas and large-scale pest plant removal involving machinery during the bird nesting season



Noddy tern (*Anous minutus*) nesting in pisonia (*Pisonia grandis*). © GBRMPA

8. Establish a plant nursery and one or more 'turf farms' on the island to grow plants to enhance natural ecosystem establishment and for landscape planting in human use zones
9. Carry out small indicator trials to determine best pest plant control methods for specific species and best methods for the successful establishment of desired species prior to undertaking more broadscale work
10. Implement a staff education and training program and produce a Vegetation Management Manual to provide staff with knowledge of plant identification, biosecurity practices and implementation of Standard Operating Procedures
11. Provide information to resort guests to explain the importance of the project and any temporary inconvenience and loss of aesthetics resulting from Plan implementation.
12. Provide activities and interpretive signage to increase visitor awareness of the importance of terrestrial cay ecosystems (including vegetation) and biosecurity
13. Establish a monitoring, reporting and review program to report progress in relation to objectives; identify unforeseen issues and provide information to input into the review of the Plan as required
14. Investigate the benefits, risks and feasibility of the application of calcareous sand and/or coral rubble over sections of the island's ground surface. If it is determined that this is a viable strategy, then some of the other strategies, proposed actions and restoration methods in this Plan will need to be reviewed. Potential benefits of this action include:
  - increasing the elevation of the cay and delaying the impacts of rising sea levels and intensive storm surges
  - smothering of pest plants and burial of their soil seedbank
  - providing suitable adequate substrate for shearwater nesting
  - providing more turtle nesting habitat.
15. Review and update the Plan every five years.

## 4.0 MANAGEMENT ZONES

For management purposes, the island has been divided into four 'natural area' and six 'human use' land use zones.

### A. Natural areas include:

1. Coastal Zone – including the beach and adjoining vegetation of the frontal beach ridges
2. South-West Zone – incorporating the area currently dominated by naturalised non-cay provenance coastal she-oak (*Casuarina equisetifolia*) and lantana (*Lantana camara*), west of the current airstrip and excluding the Composting and Waste Management Precincts, the old airstrip and the Heritage Precinct (lightstation)
3. North-West Zone – incorporating the area west of the current airstrip and north of the area currently dominated by the naturalised casuarina.
4. North-East Zone – north of the resort precinct and east of the current airstrip (referred to as the bird sanctuary by the Eco Resort).

### B. Human use areas include:

1. Resort Precinct – located in the south-eastern part of the island

2. Cultural Heritage Management Area – consisting of the Heritage Precinct (including the Lightstation) located at the western end of the old airstrip, and the nearby fowl yards, well and gravesites that are outside the Heritage Precinct
3. Airstrip – includes the old airstrip running north-east to south-west and the current airstrip running north-south
4. Composting and Waste Management Precincts – located at the south-western end of the current airstrip
5. Buffer Zones – includes the edges of the airstrip, privacy screens and visual/ light screening plantings
6. Walking tracks.

The location and relative area of each of these zones (excluding walking tracks) are shown in Figure 2 and Table 1. The vegetation zone boundaries are based on the Batiannoff *et al.* (2012) surveys with some minor modifications to accommodate existing biodiversity and some logistical and management requirements.

**Table 1: The 10 management zones. The relative size (ha) of each zone; and for each zone, the percentage of total island area. The area calculations are based on outputs from ARCMAP (Figure 2).**

Management Zones	Area (ha)	% of total Island area
<b>Human Use Areas</b>		
Resort Precinct	3.1	6.87
Cultural Heritage Management Area	1.2	2.66
Airstrips	5.1	11.30
Composting Precinct	0.03	0.07
Waste Management Precinct	0.4	0.89
Buffer Zones	9.6	21.27
<b>TOTAL Human Use Areas</b>	<b>19.43</b>	<b>43.05</b>
<b>Natural Areas</b>		
Coastal Zone	6.0	13.29
South-West Zone	11.2	24.82
North-West Zone	4.3	9.53
North-East Zone	4.2	9.31
<b>TOTAL Natural Areas</b>	<b>25.7</b>	<b>56.95</b>
<b>TOTAL ISLAND AREA</b>	<b>45.13</b>	

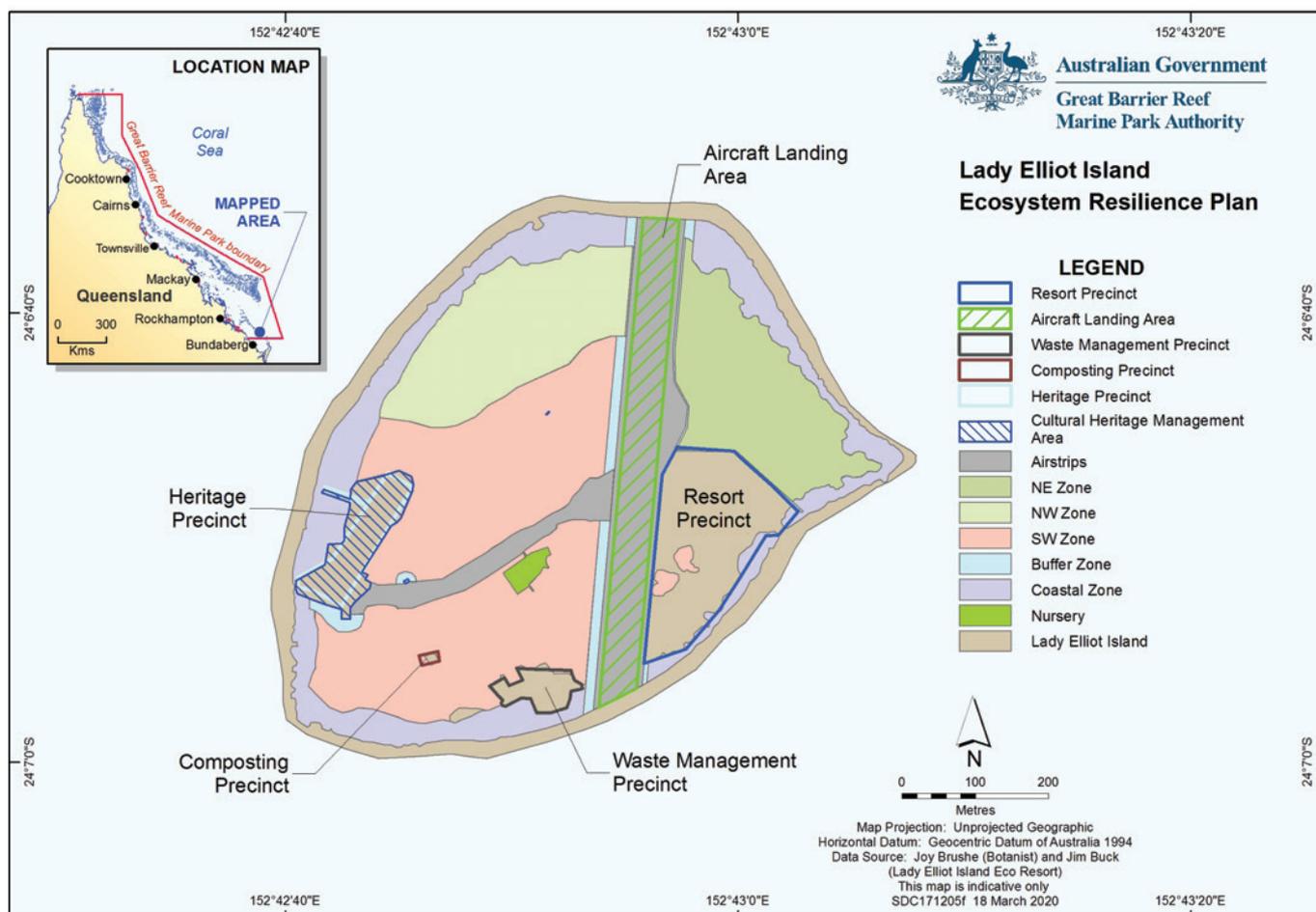


Figure 2: Map of Lady Elliot Island showing relative location of the 10 management zones: four 'Natural Areas' and six 'Human Use Areas'.



Lady Elliot Island. ©Lady Elliot Island Eco Resort

## 5.0 PEST PLANT MANAGEMENT – GUIDELINES

*Prior to the development of the Plan, all management zones (except the Coastal Zone) were dominated by invasive non-cay pest plant species to the extent that, these species represented over 80 per cent of the vegetated areas on the island (Batianoff et al. 2012).*

Initial removal of existing pest plants is the first step in pest plant management. It is essential to remove any regrowth prior to seeding to reduce and eventually remove pest seeds from the soil seedbank. Areas should only be weeded if adequate resources are available for timely follow-up management. Remoteness, small size and limited connectivity of cays make the eradication of pest species possible on cays. Therefore, strategic follow-up management may eventually result in the eradication of many pest plant species on LEI.

Pest plant species that cannot be eradicated are to be monitored and managed with ongoing control programs to ensure their abundance and hence the risk of competing with native cay species remains low (particularly following cyclone damage, saltwater inundation, prolonged drought and other disturbances).

The use of chemicals to manage pest plants will be minimal. Indicator trials of organically certified herbicides (e.g. Slasher), other substances (e.g. salt, vinegar), mechanical and other methods (e.g. hand pulling, slashing, brush cutting, steam, flame) to be conducted to identify suitable alternatives to proprietary systemic herbicides.

Suppression by native species is an important component of pest plant management. Natural regeneration of desired native species enhanced by planting and direct seeding will assist in this process.

Restoration work, including pest plant removal, will be carried out simultaneously in the South-West, North-East and North-West Zones. This is to ensure that there is enough time for follow-up weeding and native plant establishment in the North-East and North-West Zones to achieve minimum maintenance by Year 10 and that the planted pisonia forest in the South-West Zone has achieved pest plant exclusion by Year 10.

Within each zone, pest plant removal is to be done systematically as follows:

- from the edges of previously completed areas to minimise the chances of reinfestation
- from windward to leeward to minimise wind seed dispersal
- quarantining areas as required to minimise re-introductions and
- surveillance to detect incursions.

Exceptions to the above, requiring removal ahead of (or following) systematic pest plant removal are:

- specific invasive pest plant species, for example, Mossman River grass (*Cenchrus echinatus*), green panic (*Megathrysis maximus* var. *pubiglumis*) and red natal grass (*Melinis repens*) to prevent further spread into newly weeded areas
- very small infestations of highly invasive species that are likely to spread, for example, buffel grass (*Cenchrus ciliaris*), mile-a-minute (*Ipomoea cairica*) and rosy dock (*Acetosa vesicaria*)
- severe infestations of invasive pest species that are particularly time consuming to remove and require the use of machinery or specialised techniques, for example, umbrella trees (*Schefflera actinophylla*) and other non-cay species, including dragon fruit (*Hylocereus undatus*), *Agave* spp., mother in law's tongue (*Sansevieria trifasciata*) and some of the other succulents
- where dense vegetation buffers are required either to prevent the spread of invasive pest plants or for visual amenity
- to manage bird habitat.

Machinery to be used to remove and process lantana and other woody pest plants.

Hand-pulled pest plants to be bagged, removed from the site and either composted or deeply buried to destroy attached seeds and prevent reshooting.

Biosecurity measures to be used to prevent the spread of herbaceous pest plants from infested areas to 'clean' areas (refer to Section 10).

Appendix 1 lists the plant species currently growing on LEI that are considered to be pest plants including both naturalised non-native plants and native species not naturally occurring on the Capricorn Bunker cays. These species have each been allocated a priority ranking of either 'eradication' or 'control'. Eradication of all of these pest plants would be the optimal outcome. However, the cost and effort for the eradication of some species cannot be justified in relation to the magnitude of their impact. The objective for such pest plants is long-term control rather than eradication.

Isolated occurrences of a pest plant species in any area where they are not already established should be eradicated while they are still manageable to reduce the chances of establishment and/or spread.

If a new plant species, previously not seen on the island, is detected:

- photograph examples (preferably showing flowers or fruit and leaf arrangement) and send to QPWS or the Authority
- if directed by QPWS or the Authority, send a dried pressed specimen (containing leaves, flowers and fruit) together with relevant information to the Queensland Herbarium for identification. Information on how to prepare and send plant specimens for identification can be found on the Queensland Herbarium website
- if the new species is identified as a pest plant, eradicate it as soon as possible.

Ensure that necessary biosecurity measures are implemented to prevent the introduction of new pest plants to LEI and prevent pest plants spreading to other islands either naturally (e.g. by birds and wind) or through human activity (e.g. barges, equipment and people who visit other islands after leaving LEI).



*Octopus bush (Argusia argentea) planted in the Coastal Zone. ©Jim Buck, Environmental Management Officer, Lady Elliot Island Eco Resort*



*Coastal Zone adjacent to the reef flat on the south eastern side of Lady Elliot Island. ©Lady Elliot Island Eco Resort.*



## 6.0 ESTABLISHING CAPRICORN BUNKER CAY REGIONAL ECOSYSTEMS

There are a number of native cay species already present on LEI. Appendix 2 lists the native cay plant species and outlines actions for future management of these species. Surrounding the resort and within the Resort Precinct there are a number of landscaped areas. Appendix 3 lists a number of native cay plant species that are suitable for use in landscaping. The Capricornia Cay Regional Ecosystems that will be maintained or established are based on descriptions compiled using site survey data from the Queensland Herbarium's CORVEG database (as described in Batianoff *et al.* 2012). Appendix 4 lists the species in the

19 Regional Ecosystem vegetation communities that will be established across the four natural land use zones. For full technical descriptions of each Regional Ecosystem, refer to Neldner *et al.* (2012). Note the plant taxonomy used in this document is according to Brown and Bostock (2019).

Methods recommended for pest plant removal, invertebrate pest management, propagation and planting, and monitoring to assess ecological restoration progress are detailed in Appendix 7. The methods will be updated as new approaches and technologies are developed.

### 6.1 COASTAL ZONE

#### 6.1.1 COASTAL ZONE GUIDELINES

The Coastal Zone is important for seabird and turtle nesting and also provides valuable roosting habitat for certain seabird species, for example frigates and boobies (refer to Appendices 5 and 6).

The Coastal Zone vegetation also helps to maintain optimum stable temperatures important for successful turtle nesting.

The following cay Regional Ecosystem communities described in Batianoff *et al.* (2012) and Neldner *et al.* (2012) will be established:

- beach spinifex (*Spinifex sericeus*) open-hummock grassland – Regional Ecosystem 12.2.14e
- small patches of bay cedar (*Suriana maritima*) open to closed-scrub – Regional Ecosystem 12.2.19c
- small patches of sea trumpet (*Cordia subcordata*) low closed-forest – Regional Ecosystem part of 12.2.19a (not mapped or defined in 2007)
- octopus bush (*Argusia argentea*) and sea lettuce (*Scaevola taccada*), open scrub +/- Pandanus (*Pandanus tectorius*) emergents – Regional Ecosystem 12.2.19a
- sea lettuce will be added to Regional Ecosystem 12.2.14b in some places.

The following cay Regional Ecosystems that already occur in the Coastal Zone will be maintained and enhanced:

- shingle shores with sparse vegetation e.g. coastal jack bean (*Canavalia rosea*) – Regional Ecosystem 12.2.14h
- casuarina (*Casuarina equisetifolia* subsp. *incana*) woodland to low open-forest on exposed frontal areas – Regional Ecosystem 12.2.14a

- casuarina (*Casuarina equisetifolia* subsp. *incana*) woodland to low open-forest with mid-dense shrub of octopus bush/sea lettuce (*Argusia argentea*/ *Scaevola taccada*) – Regional Ecosystem 12.2.14b
- casuarina (*Casuarina equisetifolia* subsp. *incana*) open-forest to woodland with pandanus (*Pandanus tectorius*) sub-canopy – Regional Ecosystem 12.2.14c
- octopus bush (*Argusia argentea*) open scrub +/- casuarina (*Casuarina equisetifolia* subsp. *incana*) emergents – Regional Ecosystem 12.2.19b
- pandanus (*Pandanus tectorius*) low open-forest to low closed-forest – Regional Ecosystem 12.2.20a.

Natural establishment of Coastal Zone species that are components of the above Coastal Zone Regional Ecosystems will be allowed to continue along the shoreline, unless habitat manipulation is required for seabird or turtle conservation management.

No pisonia is to be planted in the Coastal Zone. There is a risk that the build-up of decomposing leaves and other plant material under pisonia trees promotes fungus, which may adversely affect the turtle incubation success rate (pers. comm. Jim Buck).

Generous buffer areas are to be left between the current turtle nesting locations and the planted pisonia to allow for the natural movement of sand areas suitable for turtle nesting in the future. Pandanus to be planted on the landward edge of the zone to assist in the protection of planted pisonia. Sufficient casuarina and octopus bush to be maintained in the Coastal Zone adjacent to sandy beaches to provide shade, thus maintaining suitable stable sand temperatures in turtle nesting areas. More shade and additional planting may be needed in the future as temperatures increase.

The area adjacent to the end of the existing Coral Gardens track on the northern end of the island is an important turtle nesting area. The relocation of the existing track away from the sandy beach will better protect this nesting site, particularly if future shoreline erosion occurs.

Sand stabilising plants e.g. beach spinifex to be established in the Coastal Zone at the ends of the airstrip and in turtle nesting areas to minimise sand erosion during king tides, strong winds and storm surges.

Other species suitable for introduction into the Coastal Zone are sea trumpet, necklace bean (*Sophora tomentosa*), sea lettuce, bay cedar, trachymene (*Trachymene cussonii*), beach buffalo grass (*Stenotaphrum micrantha*), and goat's head burr (*Tribulus cistoides*). Pandanus is suitable for sub-coastal planting (landward of the foredune vegetation) and planting in rocky or seepage shoreline areas.

### 6.1.3 COASTAL ZONE IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Year 1 (2018)	Remove rosy dock and mile-a-minute.
March to May Years 3 to 6	Extend first pass removal of pest plants in adjoining North-East and North-West Zones into the adjacent Coastal Zones to minimise pest plant spread.
By May Year 6	Complete first pass removal of all pest plants (with the exception of sea rocket).
By October Year 5	Collect casuarina seed from other cays in the Capricorn Bunker Group, grow these in the nursery and plant in newly accreted supratidal sand areas and existing Coastal Zone areas containing casuarina to ensure these areas are colonised by casuarina provenance adapted to the cay environment.
By Year 5	Move the vehicle track and turning circle currently located in the Coral Gardens Coastal Zone further away from the coastline to provide more area for turtle nesting habitat.
By Year 5	Carry out supplementary planting in the Coastal Zone where required, including additional coastal zone species from other cays.
By Year 5	Densely plant patches of pandanas at and adjacent to the landward edge of the Coastal Zone at suitable sites.
Ongoing	Carry out supplementary planting or removal of plants if required to maintain the optimum temperatures for turtle nesting and suitable habitat for seabirds.
Ongoing	Remove sea rocket if it increases significantly in abundance in the future or adversely impacts the habitats of key species.
Ongoing	Remove any newly established pest plant species from this zone before they become a problem.
Ongoing	The ends of the airstrip to be hand weeded NOT mown.  Previously the ends of the airstrip were brush cut, then more recently mown.  However, regular mowing will facilitate the spread of exotic airstrip grasses into these areas and potentially into the surrounding Coastal Zone.
Ongoing	Remove seedlings of casuarina, octopus bush and other woody species in the Buffer Zone to comply with air safety regulations.
Early June Years 1 to 7 and Year 10	Carry out monitoring to ensure that Regional Ecosystem structure and floristic composition is consistent with descriptions in Neldner <i>et al.</i> 2012 (and Appendix 4) and is providing the desired habitat for birds and turtles.

### 6.1.2 MANAGING PEST PLANTS

Pest plant management will focus on the removal of species identified for eradication (Appendix 1) and prevention of the spread of pest plants. Systematic weeding of the North-East and North-West Zones to be extended to include the adjacent Coastal Zone to prevent the spread of pest plants into adjacent areas.

In the north-western section of the Coastal Zone, single isolated patches of rosy dock and mile-a-minute are to be removed as soon as possible to reduce the risk of spreading and maximise the likelihood of eradication.

Sea rocket (*Cakile edentula*) is a common annual succulent pest plant species that establishes along the seashore each year. The abundance of this species is to be monitored and control only undertaken if it is adversely impacting the Coastal Zone habitat.

## 6.2 SOUTH-WEST ZONE

### 6.2.1 SOUTH-WEST ZONE GUIDELINES

The South-West Zone will be rehabilitated to increase representation of the globally important *Pisonia grandis* forest ecosystem for arboreal nesting birds such as black noddies (*Anous minutus*) and in the longer term as the soil depth profile develops, to provide burrowing habitat for wedge-tailed shearwaters (*Ardenna pacifica*).

Most of the South-West Zone is covered with extensive, impenetrable lantana thickets with a canopy of casuarina of unknown provenance that have spread from past revegetation plantings (Figure 3). These will be replaced by pisonia forest.



Figure 3: Current vegetation in the South-West Zone. The lantana (*Lantana camara*), pine trees (*Araucaria* spp.) and umbrella tree (*Schefflera actinophylla*) to be removed prior to pisonia (*Pisonia grandis*) planting (photograph J. Buck).

The vegetation of the South-West Zone will include the following Regional Ecosystems and vegetation communities (described in Batianoff *et al.* 2012 and Neldner *et al.* 2012):

- pisonia (*Pisonia grandis*) closed-forest to low closed-forest, sometimes with pandanus (*Pandanus tectorius*), native elm (*Celtis paniculata*) and *Ficus* spp. – Regional Ecosystem: 12.2.21b. This will be the predominant Regional Ecosystem in this zone
- pisonia (*Pisonia grandis*) low open-forest to low closed-forest – Regional Ecosystem 12.2.21a
- native elm (*Celtis paniculata*) +/- *Pisonia grandis* +/- pandanus (*Pandanus tectorius*) woodland to closed-forest – Regional Ecosystem 12.2.20b
- Port Jackson fig (*Ficus rubiginosa*) open-forest; small area in the vicinity of the soak and other small areas within this zone – Regional Ecosystem 12.2.21c

- ephemeral wetlands; small area (soak) – Regional Ecosystem 12.2.17c
- sea purslane (*Sesuvium portulacastrum*) herbland; small patch in the vicinity of the soak – Regional Ecosystem 12.2.17b.

There is currently limited scientific knowledge regarding the genetic diversity of *Pisonia grandis*. *Pisonia* seeds collected from a number of Capricorn Bunker cays will be grown and planted to maximise genetic diversity to enhance resilience of the established pisonia forest to climate change and other stresses.

The main strategy is to establish a pisonia forest within the first four years of the Plan to exclude pest plants. The program will require the planting of approximately 9000 plants.

*Pisonia* will be planted at approximately three to four metre spacings during the first four years of the implementation of the Plan.

Ideally, lantana removal and pisonia planting will start at the boundary of the South-West and North-West Zones and proceed southwards to minimise pest plants spreading from the South-West Zone into the North-West Zone.

If there are insufficient resources to carry out all of the implementation actions in each of the management zones in the first four years, the pisonia planting period could be extended to allow completion of actions scheduled for the North-East and North-West Zones. Follow-up pest plant removal will be necessary in these zones for many years compared to the relatively minimal follow-up maintenance required following the establishment of planted pisonias.

Supplementary pisonia planting can be carried out more slowly over the remainder of the implementation period (if required) to replace plants that do not survive the initial planting and create more natural uneven age stands. There will also be some increase in density caused by vegetative growth following natural tree-fall as the pisonia forest grows.

*Pisonia* will not be planted too close to the Coastal Zone, which is to ensure that the pisonia forest does not displace the existing Coastal Zone vegetation. This is particularly important adjacent to sandy shorelines where turtle nesting occurs. An adequate distance should be left free of planted pisonia in these areas to accommodate future shifts in shoreline location.

Tops of berm ridges may be less favourable than deeper swales for pisonia so other species such as sandpaper fig (*Ficus opposita*), native mulberry (*Pipturus argenteus*), lantern bush (*Abutilon albescens*), native grasses and vines may be more suitable for these sites.

Native elm, native mulberry, sandpaper fig, lantern bush, gum fruit (*Commicarpus insularum*), native plumbago (*Plumbago zeylanica*), bird's beak grass (*Thuarea involuta*) and stalky grass (*Lepturus repens*) to be either planted or direct seeded at several nodes throughout the zone.

Sea purslane, New Zealand spinach (*Tetragona tetragonoides*), stalky grass and moon flower (*Ipomoea violacea*) are suitable species to plant in the vicinity of the soak (Frog Hollow adjacent to Noddy Lane).

Casuarina will not be planted in the South-West Zone as it does not occur naturally in *Pisonia grandis* Regional Ecosystems (refer to technical descriptions in Neldner *et al.* 2012). If recruitment of casuarina occurs, the plants will be removed. Standing dead trees are to be removed from areas adjacent to tracks, buildings and other areas where falling trees could pose a safety risk or damage infrastructure. Some end-of-life trees will be removed to reduce damage to pisonia plantings from tree-fall. Removed casuarinas will be used as a source of mulch or to provide log borders for landscaping in human use areas. Remaining casuarinas are to be allowed to die out naturally, which will provide interim nesting habitat for black noddies (*Anous minutus*) while the pisonia forest grows. Casuarina has an approximate maximum lifespan of 40 to 50 years. If this is the case on LEI, then the mature casuarina in the South-West Zone should die out naturally by about 2030.

### 6.2.3 SOUTH-WEST ZONE IMPLEMENTATION PLAN

Timeline (calendar years)	Action
By August Year 1	Carry out trials to determine the most suitable method for lantana removal.
By August Year 1	Remove all non-native cay tree species (other than casuarina) that will be difficult to remove after pisonia is planted including umbrella tree, athel pine ( <i>Tamarix aphylla</i> ), pine trees ( <i>Araucaria</i> spp.), beach almond ( <i>Terminalia catappa</i> ), brown damson ( <i>Terminalia arenicola</i> ) and paw paw ( <i>Carica papaya</i> ).
By August Year 1	Carry out trials for direct planting of pisonia cuttings.
July Year 1 to August Year 4	Remove dragon fruit, <i>Agave</i> spp., mother in law's tongue and basket plant ( <i>Callisia</i> sp.) ahead of pisonia planting.
September/October Year 1	Pot 2500 pisonia cuttings (less if direct planting trials are successful) utilising tree loppings from Heron Island and Capricornia cays campgrounds, if available, and from the North-West Zone of LEI.
By December Year 1	Identify turtle nesting and ground nesting seabird locations on the island before planting pisonia in the South-West Zone. Ensure pisonia is not planted in or immediately adjacent to these areas to provide sufficient width in the Coastal Zone to provide for future sand movement.
December to January Years 1 to 3	Collect pisonia seeds from as many other Capricorn Bunker locations as possible.

### 6.2.2 MANAGING PEST PLANTS

Remove lantana prior to planting pisonia cuttings to allow access to planting sites and to reduce the risk of lantana smothering seedlings before they establish.

Figure 4 shows a dense cover of dwarf poinsettia (*Euphorbia cyathophora*). It may be necessary to remove these in some areas prior to planting to provide access. Once the planted pisonia is established, there will be no need to carry out further treatment of this or other invasive herbaceous pest plant species such as nightshade (*Solanum nodiflorum*), and cobbler's pegs (*Bidens pilosa*) as they will be completely shaded out once the pisonia canopy closes.



Figure 4: Dense cover of dwarf poinsettia (*Euphorbia cyathophora*) and lantana (*Lantana camara*) in the South-West Zone (photograph J. Brushe).

Timeline (calendar years)	Action
Years 1 to 4	Propagate and grow the collected pisonia seeds in the nursery for planting along with the cutting grown pisonias.
By July Years 2 to 5	Use contractors and machinery to remove the lantana from a 2 to 2.5 ha area per year in the South-West Zone. Mulch from the removed lantana can be left on the ground to suppress regrowth, establishment of new pest plants and to provide nutrient for the planted pisonias. Remove any lantana in the Coastal Zone adjacent to these areas.
July to September Year 2 and ongoing	Follow-up removal of lantana until total eradication is achieved.
Between July and September Years 2 to 5	Plant potted pisonia and seed grown pisonia in the area cleared of lantana at 4m spacings. Use vehicles and machinery to assist with and speed up the planting. Leave small glades within the pisonia planting area and plant these areas with native elm, sandpaper fig, native mulberry, lantern bush, gum fruit, native plumbago, bird's beak grass and stalky grass.
For three months after initial planting of pisonias	Water the planted pisonias during initial establishment.
By December Year 2	Finish first pass removal of all pest plants with 'Very High' and 'High' priority for eradication excluding lantana, mother of millions ( <i>Bryophyllum delagoense</i> ) and resurrection plant ( <i>Bryophyllum pinnatum</i> ), which will be removed systematically together with other pest plants (Appendix 1).
Between September Year 4 and August Year 10	Following the initial planting, continue potting and planting of pisonia over the remainder of the implementation period as required to increase the planting density and replace those plants that do not survive the initial planting.
Between July and September Years 2 to 5	Plant pisonias along track edges at minimum practical spacings and close enough to the track to create a closed pisonia canopy and prevent pest plant growth along tracks. The resulting track width must remain wide enough to allow machinery access without the need for constant pruning.
Ongoing	Follow-up removal of all pest plants for eradication until eradication is achieved.
Ongoing	Once pisonia is planted, pest plant control will only be for the purposes of removing Very High and High priority species for eradication and pest plants that are smothering planted pisonias.
Ongoing	Remove dead and end-of-life casuarina where these pose a safety risk to people and property, or may damage planted pisonias.
Ongoing	Remove any casuarina seedlings.
Early June Year 1 to 7 and Year 10	Carry out monitoring to ensure that Regional Ecosystem structure and floristic composition are consistent with descriptions in Neldner <i>et al.</i> 2012) (and Appendix 4) and habitat is being provided for birds.

## 6.3 NORTH-WEST ZONE

### 6.3.1 NORTH-WEST ZONE GUIDELINES

The North-West Zone will provide habitat diversity for bird species requiring more shrubby vegetation, such as Capricorn silvereye, bridled tern (*Onychoprion anaethetus*) and various fruit-eating land birds (Appendices 5 and 6). To support this bird diversity, restoration will focus on removing lantana and non-cay herbaceous species. Replanting with dense ground covers, sandpaper figs, native grasses and other fruit-bearing native cay species will assist with the establishment of native cay shrublands.

The vegetation of the North-West Zone will be predominantly shrubland consisting of the following Regional Ecosystem communities (described in Batianoff *et al.* 2012 and Neldner *et al.* 2012):

- sandpaper fig (*Ficus opposita*) shrubland – Regional Ecosystem 12.2.21d
- lantern bush (*Abutilon albescens*) shrubland – Regional Ecosystem 12.2.18c
- beach sunflower (*Wollastonia uniflora*) +/- lantern bush (*Abutilon albescens*) shrubland – Regional Ecosystem 12.2.18a

- native plumbago (*Plumbago zeylanica*)/coastal jack bean (*Canavalia rosea*)/stalky grass (*Lepturus repens*) herbland – Regional Ecosystem 12.2.18b
- sea purslane (*Sesuvium portulacastrum*) herbland – Regional Ecosystem 12.2.17b (small area in the vicinity of the ephemeral wetland)
- strangler fig (*Ficus rubiginosa*) open-forest – Regional Ecosystem 12.2.21c (small area in the vicinity of the ephemeral wetland).

The major strategy is to remove pest plants to allow natural regeneration of native cay species. This natural regeneration will be enhanced by direct seeding and planting of species that naturally occur in the proposed Regional Ecosystems for this zone. Sandpaper fig are already well-established in this area (Figure 5).

No further planting of pisonia in the North-West Zone is required. Existing pisonia in this zone are a good source of cuttings for pisonia planting in the South-West Zone. Cuttings to be taken from these to keep the height of trees low. Pisonia to be removed when cuttings are no longer required and before they grow too high. In the meantime, the existing pisonia will assist in pest plant suppression. Remove any new pisonia seedlings.

Any mature casuarina present in this zone will not be removed unless they pose a safety hazard as they will die out naturally in the next 10 to 20 years.

Suitable native cay species to replace pest plants are: sandpaper fig, beach sunflower, lantern bush, bird's beak grass, stalky grass, marine couch (*Sporobolus virginicus*), coastal jack bean (*Canavalia rosea*), goat's foot convolvulus (*Ipomoea pes-caprae*), native plumbago, gum fruit, and boerhavia (*Boerhavia albiflora* var. *heronensis*).

Suitable species for planting in the vicinity of the ephemeral wetland/soak area are sea purslane, New Zealand spinach, stalky grass and moon flower.

### 6.3.2 MANAGING PEST PLANTS

The dominant pest plants present are lantana, corky passion vine, mother of millions, resurrection plant, dwarf poinsettia, Mossman River grass, nightshade, cobbler's pegs and umbrella tree. Seeding Mossman River grass (including seeds on the ground) and cobbler's pegs seeds should be removed immediately prior to other pest plant removal and placed in sealed bags for suitable disposal.

Priority invasive pest plants currently growing on the tracks and track edges in this zone include red natal grass, kaki weed, Mossman River grass, crow's foot grass and mother of millions. These need to be eradicated from the track and track edges ahead of broadscale removal of pest plants from this zone to prevent their spread from the tracks and establishment within the adjacent natural area.

Unwanted tree species to be removed ahead of other pest plants. Coordinate their removal from the entire island in one operation. First pass pest plant removal of other pest plant species to be undertaken in manageable sized areas over a four to five-year period. Regular long-term systematic weeding is required to maintain dominance of native cay species.



Figure 5: North-West Zone showing sandpaper fig (*Ficus opposita*) already well-established in this area growing among patches of lantana (*Lantana camara*) shrubs and dense ground cover of dwarf poinsettia (*Euphorbia cyathophora*) and other pest plants (photograph J. Brushe).

### 6.3.3 NORTH-WEST ZONE IMPLEMENTATION PLAN

Timeline (calendar years)	Action
By August Year 1	Remove all umbrella tree, paw paw trees and any other non-cay tree species.
May Year 2	Complete first pass removal of red natal grass.
By April Year 2	Carry out indicator trials to determine the most effective methods of pest plant control and desired native plant establishment.
From March Year 2	Establish a narrow mown buffer strip of native grasses on edges of the airstrip adjoining the natural area to prevent invasion of the natural area by exotic species from the mown areas. If these are successful, extend them further into the mown areas.
By September Year 3	Eradicate red natal grass and pest plants on tracks and track edges.
March to May in Years 3 to 6	In an area of one hectare each year, remove lantana and complete first pass removal of all herbaceous pest plants. Do not remove pest plants in the vicinity of the existing red natal grass in Year 3.
By June in Years 3 to 6	Transplant sprigs of native grasses from the turf farm and plant nursery grown plants of other desired species in newly weeded areas. Also distribute seeds of beach sunflower, lantern bush, bird's beak grass, stalky grass, marine couch, boerhavia, gum fruit, native plumbago and New Zealand spinach. Once these species are established, distribute seeds of coastal jack bean and goat's foot convolvulus.
June to September in Years 3 to 6	Water transplanted grasses and nursery grown plantings (as required) to ensure they are established prior to the bird nesting season.
June to September Years 3 to 10	Carry out follow-up removal of pest plant regrowth as required to prevent seeding.
September Years 3 to 10	Ensure all pest plant regrowth seedlings have been removed immediately prior to the bird nesting season to minimise risk of seeding during the bird nesting season when weeding cannot be carried out.
March/April Years 4 to 10	Remove pest plant regrowth from previously weeded areas immediately after the bird season to minimise seeding of regrowth.
By April Year 6	Complete the first pass removal of all pest plants
By May Year 6	Plant sea purslane, New Zealand spinach, stalky grass and moon flower in the vicinity of the ephemeral wetland/soak area. Water if required to ensure they are established prior to the next bird season.
Ongoing	Continue to carry out long-term regular, systematic hand weeding to keep abundance of pest plant species low and maintain dominance of desired native cay species.
Early June Years 1 to 7 and Year 10	Carry out monitoring to ensure that Regional Ecosystem structure and floristic composition are consistent with descriptions in Neldner <i>et al.</i> 2012, (and Appendix 4), and the appropriate habitat is provided for birds.

## 6.4 NORTH-EAST ZONE

### 6.4.1 NORTH-EAST ZONE GUIDELINES

The zone is important for ground nesting seabirds (refer to birds recorded on LEI, Appendices 5 and 6) and will be rehabilitated to preserve and enhance suitable habitat. Small shrubby patches consisting of sandpaper fig and lantern bush to be maintained and enhanced, particularly on the seaward edges of this zone, to encourage frigate birds and other large seabirds that prefer shrubby nesting habitat.

Encouraging larger bird species to utilise this zone will facilitate flight into the prevailing winds, away from the airstrip.

The proposed ecosystem community for the North-East Zone is:

- mixed tussock grassland to hermland – Regional Ecosystem 12.2.17a (described in Batianoff *et al.* 2012 and Neldner *et al.* 2012).

The main strategy in the North-East Zone is the removal of pest plants to allow natural regeneration of native cay species. The North-East Zone is currently dominated by a dense cover of dwarf poinsettia with some dense patches of lantana, preventing the establishment and spread of native cay species.

Removal of pest plants will only be effective if timely follow-up removal occurs to prevent reestablishment, prevent establishment of new pest plant species and to eventually eliminate the pest plant seedbank over time. Increasing dominance of native cay species (particularly native grasses) will assist in pest plant suppression.

Natural regeneration will be enhanced by direct seeding and planting of species that occur in Regional Ecosystem community 12.2.17a. Most frequently occurring species of this community are already present on the seaward edges of this zone. Further away from the Coastal Zone, there are fewer native cay species, although coastal jack bean and goat's foot convolvulus are present in most places. In other locations, long-term competition from the dense cover of dwarf poinsettia, morning glory, corky passion vine and other pest plants are excluding native species altogether (Figure 6).

Rock piles and rocky ridges will be retained to provide opportunities for bird nesting. Habitat manipulation to be undertaken to encourage nesting crested terns (*Thalasseus bergii*) and common noddies (*Anous stolidus*) to relocate from the airstrip into the North-East Zone.

Suitable species to replace the pest plants are bird's beak grass, stalky grass, marine couch, goat's head burr, boerhavia, gum fruit, coastal jack bean and goat's foot convolvulus.

No planting of pisonia to be carried out in the North-East Zone.

#### 6.4.2 MANAGING PEST PLANTS

Dwarf poinsettia is the dominant pest plant species in the North-East Zone. Other pest species are lantana, morning glory, green panic, corky passion vine, mother of millions, resurrection plant, Mossman River grass, signal grass (*Urochloa subquadriflora*), nightshade and cobbler's pegs.

Green panic to be eradicated prior to removal of dwarf poinsettia. The infestation in the North-East Zone is located on the windward side, so there is a high probability that windblown seed will be spread across the entire North-East Zone, facilitating the spread into newly weeded bare areas.

Seeding Mossman River grass (including seeds on the ground) should be removed immediately prior to other pest plant removal and placed in sealed bags for suitable disposal.

Morning glory and corky passion vine regrowth from underground tubers is likely to be difficult to control without the use of systemic chemicals.

Use small-scale indicator trials prior to undertaking pest plant control actions of larger areas to determine the most effective methods of pest plant regrowth control (initially without use of systemic chemicals) as well as best methods to establish native species.



Figure 6: Dense cover of dwarf poinsettia (*Euphorbia cyathophora*) and morning glory (*Ipomoea indica*) in the North-East Zone (photograph J. Brushe)

### 6.4.3 NORTH-EAST ZONE IMPLEMENTATION PLAN

Timeline (calendar years)	Action
September Year 1	Mow a large area in the centre of the North-East Zone to create suitable nesting habitat away from the airstrip.
September Years 2 to 5	If the mown area described above is successful, increase the size of the mown area during the next bird nesting season and vary vegetation densities and heights within it to determine habitat preference by birds. Maintain preferred habitat structure for the nesting birds by planting suitable species at optimum spacings.  Transition to hand weeding rather than mowing.  If the birds do not utilise the mown area, manage the area immediately adjacent to their nesting area on the airstrip to ensure vegetation is predominantly composed of low native grasses, herbs and vines. This is to encourage birds into the North-East Zone away from the airstrip and other currently mown areas.
From March Year 2	Establish a narrow mown buffer strip on all currently mown edges adjoining the natural area to prevent invasion of the natural area by exotic species.  If these are successful, extend them further into the mown areas.
By April Year 2	Carry out trials to determine the most effective methods of control for all pest plant species and the most effective methods for native plant establishment, particularly native grasses.
May Year 2	Complete first pass removal of green panic.
By September Year 2	Eradicate green panic.
March to May in Years 3 to 6	In an area of 1 ha each year, remove lantana and complete first pass removal of all herbaceous pest plants. In Year 3, do not remove pest plants in the vicinity of the existing green panic where viable seed is likely to still be present on the ground.
By June in Years 3 to 6	Transplant sprigs of native grasses from the turf farm and plant nursery grown plants of other desired species in newly weeded areas. Also distribute seeds of bird's beak grass, stalky grass, marine couch, boerhavia, New Zealand spinach and goat's head burr. Once these species are established and spreading, distribute seeds of coastal jack bean and goat's foot convolvulus.
June to September in Years 3 to 6	Water transplanted grasses and nursery grown plants as required to ensure they are established prior to the bird nesting season.
June to September Years 3 to 10	Carry out follow-up removal of pest plant regrowth as required to prevent seeding.
September Years 3 to 10	Ensure that all pest plant regrowth seedlings have been removed immediately prior to the bird nesting season to minimise risk of seeding during the bird nesting season when weeding cannot be carried out.
March/April Years 4 to 10	Remove pest plant regrowth from previously weeded areas immediately after the bird season to minimise seeding of regrowth.
By May Year 6	Complete the first pass removal of all pest plants from this zone.
Between March to May Years 3 to 6	Establish a Buffer Zone as a narrow dense barrier immediately adjacent to the mown airstrip and Resort Precinct merging into the grassland/ hermland to discourage birds moving onto the airstrip from the North-East Zone and to prevent exotic grasses from spreading into the North-East Zone. Carry out planting in the Buffer Zone immediately following pest plant removal. Stalky grass, marine couch, gum fruit and native plumbago are suitable species to include in the Buffer Zone.
Ongoing	Continue long-term regular, systematic hand weeding to keep abundance of pest plant species low and maintain dominance of desired native cay species.
Ongoing	Carry out supplementary planting or remove undesirable native species if required to maintain preferred habitat for bird nesting.
Early June Years 1 to 7 and Year 10	Carry out monitoring to ensure that Regional Ecosystem structure and floristic composition are consistent with descriptions in Neldner <i>et al.</i> (2012), (and Appendix 4), and is providing appropriate habitat for birds.



Lady Elliot Island Eco Resort solar power system. ©Lady Elliot Island Eco Resort

## 7.0 MANAGEMENT OF VEGETATION IN HUMAN USE AREAS

### 7.1 HUMAN USE AREA – GENERAL MANAGEMENT

Human use areas to be managed to minimise adverse impacts on natural ecosystems and, where possible, enhance the function of these ecosystems. Vegetation in human use areas will be managed to:

- prevent invasive pest plant species escaping from human use areas into natural areas
- provide food and habitat for insects (excluding pest species) and native birds
- provide aesthetically pleasing landscaped areas
- display and interpret native cay vegetation and habitats
- provide visual and light screens.

A Vegetation Management Manual will be prepared for Eco Resort staff to assist in plant identification and provide information on implementation of Standard Operating Procedures for pest plant management, plant waste processing, landscaping and plant propagation.

A Standard Operating Procedure will be developed for plant waste processing to ensure pest plants and exotic garden species do not establish and spread into natural areas. Garden waste should not be deposited in natural areas (as shown in Figure 7). It should be mulched and/or composted in designated precincts and used as mulch in landscaped areas or used in potting mixes. Prunings and other waste material from some species may need to be deeply buried to prevent them re-growing in the mulch.



Figure 7: *Agave sp.* and *Moses in the cradle (Tradescantia spathacea)* growing in garden waste at the end of a track pushed through the *lantana* in the South-West Zone (photograph J. Brushe)

## 7.2 BUFFER ZONES

Buffer Zones are located between two different land use areas. Although Buffer Zones will be planted with native cay species compatible with the adjoining natural ecosystem, they will be established and maintained to accommodate adjacent human land use and their structure and floristic diversity will vary from the benchmark for natural Regional Ecosystems. Therefore, Buffer Zones are classified as part of the Human Use Areas.

A Buffer Zone will be established adjoining the airstrip in the South-West and North-West zones to comply with Civil Aviation Safety Authority (CASA) requirements and provide some additional safety measures to ensure the safe use of the Lady Elliot Airstrip. Need to ensure no woody plants are present immediately adjacent to the airstrip and that the height of woody plants further into the area are managed to prevent any woody plants falling onto the airstrip or aircraft parking areas.

The Buffer Zone will be densely planted to prevent exotic grasses from the airstrip spreading into adjoining natural areas. Adjacent to the airstrip in the South-West Zone to be planted with beach sunflower, gum fruit, moon flower and lantern bush. Native mulberry could be planted adjacent to the pisonia forest edge further away from the airstrip. Suitable species for planting in the Buffer Zone adjacent to the airstrip in the North-West Zone include beach sunflower, gum fruit, native plumbago and lantern bush. Suitable species for planting in the Buffer Zone adjacent to the airstrip in the North-East Zone include stalky grass, gum fruit and native plumbago.

In addition to the Buffer Zone adjacent to the airstrip, mown narrow buffer strips of native grasses and native herbaceous plants to be established on the outside edges of the current airstrip adjoining natural areas. Mown narrow buffer strips will also be established on the mown edges of the power station, staff accommodation areas, and adjacent to any areas on the old airstrip where pisonia is not planted. The mown narrow buffer strips will function as a buffer between the invasive exotic grasses and forbs in the mown areas and newly weeded and planted areas.

Suitable plant species include marine couch, bird's beak grass, stalky grass, beach buffalo grass and boerhavia. If native grass establishment in these narrow mown buffer strips proves to be successful, the strips should be gradually widened to extend further into the adjacent mown areas. Steaming would be a suitable method to remove the exotic species from the mown areas prior to planting.

A Buffer Zone will be established adjacent to the north eastern edge of the Resort Precinct as a visual and light screen between the eco resort and nearby coastal bird and turtle nesting areas. In some locations, clearing all of the lantana will result in reduced visual amenity by exposure of previously unseen infrastructure. Visual screening buffers will be planted to block views of the Composting and Waste Management Precincts and for privacy screening adjacent to the cottages in the Heritage Precinct. Denser planting of pisonia could be used for visual screening buffers in the South-West Zone provided they are not too close to infrastructure. Other suitable species for this zone include beach sunflower, lantern bush, native mulberry, sandpaper fig and native elm.

Bay cedar, sea lettuce and sea trumpet are attractive screening plants that could be used within the Resort Precinct and the Heritage Precinct for screen planting adjacent to the Coastal Zone.

### 7.2.1 MANAGING PEST PLANTS

Buffer Zones adjacent to the airstrip and Resort Precinct to be weeded and planted at the same time as adjoining areas in adjacent zones. Other Buffer Zones to be weeded and planted as soon as replacement plants are available. Follow-up weeding in all Buffer Zones to be undertaken at the same time as follow-up weeding in adjoining areas.

## 7.2.2 BUFFER ZONE IMPLEMENTATION PLAN

Timeline (calendar years)	Action
As soon as possible	Collect seeds and cuttings of suitable species for Buffer Zone plantings. Propagate and grow in the nursery.
By June Year 1	Remove mature casuarina and any other woody tree species from the airstrip Buffer Zone.
As soon as plants are available	Remove existing pest plants from visual and light screening Buffer Zones and plant with desired species. Water until established.
Years 2 to 5	<p>Establish mown narrow buffer strips along the outside edges of the mown airstrips and Resort Precinct to replace the exotic species currently present on the mown edges to prevent the invasion of natural areas by exotic grasses and forbs. Densely planted strips of native grasses including marine couch, bird's beak grass, stalky grass, beach buffalo grass and native ground covers including boerhavia would be suitable species for the mown buffer strips.</p> <p>The mown narrow buffer strips on the airstrip edges need to be established ahead of pest plant removal in the ground layer of adjacent Buffer Zones and natural areas.</p> <p>A Buffer Zone is not necessary on the old airstrip where pisonia is planted immediately adjacent to the mown edge.</p>
March to May in Years 3 to 6	Remove existing pest plants from the Buffer Zones adjacent to the airstrip at the same time as adjoining natural areas are weeded.
By June in Years 3 to 6	Densely plant Buffer Zones adjacent to the airstrips with desired species at the same time as planting in adjoining natural areas.
June to September in Years 3 to 6	Water transplanted grasses and nursery grown plantings as required to ensure they are established prior to the bird nesting season.
June to September Years 3 to 10	Carry out follow-up removal of pest plant regrowth as required to prevent seeding at the same time as weeding adjacent natural areas.
September Years 3 to 10	Ensure all pest plant regrowth seedlings have been removed immediately prior to the bird nesting season to minimise risk of seeding during the bird nesting season when weeding cannot be done.
March/April Years 4 to 10	Remove pest plant regrowth from previously weeded areas immediately after the bird season to minimise seeding of regrowth.
Year 3 onwards	If mown buffer strips of native grasses are successful, gradually widen these to extend further into adjacent mown areas to gradually replace existing exotic species.
Ongoing	Carry out regular follow-up weeding in all Buffer Zone areas at the same time as adjoining natural areas.
Ongoing	Carry out additional planting to maintain the function of the buffer strips as required.

## 7.3 RESORT PRECINCT

### 7.3.1 RESORT PRECINCT GUIDELINES

Prevent pest plants in the Resort Precinct from spreading into natural areas. Current infestations of nutgrass to be eradicated as soon as possible.

Prior to this Plan, landscaping plantings in the Resort Precinct were dominated by exotic plant species. Gradually replace all exotic landscaping plants with native cay species.

Appendix 2 contains a list of naturally occurring Capricorn Bunker cay plant species (and information on propagation),

which are suitable for replacing exotic species currently used for landscape planting in the resort precinct.

Species for landscaping to be sourced from LEI if possible, but may be sourced from other cays in the Capricorn Bunker Group via procedures developed with QPWS.

Suitable native cay plant species not currently present on LEI to be planted in the landscaped areas to provide an ongoing source of seeds and cuttings for propagating and planting in natural areas.

### 7.3.2 RESORT PRECINCT IMPLEMENTATION PLAN

Timeline (calendar years)	Action
As soon as possible	Eradicate nutgrass infestations.
By December Year 1	Construct log border around the old growth pisonia stands to prevent the compaction of the root area by vehicles or foot traffic. Allow mulch to build up within this area to facilitate natural nutrient cycling.
By December Year 1	Develop and implement a Plant Waste Processing Standard Operating Procedure to prevent establishment and spread of garden waste and pest plants from and into natural areas.
By December Year 1	Ensure no potted non-cay plant species are present on the island.  A Standard Operating Procedure for wedding bouquet management (preference is not to have introduced flowers on site).
By December Year 1	Develop a Pest Plant Control Standard Operating Procedure
By December Year 1	Install turtle friendly lighting throughout the precinct.
As soon as possible	Collect propagation material and propagate native cay species such as: <ul style="list-style-type: none"> <li>• octopus bush – could be used for solo planting</li> <li>• boerhavia, trachymene, New Zealand spinach and prostrate burr bush (<i>Triumfetta procumbens</i>) – use as ground covers in garden beds</li> <li>• native elm – a large shade tree that provides fruit for fruit-eating birds</li> <li>• gum fruit – useful as a ground cover or in hanging baskets</li> <li>• sea trumpet – could be used instead of cotton tree (<i>Hibiscus tiliaceus</i>) for windbreak planting</li> <li>• sandpaper fig – suitable for isolated planting where a shady tree is required; can be heavily chewed by insects and becomes leafless in dry periods, may need watering at these times</li> <li>• pandanus – good substitute for coconut palms in the precinct</li> <li>• pisonia – do not plant close to buildings or adjacent to paths as large limbs (or entire tree) may fall; may be a successful bonsai plant for use in large pots in outdoor areas</li> <li>• native mulberry – a shade tree with edible fruit; food for fruit-eating birds including silveryeye</li> <li>• native plumbago – useful ground cover in medium to large garden beds</li> <li>• sea lettuce – useful for mass planting or solo planting</li> <li>• bay cedar – attractive woody shrub that could be used as a screen or windbreak plant or solo planting</li> <li>• bird’s beak grass – attractive native cay grass, may be a suitable substitute for exotic grass species in mown grass areas with low foot traffic</li> <li>• marine couch – suitable for areas with higher exposure to foot traffic</li> <li>• beach buffalo grass – can be used with bird’s beak grass in mown grass area</li> <li>• beach sunflower – suitable as a pruned hedge plant either in garden beds or as a low screening plant or ground cover in larger garden beds.</li> </ul>
From Year 1	Carry out planting trials of the above species to determine their suitability for use in landscaping. Introduce into landscape planting if trials are successful.

Timeline (calendar years)	Action
By July Year 2	Remove invasive exotic garden species that are 'Very High' and 'High' priority for eradication and that have already naturalised outside the developed areas including the following species: <ul style="list-style-type: none"> <li>• century plant (<i>Agave americana</i> var. <i>americana</i> 'Marginata'), sisal hemp (<i>A. sisalana</i>), foxtail agave (<i>Agave attenuata</i>) and narrow-leaved century plant (<i>Agave vivipara</i> var. <i>vivipara</i>)</li> <li>• pink periwinkle (<i>Catharanthus roseus</i>)</li> <li>• lantana</li> <li>• mother in law's tongue</li> <li>• umbrella tree.</li> </ul>
Year 1	Maintain mown areas to minimise seeding of exotic species. Develop a Mowing Standard Operating Procedure to ensure mown footprint does not increase and minimise spread of pest plants on mowing equipment.
Year 1 to Year 3	Phase out coconut ( <i>Cocos nucifera</i> ) and replace with suitable native cay species (e.g. pandanus). In the interim, develop a Standard Operating Procedure for the processing of coconut fruit to ensure coconuts do not become naturalised outside the Eco Resort or reach the sea.
Over 5-year period	Phase out copper leaf ( <i>Acalypha wilkesiana</i> ) and Moses in the cradle ( <i>Tradescantia spathacea</i> ); replace with suitable native cay species. These species are a high priority to be removed from natural areas.
By September Year 6	Replace all exotic and non-cay native trees, shrubs, vines, forbs and ferns (including all succulents) with suitable native cay species with consideration to providing a range of food resources for a diversity of birds and insects.
By September Year 10	Trial replacement of exotic grasses in mown areas with native cay species. If not successful, establish a dense border of native cay species to form a barrier to the invasion of natural areas by exotic grasses and forbs from the mown areas.
Ongoing	Do not extend the mown grass areas further into natural areas. Reduce the areas of mown grass to increase the extent of the natural areas where appropriate.
Ongoing	Control all pest plants according to priorities in Appendix 1 and Section 5.

## 7.4 CULTURAL HERITAGE MANAGEMENT AREA

### 7.4.1 CULTURAL HERITAGE MANAGEMENT AREA GUIDELINES

The *Lady Elliot Island Lightstation Heritage Management Plan* (Great Barrier Reef Marine Park Authority 2012), notes that exotic plant species planted by the light keepers were reported to be, 'moderately significant for their evidence of the development and operation of the lightstation particularly in demonstrating the efforts of the keepers to improve the amenity of the lightstation'. The Plan states that 'The history of changes to vegetation – including the results of past clearing and guano extraction, goat grazing, household gardening and revegetation – is part of the cultural significance of Lady Elliot Island' and 'where the protection of cultural values is inconsistent with other conservation aims, such conflicts should be resolved by finding a subtle balance in the process of managing and caring for the vegetation on Lady Elliot Island'.

Naturalised invasive introduced plants are prevalent in the vicinity of the Heritage Precinct. Most species were probably introduced by lighthouse keepers for use in cottage gardens.

Nearly all the exotic herbaceous species are invasive and the presence of most will be detrimental to the implementation of this Plan.

Invasive species that may adversely impact natural ecosystems on LEI or other cays are to be removed and no additional non-cay plant species to be brought to the island. Nut grass infestations are spreading rapidly within the Heritage Precinct. Early eradication of nutgrass is a very high priority to prevent further spread. This species is difficult to eradicate once established.

Expert heritage advice to be sought to preserve the heritage significance of the vegetation and landscape design of the Heritage Precinct to the greatest reasonable extent.

Vegetation will be managed so that the lighthouse will continue to be a landmark feature seen from the sea.

The heritage value of the lightstation gardens will be reflected in the landscape design of the precinct (e.g. shape, size and arrangement of garden beds, coral paths) using native cay plant species (where appropriate) of similar growth forms and foliage types to the original garden plants. Management techniques such as ordered, geometrically symmetrical planting, pruning, and edge/ border planting using native cay species could create a similar appearance to the historic gardens.

The following exotic tree species to be retained in the landscaped areas within the Heritage Precinct for their cultural heritage value:

- hoop pine (*Araucaria cunninghamii*)
- Norfolk Island pine (*Araucaria heterophylla*)

- poinciana (*Delonix regia*)
- Norfolk Island hibiscus (*Lagunaria patersonii*)
- banana trees (*Musa acuminata*)
- frangipani (*Plumeria obtusifolia*).

If specimens of the above species need to be replaced, planting material should be sourced only from plants already growing on the island. Although these species are not highly invasive, they have the potential to become invasive if not managed.

To ensure that these species do not establish and spread to natural areas on the island, plant waste material must be managed in accordance with the Plant Waste Standard Operating Procedure. If they start to naturalise in natural areas, they should be eradicated from the entire island.

#### 7.4.2 CULTURAL HERITAGE MANAGEMENT AREA IMPLEMENTATION PLAN

Timeline (calendar years)	Action
As soon as possible	Eradicate green panic and nut grass.
By July Year 2	Remove invasive exotic garden species identified as ‘Very High’ and ‘High’ priority for eradication including the following species: <ul style="list-style-type: none"> <li>• umbrella tree</li> <li>• dragon fruit</li> <li>• basket plant (<i>Callisia</i> sp.)</li> <li>• pink periwinkle</li> <li>• mother in law’s tongue</li> <li>• century plant, sisal hemp, foxtail agave and narrow-leaved century plant</li> <li>• lantana.</li> </ul>
Year 2 to Year 10	Carry out regular weeding to eradicate or control pest plant species according to priorities in Appendix 1.
Ongoing	Manage mown grass areas in the same way as mown grass areas in the Resort Precinct.
Ongoing	Ensure the landscape design of the precinct continues to reflect the original designs of the lightstation and residential precinct gardens. Incorporate native cay species into gardens and landscaping using pruning and other techniques to recreate the appearance of the gardens planted by the early light keepers.
Ongoing	Ensure vegetation in the precinct does not cause deterioration of the cultural values of the site by removing or pruning vegetation that may damage structures or obscure visual aesthetics. No planting on the historic coral paths.
Ongoing	Remove pest plants and woody species from gravesites.
Ongoing	Apply the Plant Waste Processing Standard Operating Procedure.
Ongoing	Ensure no potted non-cay plant species are present in the precinct.
Ongoing	Ensure no food plants are grown in the precinct (with the possible exception of bananas).
Ongoing	Do not extend the mown grass areas further into natural areas. Reduce mown areas to increase the extent of the natural areas where appropriate.

## 7.5 AIRSTRIP

### 7.5.1 AIRSTRIP GUIDELINES

The main airstrip is currently dominated by the naturalised non-cay grasses, love grass (*Eragrostis tenuifolia*), crows foot grass (*Eleusine indica*) and couch (*Cynodon dactylon* var. *dactylon*). The old airstrip is dominated by chickweed (*Stellaria media*) and a range of other introduced non-cay herbaceous plants. Both are regularly mown.

The current airstrip to be maintained in accordance with CASA requirements.

Exotic grasses and other exotic species on the airstrip to be gradually replaced by native cay grasses and forbs if these prove to be suitable.

The Buffer Zone along the edges of the main airstrip not to contain any trees or large woody shrubs. To be densely planted to prevent invasion by the exotic grasses and forbs growing on the mown airstrip.

Native grasses, particularly marine couch and boerhavia may be suitable species to replace the existing exotic grasses and forbs on the airstrips.

### 7.5.2 AIRSTRIP IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Years 2 to 5	Establish mown narrow buffer on the edges of the mown areas, as described in Section 7.2.
By October Year 2	Plant small area on old airstrip with marine couch or a combination of marine couch, bird's beak grass, stalky grass, beach buffalo grass and boerhavia. Once these species are well-established, determine the effect of foot traffic and regular mowing.
By October Year 5	If marine couch or a combination of marine couch and other trialled species are found to be suitable for high foot traffic areas, gradually replace existing grasses and forbs on the old airstrip with the native species. Restrict vehicle traffic to the vehicle track.
By September Year 5	Trial the above species, particularly marine couch and boerhavia, on the current airstrip.
By September Year 10	If trials of the above species are successful on the current airstrip, gradually replace the exotic species with these.
Ongoing	If native grasses and forbs are not suitable for use on the airstrips, maintain the buffer strip of mown native vegetation along the edges of the airstrip to prevent the invasion of natural areas by exotic species. Mow areas of exotic species regularly and keep height low to minimise seed spread.
Ongoing	Manage nesting seabird habitat so that birds are kept away from the airstrip. Establish and maintain natural ecosystems to provide sufficient alternative habitat for crested terns ( <i>Thalasseus bergii</i> ) and common noddies ( <i>Anous stolidus</i> ) that nest and congregate in low grassy areas. Maintain a low densely vegetated airstrip edge to assist in keeping birds away from the airstrip.
Ongoing	The airstrip should be maintained in accordance with CASA regulations and to ensure safe air traffic.
Ongoing	Areas adjacent to the airstrip to be managed to minimise air strike and other adverse impact on nesting seabirds from airstrip use and management.
Ongoing	Create nesting habitat for large seabirds upwind from the airstrip and manipulate other habitat to discourage them from nesting in locations from which they are likely to take off across the airstrip into the prevailing winds.
Ongoing	Do not extend the mown grass areas further into natural areas. Reduce mown areas to increase the extent of the natural areas where appropriate.

## 7.6 WALKING TRACKS

### 7.6.1 WALKING TRACKS GUIDELINES

The aim is to have no overall increase in the footprint area of tracks. The track system to be rationalised with consideration given to the closure of some tracks.

A large diversity of pest plants dominates the walking and vehicle tracks. Species such as kaki burr (*Alternanthera pungens*) and Mossman River grass are spread via footwear and vehicle tyres along the tracks and from the tracks to other areas.

Standard Operating Procedures to be developed to manage the spread of pest plants along tracks. Temporary track closure to be undertaken as required to assist with weed control.

In areas of pisonia forest, pest plants to be shaded out by planting pisonia at closer spacing and close enough to the edge of the track to create a closed canopy over the track where possible.

Tracks to be maintained vegetation free using steam. Maintaining a mulch cover over the tracks in problem pest plant spots will assist in keeping the tracks pest plant free. Alternatively, pest plants can be replaced with native cay species that can tolerate vehicle and foot traffic and regular slashing. Marine couch, bird's beak grass, stalky grass, beach buffalo grass and boerhavia are suitable species to replace existing pest plants on the tracks.

### 7.6.2 WALKING TRACKS IMPLEMENTATION PLAN

Timeline (calendar years)	Action
By May Year 2	Develop Standard Operating Procedures to manage the spread of pest plants along tracks.
By Year 2	Trial the use of steam and mulch (if available in sufficient quantities) on tracks in non-pisonia ecosystems to kill pest plants, suppress further pest plant establishment and prevent pest plant spread around the island.
Year 2 to Year 5	If the use of steam and mulch is not successful in achieving vegetation free paths, replace exotic grasses and forbs on mown tracks in the North-West Zone with a mixture of marine couch, bird's beak grass, stalky grass, beach buffalo grass and boerhavia.
Between July and September Years 2 to 5	Plant pisonia at 2 to 3 m spacings along track edges in the South-West Zone, which will create a closed canopy over the track as the pisonia forest matures. Planting needs to be as close as possible to the track edges to allow vehicle passage with minimum ongoing pruning of the growing trees adjacent to the track.
Ongoing	Island tracks to be maintained in appropriate locations to: <ul style="list-style-type: none"> <li>• minimise impact of trampling natural vegetation</li> <li>• avoid disturbance to nesting and roosting birds</li> <li>• allow vehicle access for track maintenance and fire control</li> <li>• allow guest access and experience the natural terrestrial cay environment.</li> </ul>
Ongoing	Track numbers to be kept to a minimum and located to minimise disturbance to bird and turtle nesting areas.
Ongoing	New tracks only to be created if existing tracks are closed and only for the purposes of relocating existing tracks to prevent adverse environmental impacts.

## 7.7 COMPOSTING AND WASTE MANAGEMENT PRECINCTS

### 7.7.1 COMPOSTING AND WASTE MANAGEMENT PRECINCTS GUIDELINES

The Marine Parks Permit (G20/38150.1) defines the area of the precincts and specifies operating requirements. There is a high risk of pest plant invasion due to large areas of disturbed bare ground and high vehicle usage. Monitor to detect new pest plant introductions and prevent pest plant establishment and spread from the precincts.

Buffer Zones will be established around the Composting and Waste Management Precincts where appropriate.

The on-site composting apparatus (OSCA) to be managed in accordance with the OSCA Standard Operating Procedure to ensure food scraps are composted and viable seeds destroyed.

Garden and pest plant waste to be processed in precincts in accordance with the Marine Parks Permit and Plant Waste Processing Standard Operating Procedure.

### 7.7.2 COMPOSTING AND WASTE MANAGEMENT PRECINCTS IMPLEMENTATION PLAN

Timeline (calendar years)	Action
As soon as possible	Eradicate the green panic and nut grass infestations.
As soon as possible	Develop a Biosecurity and Plant Waste Processing Standard Operating Procedure. Review the OSCA compost Standard Operating Procedure to ensure the composting system meets Australian Standards.
By December Year 3	Eradicate all other introduced non-native and non-cay native plant species with 'Very High' and 'High' priority for eradication.
Ongoing	Carry out regular pest plant control to prevent seeding of pest plant species and consequent spread to natural areas.
Ongoing	Ensure birds do not have access to food scraps or weed seeds during waste processing.
Ongoing	Implement Plant Waste Processing, Coconut Management, OSCA Compost and Biosecurity Standard Operating Procedures.



## 8.0 PLANT NURSERY AND TURF FARMS

Establishing the plant propagation nursery is one of the first priorities in the implementation of the Plan to allow time to strike pisonia cuttings and grow suitable species to replace pest plants and non-native landscape plants.

The plant nursery is also required to grow additional species from the Capricorn Bunker cays to increase the native cay plant species and genetic diversity.

All plant propagation to be undertaken on LEI from seeds or cuttings sourced from LEI or other Capricorn Bunker cays to ensure only cay adapted provenance are used. Mulch and compost used in potting mixes to be sourced from organic island waste to reduce the risk of the accidental introduction of pest plants, pests and diseases.

The nursery will contain:

- a greenhouse incorporating a misting house to propagate seedlings and cuttings with automatic watering facilities and pump
- areas for sun hardening
- a holding area for more advanced potted plants utilising dripper irrigation
- a potting bench and storage facility for nursery equipment.

Turf farms will be maintained to provide the large quantity of native cay grasses required for revegetation, to assist in pest plant suppression and to replace exotic grasses currently used in human use areas.

Water will be sourced from the resort's desalination plant. The nursery watering system will be designed and operated to minimise water use.



*Pandanus (Pandanus tectorius)* in Lady Elliot Island nursery. ©Jim Buck, Lady Elliot Island Eco Resort.



## 9.0 INCREASING SPECIES RICHNESS AND GENETIC DIVERSITY OF NATIVE CAY PLANT SPECIES

Suitable native cay plant species to be introduced to increase ecosystem resilience and provide additional habitat resources for insects and birds. The most suitable species are native cay species that currently grow on the Capricorn Bunker Group cays, as these are well adapted to the current climatic extremes of the region and currently grow in the Capricorn Bunkers.

Genetic diversity to be increased by collecting seeds and cutting material of species from as many plants and Capricorn Bunker cays as possible to grow in the LEI nursery. Sea trumpet and moon flower need to be sourced from other cays as only one or two plants have been found on LEI.

Increasing the genetic diversity will maximise the opportunity for long-term survival and continued genetic development of the most suitable provenance to withstand the changing climate and other environmental stresses.

Species proposed to be introduced to specific zones on LEI are listed in Table 2. All these species occur naturally on more than one cay in the Capricorn Bunker Group.

All introduced native cay species to be maintained in the landscape plantings to ensure continual supply of propagation material for the natural areas.

Some species that occur naturally on the Capricorn Bunker Group cays have been excluded. Knicker nut (*Caesalpinia bonduc*) is excluded as it is not considered suitable to introduce to a resort island; it is a vigorous scrambler producing long trailers with thorns. Species that only occur on one or two cays (e.g. scrambling clerodendron (*Clerodendron inerme*), Alexandrian laurel (*Calophyllum inophyllum*) and yellow plum (*Ximenia americanum*)) have also been excluded.

**Table 2: Additional native cay plant species to be established on Lady Elliot Island**

Scientific name	Common name	Life form	Zone
<i>Celtis paniculata</i>	<b>Native elm</b>	tree	SW
<i>Commicarpus insularum</i>	<b>Gum fruit</b>	ground cover/vine	NW, NE and Buffer Zones adjacent to Airstrip
<i>Cordia subcordata</i>	<b>Sea trumpet</b>	tree	Coastal and Heritage Precinct Buffer Zones (coastal side)
<i>Euphorbia obliqua</i>		perennial grass	NE, NW and Coastal
<i>Ipomoea violacea</i>	<b>Moon flower</b>	vine	SW and NW
<i>Pipturus argenteus</i>	<b>Native mulberry, white nettle</b>	tree	Coastal and SW
<i>Plumbago zeylanica</i>	<b>Native plumbago</b>	herb	NW and Buffer Zone adjacent to Airstrip
<i>Sesuvium portulacastrum</i>	<b>Sea purslane</b>	succulent herb	Ephemeral wetlands, soaks and seepage areas including seepage areas on seashore
<i>Scaevola taccada</i>	<b>Sea lettuce</b>	shrub	Coastal
<i>Sophora tomentosa subsp. australis</i>	<b>Necklace bean</b>	shrub	Coastal
<i>Spinifex sericeus</i>	<b>Beach spinifex</b>	grass	Coastal/Shoreline (good for preventing sand erosion)
<i>Sporobolus virginicus</i>	<b>Marine couch</b>	grass	NE, NW, Coastal, Airstrip and Tracks
<i>Stenotaphrum micranthum</i>	<b>Beach buffalo grass</b>	grass	NE, NW and Coastal
<i>Suriana maritima</i>	<b>Bay cedar</b>	shrub	Coastal and human use Buffer Zones
<i>Tetragonia tetragonioides</i>	<b>New Zealand spinach</b>	succulent herb	NE, NW, Coastal, and around soaks and ephemeral wetlands
<i>Trachymene cussonii</i>	<b>Trachymene</b>	annual herb	Coastal

The collection of propagation material from other cays to be carried out under the supervision of QPWS rangers. Follow protocols to ensure there are no detrimental impacts on collection habitats. Biosecurity measures to

be implemented during the collection of propagation material from other cays to prevent the accidental transfer of pests and diseases between islands.



## 10.0 MANAGING BIOSECURITY

### 10.1 BIOSECURITY GUIDELINES

Biosecurity management is an integral part of this Plan and includes quarantine, surveillance and emergency response to prevent pest establishment. The presence of introduced pest species and diseases places stress on natural ecosystems and reduces ecosystem resilience to major stresses like climate change. Measures to control the spread of existing

pests and diseases, to prevent their spread to other cays and to minimise the risk of introduction of additional pests and diseases to the island are included in this Plan.

A Biosecurity Standard Operating Procedure based on relevant State/Commonwealth biosecurity legislation requirements and QPWS policies to be developed and implemented.

### 10.2 BIOSECURITY IMPLEMENTATION PLAN

Timeline (calendar years)	Action
By March Year 2	Develop and implement Biosecurity, Weed Hygiene, Waste Plant Processing, Floral arrangements and Wedding Bouquets, and Mowing and Track Management Standard Operating Procedures incorporating points listed below.
By March Year 2	Establish a vehicle washdown facility to washdown machinery following use in weed infested areas and prior to entering ‘clean’ rehabilitation areas. Ensure that washed off seeds are not spread from this facility to other places.
By February Year 3	Prepare the Vegetation Management Manual.
Immediate and ongoing	Provide staff training to ensure that biosecurity protocols are adhered to.
Immediate and ongoing	No domestic animals, poultry or pets (including caged birds) are to be brought to or kept on the island. Legislation currently exists making it illegal to bring a living terrestrial animal to the island (Great Barrier Reef Marine Park Regulations 2019).
Immediate and ongoing	Carry out regular monitoring for the presence or increase in abundance of pest species.
Immediate and ongoing	Manage pest plants on the island according to the Waste Plant Processing Standard Operating Procedure and methods described in this Plan.
Immediate and ongoing	Avoid walking and driving through areas infested with pest plants. If this cannot be avoided, remove any seeds, fruit and other plant parts adhering to clothing, shoes, bags or equipment as soon as leaving the pest plant infestation and dispose of appropriately as prescribed in the Standard Operating Procedures.
Immediate and ongoing	Prevent the spread of pest plants from LEI by people, particularly the spread of pest plants to other cays by all persons who visit other islands after they leave LEI.
Immediate and ongoing	Eradicate or control introduced birds, pest invertebrates and other fauna.
Immediate and ongoing	Prior to leaving the mainland, thoroughly wash down and inspect all vehicles, machinery and tools scheduled for transport to the island.
Immediate and ongoing	Do not bring soil, sand, gravel, timber, mulch or plant material to the island unless absolutely necessary. If any of these materials have to be brought to the island, they must come from as clean a source as possible, be treated and inspected or tested prior to leaving the mainland to ensure they do not contain pests, diseases, seeds or other unwanted live plant material or microbes. Propagate all landscaping plants on the island. Use island sand, mulch and compost to make potting mix if possible.
Immediate and ongoing	Develop an island quarantine area for high-risk materials to ensure potential incursions are contained before treatment.
Immediate and ongoing	Develop quarantine procedures for goods brought to the island and thoroughly inspect all supplies and containers for the presence of insects, rodents and reptiles and treat as necessary.

Immediate and ongoing	Develop and implement biosecurity protocols for the aircraft and monthly barge that transfer passengers and goods to and from the island.
Immediate and ongoing	Prevent the invasion of natural areas and other cays by introduced species from human use areas.
Immediate and ongoing	Species not previously recorded on the island should be immediately identified. If they are identified as pest species, they should be eradicated as soon as possible.
Immediate and ongoing	Educate visitors about biosecurity risks, consequences and measures to avoid the inadvertent transport of pests and diseases to the cays. Include this information on the Eco Resort website and with booking confirmation and other information sent to visitors prior to travel to the island.
Ongoing	Implement biosecurity protocols consistently and continually.



## 11.0 FIRE MANAGEMENT

### 11.1 GUIDELINES FOR FIRE MANAGEMENT

The natural Regional Ecosystems on the island are fire sensitive — no planned burning of natural areas to occur. Fires are not permitted on other Capricornia cays (QPWS Capricornia Cays National Park and adjoining State Waters Management Plan, 2014).

Establishment of native cay Regional Ecosystems in the natural area land use zones will reduce the current fire risk that results from vegetation dominated by pest plant species that die back in dry conditions, thus creating high fuel loads.

Fire management for the island to focus on protection of life and property, and prevention and control of wildfire in natural areas (refer to the Lady Elliott Island Eco Resort Emergency Management Plans).

It is predicted that droughts will become more extreme. Therefore, fire management may become more of an issue in the future with the build-up of high fuel loads as vegetation dies off in dry periods.

### 11.2 FIRE MANAGEMENT IMPLEMENTATION PLAN

Timeline (calendar years)	Action
By March Year 2	Include LEI in the Capricornia Cays Protected Areas Fire Management Statement. Develop a Standard Operating Procedure for fire management that considers the cultural heritage value of the light keepers' cottages and other infrastructure, and manages the risk of storage of fuels and other flammable materials, sparks generated by use of machinery and the potential threat of cigarette smoking by resort guests and staff.



Red-tailed tropic bird (*Phaethon rubricauda*) adult and chick on Lady Elliot Island. ©Lady Elliot Island Eco Resort

## 12.0 SEABIRD AND MARINE TURTLE HABITAT MANAGEMENT

### 12.1 GUIDELINES – SEABIRD AND MARINE TURTLE HABITAT MANAGEMENT

Enhancing habitat for seabirds and marine turtles is an important objective of the Plan.

During the nesting season, visitors to be informed of areas to avoid so as not to disturb nesting seabirds. If birds are nesting or congregating in areas normally frequented by people, these areas to be roped off and signage placed to prevent access and disturbance to the birds. This is particularly important for species that are easily disturbed such as little terns (*Sternula albifrons*), roseate terns (*Sterna dougallii*), black-naped terns (*Sterna sumatrana*) and crested terns (*Thalasseus bergii*).

Establish patches of shrubby vegetation to provide optimum nesting habitat for frigate birds and other shrub nesting birds. Based on historical data, it is likely that LEI was a nesting site for larger species of seabirds (frigate birds, boobies). To assist with promoting the successful establishment and breeding of these species, the installation of signage to restrict access to people to the beach on the North-East Zone may be required.

Section 6 includes habitat requirements for marine turtles including strategies to retain sufficient vegetation to provide shade to maintain suitable and stable sand temperatures in turtle nesting areas.



*Manta ray (Mobula alfredi) western reef edge Lady Elliot Island. ©Lady Elliot Island Eco Resort*



## 13.0 PEST ANIMAL SPECIES MANAGEMENT

### 13.1 GUIDELINES – PEST ANIMAL SPECIES MANAGEMENT

In the Capricorn cays, seagulls prey on other seabird chicks and eggs and also turtle hatchlings — this has been observed at LEI. Ensure numbers and behaviour

of seagulls and other native birds are not influenced by feeding and that these species cannot access food scraps or other anthropogenic food sources.

### 13.2 PEST ANIMAL SPECIES MANAGEMENT IMPLEMENTATION PLAN

Timeline (calendar years)	Action
As soon as possible	Control house sparrow ( <i>Passer domesticus</i> ) population. Numbers have recently increased on LEI.
Ongoing	Implement quarantine and biosecurity protocols to prevent accidental introduction of pest species. Incorporate these into the Biosecurity Standard Operating Procedure.
Ongoing	Black rats ( <i>Rattus rattus</i> ), house mice ( <i>Mus musculus</i> ), cane toads ( <i>Rhinella marinus</i> ), and high-risk tramp ants to be eradicated as soon as they are known to be on the island.
Ongoing	In the event of a major outbreak of scale insect ( <i>Pulvinaria urbicola</i> ) associated with a build-up in populations of African big-headed ant ( <i>Pheidole megacephala</i> ) or other invasive ant species, or if invasive ants are adversely affecting bird nesting this should be immediately reported to QPWS who will provide appropriate advice.
Ongoing	If ant baiting is necessary, the method of Gaigher <i>et al.</i> (2012) for eradication of the ants using bait stations should be considered.
Ongoing	Abundance of Asian house geckos ( <i>Hemidactylus frenatus</i> ) should be monitored and appropriate action taken if justified in the future.
Ongoing	Monitor silver gulls ( <i>Chroicocephalus novaehollandiae</i> ), contact QPWS if issues with interactions with other seabird species.
Ongoing	Monitor for any new species not previously observed on the island and contact QPWS if seen.



## 14.0 MONITORING

An effective monitoring program(s) to be established that will inform an evaluation of the performance of the Ecosystem Resilience Plan in:

- achieving the objectives
- not having unforeseen adverse impacts on the broader LEI ecosystem.

Monitoring should be designed and implemented to measure the effectiveness of management controls/actions.

All monitoring programs on LEI should be designed, planned and undertaken in consultation with QPWS and the Authority and carried out as part of (or an extension of) broader Capricorn Bunker monitoring programs using the same standard methods where possible.

### 14.1 VEGETATION MONITORING

Vegetation monitoring surveys to be carried out by an experienced botanist using established methods for determining vegetation structure, floristic composition and biocondition (Neldner and Ngugi 2014). All surveys to use peer reviewed and accepted Queensland standard

methods (Eyre *et al.* 2011 and Neldner *et al.* 2019). Details of vegetation survey methods are in Appendix 7.

Monitoring should be carried out annually during the implementation phase (Phase 1). Post implementation, monitoring every three to five years, during intervening years a simpler 'rapid' survey may be conducted.



Good reference benchmark data is not available for some of the vegetation communities and is not available for some of the attributes being monitored. The additional reference data required will be collected from benchmark reference sites located on other cays throughout the Capricorn Bunker Group as part of this project. Permanent reference sites will be established for future monitoring of the cay ecosystems as required. The survey data recorded at these sites will also serve as reference benchmark

data for other vegetation restoration projects as well as routine monitoring in the Capricorn Bunker Group.

Vegetation monitoring data will be stored in the Queensland Herbarium CORVEG database and the Queensland Herbarium photograph database.

In addition to the plot photographs taken as part of the annual vegetation monitoring, permanent photograph monitoring sites to be established to provide panoramic views demonstrating the vegetation changes at the landscape level, over time.

#### 14.1.1 VEGETATION MONITORING IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Late May/Early June Year 1	Establish vegetation monitoring sites in all major vegetation communities in accordance with Queensland Herbarium methods.
Late May Early June Year 2	Engage Queensland Herbarium to establish reference sites throughout the Capricorn Bunkers and collect benchmark site data for each of the vegetation communities.
Late May/ Early June Years 1 to 7 and Year 10	Carry out vegetation surveys and biocondition assessment in accordance with Queensland Herbarium survey methods and Queensland Biocondition methods.
Late May/ Early June Annually	Take panoramic landscape photographs from fixed photo-points.
After Year 7	Carry out vegetation surveys every three years or as required.

#### 14.2 SOIL CONDITION MONITORING

Soil analyses will be done every three years (during the annual vegetation surveys) on soil samples collected from vegetation monitoring sites. Analyses will include: pH, electrical conductivity (dS/m2), total nitrogen (Wt%), total carbon (Wt%), organic carbon (Wt%), Colwell-P (mg/kg), Ca (cmol(+)/kg), K (cmol(+)/kg), Mg (cmol(+)/kg), Na (cmol(+)/kg), CEC (cmol(+)/kg), Total P (Wt%), Total Al (mg/kg), Total Cu (mg/kg), Total

Fe (mg/kg), Total K (mg/kg), Total Mg (mg/kg), Total Mn (mg/kg), Total Na (mg/kg), Total S (mg/kg), Total Zn (mg/kg).

These analyses to be compared with baseline data obtained from soil analyses carried out as part of the Queensland Herbarium Capricornia Cays Survey and Mapping Project (Batianoff *et al.* 2012).

#### 14.3 SEABIRD MONITORING

QPWS will undertake annual monitoring of the seabird population on LEI in accordance with the *QPWS Coastal Bird Monitoring Strategy* as part of their annual Queensland surveys.

changes in population size that may be associated with the implementation of the Plan. This may involve the use of other methods such as acoustic surveys.

A specific survey design will be developed for LEI to determine statistically robust small-scale spatial or temporal

Monitoring will also include introduced pest species and the assessment of silver gull numbers.

#### 14.3.1 SEABIRD MONITORING IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Annually	QPWS to carry out seabird surveys on LEI in accordance with the <i>QPWS Coastal Bird Monitoring Strategy</i> .
Year 2 – Ongoing	Seabird surveys carried out to detect small-scale changes in abundance.
December Year 1 to February Year 2	Trial acoustic surveys to determine abundance of nesting black noddies and wedge-tailed shearwaters.
Annually	If acoustic surveys are successful, repeat surveys annually.
After Year 7	Carry out vegetation surveys every three years or as required.

## 14.4 TURTLE MONITORING

The *Recovery Plan for Marine Turtles in Australia 2017-2027* lists LEI as a ‘minor’ breeding site with nesting occurring from October to April (the peak in late December to early January).

To ensure the Plan is enhancing turtle habitat and not adversely impacting turtle nesting and nest success, surveys will be carried out in accordance with the *Queensland Marine Turtle Conservation Strategy (May 2018)*.

Although LEI is not listed as an Index Monitoring Site for Nesting, significant restoration is occurring at this site so it is considered appropriate that monitoring is conducted in accordance with the Conservation Strategy.

The data collected will be included in the turtle migration database and the turtle nesting database (partly derived from TURTDATA).

### 14.4.1 TURTLE MONITORING IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Year 2 – Ongoing November to May	<p>Conduct surveys in accordance with the <i>Queensland Marine Turtle Conservation Strategy</i>.</p> <ul style="list-style-type: none"> <li>• Daily track counts (sector based), including weather data (for the season)</li> <li>• GPS locations of successful nesting attempts</li> <li>• Incubation and emergence success rates</li> <li>• Opportunistic tagging and tag recovery data (for the season)</li> <li>• Nest temperature data collection.</li> </ul>
Year 3 – Ongoing December and March	<p>Consider aligning monitoring methods with Queensland Turtle Index nesting beach methods (Lady Musgrave Island model) for consistency in reporting.</p>

## 14.5 INVERTEBRATE MONITORING

The Queensland Museum carried out an invertebrate survey of LEI in 2009 (Burwell *et al.* 2010, 2012) as part of a broader invertebrate survey of the Capricorn Bunker cays. The survey provided good baseline data as well as comparative data with other cays. This survey to be repeated on both LEI and other cays during implementation of the Plan. A list of invertebrate species recorded for LEI is at Appendix 8.

Additional, periodic monitoring of invertebrates to be done to determine whether the implementation of the Plan is having any adverse effects on desirable species such as land hermit crabs, native ants and other native insects. Refer to methods described in Appendix 7. Monitoring will also detect whether undesirable species such as scale insect or exotic invasive

ants including African big-headed ant, *Paratrechina longicornis* and *Plagiolepis alluaudi* are increasing in abundance.

Monitoring for the presence and abundance of the scale insect and tending ants, such as African big-headed ants, on pisonia trees should be routinely and regularly carried out to prevent a repeat of the devastating loss of the pisonia forest on Tryon Island (Olds 2006, Cruise *et al.* 2006).

If a scale outbreak is suspected, immediately report it to QPWS.

Insects are food sources for a range of land birds and are the major food source of the silveryeye (pers. comm. Andrew McDougall, QPWS). Invertebrate monitoring will also serve to monitor the food resources of these species.

### 14.5.1 INVERTEBRATE MONITORING IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Ongoing	<p>Visual monitoring for the presence and abundance of the scale insect and ants such as African big-headed ants on pisonia trees using QPWS methods described in Olds (2018)</p>
Years 2 and 5	<p>Experienced entomologists repeat the 2009 invertebrate surveys in accordance with Queensland Museum survey methods.</p>
Annually if required	<p>Carry out follow-up invertebrate surveys using methods described in Appendix 7.</p>

## 14.6 REGULAR SURVEILLANCE FOR PEST FAUNA

Eco Resort staff to be trained to identify the island’s bird species.

Observations of exotic bird species to be reported to QPWS.  
Visual counts of exotic bird species to be included in the bird

monitoring surveys. Photographs should be taken of birds that cannot be identified and forwarded to QPWS for identification.

Monitoring, using methods described in Appendix 7, to be routinely carried out to detect the presence of black rats, house mice, cane toads and tramp ant species.

### 14.6.1 MONITORING FOR PEST FAUNA IMPLEMENTATION PLAN

Timeline (calendar years)	Action
Annually	Carry out Elliot trapping as described in Appendix 7.
Annually	Incorporate counts of native bird species in the annual QPWS Coastal Bird Monitoring surveys.
Annually	Incorporate monitoring of pest bird species in the annual QPWS Coastal Bird Monitoring surveys.

## 14.7 MONITORING OF FRESHWATER AQUIFERS

Regular monitoring of the freshwater lens(es) of the island to:

- determine whether the increased water uptake by the growing pisonia forest is causing changes in height or increased salinity levels in the lens
- determine any effects from the removal of umbrella trees and other unwanted tree species
- ensure contaminants from the sewage treatment plant or leachates from the Composting and Waste Management Precincts are not present in the freshwater lens

- ensure leachate from the nursery or methods used during implementation of the Plan are not adversely affecting levels of nutrients in the freshwater lens or nutrient input to the surrounding reef.

There are two wells on the island and LEI Eco Resort has established four monitoring bores. These bores will be covered and maintained to access samples for future monitoring.

Baseline data should be obtained prior to commencement of Plan implementation.

## 14.8 MONITORING REEF HEALTH

This Plan is limited to the management of the terrestrial ecosystems. The actions under the Plan have been developed to ensure that there will be no detrimental impact on the

adjacent marine or coral reef ecosystems. However, reef health monitoring should be carried out to detect any significant changes during the Plan’s implementation.

## 14.9 AERIAL PHOTOGRAPHY

Aerial drone photography should be taken every two years throughout the project. These should be spatially rectified for planning and reporting use. Aerial photography and other remote sensing should be coordinated with QPWS aerial photography and other remote sensing monitoring of the Capricorn Bunker cays.

## 14.10 QPWS HEALTH CHECKS

The QPWS Values Based Management Framework incorporates monitoring of key park values using Natural, Historic and Visitor values in Health Checks. Health Checks are the QPWS recognised basic monitoring tool for efficiently and routinely assessing the condition of key park values. These Health Checks will be carried out regularly by trained QPWS rangers on all the Capricorn Bunker cays including LEI.



## 15.0 PERFORMANCE EVALUATION, REPORTING AND PLAN REVIEW

### 15.1 REPORTING AND PLAN REVIEW

Progress on the implementation of the Plan will be reported using existing project governance systems, namely the Project Advisory Group for LEI under the Great Barrier Reef Foundation (GBRF) RII and the annual LEI Operations Committee for the management of the lease.

Any progress reports should include updates on progress in delivering actions set out under each section of the Plan and performance against key objectives and performance measures listed in section 15.2. Progress reports will be reviewed by the LEI Project Team and endorsed by the LEI Project Advisory Group, which includes representatives from the Great Barrier Reef Marine Park Authority, LEIER, GBRF RII and QPWS.

The Plan will be updated and reviewed on a five-year cycle to ensure that the objectives and timeframes for implementation remain appropriate to achieving whole-of-cay ecosystem resilience to environmental change.

As the Plan implementation progresses, monitoring results are assessed, new information becomes available or as new or unforeseen impacts of climate change occur, there may be a need to adapt the Plan including reviewing objectives, strategies and methods including the rate at which vegetation changes are made on the island. Regular review of the Plan will provide for ongoing adaptation to climate change and unforeseen negative impacts of establishing the diversity of cay regional ecosystems.

The vegetation and Regional Ecosystem mapping of the island will need to be updated periodically to reflect changes in the vegetation on the island as the pisonia forest develops, the abundance of casuarina decreases, and native vegetation replace non-remnant vegetation, and to incorporate any major changes in vegetation communities of the island.

### 15.2 PERFORMANCE EVALUATION

Key performance criteria have been developed for each of the objectives of the Plan. These are consistent with the RII LEI program (denoted by \* in Table 3) to streamline the reporting.

**Table 3: Key performance criteria for each of the main objectives and outputs of the Plan**

	<b>Objectives</b>	<b>Performance measures/outcomes</b>
1	Pest plant dominated vegetation is replaced with natural cay vegetation communities that are representative of Capricorn Bunker Cay Regional Ecosystems.	Vegetation of natural area zones consists of native plant communities whose structure, floristic composition and spatial distribution is consistent with or on track to equal those on other Capricorn Bunker Group cays.
2	Regional Ecosystems are improved to, then maintained at, benchmark condition.	Biocondition scores matching or approaching those of benchmark sites.
3	Regional Ecosystems require minimal maintenance by Year 10 of the Plan’s implementation	Annual work plans are minimal and annual maintenance cost (including volunteer time) is minimal.
4	Increase species and genetic diversity of native cay plant species.	Total of 35 species plant species native to the Capricorn Bunker Group cays are successfully established on LEI.  Seeds and cuttings from a range of plant species native to cays of the Capricorn Bunker Group have been collected from multiple cays, and have been successfully propagated, planted and established on LEI.

	<b>Objectives</b>	<b>Performance measures/outcomes</b>
5	Manage vegetation within human use areas to maximise native cay plant species and minimise non-native species and adverse impacts on adjacent natural areas and other cays.	Non-native species used in landscaping have all been replaced with plant species native to the Capricorn Bunker Group cays.  Pest plant species are well controlled and have no detrimental impact on the ecosystem function of LEI*.
6	Maintain effective biosecurity and weed hygiene.	Pest plants, animals and diseases are managed and new incursions are detected, controlled and/or eradicated.  Standard Operating Procedures developed and implemented.
7	Maintain and enhance the current high diversity of birds and their habitats, particularly ground and arboreal nesting seabirds, shorebirds, coastal raptors and silvereeye.	Bird nesting relocated from the airstrip to the natural area zones.  Current species richness and abundances of nesting birds either maintained or enhanced relative to long-term averages.  Newly created habitats being utilised.
8	Extent of good condition turtle nesting habitat is maximised.	Turtles continue to nest in the Coastal Zone.
9	Ensure that Ecosystem restoration provides for the continued operation of the LEI Eco Resort.	Positive feedback from guest and staff surveys. Staff involved and supportive of restoration initiatives.
10	Continue stakeholder involvement to ensure the Plan and its implementation is based on the best available knowledge.	Relevant expertise engaged in implementation and formal review of the Plan.  Traditional Owners are engaged and actively involved in the project*.
11	Improve public appreciation of the value of the southern Great Barrier Reef coral cay natural ecosystems.	Good communication between all stakeholders. Inhabitants and communities understand the values of coral cay natural ecosystems being established and managed on LEI*.



*Lady Elliot Island Lightstation part of the Cultural Heritage Precinct. ©Lady Elliot Island Eco Resort*

## REFERENCES

- Batianoff, G. N. and Butler, D.W. 2002, Assessment of invasive naturalised plants in southeast Queensland, *Plant Protection Quarterly*, 17: 27–34.
- Batianoff, G.N., Neldner, V.J., Naylor, G.C., Olds, J.A. 2012, Mapping and evaluating Capricornia Cays vegetation and regional ecosystems, Department of Science, Information Technology, Innovation and the Arts, Queensland Government.
- Brushe, J.M. (in prep), Report on progress of weed control and rehabilitation on Lady Musgrave Island from June 2011 to June 2013, report to QPWS.
- Brown, G.K., and Bostock P.D. 2019, Introduction to the Census of the Queensland Flora. Queensland Department of Environment and Science, Queensland Government.
- Brushe, J. 2018, Tryon island 1992 to 2018: a report on the assessment, monitoring, restoration and management of the terrestrial ecosystems on coral cays with particular reference to Tryon Island in the Southern Great Barrier Reef following an outbreak of *Pulvinaria urbicola* and the subsequent death of the island's *Pisonia grandis* forest. Draft Report prepared for Queensland Parks and Wildlife Service.
- Burwell, C.J., Nakamura, A., Lambkin, C.L., Raven, R.J., Wright, K. 2010, Invertebrates of the Capricornia Cays: human impacts, pest species and their interactions with native fauna, Report for DERM by the Queensland Museum.
- Burwell, C.J., Nakamura, A., McDougall, A., Neldner, V.J. 2012, Invasive African big-headed ants, *Pheidole megacephala*, on coral cays of the southern Great Barrier Reef: distribution and impacts on other ants, *Journal of Insect Conservation*, 16:777-789.
- Conservation & Biodiversity Operations Branch, Department of Environment and Science 2018. Marine Turtle Conservation Strategy – Queensland, Brisbane: Department of Environment and Science, Queensland Government.
- Cruise, J., Olds J.A., Melzer, R. 2006, Tryon Island restoration – Project brief. Pest arrest in Central Queensland. Queensland Parks and Wildlife Service: Rockhampton.
- Eyre, T.J., Kelly, A.L., Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J., Franks, A.J. 2011, Bio-condition: a condition assessment framework for terrestrial biodiversity in Queensland Field Assessment Manual, Version 2.1, DERM, Biodiversity and Ecosystem Sciences, Brisbane.
- Gaigher, R., Samways, M. J., Jolliffe K. G. and Jolliffe, S. 2012, Precision control of an invasive ant on an ecologically sensitive tropical island: a principle with wide applicability. *Ecological Applications*, 22(5) 1405–1412.
- Great Barrier Reef Marine Park Authority 2012, Lady Elliot Island lightstation heritage management plan, GBRMPA, Townsville.
- Great Barrier Reef Marine Park Authority 2019a, Great Barrier Reef outlook report 2019, GBRMPA, Townsville.
- Great Barrier Reef Marine Park Authority 2019b, Climate change position statement, GBRMPA, Townsville.
- Groves, R.H., Boden, R. and Lonsdale, W.M. 2005, Jumping the Garden Fence: Invasive Garden Plants in Australia and their environmental and agricultural impacts, CSIRO report prepared for WWF-Australia.
- Neldner, V.J., Batianoff, G.N., Halford, D.A. ed, 2012, Technical descriptions of regional ecosystems and vegetation communities of the Capricornia cays, SEQ, (2012) Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts, Brisbane, viewed June 2013.
- Neldner, J.V. Ngugi, M.R. 2014, Application of the bio-condition assessment framework to mine vegetation rehabilitation, *Ecological Management and Restoration* 15 (2) Ecological Society of Australia and Wiley Publishing Asia Pty Ltd.
- Neldner, V.J., Wilson, B.A., Thompson, E.J. and Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F., Addicott, E.P., Appleman, C.N. 2019, Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland, Version 5.0. Updated March 2019, Queensland Herbarium, Department of Environment and Science, Brisbane.
- Olds, J.A. 2006, Report on 2006 scale insect *Pulvinaria urbicola* outbreaks and pest-arrest project in the Capricornia Cays, Queensland Parks and Wildlife Service, Rockhampton.
- Olds J.A. 2018, Management of cottony urbicola scale and African big-headed ants in the Capricorn and Bunker Group: *Pulvinaria urbicola* and *Pheidole megacephala* impacts on *Pisonia grandis*. Internal Report. Ecological Assessment Unit, Queensland Parks and Wildlife Service, Department of Environment and Science, Queensland Government.
- Queensland Parks and Wildlife Service 2007, Managing scale insect outbreaks in the Capricornia Cays. Pest Arrest brochure, QPWS, Rockhampton.
- Queensland Parks and Wildlife Service 2014, Management plan Capricornia Cays National Park and adjoining Sate waters. Department of Environment and Science, Brisbane.
- Standards Reference Group SERA 2017, National standards for the practice of ecological restoration in Australia. Second Edition. Society for Ecological Restoration Australasia, www.seraustralasia.com
- Thorp, J R, and Lynch, R. 2000, The Determination of Weeds of National Significance. National Weeds Strategy Executive Committee, Launceston.

APPENDIX 1:

## PLANT SPECIES FOR ERADICATION AND CONTROL

<sup>a</sup> = listed as a weed of national significance under the National Weed Strategy (Thorp and Lynch 2000);

<sup>b</sup> = listed as a 'category 3' restricted invasive plant under Queensland legislation; **Status:** \* = not native to Australia or #

= mainland native but not native to cays; <sup>c</sup> = High feasibility, very high priority ranking in QPWS level 2 Pest Management Strategy; <sup>d</sup> = High feasibility, moderate priority ranking in QPWS Pest Management Strategy; **Ranking:** refers to the rank in the 200 Most Invasive Species list for SEQ (Batianoff and Butler 2002); LSHP = (lightstation) Heritage Precinct.

Priority for Eradication or Control	Scientific name	Common Name	Growth Form	Status	Ranking	Recorded on CB cays (Batianoff et al. 2012)	Other Information Priority level refers to Ranking in level 1 Pest Management Strategy (Geddes et al. 2009)
Eradicate – Very High priority	<i>Bryophyllum delagoense</i> <sup>b</sup>	mother of millions	succulent herb	*	3	No	Very High priority. Invasive garden escape
	<i>Bryophyllum pinnatum</i> <sup>b</sup>	resurrection plant	succulent herb	*	47	No	Invasive garden escape
	<i>Cenchrus ciliaris</i>	buffel grass	perennial grass	*	78	No	Introduced improved pasture plan quickly dominates ground layer
	<i>Cyperus rotundus</i>	nut grass	sedge	*		No	Spreads rapidly and very difficult to control
	<i>Ipomoea cairica</i>	mile-a – minute	non-woody vine	*	28	Yes	Invasive garden escape
	<i>Ipomoea indica</i> <sup>c</sup>	morning glory	non-woody vine	*	40	Yes	High priority. Has completely smothered large areas of vegetation on Lady Musgrave Island. Invasive garden escape
	<i>Lantana camara</i> <sup>a,b</sup>	lantana	scandant shrub	*	1	No	Very High priority. Listed on the World Conservation Union's list of the world's worst invasive alien species (ISSG 2000); toxic plant
	<i>Megathyrsus maximus</i> var. <i>pubiglumis</i>	green panic	perennial grass	*	20	Yes	High priority. Highly invasive grass. Potential fire risk
	<i>Melinis repens</i>	red natal grass	perennial grass	*	65	No	Highly invasive grass
	<i>Opuntia stricta</i> <sup>a,b,c</sup>	prickly pear	succulent		111	Yes	Very High priority
	<i>Schefflera actinophylla</i>	umbrella tree	tree	#		No	Highly invasive roots will quickly invade fresh water lens and may damage infrastructure; seeds spread by birds
	<i>Senna pendula</i> var. <i>glabrata</i>	Easter cassia	shrub	*	45	No	Invasive garden escape
	<i>Tamarix aphylla</i> <sup>a,b</sup>	athel pine	tree	*		No	
Eradicate – High priority	<i>Acetosa vesicaria</i>	rosy dock	annual succulent herb	*		No	Invasive garden escape
	<i>Agave americana</i> var. <i>americana</i> cv. <i>Marginata</i>	century plant	succulent herb	*	138	No	High priority. Invasive garden escape
	<i>Agave attenuata</i>	foxtail agave	succulent herb	*		No	High priority. Invasive garden escape
	<i>Agave sisalana</i>	sisal hemp	succulent herb	*	143	No	High priority. Invasive garden escape

Priority for Eradication or Control	Scientific name	Common Name	Growth Form	Status	Ranking	Recorded on CB cays (Batianoff <i>et al.</i> 2012)	Other Information Priority level refers to Ranking in level 1 Pest Management Strategy (Geddes <i>et al.</i> 2009)
	<i>Agave vivipara</i> <i>var. vivipara</i>	narrow-leaved century plant	succulent herb	*	144	No	High priority. Invasive garden escape
	<i>Aloe arborescens</i>	aloe	succulent herb	*		No	Invasive garden escape
	<i>Aloe parvibracteata</i>	aloe	succulent herb	*		No	Invasive garden escape
	<i>Callisia sp.</i>	basket plant	succulent herb	*	103 (C. fragrans)	No	Invasive garden escape
	<i>Cascabela thevetia</i> <sup>b</sup>	yellow oleander	shrub	*	188	No	Invasive garden escape
	<i>Catharanthus roseus</i>	pink periwinkle	herb	*	62	No	Moderate priority. Listed as one of the 10 most serious invasive garden plants in Qld, currently available for sale by nurseries (Groves <i>et al.</i> 2005)
	<i>Cenchrus purpurascens</i>	swamp foxtail	grass	#		No	Invasive garden escape
	<i>Duranta erecta</i>	duranta	shrub	*	96	No	Invasive garden escape
	<i>Ficus elastica</i>	rubber tree	tree	*		No	Roots can invade pipes and sewage systems and break up footpaths and driveways
	<i>Hylocereus undatus</i>	dragon fruit	succulent climber	*		No	Invasive garden escape
	<i>Lonicera japonica</i>	Japanese honeysuckle	vine	*	49	No	Listed as one of the 10 most serious invasive; garden plants in Australia, currently available for sale by nurseries (Groves <i>et al.</i> 2005)
	<i>Macroptilium lathyroides</i>	phasey bean	non-woody vine	*		No	Nuisance herbaceous vine; will spread rapidly
	<i>Mirabilis jalapa</i>	four o'clocks	herb	*		No	Invasive garden escape
	<i>Nerium oleander</i>	oleander	shrub	*		No	Garden plant; very poisonous
	<i>Sansevieria trifasciata</i> var. <i>trifasciata</i>	mother in law's tongue	succulent herb	*	195	No	Low priority. Invasive garden escape
Eradicate – high priority from natural areas.	<i>Plectranthus amboinicus</i>	five in one herb	succulent herb	*		No	Invasive garden escape
	<i>Stenotaphrum secundatum</i>	St Augustine buffalo grass	perennial grass	*	187	No	
Moderate priority from landscaped areas	<i>Acalypha wilkesiana</i>	copperleaf	shrub	*		No	Invasive garden escape
	<i>Cocos nucifera</i>	coconut palm	palm	*		No	Low priority. Can spread to other islands and mainland areas via the sea
	<i>Tradescantia pallida</i>	purple heart	succulent herb	*		No	Poisonous
	<i>Tradescantia spathacea</i>	Moses in the cradle	succulent herb	*		No	Invasive garden escape
Eradicate – Moderate priority	<i>Araucaria cunninghamii</i> var. <i>cunninghamii</i>	hoop pine	emergent tree	#		No	
	<i>Araucaria heterophylla</i>	Norfolk Island pine	emergent tree	#		No	

Priority for Eradication or Control	Scientific name	Common Name	Growth Form	Status	Ranking	Recorded on CB cays (Batianoff <i>et al.</i> 2012)	Other Information Priority level refers to Ranking in level 1 Pest Management Strategy (Geddes <i>et al.</i> 2009)
	<i>Corymbia tessellaris</i>	Moreton Bay ash	tree	#		No	
	<i>Curcubita pepo</i>	pumpkin, squash, zucchini	annual non-woody vine	*		No	Invasive garden escape
	<i>Drypetes deplanchei</i>	yellow tulipwood	tree	#		No	
	<i>Hibiscus tiliaceus</i>	cotton tree	tree	#		No	
	<i>Lagunaria patersonius</i>	Norfolk Island hibiscus	tree	#		No	
	<i>Microsorium grossum</i>	unscented oak-leaf fern	fern	#		No	
	<i>Psilotum nudum</i>	whisk fern	fern ally	#		No	
	<i>Terminalia arenicola</i>	brown damson	tree	#		No	
	<i>Terminalia catappa</i>	beach almond	tree	#		No	
	<i>Casuarina equisetifolia</i> (planted introduced provenance)	coastal she-oak	tree	#		?	
	<i>Capsicum frutescens</i>	Bird's eye chilli	herb	*		No	Invasive garden escape
	<i>Carica papaya</i>	paw paw	non-woody tree	*		No	
	<i>Delonix regia</i>	poinciana	tree	*		No	
	<i>Eugenia uniflora</i>	Brazilian cherry	shrub/tree	*	118	No	
	<i>Epipremnum pinnatum cv. aureum</i>	pothos	non-woody vine	*		No	
	<i>Hibiscus rosasinensis</i>	hibiscus	shrub	*		No	Low priority
	<i>Liliaceae</i>	lily	lily	*		No	Yet to be identified
	<i>Pedilanthus tithymaloides</i>	zigzag plant	succulent herb	*		No	
	<i>Syngonium macrophyllum</i>	philodendron	non-woody vine	*		No	Poisonous
	<i>Syngonium podophyllum</i>	arrowhead vine	vine	*		No	Poisonous
	<i>Tamarindus indica</i>	tamarind	tree	*		No	
	<i>Zephyranthes candida</i>	white rain lily	herb	*		No	Invasive garden escape
Eradicate (except in LSHP)	<i>Musa acuminata</i>	banana	non-woody tree	*		No	
	<i>Plumeria obtusa</i>	frangipani	tree	*		No	
Control – Very High priority (Eradicate if possible)	<i>Alternanthera pungens</i>	khaki weed	annual herb	*		No	Moderate priority. Abundant on tracks; spread by vehicles
	<i>Amaranthus viridis</i> <sup>d</sup>	green amaranth	annual herb	*		Yes	Low priority
	<i>Bidens pilosa</i> <sup>c</sup>	cobbler's pegs	annual herb	*	110	Yes	High priority. Prolific seeder; prickly seeds, spread on clothing and footwear

Priority for Eradication or Control	Scientific name	Common Name	Growth Form	Status	Ranking	Recorded on CB cays (Batianoff <i>et al.</i> 2012)	Other Information Priority level refers to Ranking in level 1 Pest Management Strategy (Geddes <i>et al.</i> 2009)
	<i>Cenchrus echinatus</i> <sup>c</sup>	Mossman River grass	annual grass	*	78	Yes	High priority. Invasive; spreads rapidly; prickly seeds that attach to clothing and feathers, also spread by machinery and vehicles
	<i>Eleusine indica</i> <sup>c</sup>	crow's foot grass	annual grass	*	112	Yes	High priority
	<i>Erigeron sumatrensis</i> <sup>d</sup>	flea bane	annual herb	*	174	Yes	Low priority
	<i>Euphorbia cyathophora</i> <sup>c</sup>	dwarf poinsettia	annual herb	*	180	Yes	High priority. Invasive garden escape
	<i>Passiflora pallida</i>	corky stem passionflower	non-woody vine	*	37	Yes	Seeds spread by birds
	<i>Poa annua</i>	winter grass	grass	*		Yes	
	<i>Solanum nodiflorum</i> <sup>c</sup>	nightshade	annual herb	*		Yes	High priority. Seeds spread by birds. Invasive garden escape
	<i>Urochloa subquadripara</i>	signal grass	grass	*		Yes	
Control – Very High priority (excluding airstrips)	<i>Cynodon dactylon</i> var. <i>dactylon</i>	couch	grass	*	99	Yes	
Control – High priority	<i>Ageratum conyzoides</i> subsp. <i>conyzoides</i>	billy goat weed	annual herb	*		No	
	<i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i>	Mexican poppy	annual herb	*		Yes	Prickly plant
	<i>Brassica x napus</i>	rape	annual herb	*		No	
	<i>Cerastium glomeratum</i>	sticky chickweed	annual herb	*		No	
	<i>Chenopodium murale</i>	nettle-leaf goosefoot	annual herb	*		No	
	<i>Chloris gayana</i>	Rhodes grass	grass	*	9	No	
	<i>Chloris ventricosa</i>	tall windmill grass	annual grass	#		No	
	<i>Commelina benghalensis</i>	hairy wandering Jew	herb	*	122	No	
	<i>Digitaria ciliaris</i>	summer grass	annual grass	*		Yes	
	<i>Emilia sonchifolia</i> var. <i>javanica</i>	emilia	annual herb	*		No	
	<i>Eragrostis minor</i>	small stink grass	annual grass	*		No	
	<i>Eragrostis tenuifolia</i>	elastic grass	annual grass	*		No	
	<i>Gomphrena celosioides</i>	gomphrena weed	annual herb	*		No	
	<i>Hypochaeris radicata</i>	cat's ear	herb	*		No	
	<i>Lepidium didymum</i>	lesser swine cress	annual herb	*		Yes	

Priority for Eradication or Control	Scientific name	Common Name	Growth Form	Status	Ranking	Recorded on CB cays (Batianoff <i>et al.</i> 2012)	Other Information Priority level refers to Ranking in level 1 Pest Management Strategy (Geddes <i>et al.</i> 2009)
	<i>Lepidium virginicum</i>	pepper cress	annual herb	*		Yes	
	<i>Malva parviflora</i>	mallow	annual herb	*		No	
	<i>Malvastrum coromandelianum</i>	malvastrum	herb	*		Yes	
	<i>Oxalis corniculata</i>	yellow wood sorrel	herb	*		No	
	<i>Oxalis rubens</i>	dune wood sorrel	herb	#		No	
	<i>Plantago debilis</i>	plantain	annual herb	#		No	
	<i>Plantago lanceolata</i>	plantain	annual herb	*		No	
	<i>Polycarpon tetraphyllum</i>	four-leaf all seed	succulent herb	*		No	
	<i>Pseudognaphalium luteoalbum</i>	cudweed	herb	#		Yes	
	<i>Sida acuta</i>	spiny head wireweed	herb	*		No	
	<i>Sonchus oleraceus</i>	sow thistle	annual herb	*		Yes	Moderate priority
	<i>Stachys arvensis</i>	stagger weed	annual herb	*		No	
	<i>Stachytarpheta cayennensis</i>	snakeweed	annual herb	*		No	S. jamaicensis (similar plant) is listed as Moderate priority in the Central Qld Marine Region Level 1 Pest Management Strategy
	<i>Stellaria media</i>	common chickweed	annual herb	*		No	
	<i>Tridax procumbens</i>	tridax daisy	annual herb	*		No	
	<i>Trianthema portulacastrum</i>	black pigweed	herb	*		Yes	
	<i>Trifolium sp.</i>	clover	herb	*		No	
Control – Moderate priority	<i>Cakile edentula d</i>	sea rocket	annual succulent herb	*	141	Yes	Low priority
	<i>Capsella bursapastoris</i>	shepherd's purse	annual herb	*		Yes	Infrequent and not common on Capricorn Bunker Group cays
	<i>Commelina diffusa</i>	native wandering Jew	herb	#		No	
	<i>Cyclospermum leptophyllum</i>	slender celery	annual herb	*		Yes	
	<i>Cyperus gracilis</i>	slender flat sedge	annual sedge	#		No	
	<i>Dentella repens</i>	creeping dentella	annual herb	#		No	
	<i>Digitaria bicornis</i>	crab grass	annual grass	#		No	
	<i>Diplocyclos palmatus</i>		vine	#		No	
	<i>Euphorbia hirta</i>	asthma plant	annual herb	*		Yes	
	<i>Euphorbia prostrata</i>	red caustic creeper	annual herb	*		Yes	
	<i>Hydrocotyle acutiloba</i>	penniwort	herb	#		No	

Priority for Eradication or Control	Scientific name	Common Name	Growth Form	Status	Ranking	Recorded on CB cays (Batianoff <i>et al.</i> 2012)	Other Information Priority level refers to Ranking in level 1 Pest Management Strategy (Geddes <i>et al.</i> 2009)
	<i>Indigofera spicata</i>	creeping indigo	herb	*		No	
	<i>Portulaca pilosa</i>	hairy pigweed	annual herb	*		Yes	
	<i>Sisymbrium orientale</i>	Indian hedge mustard	annual herb	*		Yes	
	<i>Soliva anthemifolia</i>	jo-jo weed	annual herb	*		No	

## APPENDIX 2:

# LIST OF NATIVE CAY PLANT SPECIES RECORDED ON LEI AND RECOMMENDED MANAGEMENT

\*CB – Capricorn Bunker; CS – Coral Sea

Scientific name	Common name	Growth form	CB cays	CS cays	Mainland distribution		Approximate southern limit in Australian region	Action
					Restricted to coastal fringe/continental islands	Coastal & sub-coastal or inland		
<i>Abutilon albescens</i>	lantern bush	shrub	Y	Y	Y		Hervey Bay	Allow to establish and regenerate naturally in natural areas. Collect and spread seed to Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring. Remove from North-East Zone if it becomes too abundant
<i>Achyranthes aspera</i>	chaff flower	annual herb	Y	Y		Y	Lord Howe Island	Do not seed or plant this species. Allow to establish and regenerate naturally in natural areas. Do not remove except in public areas where discomfort caused by seeds may be a problem
<i>Argusia argentea</i>	octopus bush	shrub/low tree	Y	Y	Y		Hervey Bay	Allow to regenerate naturally on shoreline. Plant in the Coastal Zone to increase density where required
<i>Boerhavia albiflora</i> var. <i>heronensis</i>	boerhavia	ground cover perennial herb	Endemic to CB Group cays and LEI					Allow to establish and regenerate naturally in natural areas. Propagate, plant and spread seeds in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring
<i>Boerhavia</i> sp. (Bargara L. Pedley 5382)	boerhavia	ground cover herb				Y	QLD/NSW border	Unnamed species; more information is needed to determine whether this is a native cay species

Scientific name	Common name	Growth form	CB cays	CS cays	Mainland distribution		Approximate southern limit in Australian region	Action
					Restricted to coastal fringe/continental islands	Coastal & sub-coastal or inland		
<i>Canavalia rosea</i>	coastal jack bean	non-woody vine	Y	Y	Y		Lord Howe Island	Allow to establish and regenerate naturally in natural areas. Collect and spread seed to Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring
<i>Casuarina equisetifolia</i> subsp. <i>incana</i>	casuarina	tree	Y		Y		Northern NSW	Allow to regenerate naturally in foreshore areas. Collect seeds from other cays and spread in newly accreted sandy shorelines. Also propagate and plant in these areas
<i>Cordia subcordata</i>	sea trumpet	tree	Y	Y	Y		Lady Elliot Island	Collect seeds from CB cays. Plant and allow to regenerate naturally in the Coastal Zone
<i>Euphorbia tannensis</i> subsp. <i>tannensis</i>	desert spurge	annual succulent herb	Y		Y		Brisbane	Allow to establish and regenerate naturally in Coastal Zone
<i>Ficus opposita</i>	sandpaper fig	tree	Y			Y	Brisbane	Allow to establish and regenerate naturally in natural areas. Plant in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring
<i>Ficus rubiginosa</i> forma <i>rubiginosa</i>	Port Jackson fig	large tree	Y			Y	Southern NSW	Allow to establish and regenerate naturally in natural areas
<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	goat's foot convolvulus	non-woody vine	Y	Y	Y		QLD/NSW border	Allow to establish and regenerate naturally in natural. Collect and spread seeds in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring
<i>Ipomoea violacea</i>	moon flower	non-woody vine	Y	Y	Y		Lady Elliot Island	Allow to establish and regenerate naturally in natural areas. Plant in Regional Ecosystems where this species is recorded as typically dominant or frequently occurring
<i>Lepturus repens</i>	stalky grass	perennial grass	Y	Y	Y		Lord Howe Island	Allow to establish and regenerate naturally in natural areas. Transplant and spread seeds in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring
<i>Pandanus tectorius</i>	pandanus	tree	Y		Y		Northern NSW	Allow to establish and regenerate naturally in natural areas. Propagate and plant in sub-coastal areas in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring

Scientific name	Common name	Growth form	CB cays	CS cays	Mainland distribution		Approximate southern limit in Australian region	Action
					Restricted to coastal fringe/continental islands	Coastal & sub-coastal or inland		
<i>Pisonia grandis</i>	pisonia	tree	Y	Y	Predominantly a cay species		Lady Elliot Island	Continue to propagate cuttings and plant into South-West zone. Do not plant any more in other areas as large areas of pisonia forest on LEI may be detrimental to the nesting habitat of some ground nesting seabird species
<i>Portulaca oleracea</i>	pig weed	succulent herb	Y	Y		Y	Mid NSW	Naturalised exotic on mainland, considered naturally occurring on the cays; do not remove from natural areas.
<i>Scaevola taccada</i>	sea lettuce	shrub/low tree	Y		Y		Bundaberg	Plant in Regional Ecosystems where this species is recorded as typically dominant or frequently occurring. Allow to establish and regenerate naturally in foreshore areas.
<i>Spinifex sericeus</i>	beach spinifex	creeping, dune-binding grass	Y	Y	Y		Tasmania	Plant on erosion prone shorelines. Allow to establish and regenerate naturally in foreshore areas.
<i>Thuarea involuta</i>	bird's beak grass	perennial creeping grass	Y		Y		Hervey Bay	Allow to establish and regenerate naturally in natural areas. Propagate, plant and spread seeds in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring.
<i>Trachymene cussonii</i>	trachymene	annual herb	Endemic to CB Group cays in Australia					Allow to establish and regenerate naturally in natural areas. Remove <i>Cakile edentula</i> (sea rocket), <i>Psuedognaphalium luteoalbum</i> (cudweed) and other pest plants from around plants of this species as a priority to increase its abundance.
<i>Tribulus cistoides</i>	goat's head burr	summer annual ground cover herb	Y	Y	predominately coastal	Y	Southern QLD	Allow to establish and regenerate naturally in natural areas. Remove from paths and parts of resort area where people walk and sit as large sharp burrs can easily penetrate the skin.
<i>Triumfetta procumbens</i>	prostate burr bush	annual herb	Y		Y		LEI	Allow to establish and regenerate naturally in natural areas.
<i>Wollastonia biflora</i>	beach sunflower	scandant large perennial herb	Y		Y		Lord Howe Island	Allow to establish and regenerate naturally in natural areas. Propagate and plant in Regional Ecosystems in which this species is recorded as typically dominant or frequently occurring.



*Bridled tern (Onychoprion anaethetus) adult and chick on Lady Elliot Island. ©Lady Elliot Island Eco Resort*

APPENDIX 3:

## PLANT SPECIES SUITABLE FOR USE IN LANDSCAPING

CB – Capricorn Bunker; Information relating to the distribution of plant species is as per Batianoff *et al.* (2012).

Botanical name	Common name	Growth form	Positives	Negatives	Suitability for landscaping and propagation techniques
<i>Abutilon albescens</i>	lantern bush	shrub	Naturally occurring on LEI and other CB islands; good cover of this species inhibits weed establishment and growth		Grows to 2.5 m; dense planting may be effective in some situations; quick to droop and drop leaves in dry weather; propagate from seed
<i>Argusia argentea</i>	octopus bush	shrub/low tree	Naturally occurring on LEI and other CB islands		Grows to 4–5 m; spreading shrub/small tree; not suitable for narrow garden beds; attractive for solo planting or windbreaks; propagate from fresh seed
<i>Boerhavia albiflora</i> var. <i>heronensis</i>	boerhavia	perennial herbaceous ground cover	Naturally occurring on LEI and other CB islands; endemic to Capricornia cays		Good low traffic groundcover (0.1–0.3 m); propagate using fresh seed
<i>Canavalia rosea</i>	coastal jack bean	non-woody vine	Naturally occurring on LEI and other CB islands; nitrogen fixer		Use where large area of low traffic groundcover is required; may become a problem as it will also climb over other vegetation; may be useful as a screening vine to cover fences etc; propagate by seeds and rooted stem cuttings
<i>Casuarina equisetifolia</i> subsp. <i>incana</i> (Lady Elliot cay province)	casuarina	tree	Naturally occurring on LEI and other CB islands; provides nesting and roosting habitat for many species of seabird; nitrogen fixer		Large tree (to 12 m); plant where larger shade trees are required away from buildings; propagate from seed collected from local cay province on other cays as Lady Elliot province is unknown
<i>Celtis paniculata</i>	native elm	tree	Naturally occurring on other cays in CB group; provides food for fruit-eating birds		Large shady tree (15 m); source from Heron Island; propagate from fresh seed
<i>Commicarpus isularum</i>	gum fruit	non-woody vine	Naturally occurring on other cays in CB group;		Ground cover, hanging baskets, good screening plant for growing over fences or trellises
<i>Cordia subcordata</i>	sea trumpet	tree/shrub	Naturally occurring on other cays in CB group		Tree (4–8 m); similar to and replacement for <i>Hibiscus tiliaceus</i> , which is not a cay species; source from Heron Island; propagate from seed
<i>Euphorbia tannensis</i> subsp. <i>tannensis</i>	desert spurge	annual herb	Naturally occurring on LEI and other CB islands	Milky sap may be toxic	Possibly use as a fill-in plant in garden beds
<i>Ficus opposita</i>	sandpaper fig	tree	Naturally occurring on LEI and other CB islands; edible fruit; provides food for Capricorn sivereye and other fruit-eating birds and nesting habitat for noddies		Good small shade tree (3–7 m); may be slow growing and can suffer from insect attack; propagate from fresh seed

Botanical name	Common name	Growth form	Positives	Negatives	Suitability for landscaping and propagation techniques
<i>Ficus rubiginosa</i> <i>forma rubiginosa</i>	Port Jackson fig	large tree	Naturally occurring on LEI and other CB islands; provides food for fruit-eating birds; roosting and nesting habitat	Roots could be a problem in water pipes and in the vicinity of concrete slabs (will crack slabs) and other infrastructure	Large tree (16 m+); root system can damage water pipes and other infrastructure; plant away from infrastructure; propagate from fresh seed
<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	goat's foot convolvulus	non-woody vine	Naturally occurring on LEI and other CB islands		Use where large area of ground cover is required; propagate from seed
<i>Ipomoea violacea</i>	moon flower	non-woody vine	Naturally occurring on LEI and other CB islands		Vigorous climber; could be useful as a screening plant to cover fences, trellises etc; propagate from seed
<i>Lepturus repens</i>	stalky grass	perennial grass	Naturally occurring on LEI and other CB islands		Moderate traffic grass areas; propagate from seeds and rooted stem cuttings
<i>Pandanus tectorius</i>	pandanus	tree	Naturally occurring on LEI and other CB islands; provides food for Capricorn sivereye		Attractive tree (up to 10 m) for solo planting; juveniles may look attractive in garden beds but will require removal as they grow larger; juveniles could be used as potted plants in large pots; propagate from fresh seed
<i>Pipturus argenteus</i>	native mulberry	tree	Naturally occurring on other CB islands; edible fruit; provides food for Capricorn sivereye and other fruit-eating birds		Solo planting; shade tree (up to about 6 m); source from Heron Island; propagate from fresh seed
<i>Pisonia grandis</i>	pisonia	tree	Naturally occurring on LEI and other CB cays; southern Great Barrier Reef is very important habitat for pisonia closed-forests; genetic diversity provided by the small population at LEI may be important; provides habitat for black noddies and wedgetail shearwaters	Extensive expansion of pisonia forest on LEI may be detrimental to nesting habitat of some ground nesting seabird species	Large fast growing tree (up to 20 m); keep away from buildings, airstrip and high use areas as branches are brittle and trees fall easily; young plants may make good pot plants and eventually make bonsais in large pots; propagate from stem cuttings or seeds
<i>Plumbago zeylanica</i>	native plumbago	vigorous scrambling ground cover	Naturally occurring on other cays in CB group and adjacent mainland coasts and estuaries		Vigorous ground cover with sticky seeds (birds will spread it); roots are poisonous; propagate from seeds or cuttings
<i>Scaevola taccada</i>	sea lettuce	shrub/low tree	Naturally occurring on most CB cays; previously recorded on LEI; provides food for Capricorn sivereye		Attractive shrub for solo planting; screening or windbreak planting; grows to 3 m; propagate from fresh seeds or stem cuttings
<i>Sesuvium portulacastrum</i>	sea purslane	succulent ground cover	Naturally occurring on other cays in CB group and adjacent coasts and estuaries on the adjacent mainland		Salt tolerant ground cover for garden bed or hanging pots; likes damp situations; source from Lady Musgrave Island; propagate from fresh seeds and rooted stem cuttings

Botanical name	Common name	Growth form	Positives	Negatives	Suitability for landscaping and propagation techniques
<i>Sophora tomentosa</i> subsp. <i>australis</i>	yellow necklace pod	large shrub	Naturally occurring on other cays in CB group and adjacent coasts and estuaries on the adjacent mainland; nitrogen fixer		Large garden or solo planting; grows 2–4 m; source from Heron Island; propagate from seed, pour boiling water over seeds and soak until water is cool
<i>Sporobolus virginicus</i>	marine couch	perennial grass	Naturally occurring on other cays in CB group and adjacent coasts and estuaries on the adjacent mainland		Potential replacement for exotic grasses on airstrips; carry out trial plantings on sections of the mown airstrip to determine suitability for airstrip planting; source from Lady Musgrave Island; propagate from seeds and rooted stem cuttings
<i>Stenotaphrum micranthum</i>	beach buffalo grass	grass	Naturally occurring on other cays in CB group	Introduction to LEI will result in a small extension of southern geographical distribution	Low traffic grassy areas; source from Heron Island; propagate from seeds and rooted stem cuttings
<i>Suriana maritima</i>	bay cedar	shrub	Naturally occurring on other cays in CB group	Introduction to LEI will result in a small extension of southern geographical distribution	Attractive shrub to 4 m tall; suitable for windbreak planting; could also be kept pruned; source from Heron Island; propagate from fresh seeds
<i>Tetragonia tetragonioides</i>	New Zealand spinach	annual semi-succulent ground cover	Naturally occurring on other cays in CB group		Good ground cover for garden beds; source from Heron Island and Lady Musgrave; propagate from fresh seeds
<i>Thuarea involuta</i>	bird's beak grass	perennial grass	Naturally occurring on LEI and other CB islands; soft and velvety (nice to sit on)		Low traffic grassy areas; very soft grass good for sitting on; propagate from seeds and rooted stem cuttings
<i>Trachymene cussonii</i>	tracymene	annual herb	In Australia, endemic to the Capricornia Cays only		Groundcover plant over coral rubble in garden beds; propagate from fresh seeds
<i>Triumfetta procumbens</i>	prostate burr bush	herb	Naturally occurring on LEI and other CB islands		Attractive ground cover to small shrub; propagate from seeds and rooted stem cuttings
<i>Wollastonia biflora</i>	beach sunflower	scandent large perennial herb	Naturally occurring on LEI and other CB islands		Grows to approximately 2 m; useful as pruned hedge plant in landscaping; propagate from seeds and rooted stem cuttings



Seedlings in the Lady Elliot Island nursery shade house. ©Jim Buck, Lady Elliot Island Eco Resort

## APPENDIX 4: THE 19 REGIONAL ECOSYSTEM COMMUNITIES AND PLANT SPECIES TO BE ESTABLISHED ACROSS THE FOUR NATURAL LAND USE ZONES

The technical descriptions of the Regional Ecosystems and vegetation communities of the Capricornia Cays are described in Neldner *et al.* (2012).

### CAPRICORNIA CAY REGIONAL ECOSYSTEMS and VEGETATION COMMUNITIES

Scientific name	Common name	12.2.14a 12.2.14b 12.2.14c 12.2.14e 12.2.14h 12.2.19a 12.2.19b 12.2.19c 12.2.19a 12.2.19a 12.2.14h 12.2.14e 12.2.14c 12.2.14b 12.2.14a																		
		Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal	Coastal
<i>Abutilon albescens</i>	lantern bush	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Achyranthes aspera</i>	chaff flower	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Argusia argentea</i>	octopus bush	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Boerhavia albiflora</i> var. <i>heronensis</i>	boerhavia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Canavalia rosea</i>	coastal jack bean	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Casuarina equisetifolia</i> subsp. <i>incana</i>	casuarina	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Celtis paniculata</i>	native elm																	✓	✓	✓
<i>Commicarpus insularum</i>	gum fruit																		✓	✓
<i>Cordia subcordata</i>	sea trumpet	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Euphorbia obliqua</i>	beach spurge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Euphorbia tannensis</i> subsp. <i>tannensis</i>	desert spurge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Ficus opposita</i>	sandpaper fig																		✓	✓
<i>Ficus rubiginosa</i> forma <i>rubiginosa</i>	Port Jackson fig																		✓	✓
<i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i>	goat's foot convolvulus																		✓	✓

**CAPRICORNIA CAY REGIONAL ECOSYSTEMS and VEGETATION COMMUNITIES**

Scientific name	Common name	12.2:14a	12.2:14b	12.2:14c	12.2:14e	12.2:14h	12.2:19a	12.2:19b	12.2:19c	12.2:20a	12.2:18a	12.2:18b	12.2:18c	12.2:17b	12.2:21d	12.2:21c	12.2:20b	12.2:21a	12.2:21b	12.2:17a
<i>Ipomoea violacea</i>	moon flower				✓									✓	✓	✓				
<i>Lepturus repens</i>	stalky grass	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Pandanus tectorius</i>	pandanus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Pipturus argenteus</i>	native mulberry, white nettle	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Pisonia grandis</i>	pisonia													✓	✓	✓	✓	✓	✓	✓
<i>Plumbago zeylanica</i>	native plumbago						✓													✓
<i>Portulaca oleracea</i>	pig weed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Scaevola taccada</i>	sea lettuce	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Sesuvium portulacastrum</i>	sea purslane	✓	✓	✓	✓	✓								✓						
<i>Solanum americanum</i>	glossy nightshade											✓								
<i>Sophora tomentosa</i>	necklace bean	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>S. subsp. australis</i>																				
<i>Spinifex sericeus</i>	beach spinifex	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Sporobolus virginicus</i>	marine couch	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Stenotaphrum micranthum</i>	beach buffalo grass	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Suriana maritima</i>	bay cedar							✓												
<i>Tetragonia tetragonioides</i>	New Zealand spinach					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Thuarea involuta</i>	bird's beak grass	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Trachymene cussonii</i>	trachymene						✓													
<i>Tribulus cistoides</i>	goat's head burr	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<i>Triumfetta procumbens</i>	prostate burr bush						✓													
<i>Wollastonia biflora</i>	beach sunflower	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

APPENDIX 5:

## HABITAT INFORMATION FOR BIRD SPECIES COMMONLY RECORDED ON LADY ELLIOT ISLAND

Common name	Scientific name	LEI habitat information	Preferred habitat requirements
<b>Seabirds</b>			
black noddy	<i>Anous minutus</i>	Nests throughout island wherever suitable tree or shrub space is available including Casuarina and Argusia; nests from September to April; smaller population roosts all year round; nests and roosts in all tree species on the island and also on structures, remainder migrate further north (according to information supplied by Eco Resort personnel).	<i>Pisonia grandis</i> closed-forest; tree nester; prefers pisonia trees > 7 m in height for roosting; also nests in <i>Ficus opposita</i> ; use pisonia leaves for nest building; need bare areas where they can stretch their wings in the sun (sunlight strengthens their skeleton); will nest in other trees and on structures; droppings are a problem to Eco Resort and guests.
black-naped tern	<i>Sterna sumatrana</i>	Nests in North-East Zone (east of current airstrip) and in South-West Zone between lighthouse and coral gardens; breeds mid-spring to early autumn.	Nests on the ground in the open but close to vegetation at top of the beach often in association with roseate terns; prefers open, sparsely vegetated areas and sand and rubble usually on the more exposed island fringes; easily disturbed by humans on beach and by nesting sea turtles.
bridled tern	<i>Sterna anaethetus</i> ( <i>Onychoprion anaethetus</i> )	Nests throughout island under and within fallen trees and in other protected spots; breeds mid-spring to early autumn.	Nests in a ground scrape or hole under shrubs and under fallen vegetation; also utilises human-made structures and openings under coral rubble; acclimatise quickly to human presence.
brown booby	<i>Sula leucogaster</i>	Roosts in North-East Zone shoreline area.	Nests in the open, on the ground in a mound of broken shells and vegetation.
common noddy	<i>Anous stolidus</i>	Nests September to April adjacent to shoreline at northern and southern ends of airstrip (according to information supplied by resort personnel) and in other sites in the area east of the current airstrip in the North-East Zone.	Nests on ground or on bare rubble slightly raised from ground level.
crested tern	<i>Thalasseus bergii</i>	Nests in 'bird rookery' in summer (according to information supplied by Eco Resort personnel); nesting on the airstrip and runners running onto the airstrip have been problems in the past; vegetation is 'cleared' by nesting birds.	Nests on the ground in open unvegetated areas forming tight, closely packed, noisy rookeries or vegetated areas where the vegetation is low; likes very short grass; sensitive to human disturbance; very vulnerable to predation at runner stage as they form crèches of many young with few supervising adults; problems associated with airstrip solved by mowing an area adjacent to the airstrip with an unmown barrier between this mown strip and the airstrip.
great frigate bird	<i>Fregata minor</i>	Roosts on eastern point of the 'bird rookery' (according to information supplied by Eco Resort personnel).	Nests on open ground, vegetated with some sandy patches, also known to nest on flattened shrubs.
lesser frigate bird	<i>Fregata ariel</i>	Roosts in <i>Casuarina equisetifolia</i> .	Ground nester; will nest on bare ground or a mixture of bare ground and some vegetation.
little tern	<i>Sternula albifrons</i>		Nests on ground on sand spits.
masked booby	<i>Sula dactylatra</i>		Nests on the ground in open areas; will nest on bare ground or a mixture of bare ground and some vegetation; easily disturbed.
red-tailed tropic bird	<i>Phaethon rubricauda</i>	Nests on windward side of island under <i>Argusia argentea</i> adjacent to shoreline immediately in front of resort beach units; peak nesting is September to April, with some nesting from May to August.	Nests on the ground under low dense shrubs or in cavernous beach rock 'caves'; likes deep shade; does not nest in the open; travels a long way off shore to feed.

Common name	Scientific name	LEI habitat information	Preferred habitat requirements
roseate tern	<i>Sterna dougallii</i>	Nests from September to February on SW beach adjacent to lighthouse reserve and also on SE beach near coral gardens (according to information supplied by Eco Resort personnel); two separate groups –one group migrates from Korea and Japan, the other group moves to the Swaines in summer.	Nests in a ground scrape, on sand and rubble often in a hollow or under dense vegetation or in the open but close to vegetation at top of the beach, often in association with black-naped terns; prefers areas with a covering of herbs and short grasses; easily disturbed by humans and sea turtles on beach; prefers open ground close to vegetation (needs some shelter).
silver gull	<i>Larus novaehollandiae</i>	Currently nest on island.	Nests on the ground, on grass, in grassland/ herbland and under shrubs and small trees and amongst rocks; breeds all year round; nest consists of seaweed, roots and plant stems; naturally feeds on worms, fish, insects and crustaceans; successful scavenger, with increased numbers near human settlements; can become a problem in association with human use of islands, currently regarded as a pest species.
sooty tern	<i>Onychoprion fuscatus</i>	Nests on exposed rubble banks in top NW corner.	Ground nester.
wedge-tailed shearwater	<i>Ardenna pacifica</i>	Nests in burrows under mature pisonia trees, near the resort units and in various locations throughout the island including mullock heaps, railway mounds and sites created by building of infrastructure; breeds late spring to late autumn.	Pisonia closed-forest or areas with soil deep enough to dig burrows and stabilised by roots or organic matter to prevent collapse of burrows, two stage feeding cycle, require local food supply to feed chicks and also undertake longer foraging journeys to good food sources to obtain food for themselves; Capricorn Bunker cays are considered globally important for the conservation of wedge-tailed shearwaters.
<b>Shorebirds</b>			
pie oyster catcher	<i>Haematopus longirostris</i>	Yearlong resident on island.	
sooty oyster catcher	<i>Haematopus fuliginosus</i>		Nests on sand and rubble on top of beach.
<b>Waterbirds</b>			
eastern reef egret (reef heron)	<i>Egretta sacra</i>	Nests on island in North-West and South-West Zones, breeds all year round and is a yearlong resident on the island.	Nests in trees and shrubs not very high off the ground; nests are constructed from branches and blossoms; sensitive to human disturbance.
striated heron	<i>Butorides striata</i>	Yearlong resident on island.	
white-faced heron	<i>Egretta novaehollandiae</i>	Short-term visitor to island.	
<b>Raptors</b>			
spotted harrier	<i>Circus assimilis</i>	Seen roosting in bird rookery (North-East Zone).	
white-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	Roosts in NE zone and also in SW & SE shoreline areas .	
<b>Other birds</b>			
Buff banded rail	<i>Gallirallus philippensis</i>	Year long resident on island, breeds all year round.	Ground nester usually in dense vegetation or on floor of pisonia forest, feeds on a range of terrestrial invertebrates and small vertebrates, seeds, fallen fruit and other vegetable matter, as well as carrion and refuse.
Capricorn silveryeye	<i>Zosterops lateralis chlorocephalus</i>	Year long resident on island, tree nester, breeds all year round at various locations through out the island .	Likes pisonia forest, adaptable, also nests in a wide range of trees and shrubs including lantern bush; feeds mainly on insects, but also on fruits of pandanus, sandpaper fig and native mulberry .



Noddy tern (*Anous minutus*) adult and chick in pisonia (*Pisonia grandis*). ©Lady Elliot Island Eco Resort

APPENDIX 6:

## BIRD SPECIES LIST FOR LADY ELLIOT ISLAND

(not including species listed in Appendix 5)

Common name	Scientific name
<b>Seabirds</b>	
common tern	<i>Sterna hirundo</i>
fairy tern	<i>Sternula nereis</i>
fluttering shearwater	<i>Puffinus gavia</i>
grey ternlet	<i>Procelsterna cerulea</i>
lesser crested tern	<i>Thalasseus bengalensis</i>
little black cormorant	<i>Phalacrocorax sulcirostris</i>
little pied cormorant	<i>Microcarbo melanoleucos</i>
pied cormorant	<i>Phalacrocorax varius</i>
short-tailed shearwater	<i>Puffinus tenuirostris</i>
southern giant-petrel	<i>Macronectes giganteus</i>
white tern	<i>Gygis alba</i>
<b>Shorebirds</b>	
bar-tailed godwit	<i>Limosa lapponica</i>
beach stone-curlew	<i>Esacus magnirostris</i>
common greenshank	<i>Tringa nebularia</i>
common sandpiper	<i>Actitis hypoleucos</i>
curlew sandpiper	<i>Calidris ferruginea</i>
double-banded plover	<i>Charadrius bicinctus</i>
eastern curlew	<i>Numenius madagascariensis</i>
great knot	<i>Calidris tenuirostris</i>
greater sand plover	<i>Charadrius leschenaultii</i>
grey plover	<i>Pluvialis squatarola</i>
grey-tailed tattler	<i>Tringa brevipes</i>
lesser sand plover	<i>Charadrius mongolus</i>
little curlew	<i>Numenius minutus</i>
oriental plover	<i>Charadrius veredus</i>
Pacific golden plover	<i>Pluvialis fulva</i>
red-capped plover	<i>Charadrius ruficapillus</i>
red knot	<i>Calidris canutus</i>
red-necked stint	<i>Calidris ruficollis</i>
ruddy turnstone	<i>Arenaria interpres</i>
sharp-tailed sandpiper	<i>Calidris acuminata</i>
terek sandpiper	<i>Xenus cinereus</i>
wandering tattler	<i>Tringa incana</i>
whimbrel	<i>Numenius phaeopus</i>
white ibis	<i>Threskiornis moluccus</i>
<b>Waterbirds</b>	
Australasian darter	<i>Anhinga novaehollandiae</i>
black swan	<i>Cygnus atratus</i>
Pacific black duck	<i>Anas superciliosa</i>
purple swamphen	<i>Porphyrio porphyrio</i>
<b>Raptors</b>	
black-shouldered kite	<i>Elanus axillaris</i>
brown goshawk	<i>Accipiter fasciatus</i>
collared sparrowhawk	<i>Accipiter cirrocephalus</i>

Common name	Scientific name
eastern osprey	<i>Pandion cristatus</i>
grey goshawk	<i>Accipiter novaehollandiae</i>
nankeen kestrel	<i>Falco cenchroides</i>
<b>Other birds</b>	
Australasian figbird	<i>Sphecotheres vieilloti</i>
Australasian pipit	<i>Anthus novaeseelandiae</i>
Australian magpie	<i>Cracticus tibicen</i>
bar-shouldered dove	<i>Geopelia humeralis</i>
black-faced cuckoo-shrike	<i>Coracina novaehollandiae</i>
black-faced monarch	<i>Monarcha melanopsis</i>
brown honeyeater	<i>Lichmera indistincta</i>
channel-billed cuckoo	<i>Scythrops novaehollandiae</i>
dollar bird	<i>Eurystomus orientalis</i>
eastern koel	<i>Eudynamys orientalis</i>
emerald dove	<i>Chalcophaps indica</i>
fan-tailed cuckoo	<i>Cacomantis flabelliformis</i>
galah	<i>Eolophus roseicapillus</i>
golden-headed cisticola	<i>Cisticola exilis</i>
Gould's bronze-cuckoo	<i>Chalcites minutillus russatus</i>
grey butcherbird	<i>Cracticus torquatus</i>
grey fantail	<i>Rhipidura albiscapa</i>
house sparrow	<i>Passer domesticus</i>
leaden flycatcher	<i>Myiagra rubecula</i>
magpie-lark	<i>Grallina cyanoleuca</i>
masked wood swallow	<i>Artamus personatus</i>
olive-backed oriole	<i>Oriolus sagittatus</i>
oriental cuckoo	<i>Cuculus optatus</i>
rainbow lorikeet	<i>Trichoglossus haematodus moluccanus</i>
red jungle fowl	<i>Gallus gallus</i>
rock dove	<i>Columba livia</i>
rose-crowned fruit dove	<i>Ptilinopus regina</i>
rufous fantail	<i>Rhipidura rufifrons</i>
rufous whistler	<i>Pachycephala rufiventris</i>
sacred kingfisher	<i>Todiramphus sanctus</i>
scarlet honeyeater	<i>Myzomela sanguinolenta</i>
shining bronze-cuckoo	<i>Chalcites lucidus</i>
spangled drongo	<i>Dicrurus bracteatus</i>
tawny grassbird	<i>Megalurus timoriensis</i>
tree martin	<i>Petrochelidon nigricans</i>
welcome swallow	<i>Hirundo neoxena</i>
white-browed wood swallow	<i>Artamus superciliosus</i>
white-winged triller	<i>Lalage tricolor</i>
willie wagtail	<i>Rhipidura leucophrys</i>



*Weed removal by a team of volunteers led by Joy Brushe. ©Joy Brushe*

~~~~~  
**APPENDIX 7:**

## RECOMMENDED METHODS FOR USE IN WEED REMOVAL, PEST CONTROL, REVEGETATION AND MONITORING.

The methods summarised in this appendix are based on knowledge and experience gained from restoration projects on other Capricorn Bunker cays and methods proven successful in vegetation restoration projects on Lady Elliot Island.

APPENDIX 8:

## INVERTEBRATE SPECIES LIST FOR LADY ELLIOT ISLAND.

| Order       | Family         | Group     | Species                                 | Introduced |
|-------------|----------------|-----------|-----------------------------------------|------------|
| Lepidoptera | Hesperiidae    | butterfly | <i>Ocybadistes walkeri sothis</i>       |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Catochrysops panormus platissa</i>   |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Jamides phaseli</i>                  |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Lampides boeticus</i>                |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Nacaduba berenice berenice</i>       |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Prosotas dubiosa dubiosa</i>         |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Psychonotis caelius taygetus</i>     |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Zizeeria karsandra</i>               |            |
| Lepidoptera | Lycaenidae     | butterfly | <i>Zizina labradus labradus</i>         |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Acraea andromacha andromacha</i>     |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Danaus affinus</i>                   |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Hypolimnas bolina nerina</i>         |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Junonia orithya albicincta</i>       |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Junonia villida calybe</i>           |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Melanitis leda bankia</i>            |            |
| Lepidoptera | Nymphalidae    | butterfly | <i>Tirumala hamata hamata</i>           |            |
| Lepidoptera | Papilionidae   | butterfly | <i>Graphium eurypylus lycaon</i>        |            |
| Lepidoptera | Papilionidae   | butterfly | <i>Papilio aegaeus aegaeus</i>          |            |
| Lepidoptera | Pieridae       | butterfly | <i>Appias paulina ega</i>               |            |
| Lepidoptera | Pieridae       | butterfly | <i>Belenois java</i>                    |            |
| Lepidoptera | Pieridae       | butterfly | <i>Catopsilia pomona</i>                |            |
| Lepidoptera | Pieridae       | butterfly | <i>Catopsilia gorgophone gorgophone</i> |            |
| Lepidoptera | Pieridae       | butterfly | <i>Delias nigrina</i>                   |            |
| Lepidoptera | Pieridae       | butterfly | <i>Eurema hecabe hecabe</i>             |            |
| Lepidoptera | Sphingidae     | hawkmoth  | <i>Hippotion velox</i>                  |            |
| Lepidoptera | Sphingidae     | hawkmoth  | <i>Theretra margarita</i>               |            |
| Odonata     | Coenagrionidae | damselfly | <i>Ischnura aurora</i>                  |            |
| Odonata     | Coenagrionidae | damselfly | <i>Ischnura heterosticta</i>            |            |
| Odonata     | Aeshnidae      | dragonfly | <i>Hemianax papuensis</i>               |            |
| Odonata     | Libellulidae   | dragonfly | <i>Diplacodes bipunctata</i>            |            |
| Odonata     | Libellulidae   | dragonfly | <i>Diplacodes trivialis</i>             |            |
| Odonata     | Libellulidae   | dragonfly | <i>Orthetrum caledonicum</i>            |            |
| Odonata     | Libellulidae   | dragonfly | <i>Orthetrum sabina</i>                 |            |
| Odonata     | Libellulidae   | dragonfly | <i>Orthetrum serapia</i>                |            |
| Odonata     | Libellulidae   | dragonfly | <i>Pantala flavescens</i>               |            |
| Odonata     | Libellulidae   | dragonfly | <i>Tramea loewii</i>                    |            |
| Hymenoptera | Formicidae     | ant       | <i>Cardiocondyla 'nuda'</i>             |            |
| Hymenoptera | Formicidae     | ant       | <i>Hypoconerops 'punctatissima'</i>     | yes        |
| Hymenoptera | Formicidae     | ant       | <i>Iridomyrmex suchieri</i>             |            |
| Hymenoptera | Formicidae     | ant       | <i>Iridomyrmex bicknelli</i>            |            |
| Hymenoptera | Formicidae     | ant       | <i>Monomorium sechellense</i>           | yes        |
| Hymenoptera | Formicidae     | ant       | <i>Paratrechina longicornis</i>         | yes        |
| Hymenoptera | Formicidae     | ant       | <i>Pheidole megacephala</i>             | yes        |
| Hymenoptera | Formicidae     | ant       | <i>Plagiolepis alluaudi</i>             | yes        |
| Hymenoptera | Formicidae     | ant       | <i>Ponera leae</i>                      |            |
| Hymenoptera | Formicidae     | ant       | <i>Solenopsis sp. A</i>                 |            |
| Coleoptera  | Anthicidae     | beetle    | ? <i>Anthicinus sp. A</i>               |            |

| Order      | Family         | Group  | Species                    | Introduced |
|------------|----------------|--------|----------------------------|------------|
| Coleoptera | Anthicidae     | beetle | ?Anthicinus sp. B          |            |
| Coleoptera | Anthribidae    | beetle | Araecerus sp. A            |            |
| Coleoptera | Anthribidae    | beetle | Exillis sp. A              |            |
| Coleoptera | Carabidae      | beetle | Amblystomus sp. A          |            |
| Coleoptera | Carabidae      | beetle | Bembidion jacksoniense     |            |
| Coleoptera | Carabidae      | beetle | Carabidae sp. K            |            |
| Coleoptera | Carabidae      | beetle | indet. Harpalini sp. A     |            |
| Coleoptera | Carabidae      | beetle | indet. Harpalini sp. B     |            |
| Coleoptera | Carabidae      | beetle | indet. Harpalini sp. C     |            |
| Coleoptera | Carabidae      | beetle | indet. Harpalini sp. D     |            |
| Coleoptera | Carabidae      | beetle | indet. Pterostichini sp. A |            |
| Coleoptera | Carabidae      | beetle | indet. Pterostichini sp. B |            |
| Coleoptera | Carabidae      | beetle | Lebia melanota             |            |
| Coleoptera | Carabidae      | beetle | Pentagonica 'ruficollis'   |            |
| Coleoptera | Cerambycidae   | beetle | Phaeapate denticollis      |            |
| Coleoptera | Chrysomelidae  | beetle | Arsipoda sp. A             |            |
| Coleoptera | Chrysomelidae  | beetle | Ponerida australis         |            |
| Coleoptera | Ciidae         | beetle | Ceracis sp. A              |            |
| Coleoptera | Ciidae         | beetle | Hadrule sp. A              |            |
| Coleoptera | Coccinellidae  | beetle | Coelophora inaequalis      |            |
| Coleoptera | Coccinellidae  | beetle | Cryptolaemus montrouzieri  |            |
| Coleoptera | Coccinellidae  | beetle | Epilachna sp. A            |            |
| Coleoptera | Coccinellidae  | beetle | Scymnus mitior             |            |
| Coleoptera | Corylophidae   | beetle | Corylophidae sp. B         |            |
| Coleoptera | Curculionidae  | beetle | Curculionidae sp. A        |            |
| Coleoptera | Curculionidae  | beetle | Curculionidae sp. B        |            |
| Coleoptera | Curculionidae  | beetle | Curculionidae sp. H        |            |
| Coleoptera | Curculionidae  | beetle | Curculionidae sp. I        |            |
| Coleoptera | Curculionidae  | beetle | Curculionidae sp. L        |            |
| Coleoptera | Curculionidae  | beetle | Curculionidae sp. M        |            |
| Coleoptera | Dermestidae    | beetle | Dermestes sp. A            |            |
| Coleoptera | Dytisidae      | beetle | Dytisidae sp. A            |            |
| Coleoptera | Dytisidae      | beetle | Dytisidae sp. B            |            |
| Coleoptera | Elateridae     | beetle | Conoderus sp. A            |            |
| Coleoptera | Erotylidae     | beetle | Episcaphula australis      |            |
| Coleoptera | Heteroceridae  | beetle | Heterocerus sp. A          |            |
| Coleoptera | Histeridae     | beetle | Histeridae sp. A           |            |
| Coleoptera | Hydrophilidae  | beetle | Hydrophilidae sp. B        |            |
| Coleoptera | Laemophloeidae | beetle | Laemophloeidae sp. A       |            |
| Coleoptera | Melyridae      | beetle | Carphurus sp. A            |            |
| Coleoptera | Mycetophagidae | beetle | Mycetophagidae A           |            |
| Coleoptera | Nitidulidae    | beetle | Brachypeplus sp. A         |            |
| Coleoptera | Nitidulidae    | beetle | Brachypeplus sp. B         |            |
| Coleoptera | Nitidulidae    | beetle | Nitidulidae sp. E          |            |
| Coleoptera | Phalacridae    | beetle | Phalacridae sp. A          |            |
| Coleoptera | Phycosecidae   | beetle | Phycosecis hilli           |            |
| Coleoptera | Scarabaeidae   | beetle | Aphodius lividus           |            |
| Coleoptera | Scarabaeidae   | beetle | Platytomus tibialis        | yes        |
| Coleoptera | Scarabaeidae   | beetle | Protaetia fusca            |            |
| Coleoptera | Silvanidae     | beetle | Cryptomorpha sp. A         |            |
| Coleoptera | Silvanidae     | beetle | Silvanidae sp. B           |            |

| Order      | Family         | Group  | Species                             | Introduced |
|------------|----------------|--------|-------------------------------------|------------|
| Coleoptera | Sphindidae     | beetle | <i>Sphindidus sp. A</i>             |            |
| Coleoptera | Staphylinidae  | beetle | <i>indet. Scaphidiinae B</i>        |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. C</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. E</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. G</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. H</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. L</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. P</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. T</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. U</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. V</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. X</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. Y</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. Z</i>          |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. AA</i>         |            |
| Coleoptera | Staphylinidae  | beetle | <i>Staphylinidae sp. AB</i>         |            |
| Coleoptera | Tenebrionidae  | beetle | <i>Gonocephalum sp. A</i>           |            |
| Coleoptera | Tenebrionidae  | beetle | <i>Lyphia sp. A</i>                 |            |
| Coleoptera | Tenebrionidae  | beetle | <i>Platycotylus sp. A</i>           |            |
| Coleoptera | Tenebrionidae  | beetle | <i>Ulomoides tetraspilotus</i>      |            |
| Coleoptera | Trogossitidae  | beetle | <i>Neaspis sp. A</i>                |            |
| Coleoptera | Endomychidae   | beetle | <i>?Endomychidae sp. A</i>          |            |
| Coleoptera | Cryptophagidae | beetle | <i>?Cryptophagidae sp. A</i>        |            |
| Coleoptera | Zopheridae     | beetle | <i>Bitoma serricollis</i>           |            |
| Coleoptera | Zopheridae     | beetle | <i>Bitoma notata</i>                |            |
| Diptera    | Tachinidae     | fly    | <i>?genus 1 Leskiini</i>            |            |
| Diptera    | Tachinidae     | fly    | <i>Anagonia sp.1</i>                |            |
| Diptera    | Anthomyiidae   | fly    | <i>Anthomyia silvestris</i>         |            |
| Diptera    | Muscidae       | fly    | <i>Atherigonia sp.1</i>             |            |
| Diptera    | Muscidae       | fly    | <i>Atherigonia sp.2</i>             |            |
| Diptera    | Tachinidae     | fly    | <i>Carcelia sp.1</i>                |            |
| Diptera    | Tachinidae     | fly    | <i>Ceromyia sp.2</i>                |            |
| Diptera    | Tachinidae     | fly    | <i>Cuphocera javana</i>             |            |
| Diptera    | Muscidae       | fly    | <i>Helina hypopleuralis</i>         |            |
| Diptera    | Muscidae       | fly    | <i>Helina sp.1</i>                  |            |
| Diptera    | Muscidae       | fly    | <i>Lispe sp. 2</i>                  |            |
| Diptera    | Muscidae       | fly    | <i>Lispe sydneyensis</i>            |            |
| Diptera    | Muscidae       | fly    | <i>Muscidae sp.1</i>                |            |
| Diptera    | Muscidae       | fly    | <i>Muscidae sp.2</i>                |            |
| Diptera    | Tachinidae     | fly    | <i>Paradrino sp.1</i>               |            |
| Diptera    | Tachinidae     | fly    | <i>Paradrino sp.2</i>               |            |
| Diptera    | Calliphoridae  | fly    | <i>Stomorhina xanthogaster</i>      |            |
| Diptera    | Tachinidae     | fly    | <i>Blepharipa sp.1</i>              |            |
| Diptera    | Tachinidae     | fly    | <i>Chaetoria sp.1</i>               |            |
| Diptera    | Muscidae       | fly    | <i>Lispe sp. 3</i>                  |            |
| Diptera    | Muscidae       | fly    | <i>Lispe sp. nr albimaculata</i>    |            |
| Diptera    | Tachinidae     | fly    | <i>Paropsivora sp.1</i>             |            |
| Diptera    | Tachinidae     | fly    | <i>Actia sp.1</i>                   |            |
| Diptera    | Tachinidae     | fly    | <i>Palexorista sp.1</i>             |            |
| Diptera    | Sarcophagidae  | fly    | <i>Sarcorohdendorfia praedatrix</i> |            |
| Diptera    | Tachinidae     | fly    | <i>Winthemia sp.1</i>               |            |

| Order     | Family          | Group        | Species                             | Introduced |
|-----------|-----------------|--------------|-------------------------------------|------------|
| Diptera   | Calliphoridae   | fly          | <i>Hemipyrellia sp.1</i>            |            |
| Diptera   | Sarcophagidae   | fly          | <i>Liosarcophaga aurifrons</i>      |            |
| Diptera   | Muscidae        | fly          | <i>Coenosia dark femora</i>         |            |
| Diptera   | Muscidae        | fly          | <i>Coenosia sp.2 pale frons</i>     |            |
| Diptera   | Muscidae        | fly          | <i>Helina micans</i>                |            |
| Diptera   | Tachinidae      | fly          | ?tribe Tachinidae                   |            |
| Diptera   | Calliphoridae   | fly          | <i>Chrysomyia megacephala</i>       |            |
| Diptera   | Hippoboscidae   | fly          | <i>Olfersia sp.1</i>                |            |
| Diptera   | Sarcophagidae   | fly          | <i>Australopierretia australis</i>  |            |
| Diptera   | Tachinidae      | fly          | <i>Peribaea sp.1</i>                |            |
| Diptera   | Muscidae        | fly          | <i>Coenosia sp.1 dark frons</i>     |            |
| Diptera   | Muscidae        | fly          | <i>Atherigona orientalis</i>        |            |
| Diptera   | Muscidae        | fly          | <i>Lispe eidsvoldica</i>            |            |
| Diptera   | Muscidae        | fly          | <i>Atherigona matema</i>            |            |
| Blattodea | Ectobiidae      | cockroach    | <i>Megamareta phaneropyga</i>       |            |
| Blattodea | Blaberidae      | cockroach    | <i>Pycnoscelus surinamensis</i>     |            |
| Hemiptera | Coccidae        | scale insect | <i>Pulvinaria urbicola</i>          |            |
| Diptera   | Platystomatidae | fly          | <i>Plagiostenoptera enderleini</i>  |            |
| Diptera   | Lonchaeidae     | fly          | <i>Lonchaeidae CCsp1</i>            |            |
| Diptera   | Dolichopodidae  | fly          | <i>Dolichopodidae CCsp5</i>         |            |
| Diptera   | Dolichopodidae  | fly          | <i>Austrosciapus connexus</i>       |            |
| Diptera   | Asilidae        | fly          | <i>Leptogaster CCsp1</i>            |            |
| Diptera   | Dolichopodidae  | fly          | <i>Dolichopodidae CCsp3</i>         |            |
| Diptera   | Platystomatidae | fly          | <i>Microepicausta CCsp1</i>         |            |
| Diptera   | Platystomatidae | fly          | <i>Pogonortalis CCsp1</i>           |            |
| Diptera   | Dolichopodidae  | fly          | <i>Dolichopodidae CCsp1</i>         |            |
| Diptera   | Dolichopodidae  | fly          | <i>Dolichopodidae CCsp2</i>         |            |
| Diptera   | Bombyliidae     | fly          | <i>Exechohypopion nigricostatum</i> |            |
| Diptera   | Asilidae        | fly          | <i>Leptogaster CCsp2</i>            |            |
| Diptera   | Hybotidae       | fly          | <i>Tachypeza CCsp1</i>              |            |
| Diptera   | Syrphidae       | fly          | <i>Melanostoma apicale</i>          |            |
| Diptera   | Tachinidae      | fly          | <i>Therobia sp.</i>                 |            |
| Diptera   | Dolichopodidae  | fly          | <i>Dolichopodidae CCsp4</i>         |            |
| Diptera   | Dolichopodidae  | fly          | <i>Dolichopodidae CCsp6</i>         |            |
| Diptera   | Ephydriidae     | fly          | <i>Ephydriidae CCsp1</i>            |            |
| Diptera   | Heleomyzidae    | fly          | <i>Heleomyzidae CCsp2</i>           |            |
| Diptera   | Syrphidae       | fly          | <i>Simosyrphus grandicornis</i>     |            |
| Diptera   | Syrphidae       | fly          | <i>Sphaerophoria macrogaster</i>    |            |
| Diptera   | Tephritidae     | fly          | <i>Bactrocera neohumeralis</i>      |            |
| Diptera   | Syrphidae       | fly          | <i>Dideopsis aegrota</i>            |            |
| Diptera   | Tephritidae     | fly          | <i>Dioxya sororcula</i>             |            |
| Diptera   | Syrphidae       | fly          | <i>Eumerus rieki</i>                |            |
| Diptera   | Hybotidae       | fly          | <i>Tachypeza CCsp2</i>              |            |
| Diptera   | Tachinidae      | fly          | <i>Alophora sp.</i>                 |            |
| Araneae   | Amaurobiidae    | spider       | <i>Barahna yeppoon</i>              |            |
| Araneae   | Clubionidae     | spider       | <i>Cheiracanthium ?gilva</i>        |            |
| Araneae   | Corinnidae      | spider       | <i>Supunna funerea</i>              |            |
| Araneae   | Dictynidae      | spider       | <i>Arangina sp.</i>                 |            |
| Araneae   | Gnaphosidae     | spider       | <i>Anzacia sp.</i>                  |            |
| Araneae   | Gnaphosidae     | spider       | <i>Encopthartria 'blak1'</i>        |            |
| Araneae   | Gnaphosidae     | spider       | <i>Encopthartria 'h1'</i>           |            |

| Order   | Family          | Group  | Species                        | Introduced |
|---------|-----------------|--------|--------------------------------|------------|
| Araneae | Linyphiidae     | spider | <i>Linyphiidae 'smBlack'</i>   |            |
| Araneae | Lycosidae       | spider | <i>Hogna crispipes</i>         |            |
| Araneae | Lycosidae       | spider | <i>Venatrix 'dagger'</i>       |            |
| Araneae | Ochyroceratidae | spider | <i>Theotima minutissima</i>    | yes        |
| Araneae | Oonopidae       | spider | <i>Heteroonops spinimanus</i>  | yes        |
| Araneae | Oonopidae       | spider | <i>Ischnothryeus sp.</i>       |            |
| Araneae | Oonopidae       | spider | <i>Opopaea sp.</i>             |            |
| Araneae | Oonopidae       | spider | <i>?Xestaspis sp.</i>          |            |
| Araneae | Oxyopidae       | spider | <i>Oxyopes elegans</i>         |            |
| Araneae | Oxyopidae       | spider | <i>Oxyopes molaris</i>         |            |
| Araneae | Pholcidae       | spider | <i>Micropholcus fauroti</i>    | yes        |
| Araneae | Pholcidae       | spider | <i>Pholcus phalangiodes</i>    | yes        |
| Araneae | Salticidae      | spider | <i>Hasarius adansoni</i>       | yes        |
| Araneae | Salticidae      | spider | <i>Helpis sp.</i>              |            |
| Araneae | Salticidae      | spider | <i>Maratus 'h1'</i>            |            |
| Araneae | Salticidae      | spider | <i>Prostheclina sp.</i>        |            |
| Araneae | Salticidae      | spider | <i>Zenodorus 't1'</i>          |            |
| Araneae | Scytodidae      | spider | <i>Scytodes ?thoracica</i>     | yes        |
| Araneae | Sparassidae     | spider | <i>Isopeda flavida</i>         |            |
| Araneae | Tetragnathidae  | spider | <i>Tetragnatha sp.</i>         |            |
| Araneae | Theridiidae     | spider | <i>Achaearana tepidariorum</i> | yes        |
| Araneae | Theridiidae     | spider | <i>Hadrotarsinae sp.</i>       |            |
| Araneae | Thomisidae      | spider | <i>Diaea 'spotted white'</i>   |            |



**Australian Government**

---

**Great Barrier Reef  
Marine Park Authority**

**[gbrmpa.gov.au](http://gbrmpa.gov.au)**