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# 10 Flora and Fauna

# 10.1 Introduction

The Lindeman Island study area contains a variety of remnant, mature regrowth (non-remnant), and disturbed habitats. Remnant vegetation within the study area mainly consists of mixed eucalypt woodland with a grassy understory, with some rocky slopes along the coastline containing coastal vine thicket. The east and west margins of the runway strip contain Broad-leaved Tea Tree woodland and the existing resort, golf course and runway strip areas contain non-remnant vegetation. Northern Resource Consultants Pty Limited (NRC) conducted a detailed desktop and field-based vegetation assessment within the lease areas associated with the resort in July-August 2013. These surveys resolved large areas of heterogeneous polygons on the Queensland regional ecosystem (RE) mapping into single unit polygons. The surveys culminated in amendments to the RE mapping via approval of a new Property Map of Assessable Vegetation (PMAV) (31 May 2017) and liaising with the Queensland Herbarium regarding updates to the mapping of vegetation within the Lindeman Island National Park.

Since the vegetation surveys conducted in 2013, the development design concept has been modified and consequently NRC conducted further field assessments over multiple seasons in 2015. This report details those assessments and builds on the work conducted in 2013 to deliver the following terrestrial flora and fauna assessments:

- Field-based flora surveys including vegetation community assessments, RE ground-truthing, vegetation community mapping and targeted threatened flora searches conducted in July-August 2013;
- A desktop assessment of terrestrial flora and fauna biodiversity values, with a focus on species and communities of conservation significance;
- Two field-based terrestrial vertebrate fauna surveys in different habitat types within the proposed development area and surrounding National Park land conducted over multiple seasons in 2015, including a variety of systematic and targeted survey techniques; and
- Two field-based flora surveys conducted over multiple seasons in 2015 to build on the data obtained during the 2013 surveys and incorporate a broader study area including the surrounding National Park land.

This chapter of the EIS details the methodologies employed for assessing the terrestrial flora and fauna within the study area over multiple survey periods. It also assesses the presence and status of species and communities within the site and potential ecological impacts of the project and recommendations for mitigating impacts, with a focus on species and communities of conservation concern, such as those listed under Queensland and Commonwealth legislation.

Refer to the Terrestrial Flora and Fauna report prepared by Northern Resource Consultants Pty Ltd in **Appendix I** for further information.



Addendum: This EIS was initially prepared assuming that the safe harbour was to be part of the Lindeman Great Barrier Reef Resort Project. With the commencement of the Great Barrier Reef Marine Park Authority's (GBRMPA) Dredging Coral Reef Habitat Policy (2016), further impacts on Great Barrier Reef coral reef habitats from yet more bleaching, and the recent impacts from Tropical Cyclone Debbie, the proponent no longer seeks assessment and approval to construct a safe harbour at Lindeman Island. Instead the proponent seeks assessment and approval for upgrades to the existing jetty and additional moorings in sheltered locations around the island to enable the resort's marine craft to obtain safe shelter under a range of wind and wave conditions. Accordingly, remaining references to, and images of, a safe harbour on various figures and maps in the EIS are no longer current.

# 10.2 Statutory Framework

# 10.2.1 Commonwealth Legislation

# Environment Protection and Biodiversity Conservation Act 1999

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is administered by the Australian Government Department of Environment and Energy (DoEE). The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance (MNES). The MNES listed in the EPBC Act that are relevant to this report are nationally threatened species and ecological communities and migratory species. Database searches and field assessments should be conducted as part of any flora and fauna impact assessment. The results of these assessments can be used to determine the presence or likelihood of the occurrence of any MNES within a proposed project area. If any species or communities listed under the EPBC Act are present or likely to be present, an assessment of significance is required. If the proposed action may have a significant impact on MNES, it must be referred to DoEE for assessment. If DoEE determines the proposed action is likely to have significant impacts, the project will be considered as a controlled action and will require formal assessment and approval. If the proposed action is not likely to be significant, approval is not required if the action is taken in accordance with the referral. Consequently, the action can proceed, subject to any state or local government approvals.

# Great Barrier Reef Marine Park Act 1975

The Great Barrier Reef Marine Park Act 1975 (GBRMP Act) is the primary act relating to the Great Barrier Reef Marine Park (GBRMP). The objective of the GBRMP Act is to provide for the long term protection and conservation of the environment, biodiversity and heritage values of the Great Barrier Reef Region. The GBRMP Act provides the framework for planning and management of the Marine Park and implements a cooperative approach to management agreed between the Australian and Queensland governments. The EPBC Act provides the overarching basis for environmental impact assessment and approval for actions within the GBRMP. Where the proposed action is within the Marine Park, responsibility for assessment under the EPBC Act generally remains with the Great Barrier Reef Marine Park Authority (the Authority). The Authority is responsible for performing its normal regulatory permitting functions and the assessment is generally performed as a single integrated assessment across both Commonwealth Acts.



# 10.2.2 State Legislation

#### Vegetation Management Act 1999

The Vegetation Management Act 1999 (VM Act) is administered by the Queensland Department of Natural Resources and Mines (DNRM) and protects Queensland's biodiversity by conserving native vegetation and addressing land degradation issues. Queensland's vegetation management framework regulates the clearing of certain native vegetation. The VM Act incorporates the regional ecosystem (RE) classification scheme to regulate the clearing of native vegetation. REs are remnant vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Remnant vegetation is defined under the VM Act as vegetation where the dominant canopy layer has greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy. The Queensland Herbarium has mapped the remnant extent of regional ecosystems for much of the state using a combination of satellite imagery, aerial photography and on-ground studies (ground-truthing). Regional ecosystem maps published by DNRM describe the extent and conservation status of remnant vegetation as REs. REs are classified in the following vegetation management class and biodiversity status categories:

- Endangered;
- Of Concern; and
- Least Concern/Not of Concern.

The clearing of native vegetation is regulated under Module 8 of the State Development Assessment Provisions. The classification of REs is relevant to identifying vegetation communities of conservation significance in a regional context and potential environmental offset requirements under the Queensland Environmental Offsets Framework.

# Sustainable Planning Act 2009

The Sustainable Planning Act 2009 (SP Act) is the overarching framework for Queensland's planning and development system. The process for assessing development applications required under the SP Act is known as the Integrated Development Assessment System (IDAS). IDAS sets out a development application process by which councils and other agencies assess and make decisions on the various types of land use and development proposals.

#### Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) is administered by EHP and provides the framework for the declaration and management of protected areas, and protection of wildlife listed under the *Nature Conservation* (*Wildlife*) *Regulation 2006* (*NC Regulation*).

Protected areas are declared under the NC Act for the conservation of Queensland's natural and cultural resources. Classes of protected areas under the NC Act include national parks, regional parks and nature refuges. An environmental offset may be required for actions resulting in significant residual impacts within a protected area. Under the Queensland Environmental Offsets Framework, an impact on a protected area is significant if a prescribed activity results, or is likely to result, in one or more of the following:

- The authorised clearing or inundation of all or part of the protected area for the construction of private or publicly owned infrastructure on the area;
- The exclusion of, or reduction in, the public use or enjoyment of all or part of the protected area; and
- A reduction in the natural or cultural *Protected Wildlife* values of all or part of the protected area.

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The purpose of the NC Regulation is to class wildlife as one of the following:

- Extinct in the wild;
- Endangered;
- Vulnerable;
- Near threatened; and
- Least concern.

Threatened wildlife under the NC Act is wildlife that is prescribed under the Act as extinct in the wild, endangered or vulnerable. All native flora and fauna species are protected under the Act and 'permits to take' protected wildlife are required from EHP. EHP hosts the Wildlife Online database, which can be searched to generate a list of all species recorded within a specified area. This tool is useful for determining the presence or likelihood of occurrence of threatened species in an area. A Protected Plants Flora Survey Trigger Map is now also available, which shows high risk areas for protected plants (those considered as EVNT species - endangered, vulnerable and near threatened) and is used to help determine flora survey and clearing permit requirements for a specified area. If the study area is located within a high risk area, a comprehensive flora survey is required to be undertaken before any clearing of protected plants (EHP 2014).

If threatened plants are found to occur within the high risk area during the field survey and these are likely to be cleared or impacted by the proposed project, an application for a clearing permit from EHP will be required. This application will need to be accompanied by the flora survey results and potential impact management options for the protected plants that include appropriate avoidance, mitigation or offsetting measures. In addition to this, if threatened plants are found outside a high risk area during the field survey, and these plants are likely to be cleared or impacted by the proposed project, a clearing permit will also be required. Where a flora survey identifies there are no protected plants present or impacts can be avoided, clearing will be exempt from requiring a permit under the NC Act.

#### **Biosecurity Act 2014**

The *Biosecurity Act 2014* commenced on 1 July 2016, with the aim to ensure a consistent, modern, risk-based and less prescriptive approach to biosecurity in Queensland. The *Biosecurity Act 2014* replaced the many separate pieces of legislation that were previously used to manage biosecurity. Under this Act, the *Biosecurity Regulation 2016* sets out how the Act is implemented and applied. Under *Biosecurity Act 2014*, there are three types of invasive plant species:

- Prohibited invasive plants;
- Restricted Invasive plants; and
- Invasive plants.

Prohibited invasive plants are not present in Queensland and would seriously threaten Queensland's primary industries, natural environment, livestock, human health and people's livelihoods. If a prohibited invasive plant is found in Queensland, it must be reported to Biosecurity Queensland within 24 hours of the sighting. Restricted invasive plants also seriously threaten Queensland's primary industries, natural environment, livestock, human health and people's primary industries, natural environment, livestock, human health and people's livelihoods, but are already established in Queensland. Under the *Biosecurity Act 2014*, restricted invasive plants may fall into one or more categories, with different restrictions relevant to each category. Restricted invasive plant categories and restrictions:

• Category 2: the invasive plant must be reported within 24 hours Biosecurity Queensland;



- Category 3: the invasive plant must not be distributed or released into the environment;
- Category 4: the invasive plant must not be moved; and
- Category 5: the invasive plant must not be kept.

Invasive plants include species that are not listed as prohibited or restricted invasive plants, but the species has, or is likely to have, an adverse impact on a biosecurity consideration because of the introduction, spread or increase in population size of the species in an area. Everyone is obligated to take all reasonable and practical steps to minimise the risks associated with invasive plants under their control. Local governments and Biosecurity Queensland provide weed control support services but may also enforce landowner responsibilities if necessary. Invasive animals are classified in a similar manner to plants and include prohibited and restricted classifications. Landholder responsibilities and restrictions pertaining to these classifications are specific for each category and an invasive animal may be listed under multiple categories. Category actions that must, or must not, be carried out are defined under the *Biosecurity Act 2014*.

# **Queensland Environmental Offsets Framework**

On 1 July 2014, a new environmental offsets framework was introduced in Queensland. The framework includes an Act, a regulation and a single policy, which replaces the five previous single-issue policies. The *Environmental Offsets Regulation 2014* provides detail of the prescribed activities regulated under legislation and the prescribed environmental matters (known as Matters of State Environmental Significance or MSES) to which the framework applies. Examples of MSES include:

- Wetlands and watercourses;
- Endangered and 'of concern' regional ecosystems;
- Connectivity areas; and
- Protected wildlife habitat.

For any new development, all impacts to MSES must be avoided or minimised where possible. Where there is a *significant residual impact* to MSES, an environmental offset may be required in accordance with the Queensland Environmental Offsets Policy (QEOP).

# **10.3 Flora Survey Methodology**

A vegetation survey incorporating the lease areas associated with the existing resort was conducted by NRC in July-August 2013. Knowledge of the site gained during this study was used in conjunction with current desktop assessments to inform the design of the 2015 field survey program. A site familiarisation process was also conducted prior to each of the 2015 surveys to ensure systematic fauna trapping sites covered an appropriate variety of habitat types within the study area. For vegetation surveys, focus was given to areas where vegetation clearing may occur as part of the proposed development. Focus was also given to areas not covered in the previous survey conducted in 2013, as well as describing environmental values for flora in the surrounding national park areas.

NRC employed a joint approach of desktop analysis and field surveys in this study using best practice recommendations from sources such as:

- Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner et al. 2012); and
- Flora Survey Guidelines Protected Plants (EHP 2014).

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This section provides a summary of the assessment methodology used in undertaking the assessment, further supporting information is available in **Appendix I**.

# 10.3.1 Desktop Analysis

# 10.3.1.1 Literature review and previous studies

A previous flora study conducted by NRC for the proposed Lindeman Island resort development area in July 2013 was the only known recent terrestrial ecology study in the local area. The outcomes of this study were used in conjunction with field guides and scientific publications, which were reviewed prior to field surveys, to determine species likely to be present within the study area and preferred habitat. Focus was given to threatened species identified as having the potential to occur within the study area. The desktop assessment relied primarily on database searches and the previous report to determine species, communities and species habitat relevant to the study area.

# 10.3.1.2 Database Searches

The DoEE protected matters search tool and the Queensland Government Wildlife Online database were utilised to determine species, communities and areas of conservation significance of potential relevance to the proposed development. Both searches included a 50km buffer around a central co-ordinate within the study area (-20.4469° S, 149.0430° E), which includes the entire study area as well as a large buffer incorporating similar habitats in the surrounding landscape.

The results of the database searches and their relevance to the proposed development are discussed in the results section of this report. NRC has developed an approach for ranking threatened species and communities recorded from the desktop searches in terms of their likelihood of occurring within the study area. The approach is based on the presence of local records and the habitat requirements for each species, which are recommended criteria for desktop impact assessment in State published survey guideline documents, such as *Eyre et al.* (2014). Details of the criteria used to assess the likelihood of occurrence for threatened and near threatened species are provided in **Table 10-1**. The potential impacts to threatened species that may occur within the study area are discussed in the Impacts Assessment section of this report. It is possible some locally occurring, near threatened or threatened species, may not be recorded in the State and Commonwealth databases. The comprehensive field survey component of this assessment is therefore an important aspect of the impact assessment process, in order to determine the presence of any threatened species that have not been previously recorded in the local area.

As part of the desktop assessment, the key diagnostic characteristics and condition thresholds specified in the Commonwealth listing advice for threatened ecological communities (TECs) listed under the EPBC Act were reviewed. The application of these criteria is discussed in the flora survey methodology section.

likelihood of occurring	key criteria	definition
Present	Present during survey or historical records in the study area	Species was recorded during field surveys or a historical record of the species was located in the study area
High	Known records (<50km) AND	Historical records of the species occur within a 50km radius of the study area
	Known to occur on islands or access islands in the region*	The species is known to occur on islands or can access islands in the region*
	AND Suitable habitat of high quality is present	Suitable habitat of high quality exists with the study area
Moderate	Known records (<50km) AND	Historical records of the species occur within a 50km radius of the study area
	Known to occur on islands or access islands in the region*	The species is known to occur on islands or can access islands in the region*
	AND Suitable habitat is present, but degraded	Suitable habitat is present but is significantly degraded or fragmented
Low	No records (<50km) OR	No historical records of this species occur within a 50km radius of the study area
	Not known to occur on islands or access islands in the region*	The species is not known to occur on islands or access islands in the region*
	OR	OR
	Habitat present is unsuitable, absent, or highly degraded	The habitat within the study area is not suitable and/or is in extremely poor condition, or is absent for the species

# Table 10-1. Key assessment criteria for likelihood of occurrence of threatened and near threatened species

\*Criterion relates to fauna species only

# 10.3.1.3 <u>Mapping</u>

The following mapping sources were reviewed as part of the desktop analysis:

- Regulated Vegetation Management Map (DNRM 2015);
- Geoscience Australia Proserpine SF 55-4 1:250000 Mapsheet (1971);
- Environmentally Sensitive Areas Map (EHP 2015b);
- Flora Survey Trigger Map;
- Essential Habitat mapping as shown on a Regulated Vegetation Management Map;
- Referable Wetlands; and
- Environment and heritage layers on the State Planning Policy interactive mapping.

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# 10.3.2 Nomenclature and Taxonomy

With the exception of technical descriptions and tables, all flora and fauna species are referred to by their common names throughout this report, with their scientific names given in brackets after the first reference. Scientific names for flora species within this report follow Bostock and Holland (2013). Where no common name is provided in reference texts, a search was conducted for other accepted common names, and if none were found then the scientific name only was used. An asterisk is used to denote species that are not native to Australia.

The use of scientific and common names for fauna species is in accordance with the following:

- Birds: Pizzey and Knight (2012);
- Amphibians: Vanderduys (2012);
- Reptiles: Wilson (2015);
- Mammals (except microbats): Van Dyck and Strahan (2008); and
- Microbats: Reardon *et al.* (2015).

# 10.3.3 Flora Survey Overall methodology

Techniques described in the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner *et al.* 2012) were used to collect sufficient data during the field vegetation assessments to verify the RE codes of the remnant vegetation in the assessment area. The key features recorded in the field relevant to this report are:

- Vegetation structure including height of each stratum and cover density;
- Key species within each stratum; and
- Geology, landform and other landzone characteristics.

The species composition and structure for each community were compared to the technical descriptions provided in the Regional Ecosystem Description Database (Queensland Herbarium 2015) (refer to **Figure 10-1**). The landzone characteristics of each site were compared to the descriptions provided in Wilson and Taylor (2012). This information provided the basis for determining the appropriate RE code for each community. The information in these documents was also used in conjunction with site observations to determine appropriate values for the factors relating to remnant status.

Vegetation surveys were conducted over three survey periods: July 2013, May 2015 and December 2015.

The purpose of these vegetation surveys was to:

- Determine the appropriate RE code, extent, and remnant status of vegetation communities throughout the study area;
- Perform targeted searches for threatened flora species identified during desktop analyses, including 'meander' searches in accordance with the Flora Survey Guidelines – Protected Plants (EHP 2014); and
- Compile a flora species inventory for the study area.





# 10.3.4 Vegetation Assessment Sites

# 10.3.4.1 <u>Site Selection</u>

Ground-truthing of the remnant and regulated regrowth vegetation mapping involved detailed assessments of vegetation characteristics at multiple transect locations within the study area (refer to **Figure 10-2**). Assessment sites were selected where they would provide representative data for the vegetation type that was the subject of the assessment. The location of the assessment sites and the survey techniques employed were selected to achieve the following:

- Validate the state published RE and regrowth mapping;
- Accurately determine the extent of each vegetation type;
- Resolve heterogeneous polygons;
- Determine the remnant status of vegetation; and
- Compile a species inventory for each vegetation community and the entire study area.

A total of five secondary, 14 tertiary, 14 quaternary, and 25 ground cover assessments were conducted over the two survey periods (**Table 10-2**), with sites distributed over the study area to encompass any potential changes in community composition or structure.

Vegetation assessment type	July 2013	May 2015	December 2015	total
Secondary	-	4	1	5
Tertiary	9	2	3	14
Quaternary	-	6	8	14
Grassland	22	3	-	25

Table 10-2. Vegetation assessments conducted during the survey periods.





# 10.3.4.2 Survey Techniques

#### Secondary and Tertiary Assessments

A 50m x 10m vegetation assessment transect was established at each of the secondary and tertiary assessment sites within the study area. Within these transects a combination of quantitative and qualitative techniques was employed. The vegetation survey techniques employed and attributes recorded during the assessments are detailed in **Table 10-3**. Quantitative measurements such as basal area (using the Bitterlich stick methodology, Grosenbaugh 1952) and canopy height and cover were used to describe the structural form of each community and determine the remnant status of the vegetation. Species composition and structure were used to determine the relevant RE code for each community.

#### **Quaternary Assessment Sites**

Quaternary assessment sites were conducted to validate the vegetation community mapping and to capture any variability in the structure and composition of the community. Data collected at Quaternary sites include all location, environmental and structural information for the dominant and conspicuous species in each layer. In general, focus was given to the dominant species, crown cover and median height of the ecologically dominant layer, which is used to define each community and determine the appropriate RE code.

Survey Method	Attributes Measured	
Survey Plot 50m x 10m	Key species of each stratum Median height of each stratum Weed species and cover Complete species list Central coordinate	
Transect 50m	Percentage cover of each stratum	
Quadrats (x5) 1m x 1m	Ground cover species and percentage of cover	
Greater area encompassing the present vegetation community	Tree basal area Incidental species observed Additional relevant notes	

Table 1	0-3.	Vegetation	attributes	measured i	n veo	etation	survev	transects.
	<u> </u>	<b>v</b> egetation	attinutes	incusurcu i	11 109	Clation	Juivey	ti unocoto.

# Grassland Assessment Sites

The species composition and structure of grassland areas was assessed using a 25m transect. Five 1m<sup>2</sup> quadrats were placed at five metre intervals along each transect and the relative cover of each ground cover species was recorded. The height and cover of emergent trees and shrubs were also recorded.

The Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in *Queensland* (Neldner *et al.* 2012) identifies the following criteria for determining remnant status of grassland communities:

- The community contains native species normally found in the RE; and
- The community is not dominated by non-native perennial species.

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The species composition of grassland communities was therefore assessed to determine the remnant RE status. Remnant status was assigned to grassland areas where the relative cover of native perennial species (normally occurring in the relevant RE) was greater than 50 per cent. Areas where non-native species comprised more than 50% of the ground cover were classified as non-remnant vegetation.

# 10.3.5 Vegetation Mapping

# 10.3.5.1 General Approach

Mapping of vegetation communities was performed using a combination of vegetation traverses and aerial imagery. Using the information gained at each of the vegetation assessment sites, and observations made when traversing the study area, the boundaries of vegetation communities were recorded using a handheld GPS device. Some vegetation mapping was also refined using current, high-resolution aerial images.

# 10.3.5.2 Key Diagnostic Characteristics and Condition Thresholds for Communities Listed Under the EPBC Act

The 2015 surveys focussed on accurately mapping the current spatial extent of TECs listed under the EPBC Act within the study area. Vegetation surveys and mapping techniques for TECs followed the previously described methodology. However, the key diagnostic characteristics and condition thresholds described in the Commonwealth listing advice for each TEC were considered when mapping the extent of these communities. These criteria differ to the remnant vegetation criteria under the VM Act (Qld) for regional ecosystem mapping. The ground-truthed and mapped spatial extent to which a remnant vegetation community equates to a RE under the VM Act (Qld) may not wholly equate to the same spatial extent to which that community is protected under the EPBC Act.

The 2015 surveys focussed on obtaining species composition and structure data from various locations within communities listed under the EPBC Act to facilitate assessment against key diagnostic characteristics and condition thresholds. Separate vegetation community mapping was produced where vegetation communities did not meet the condition thresholds for protection under the EPBC Act. This was completed using the general approach methodology described previously to delineate and exclude areas that did not meet condition thresholds (refer to **Appendix I** for further information).

# 10.3.6 Random Meander Technique

Various parts of the study area were traversed using the Random Meander technique documented by Cropper (1993) and recommended as the preferred approach in the *Flora Survey Guidelines – Protected Plants* (EHP 2014). This technique was applied to supplement other survey techniques and to:

- locate and record any flora species not identified in the vegetation assessment transects;
- target threatened flora species;
- validate vegetation community mapping; and
- determine the presence and extent of pest species.



# **10.4 Fauna Survey Methodology**

NRC is a registered scientific user with ethics approval to conduct fauna studies from the Department of Agriculture and Fisheries (DAF) and Animal Ethics Committee (AEC). The survey work involved in this report was conducted under Scientific Purposes Permit number WISP14046014. Survey work performed within the Lindeman Islands National Park estate areas was conducted under Scientific Purposes Permit number WITK16263815.

# 10.4.1.1 Survey Timing and Environmental Conditions

The fauna survey incorporated survey timing and effort recommendations outlined in the *Terrestrial Vertebrate Survey Guidelines for Queensland* (Eyre *et al.* 2014). Surveys were conducted over two different seasonal periods to identify seasonal variation in species presence, abundance and habitat utilisation. The first survey was conducted during autumn, from 11-15 May 2015. During autumn, the air is still moist which coincides with grass seeding and growing. Vertebrate activity is high as animals start to disperse and migrate due to the onset of decreasing temperatures (Eyre *et al.* 2014). The second survey was conducted during late-spring/early-summer from 30 November – 6 December 2015. The timing of this survey incorporates a period where temperatures begin to warm up after winter and there is a peak in vertebrate activity with the commencement of breeding activity for many species (Eyre *et al.* 2014). The second survey was also time to coincide with peak periods for migratory shorebird presence.

Weather data relevant to the fauna survey period were collected from the Bureau of Meteorology (BoM) Hamilton Island Airport weather station (station number 033106) and a summary is provided in **Table 10-4**. The weather before and during each fauna survey period was characterised by warm to hot days and cooler nights. Overall the weather conditions for each survey period were considered favourable for detecting most vertebrate fauna groups.

Devied	Date Rainfall		Temperature (°C)		
Period		Raimaii (mm)	MINIMUM	МАХІМИМ	Humidity
	04/05/2015	0	21.9	26.9	70
	05/05/2015	0	21.8	27.7	59
	06/05/2015	0	22.8	27.3	70
May 2015 Pre- survey	07/05/2015	0	23.0	27.6	74
	08/05/2015	0	20.8	23.7	42
	09/05/2015	0	20.7	25.0	51
	10/05/2015	0	21.5	25.7	71
	11/05/2015	0	21.1	25.9	56
May 2015 During	12/05/2015	0	21.6	25.5	54
Survey	13/05/2015	0	20.6	26.2	56
	14/04/2015	0	18.2	20.5	53

# Table 10-4. Weather conditions relevant to each fauna survey period.

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LINDEMAN GREAT BARRIER REEF RESORT PROJECT ENVIRONMENTAL IMPACT STATEMENT

				GR	ISLAND REAT BARRIER REEF
Deried	Dete		Temperat	l le una i al i de c	
Periou	Date	Rainian (inin)	МІЛІМИМ	MAXIMUM	Humaity
	15/05/2015	0	17.3	22.9	54
	24/11/2015	0	24.0	29.0	62
	25/11/2015	0	24.2	29.5	68
November -	26/11/2015	0	25.1	29.4	68
December 2015 Pre-survey	27/11/2015	0	23.7	32.0	77
	28/11/2015	0	24.5	32.4	71
	29/11/2015	0	25.2	30.5	58
	30/11/2015	0	24.0	29.5	65
	01/12/2015	0	24.5	29.8	69
Novombor	02/12/2015	0	24.8	29.8	71
November - December 2015 During Survey	03/12/2015	0	25.6	30.4	61
	04/12/2015	0	24.4	29.7	64
	05/12/2015	0.2	24.8	30.4	55
	06/12/2015	0	24.7	30.6	62

# 10.4.2 Systematic Survey Sites

Over the two survey period, six systematic survey sites were established where an array of fauna trapping and surveying techniques were employed. These systematic survey sites were located in a variety of different habitat types within the study area (refer **Table 10-5**).

Overall, the six systematic survey sites were positioned to provide an appropriate spatial distribution within the study area as well as encompassing the different habitat types. A description of the habitat present at each systematic survey site is provided in **Table 10-5**. The location of each systematic trapping site is depicted in the fauna survey map (refer to **Figure 10-3**).

Site number and location	Habitat description	Photograph of habitat
<ol> <li>Northwest section of the study area.</li> <li>Surveyed during the autumn 2015 survey event.</li> </ol>	Remnant RE 8.12.12d Eucalyptus woodland to open forest on hill slopes on igneous rocks. Low to moderate levels of microhabitat features in the form of hollow-bearing trees, loose bark and coarse woody debris and litter.	

Table 10-5. Habitat descriptions for systematic fauna survey sites

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Site number and location	Habitat description	Photograph of habitat
<ol> <li>Southwest section of the study area.</li> <li>Surveyed during the autumn 2015 survey event.</li> </ol>	Remnant RE 8.12.11c Coastal rainforest/vine-thicket community with a dense canopy and diverse structure and composition. Low to moderate levels of microhabitat features in the form of hollow-bearing trees, loose bark and coarse woody debris, litter. Generally high abundance of boulder and rock cover.	
3. Adjacent to the Gap Creek Dam wall. Surveyed during the autumn 2015 survey event.	Mature regrowth Eucalyptus and Pandanus forest on shallow rocky soils. Low levels of microhabitat features in the form of rocky habitats and hollow-bearing trees. High abundance of leaf litter.	
<ol> <li>Eastern side of the runway strip.</li> <li>Surveyed during the spring-summer 2015 survey event.</li> </ol>	Remnant RE 8.3.2 Melaleuca viridiflora woodland with dense native ground cover in low-lying area near drainage line. Approximately three to four years since fire. Low level of microhabitat features low and sparse structure of the woodland and relatively recent fire event. However, ground cover is very dense.	
<b>5.</b> North end of Gap Creek Dam. Surveyed during the spring-summer 2015 survey event.	Remnant RE 8.12.12d Mixed eucalypt woodland dominated by <i>E. platyphylla</i> . Adjacent to wetland habitat associated with Gap Creek Dam. Characterised by presence of flora species associated with wetter areas with poor drainage such as <i>Melaleuca</i> and <i>Pandanus</i> species. Low – moderate levels of microhabitat features including course wood debris and leaf litter.	
<ul> <li>6. Western site of golf course</li> <li>Surveyed during the spring-summer 2015 survey event.</li> </ul>	<b>Remnant RE 8.12.12d</b> Mixed eucalypt woodland on steep gradient dominated by <i>E. crebra</i> with a very sparse to sparse understorey and dense ground cover. Moderate to high levels of microhabitat features, mostly in the form of rocks, boulders and rocky outcrops.	





# 10.4.3 Survey Techniques

The survey techniques employed at each systematic survey site are detailed in **Table 10-6**. Some of these techniques were also used at other locations throughout the study area, and these are discussed in the following sections.

Survey Method	Description
Elliott traps	20 type A Elliott style traps were placed on the ground approximately 5-10m apart in a straight line for four nights at each of the trapping sites. All traps were baited with a mixture of rolled oats, peanut butter and honey.
Pitfall and Funnel traps	Drift fence lines incorporating pitfall and funnel traps were established for four nights at each of the systematic survey sites. At each of these sites, three pitfall traps (20 litre buckets) were buried flush with the ground surface with the drift fence intersecting the centre of each bucket. Six funnel traps were located along the drift fencing at each site. A shade cloth covering each funnel trap was deployed to protect trapped species from exposure.
	No pitfall-buckets were deployed at site S2 as the boulder and rocky substrate prohibited the use of this equipment. However, a drift fence was established with funnel traps within this habitat.
Cage traps	Four cage traps were placed at each site and baited with a mixture of rolled oats and a variety of different meats.
Anabat detectors	An Anabat SD2 detector was deployed for at least one night near each of the main trapping sites, and was also placed opportunistically in likely flyway zones at other targeted fauna surveys sites.
Active diurnal searches	Active diurnal searches were undertaken within each of the sites. This technique involved intensive investigation of ground layer habitat features (such as under logs, rocks and leaf litter), low vegetation (under bark and tree stumps) for cryptic fauna, particularly reptiles. The timing of searches was focussed on parts of the day when reptile activity was likely to be at its peak. Incidental observations made while conducting other survey techniques were also recorded.
Diurnal bird surveys	Birds were surveyed within each vegetation community for a total of at least one hour at multiple periods throughout the day, but with a particular focus during peak activity in the morning. Incidental observations made whilst conducting other survey techniques were also recorded. Birds were identified from either direct observation or by their calls.
Nocturnal surveys	High-powered spotlights were used to survey nocturnal mammals (flying, arboreal and terrestrial), birds (active nocturnal species, and roosting diurnal species), reptiles and frogs in each of the main trapping sites, as well as other locations throughout the study area.

Table 10-6: Fauna survey methods employed at systematic survey sites

# **10.4.4** Additional Survey Areas and Techniques

The systematic surveying and trapping sites were generally focussed on describing the biodiversity values of areas within the existing lease areas that may be subject to disturbance as part of the proposed development. In addition to the systematic survey sites, a number of additional survey sites were established to target specific areas and habitat types within the current lease and surrounding National Park areas. The purpose of the targeted habitat surveys was to identify the biodiversity values of the broader area, including the National Park, and incorporate these values into the impact assessment process and project environmental management strategies. The location and a description of the habitat type for each of the targeted fauna survey sites is provided in **Table 10-7**. During the fauna survey period the Anabat detector was deployed and active diurnal



GREAT BARRIER REEL

search, diurnal bird survey and nocturnal survey techniques were performed at additional locations outside the systematic and targeted survey sites. The locations of these are depicted in **Figure 10-3**.

In addition to the techniques outlined previously, camera traps (motion-sensing infrared cameras) were utilised at multiple locations within the study area to target fauna that may be too large or 'shy' to be detected by other trapping techniques, or utilising areas outside of the main trapping sites. Camera traps were baited with the rolled oat mixture, fruit, nuts and a variety of meats. Targeted searches for nocturnal fauna were performed in areas considered higher quality habitat for such species. These areas included the rocky hill habitats along the coastline.

Fauna species were continually observed throughout the survey period and records were frequently obtained outside of the systematic methodology of the survey. Any observations, tracks, scats or other signs of fauna were recorded with reference to the location and habitat type within the study area.

Site number and location	Habitat description	Photograph of habitat	
<b>T1.</b> North of the runway strip in adjacent National Park tenure. Surveyed during the spring-summer 2015 survey event.	Remnant RE 8.12.14c <i>Eucalyptus/Lophostemon</i> woodland to open forest on hill slopes with mid-dense sub- canopy layers often dominated by dry rainforest species. This site is near the ecotone of several vegetation communities including mixed eucalypt woodland, <i>L.</i> <i>confertus</i> open forest and vine-thicket gullies. Low to moderate levels of microhabitat features in the form of hollow-bearing trees, loose bark and coarse woody debris. Vegetative ground cover is very low with a dense layer of leaf litter.		
T2. Northeast of current lease areas in adjacent National Park tenure. Surveyed during the spring-summer 2015 survey event.	Remnant RE 8.12.14c Lophostemon confertus open forest on steep hill slope with mid-dense sub-canopy layers dominated by dry rainforest species. Low to moderate levels of microhabitat features in the form of hollow-bearing trees, loose bark and coarse woody debris. Vegetative ground cover is very low with a dense layer of leaf litter.		
<b>T3.</b> Southwest section of lease areas in native grassland adjacent to golf course. Surveyed during the spring-summer 2015 survey event.	Remnant RE 8.12.13a Native grassland dominated by <i>Heteropogon</i> <i>contortus</i> on steep hill slope with southeast aspect. Very low levels of microhabitat features with occasional rocks and very dense ground cover. Shrub and tree layers virtually absent.		

#### Table 10-7: Habitat descriptions for targeted fauna survey sites

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		GREAT DARRIER REEL
Site number and location	Habitat description	Photograph of habitat
<b>T4.</b> Southeast section of lease area in native grassland near water tower. Surveyed during the spring-summer 2015 survey event.	Remnant RE 8.12.13a Native grassland dominated by <i>Imperata</i> <i>cylindrica</i> on steep hill slope with southern aspect. Very low levels of microhabitat features with occasional rocks and very dense ground cover. Shrub and tree layers virtually absent.	
<b>B1.</b> Various viewpoints around Gap Creek Dam (particularly at point marked as B1 on the flora survey map).	Wetland Habitat This site was repeatedly surveyed for wetland birds over the course of all survey events. This large water body contains aquatic vegetation, foraging and roosting habitat for wetland bird species.	

# 10.4.5 Targeted Techniques

# 10.4.5.1 Coastal Sheathtail Bat

Targeted techniques were used to increase the likelihood of detection for the Coastal Sheathtail Bat (*Taphozous australis*), which is near threatened under the NC Act. Targeted searches for this species followed the '*Targeted Species Survey Guidelines: Taphozous australis*' published by the State of Queensland. The guidelines recommend spending one hour per two kilometres of rocky coastline within the study area to find caves, boulder piles, and fissures that contained roosting bats.

# 10.4.5.2 Northern Masked Owl

Even though the Northern Masked Owl (*Tyto novaehollandiae kimberli*) was not regarded as likely to occur in the study area (see discussion in later sections), call play-back techniques were used during nocturnal surveys, as this is known to be an effective method for increasing the likelihood of detecting this species. Call play-back for the Northern Masked Owl was typically conducted at the beginning of each spotlighting (nocturnal survey) session, using the methodology recommended by Ward (2010), as follows:

- 1. The call of the Northern Masked Owl was broadcast.
- 2. For the first five minutes of the broadcast, the survey team listened for calls of Masked Owls and watched for birds flying in to the area around the speaker (without the use of spotlights).
- 3. In the second five minutes, the survey team continued to listen for owl calls, spotlights were also used to look for owls in the trees around the site.
- 4. During subsequent spotlighting surveys, the survey team continued to listen and spotlight for owls, while also searching for other nocturnal species.



#### 10.4.5.3 Greater Large-eared Horseshoe Bat

The Greater Large-eared Horseshoe Bat (*Rhinolophus philippinensis*) was considered to have at least some potential to occur within the study area based on the desktop results (see below). This species has a distinct echolocation call, so would have a high probability of detection using bat detectors. Anabat detectors were deployed at the systematic sampling sites, as well as additional sites within the study area to increase the likelihood of detection for this species.

# 10.4.5.4 Shorebirds

Shorebird surveys were conducted at multiple locations where suitable habitat was present for these species to forage. These locations are depicted on **Figure 10-3**, and include the resort beaches, Coconut Beach, Gap Beach and an unnamed beach to the south of Coconut Beach. Shorebird surveys were focussed during low tide periods when intertidal areas are exposed providing greater foraging habitat. The surveys involved using binoculars to scan beaches, intertidal areas and rocky shorelines for bird species. The purpose of these surveys was to identify the presence of shorebird species and their use of shoreline habitats in the study area and surrounding National Park land. These techniques were also used to target species of conservation significance with potential to occur, such as those listed as threatened or migratory under State and Commonwealth legislation. Particular focus was given to this survey technique during the spring-summer surveys (November-December 2015), as this survey period coincides with the presence of migratory shorebird species in the region.

# 10.4.6 Survey Effort

The survey effort employed for each of the aforementioned techniques is outlined in **Table 10-8**, showing the effort employed at each systematic survey site and the total survey effort over the period (including effort outside the systematic surveys).

Method	Effort per site – Autumn	Effort per site – SPRING/SUMMER	Total survey effort
Pitfall trapping	12 trap nights (Array of three pits for four nights)	15 Trap nights for sites S5 and S6. 18 Trap nights for site S4 (Array of three pits for five nights at S5 and S6, and 6 nights at S4)	72 trap nights*
Funnel trapping	24 trap nights (Array of six funnels for four nights)	24 trap nights for systematic sites and 12 trap nights for targeted sites (Array of six funnels for four nights at systematic trap sites and two nights for targeted trap sites)	168 trap nights
Elliott trapping	80 trap nights (Array of 20 traps for four nights)	120 trap nights for systematic sites and 30 trap nights for targeted sites (Array of 20 traps for four nights at systematic trap sites and three nights for targeted trap sites)	720 trap nights
Cage trapping	12 - 16 trap nights (Array of three - four cages for four nights)	24 trap nights (Four cages for six nights)	112 trap nights
Camera Trapping	Four trap nights (One camera x four nights)	Six trap nights (One camera for six nights)	30 trap nights

#### Table 10-8: Fauna survey effort for each technique

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			ISLAND great barrier reef
Method	Effort per site – Autumn	Effort per site – SPRING/SUMMER	Total survey effort
Anabat call detector	One detector night (One detector for one night)	One detector night (One detector for one night)	Ten detector nights (including additional detector nights outside survey sites)
Diurnal active search	Three person hours (30 minute search x three people x two events)	Two person hours (30 minute search x two people x two events)	Approx. 25 person hours (Three at each systematic survey site plus min 10 minutes at 24 additional active search sites)
Diurnal bird survey	Three person hours (Six x 10 minute surveys x three people)	Three person hours (Six x 20 minute surveys x two people)	Approx. 34 person hours (18 person hours at systematic survey sites plus 16 additional person hours outside survey sites)
Spotlight/ nocturnal searches	Six person hours (two hour search x three people)	Four person hours (two hour search x two people)	48 person hours (30 person hours at systematic survey sites plus 18 additional person hours outside survey sites)
Call playback (owls)	Minimum 10 minutes call playback session at each site plus subsequent spotlight surveys	Minimum 10 minutes call playback session at each site plus subsequent spotlight surveys	Nine call playback sessions (>10 minutes each)
Shorebird survey	One hour surveys were conducted two times at the resort beaches and the unnamed beach near site 1	One hour surveys were conducted two times at the resort beaches and the unnamed beach near site 1, and once at Coconut Beach and Gap Beach	10 surveys at four different shoreline areas – total 10 hours

\*Pitfall traps were not established at Site 2 due to the rocky substrate at this site.



# 10.5 Flora Survey Results

# 10.5.1 Vegetation Communities

# 10.5.1.1 EPBC Act Threatened Ecological Communities

The results of the 2015 surveys support the findings of the previous survey conducted in 2013 and the outcomes of the current desktop assessment. Two Threatened Ecological Communities (TECs) listed under the EPBC Act were identified within the study area (**Figure 10-4**):

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia; and
- Broad Leaf Tea-tree (*Melaleuca viridiflora*) Woodlands in High Rainfall Coastal North Queensland.

No other TECs listed under the EPBC Act were identified within the study area.

The 2015 surveys focussed on obtaining species composition and structure data from various locations within these communities to provide detailed technical descriptions for each community (refer to **Table 10-9**). These surveys also focussed on accurately mapping the spatial extent of these communities within the study area as they pertain to protection under the EPBC Act. In this regard, assessment against the key diagnostic characteristics and condition thresholds specified in the Commonwealth listing advice for each community (and presented in the Methodology section of the technical report included in **Appendix I**) was required.

# Littoral Rainforest and Coastal Vine Thickets of Eastern Australia Community

The critically endangered Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community was confirmed present within the lease area and surrounding National Park land. Within the lease area, this community occurs mainly as small fragments restricted to the steep rocky slopes and gullies along the coastline. However, this community occurs as much larger patches in the surrounding National Park land, with one relatively large polygon ground truthed along the west coast adjacent to the lease area. The ground-truthed extent of this community is shown as RE 8.12.11a in **Figure 10-2** and **Appendix I**. The vegetation community assessments revealed the full extent of this RE is consistent with the key diagnostic characteristics and the condition thresholds specified in the Commonwealth listing advice for this community. The species composition and structure of this community are discussed in the following sections of this report.

# Broad Leaf Tea-tree (Melaleuca viridiflora) Woodlands in High Rainfall Coastal North Queensland Community

The December 2015 survey confirmed the presence of Broad leaf tea-tree communities on the margins of the runway strip, as identified in the State regional ecosystem mapping and previous field survey events. The field survey effort in December 2015 was focussed on assessing the species composition and condition of this community and mapping the extent based on these attributes. The extent of Broad leaf tea-tree vegetation was found to be significantly greater than shown on the State published RE mapping, and the ground-truthed extent of this community as it relates to remnant vegetation under the VM Act (RE 8.3.2) is discussed further in this report. It is important to note that the ground-truthed extent of RE 8.3.2 does not wholly equate to the extent of the Broad Leaf Tea-tree (*Melaleuca viridiflora*) Woodlands in High Rainfall Coastal North Queensland TEC listed under the EPBC Act (see Broad Leaf Tea-tree Community in **Figure 10-4**). Field assessments based on the condition thresholds specified in the Commonwealth listing advice for this community revealed much of this vegetation community does not meet those criteria for protection under the EPBC Act.



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The full extent of Broad leaf tea-tree vegetation on the western side of the runway strip is highly degraded, mostly due to invasion by the exotic grass species Guinea grass (*Megathyrsus maximus\**). The ground cover in the majority of this patch is dominated by this exotic species, with a relative cover substantially greater than 50 per cent. Only a few small areas that are not dominated by Guinea grass remain in this patch, but all of these are significantly smaller than one hectare and therefore do not retain sufficient conservation value to be part of the listed community. Given this patch is highly degraded and does not meet the condition thresholds for protection under the EPBC Act, the patch of Broad leaf tea-tree vegetation on the western side of the runway strip has been excluded from the TEC mapping.

The majority of the Broad leaf tea-tree vegetation on the eastern side of the runway strip is in relatively good condition. While there is some exotic species invasion, particularly along its margins, the vast majority of the large patch on the eastern side of the runway strip is dominated by native grasses in the ground layer and meets the condition thresholds for protection under the EPBC Act (refer to **Figure 10-4** and **Appendix I**). However, some areas around the margins of this vegetation community are dominated by Guinea grass, with greater than 50% cover in the ground layer, and these areas have been excluded from the TEC mapping.

Overall, the total area of the Broad leaf tea-tree vegetation community within the study area is 12.85 hectares. However, only 5.38 hectares are consistent with the Broad Leaf Tea-tree (*Melaleuca viridiflora*) Woodlands in High Rainfall Coastal North Queensland TEC listed under the EPBC Act. The species composition and structure of this community are discussed in the following sections of this report. Potential impacts to this community are identified in the Impact Assessment section of this chapter.





# 10.5.2 Vegetation Management Act 1999 Regional Ecosystems

Ground-truthing of the remnant vegetation within the study area revealed there are five remnant REs present. They are: 8.3.2, 8.12.11a, 8.12.12d, 8.12.13a and 8.12.14c (refer to **Table 10-9**). The vegetation types within the study area and surrounding National Park land are eucalypt woodland to open forest, Broad leaf tea-tree woodland, native grasslands, and coastal vine thicket to dry rainforest. There are also areas of non-remnant grassland within the study area, which are dominated by exotic species, particularly Guinea grass. Some vegetated areas surrounding the golf course contain regrowth of native vegetation communities and are typically comprised of species consistent with RE 8.12.12d.

The majority of the study area is eucalypt woodland (RE 8.12.12d), which is dominated by Poplar gum (*Eucalyptus platyphylla*), Clarkson's bloodwood (*Corymbia clarksoniana*) and Narrow-leaved ironbark (*Eucalyptus drepanophylla*) and occasionally Queensland Blue Gum (*Eucalyptus tereticornis*). The subcanopy and shrub layers general very sparse and are comprised of species such as Rusty pittosporum (*Pittosporum ferrugineum*), Black Wattle (*Acacia spirorbis subsp. solandri*), Soap tree (*Alphitonia excelsa*) and canopy species. The ground layer is typically dense and dominated by native grasses, particularly Kangaroo grass (*Themeda triandra*), Blady grass (*Imperata cylindrica*) and Black speargrass (*Heteropogon contortus*). Overall, with the exception of exotic species invasion on the boundaries of previously cleared areas, the condition of this community is highly intact.

Coastal vine thicket (RE 8.12.11a) occurred where the terrain was characterised by shallow rocky soil and steep coastal slopes and gullies. The vine thicket canopy contained a variety of species, but was frequently dominated by a variety of Ficus species (particularly *Ficus virens* in rocky gullies), Brown Tulip Oak (*Argyrodendron polyandrum*) and *Acacia spirorbis* subsp. *solandri* with emergent Hoop pines (*Araucaria cunninghamii*) occasionally present. Common sub-canopy species include *Cleistanthus (Cleistanthus dallachyanus*), Python Tree (*Gossia bidwillii*), Coastal Boodyarra (*Aglaia elaeagnoidea*), Wild prune (*Sersalisia sericea*) and Chain fruit (*Alyxia spicata*). This community occurs in rocky areas and the ground cover is generally sparse and dominated by species such as Basket fern (*Drynaria sparsisora*), Common maidenhair fern (*Adiantum atroviride*), Saw sedge (*Gahnia aspera*) and Scrub pigeon grass (*Setaria australiensis*). Vegetation surveys within the study area revealed this community is highly intact where it occurs in relatively large (>1ha) patches. This community is subject to exotic species invasion along its margins and consequently many smaller patches are in poor condition. Patches near the existing resort infrastructure are subject to significant exotic species invasion, particularly the lower vegetation strata.

Many of the coastal slopes with a southerly aspect contained patches of native grasslands (RE 8.12.13a) dominated by Kangaroo grass, Blady grass and Black speargrass in some areas. All areas of native grassland are surrounded by non-native grassland vegetation dominated by Guinea grass, with other exotic species commonly present including Bidens (*Bidens alba var. radiata*\*), Lantana (*Lantana camara*\*), Streaked rattlepod (*Crotolaria pallida*\*) and Sensitive weed (*Mimosa pudica*\*). All areas of native grassland are subject to some degree of invasion by these exotic species. In general within the lease areas, only the very steep exposed slopes with a south or southeast aspect on the southern headlands support intact native grassland with a high proportion of native grass cover. All other areas within the lease areas are in poor condition due to exotic species invasion. By contrast, rapid assessments on the slopes of Mt Oldfield in the adjacent National Park land revealed these native grasslands to be highly intact, with very minimal exotic species invasion and a species composition highly consistent with the RE description.

As discussed previously for TECs under the EPBC Act, Broad leaf tea-tree vegetation consistent with RE 8.3.2 is present in the flat plains surrounding the runway strip. The canopy of this community is dominated by Broad



leaf tea-tree with Poplar gum occasionally present in the canopy and as an emergent. The lower strata are dominated by juvenile canopy species and Beach pandanus (*Pandanus tectorius*) with Lantana common in the shrub layer throughout most areas. The grassy ground layer is dense with a patchy species composition, with each area typically dominated by a single species. The main native grasses present are Kangaroo grass, Blady grass, Black speargrass and Golden beardgrass (*Chrysopogon fallax*). The extent of the TEC mapping for this community is consistent with the area where native grasses are dominant (refer to **Appendix I**). All other areas are dominated by Guinea grass in the ground layer. The presence of exotic species in the ground layer does not affect the status of this community under the VM Act, as the main criteria for remnant vegetation are related to the canopy layer.

RE 8.12.14c occurs on hill slopes in the National Park land surrounding the study area, particularly on the western side of Mt Oldfield and the rock gullies on the track to Gap Beach. The canopy of this closed forest community is typically dominated by Brush box (*Lophostemon confertus*) with other species such as Queensland blue gum associated or sub-dominant in the canopy. Shrub and low tree layers are sparse to middense and include species such as *Acacia spirorbis* subsp. *solandri*, Rusty pittosporum, Red Kamala (*Mallotus philippensis*), Grey bollywood (*Neolitsea brassii*), Black sheoak (*Allocasuarina littoralis*) and Lantana. This community is more dense than 8.12.12d and consequently the ground cover is very sparse and typically comprised of recruiting canopy species as well as Common maidenhair fern, Wombat berry (*Eustrephus latifolius*), Razor grass (*Scleria sphaceolata*), Running mountain grass (*Oplismenus compositus*) and Saw sedge. There is generally a dense layer of leaf litter throughout this community.

RE 8.3.2 has an endangered VM Act class and biodiversity status, and RE 8.12.13a has an 'of concern' VM Act class and biodiversity status. All other REs identified have a 'least concern' VM Act class and biodiversity status. The potential impacts of the proposed development on vegetation communities are discussed in the Impact Assessment section of this chapter. The floristic composition and structure of these communities is described in **Table 10-1** and represented in **Figure 10-2**.

An application to update the spatial extent of RE 8.3.2 on the state mapping to reflect the results of the groundtruthing surveys, by means of a PMAV for land outside of National Park, was submitted to DNRM on 21 December 2016 and was subsequently approved on 31 May 2017 (**Figure 10-5**). For land within the National Park the proponent has been liaising with the Queensland Herbarium to progress mapping updates.





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# 10.5.3 Non-remnant Vegetation

Most non-remnant vegetation is located throughout the existing disturbed areas of the resort, runway strip and golf course. Vegetation associated with resort gardens, maintained lawns, the golf course and the runway strip has been excluded from the remnant vegetation mapping due to an absence, or very low cover, of native species. As previously described, all non-remnant grassland areas have also been excluded from the remnant vegetation mapping. Exotic grasses, particularly Guinea grass, dominated these areas with scattered native and exotic shrubs and trees. Other common exotic species in disturbed areas include Bidens, Lantana, Sensitive weed, Streaked rattlepod and Leucaena (*Leucaena leucocephala*). As described in the methodology in **Appendix I**, grassland areas with greater than 50% cover of non-native species are shown as non-remnant on the ground-truthed Regional Ecosystem Map (refer to **Figure 10-2**). Some areas containing woody vegetation were also excluded from the remnant vegetation mapping such as ornamental gardens throughout the resort and golf course areas. Some areas of native regrowth occur in close proximity to the golf course and infrastructure for Gap Creek Dam and these areas are not mapped as remnant vegetation, as they do not meet the relevant height or cover criteria for remnant status.

# 10.5.4 Flora Species

A total of 158 flora species from 55 families were recorded from the various vegetation assessments within the study area. The majority of flora species observed throughout the study area are common and widespread throughout the region in coastal eucalypt woodland and vine thicket communities. The floristic composition is generally consistent within each vegetation community, with some variation due to changes in topography. There is disturbance on the margins of many remnant vegetation areas with edge effects such as exotic species invasion evident. A full list of flora identified during the flora surveys is included in **Appendix I**, which includes details of the RE in which each species was observed.

# 10.5.4.1 Threatened Flora Species

No threatened or near threatened flora species (as listed under the EPBC Act or NC Act) were identified during the vegetation surveys, despite targeted survey effort in potentially suitable habitat areas. The potential for impacts to threatened and near threatened flora species is discussed further in the impact assessment section of this chapter.

# 10.5.4.2 Pest Plant Species

Pest plant species were common throughout the study area, particularly in the non-remnant vegetation communities. Pest species commonly occurring in a variety of habitats within the study area include Guinea grass, Lantana, Sensitive weed, Bidens, Chinese burr (*Triumfetta rhomboidea*\*), Balloon cotton bush (*Gomphocarpus physocarpus*\*), Common centro (*Centrosema molle*\*), and Snake weed (*Stachytarpheta cayennensis*\*).

Leucaena is present in eucalypt woodland and native grassland areas along the margins of existing disturbance areas. A control program for this species has recently taken place (early 2015) and has significantly reduced the cover of this species in the resort area. However, some large patches still remain (e.g. at the western end of the cross-strip runway) and regeneration where control has taken place was evident during the December 2015 surveys.



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Grader grass (*Themeda quadrivalvis*<sup>\*</sup>) is known to occur in disturbed areas on Lindeman Island, and the field surveys confirmed the presence of this species within the study area. The largest area of Grader grass occurs at the eastern end of the cross-strip runway, surrounding a drainage area on the southern side.

Three restricted species were observed during the field surveys: Giant rat's tail grass (*Sporobolus sp.\**), Singapore daisy (*Sphagneticola trilobata\**) and Lantana. Giant rat's tail grass was not recorded anywhere within the lease areas, but was observed at a few locations along the National Park track to 'Boat Port' and has likely been introduced by visitors using the track. Giant rat's tail grass is a restricted invasive plant under the *Biosecurity Act (2014)*. Lantana is a restricted invasive plant under the *Biosecurity Act (2014)*. Lantana is a restricted invasive plant under the *Biosecurity Act (2014)*. Lantana is a restricted invasive plant under the *Biosecurity Act (2014)* that occurs in all communities surveyed within the study area. Singapore daisy is also a restricted invasive plant that was observed in resort garden areas and adjacent coastal vine thicket vegetation near existing resort infrastructure on the southern coastline. Implications and recommendations regarding the presence of pest species are discussed in the following sections of this report.

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#### Table 10-9. Floristic composition and structure of Regional Ecosystems within the study area.

#### Floristic composition and structure **Representative Photograph Description and status** RE 8.3.2 E: Very Sparse 12.5 m Melaleuca viridiflora var. Eucalyptus platyphylla (D) viridiflora woodland. T1: Sparse 7.7 m - 12.2 m Eucalyptus platyphylla Melaleuca viridiflora var. viridiflora occurs as an occasional (D), Eucalyptus platyphylla (A-SD), emergent. The dominant and Pandanus tectorius (A-SD) canopy species are Melaleuca viridiflora var. T2: Very Sparse 4.5 m viridiflora, Eucalyptus Melaleuca viridiflora var. viridiflora platyphylla, Pandanus (D), Pandanus tectorius (SD), tectorius, and Pittosporum Pittosporum ferrugineum (SD), ferrugineum. There is a Cupaniopsis anacardioides (A) and very sparse shrub layer, Mallotus philippensis (A) which includes Melaleuca S: Very sparse 1.8 m viridiflora var. viridiflora, Pittosporum ferrugineum, Melaleuca viridiflora var. viridiflora Mallotus philippensis and (D), Pandanus tectorius (SD), and Lantana camara\*. The Pittosporum ferrugineum (SD), ground layer is typically Cupaniopsis anacardioides (A), dense and varies due to Lantana camara\* (A-D), Pittosporum the extent of exotic ferrugineum (SD), Eucalyptus species invasion, with platyphylla (A), Passiflora foetida\* (A), many areas dominated by Jagera pseudorhus (A), Centrosema Megathyrsus maximus\*, molle\* (A), Ficus opposita (A), but some areas on the Cupaniopsis anacardioides (A), eastern side of the runway Mallotus philippensis (A), Neolitsea strip are dominated by brassii (A) one or more of the G: Imperata cylindrica, Themeda following native species: triandra, Heteropogon contortus, Imperata cylindrica, Chrysopogon fallax, Megathyrsus Themeda triandra, maximus\*, Mimosa pudica\*, Heteropogon contortus Eustrephus latifolius, Dianella and Chrysopogon fallax. longifolia, Cyanthillium cinereum, Occurs in low-lying terrain Smilax australis and Ageratum on the margins of the conyzoides\*, Triumfetta rhomboidea\*, existing runway strip. Oplismenus compositus, Cassytha filiformis VM Act Status: Endangered **Biodiversity Status:**

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Endangered EPBC Act Status: Endangered

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# Description and status

#### Floristic composition and structure

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# RE 8.12.11a

Vine thicket and littoral rainforest. Dominant canopy species include Ficus vivens, Acacia spirorbis subsp. solandri, and Argyrodendron polyandrum. The shrub and low tree layers includes species such as Alyxia spicata, Planchonella pohlmaniana, Acronychia laevis, Diospyros compacta, Acacia spirorbis subsp. solandri, Pleiogynium timorense. Aglaia elaeagnoidea. Clerodendrum floribundum, Cleistanthus dallachyanus, Gossia bidwillii, Cupaniopsis anacardioides, and Lantana camara\*. The ground layer is sparse, with species such as Setaria australiensis, Drynaria rigidula, Drynaria sparsisora, Alyxia spicata, and Dendrobium discolor.

Found in rocky and steep sloped areas on the southern and western coastline.

VM Act Status: Least concern

Biodiversity Status: No concern at present

EPBC Act Status: Critically endangered

#### T1: Mid-dense 14.4 m

Ficus virens (CD), Acacia spirorbis subsp. solandri (CD), Argyrodendron polyandrum (SD), Pleiogynium timorense (A), Paraserianthes toona (A), Schefflera actinophylla (A)

T2: Mid-dense 7.5 m

Acacia spirorbis subsp. solandri (CD), Alyxia spicata (CD), Diospyros compacta (CD), Planchonella pohlmaniana SD), Gossia bidwillii (SD), Cleistanthus dallachyanus (SD), Acronychia laevis (A) Paraserianthes toona (A), Jagera pseudorhus (A), Aglaia elaeagnoidea (A), Clerodendrum floribundum (A), Sersalisia sericea (A)

S: Very sparse 2.5 m

Alyxia spicata, (CD) Gossia bidwillii (CD), Cupaniopsis anacardioides (CD), Cleistanthus dallachyanus (CD), Clerodendrum floribundum (CD), and Acacia spirorbis subsp. solandri (CD), Drypetes deplanchei (A), Trophis scandens (A), Hoya australis (A), Pandorea pandorana (A)

**G**: Setaria australiensis (CD), Drynaria rigidula (CD), Drynaria sparsisora (CD), Alyxia spicata (CD), and Dendrobium discolor (SD), Peperomia blanda var. floribunda (SD), Adiantum atroviride (A-SD), Gahnia aspera (A-SD)



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#### Description and status

#### Floristic composition and structure

GREAT BARRIER REEF

#### RE 8.12.12d

Eucalyptus/Corymbia woodland to open forest. Common co-dominant species include Corymbia tessellaris, Eucalyptus platyphylla, C. dallachiana, E. drepanophylla, and E. tereticornis. A secondary tree layer is sometimes present, usually consisting of Corymbia spp. and Eucalyptus spp. The ground layer is grassy, and is commonly dominated by species such as Imperata cylindrica, Themeda trianda, Megathyrsus maximus\*, Bidens alba var. radiata\*, Lomandra longifolia, Mimosa pudica\*, and Eustrephus latifolius

Found throughout the majority of the study area on landzone 12 (igneous) geologies.

VM Act Status: Least concern

**Biodiversity Status:** No concern at present

#### EPBC Act Status: Not Listed

T1: Mid dense 13.1 m

Eucalyptus platyphylla (CD-D), Eucalyptus drepanophylla (CD-D), Corymbia clarksoniana (CD), Corymbia tessellaris (CD), Lophostemon confertus (A), Corymbia intermedia (A), Corymbia dallachiana (A), and Eucalyptus tereticornis (A)

T2: Mid dense 5.4 m

Acacia spirorbis subsp. solandri (CD), Corymbia dallachiana (CD), Eucalyptus platyphylla (CD), Eucalyptus drepanophylla (CD), Alphitonia excelsa (CD), Pittosporum ferrugineum (CD), Cupaniopsis anacardioides (A-CD), Jagera pseudorhus (A-CD), Bursaria tenuifolia (A), and Sersalisia sericea (A), Allocasuarina littoralis (A), Melaleuca viridiflora var. viridiflora (A), Mallotus phillipensis (A)

S: Very sparse 2.5 m

Lantana camara\* (CD), Pittosporum ferrugineum (CD), Mallotus philippensis (CD), Ficus opposita (CD) and occasional recruitment of canopy species

**G:** Imperata cylindrica, Themeda trianda, Megathyrsus maximus\*, Bidens alba var. radiata\*, Lomandra longifolia, Mimosa pudica\*, Centrosema molle\* and Eustrephus latifolius


LINDEMAN GREAT BARRIER REEF RESORT PROJECT ENVIRONMENTAL IMPACT STATEMENT

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Description and status	Floristic composition and structure	Representative Photograph
Description and status RE 8.12.13a Native grassland on southern facing slopes. A very sparse shrub layer of Lantana camara*, Pittosporum ferrugineum, Ficus opposita, Eustrephus latifolius, and Passiflora foetida*. Dense gound cover of 0.3-1.0 m consisting of	Floristic composition and structure S: Very Sparse 2.5 m Lantana camara*(CD), Pittosporum ferrugineum (CD), Ficus opposita (CD), Eustrephus latifolius (A), and Passiflora foetida* (A). G: Imperata cylindrica (D), Themeda triandra (SD), Heteropogon contortus (SD), Megathyrsus maximus* (SD), Bidens alba var. radiata (SD), Eustrephus latifolius (A), Cassytha pubescens (A-SD), *, Passiflora suberosa* (A), Passiflora foetida* (A), and Lantana camara* (A).	<image/>
Imperata cylindrica, Themeda triandra, Megathyrsus maximus, Eustrephus latifolius, Cassytha pubescens, Bidens alba var. radiata*, Passiflora suberosa*, Passiflora foetida*, and Lantana camara*.		
Mostly found on slopes with southern aspect near the coastline.		
VM Act Status: Of concern		
Biodiversity Status: Of concern		
EPBC Act Status: Not Listed		

#### LINDEMAN GREAT BARRIER REEF RESORT PROJECT ENVIRONMENTAL IMPACT STATEMENT

#### **Description and status**

#### Floristic composition and structure

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#### **Representative Photograph**

#### RE 8.12.14c

Open forest with canopy dominated by Lophostemon confertus, Eucalyptus tereticornis and Acacia spirorbis subsp. solandri. The low tree and shrub layers are typically mid-dense and dominated by species such as Lophostemon confertus, Acacia spirorbis subsp. solandri, Pittosporum ferrugineum, Mallotus philippensis, Neolitsea brassii, Allocasuarina littoralis and Lantana camara\*. The around cover is verv sparse and typically comprised of recruiting canopy species as well as Adiantum atroviride, Eustrephus latifolius, Scleria sphaceolata, Oplismenus compositus and Gahnia aspera. There is generally a dense layer of leaf litter throughout this community.

Located on hillslopes and broad gullies in the surrounding National Park land.

VM Act Status: Least concern

**Biodiversity Status:** No concern at present

**EPBC Act Status:** Not Listed

E: Very Sparse 19.5 m Eucalyptus tereticornis occasional

emergent throughout this community.

T1: Mid-dense 12 m

Lophostemon confertus (D), Eucalyptus tereticornis (SD), Acacia spirorbis subsp. solandri (A).

T2: Mid-dense 6 m

Lophostemon confertus (CD), Acacia spirorbis subsp. solandri (CD), Pittosporum ferrugineum (CD), Mallotus philippensis (SD), Neolitsea brassii (A), Allocasuarina littoralis (A), Diosporus herbecarpa (A).

S: Sparse to mid-dense 2.5 m

Mallotus philippensis (CD), Neolitsea brassii (CD), Pittosporum ferrugineum (SD), Eustrephus latifolius (A), Lantana camara (A).

G: Adiantum atroviride, Eustrephus latifolius, Scleria sphaceolata, Oplismenus compositus and Gahnia aspera.





# 10.6 Fauna Survey Results

#### 10.6.1 Fauna Habitat

#### 10.6.1.1 Vegetation

The remnant vegetation throughout the study area is primarily woodland dominated by *Corymbia* and *Eucalyptus* species. Small patches of coastal vine thicket occur on the steep rocky slopes of the coast and native grasslands are scattered throughout the study area. These main remnant vegetation types are generally intact, with minimal evidence of disturbance to the canopy layer. The density of the sub-canopy and shrub layers varies over the study area from virtually absent to mid-dense. The ground layer is generally dense and dominated by native grasses. Disturbance from exotic species invasion is prevalent along the margins of remnant areas, with some patches of exotic species also scattered within remnant woodland and grassland areas. Non-remnant areas have very low flora species richness and are frequently dominated by one or two non-native species. The study area consists of remnant and non-remnant vegetation, providing habitat features for fauna species in the form of tree hollows, loose bark, coarse woody debris, boulders, crevices and rock piles. The presence of highly mobile fauna species (such as birds and bats) is likely to be influenced by seasonal characteristics such as rainfall, with these species foraging when suitable trees are flowering or fruiting.

### 10.6.1.2 Habitat Features

Habitat features vary across the study area and are largely influenced by vegetation type and topography. Overall, habitat values for most faunal groups are moderate in the majority of the study area and higher around the rocky coastal slopes and within the denser RE 8.12.14c vegetation. There are a moderate number of hollow-bearing trees within the eucalypt woodlands in the study area, and a low to moderate amount of woody debris. Other microhabitat features such as boulder areas are common throughout the coastal vine thicket. The quality and abundance of habitat features in the non-remnant areas is very low due to a lack of woody vegetation and related microhabitat features.

#### 10.6.1.3 Watercourse and Wetland Habitat

No Ramsar wetlands are located within the study area or within the broader region. Shoalwater and Corio Bays are the nearest Ramsar Wetlands and these are located over 200 km to the south of the study area. No referrable wetlands areas as shown on the Queensland referrable wetland mapping are located within the study area. However, the Queensland referrable wetland mapping identifies some general ecological significance wetlands along some of the shoreline of Lindeman Island. These areas of shoreline potentially provide habitat and foraging areas for shorebirds.

There is one large permanent water body created by the construction of Gap Creek Dam near the centre of the study area, which contains some aquatic vegetation and wetland habitat values. This water body and associated aquatic vegetation provides habitat for a variety of wetland bird species (refer to **Appendix I**). There are no watercourses as shown on the vegetation management watercourse map located within the study area, but one feature identified as Gap Creek is mapped on other State mapping layers. There are some ephemeral drainage features located within the study area in remnant and non-remnant areas. These features are located in steep and often rocky terrain with a very small catchment, and consequently they would likely only flow for very short periods of time immediately after rainfall events. These features do not sustain any significant aquatic habitat and there is no distinct riparian vegetation or additional biodiversity associated with



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the features. The vegetation communities surrounding these features represent a continuation of the surrounding non-riparian vegetation communities.

The dam diversion channel will also change the stage-storage relationship, increasing the volume of the dam from 199.6 to 207.3 ML (refer to **Chapter 18 – Water Resources**). The proposed dam diversion will involve a cut of 37,860m<sup>2</sup> and disturbance to additional areas required for the proposed channel diversion earthworks. In relation to A<sup>2</sup> excavation work is proposed to be undertaken in this area for the expansion of the dam. The tenure of this area is currently perpetual lease. When the excavation work is completed this area will be converted to National Park and there will be no need for ongoing works within that area and there will be no permanent area of inundation in the National Park

#### 10.6.1.4 Connectivity

The study area is comprised of a mix of remnant and non-remnant areas with connectivity between habitats influenced by natural and artificial processes. Connectivity between most areas of woody vegetation is high, but some areas of vine-thicket occur as isolated patches in gullies and rocky slopes, particularly along the shoreline. These isolated vine thicket patches occur naturally and are known to be resilient even as very small areas (Commonwealth of Australia, 2009). Some woodland areas are bordered by native and non-native grassland and existing resort infrastructure. However, most woodland areas maintain at least some connectivity with larger tracts of remnant vegetation and habitat fragmentation is very low.

The existing runway strip bisects an area of remnant Broad-leaved tea tree woodland described in previous sections. The biodiversity value of this community is reduced by the invasion of exotic species, particularly the prevalence of Guinea grass in the ground layer. Disturbance to the species composition in the ground layer is likely due to historical grazing activities, but the current runway strip has significantly increased potential edge-effects for this community. Non-native invasive ground cover species dominate much of the grassland community within the study area and this has resulted in isolated areas of native grassland. The isolation of the native grassland areas leaves them susceptible to further invasion. However, sloped areas with a southern aspect within the study area remain relatively intact, and this is the habitat typically occupied by the native grassland community. Therefore, this community may be resilient to invasion by exotic species in these areas.

Overall, connectivity between habitats on Lindeman Island is intact with minimal fragmentation or isolation of remnant vegetation. The study area itself does not form a critical link between any habitat areas and the connectivity value of the vegetation communities within the study area is generally low.

#### 10.6.1.5 Existing Disturbance and Habitat Condition

The main disturbance to remnant vegetation in the study area is the existing resort, runway strip, and golf course. These areas comprise maintained lawns and ornamental flora species, with some native vegetation retained or regenerated throughout. As discussed previously, the existing infrastructure has resulted in the removal and fragmentation of some native vegetation, but the overall viability and connectivity of the native vegetation communities present is generally intact.

Lindeman Island has a history of multiple land uses including grazing activities and different resort developments. The grassland around the existing resort has been modified and exotic species dominate much of this area. Native grasslands occur naturally on island headlands in the region, particularly on slopes with a south and southeast aspect. Many of the sloped grassland sites within the study area, particularly those with a southern aspect, remain relatively intact, with minimal exotic species invasion. However, the majority of flat grassland areas are comprised of exotic species, particularly Guinea grass. Disturbance in these areas is likely due to historical grazing activities, and the extent of this disturbance has resulted in the fragmentation of native



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grassland habitat. While the native grassland contains a low diversity of flora species and low fauna habitat value, invasion by exotic grasses represents a significant threat to the biodiversity values of this community. As discussed previously, exotic species invasion has also significantly impacted the biodiversity values of the Broad leaf tea-tree community. All other communities within the study area are generally intact, with exotic species invasion generally restricted to the margins of previously cleared areas.

# 10.6.2 Fauna Species

A total of 76 fauna species from 42 families were identified within the study area using a variety of different observation and trapping techniques. This included 47 species of birds, 14 reptile species, two amphibian species, and 13 mammal species (including 12 bat species). Most of the native fauna recorded are common in coastal habitats throughout much of Queensland. A combined list of all species identified during the fauna surveys to date is included in **Appendix I** (see part F). The following sections provide a brief discussion of the species observed for each taxonomic group. Potential impacts to fauna are discussed in the latter sections of this report, with a focus on conservation significant species.

# 10.6.3 Mammals

A total of 13 species of mammals were observed within the study area over the two survey periods, including 12 bat species and one introduced species, the Black rat (*Rattus rattus*). Black rats were captured multiple times at Sites 2, 3, 5 and 6. Bats are the only native terrestrial mammals previously recorded on Lindeman Island. Black flying foxes (*Pteropus alecto*) have been recorded on Lindeman Island previously; with records from the Australian Museum in the Atlas of Living Australia database showing specimens from this location. During the current fauna surveys, this species was regularly observed flying over and foraging within the study area, particularly during the autumn survey period. Habitat searches during both field survey events did not reveal the presence of camps within the study area.

The two fauna survey events identified a number of microbat species not previously recorded within the study area. Over the two survey events a total of eight species were positively identified to species level and two species were positively identified to genus from the call data collected. Some of the call data obtained was unresolved due to similarities between species, but one additional species, the Chocolate Wattled Bat (*Chalinolobus morio*), was potentially recorded during the December 2015 survey period. The Microbat Call Interpretation Reports from the Anabat data collected during each the fauna survey periods are included in **Appendix I** (see part G).

Some of the microbat echolocation call data obtained during the autumn survey event was only positively identifiable to genus level for *Taphozous*. Two *Taphozous* bats potentially occur within the study area: Troughton's sheath-tail bat (*T. troughtoni*) and the Coastal Sheathtail Bat (*T. australis*). Echolocation calls from these species are not distinguishable and the call data obtained may be from either of these species. The call data for *Taphozous* sp. was obtained on one night only (11 May 2015) and represents a very low proportion of the total files recorded over the two survey events (three calls from this genus out of a total of over 1500 files recorded). Call data for this genus was not recorded during the spring-summer survey event. Given the difficulty in distinguishing species in this genus from call data, the Targeted Species Survey Guidelines (Queensland) for the Coastal sheathtail bat recommends roost searches as the optimal survey approach. The field survey revealed suitable habitat for the Coastal sheathtail bat is present within some of the rocky slopes along shorelines surrounding the study area and targeted searches were conducted in accordance with the survey guidelines. These searches for roost sites were conducted within suitable habitat along the rocky coastline areas at low tide. No active roost sites were located during these targeted searches.



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No evidence of any other mammals listed as threatened or near threatened was observed within the study area during either of the fauna survey events.

#### 10.6.3.1 Reptiles

In total, 14 species of reptiles from four families were observed within the study area (see **Appendix I** – see part F). The majority of reptile species recorded are common and widespread throughout the region and in many cases distributed over a large expanse of coastal and sub-coastal Queensland.

The eucalypt woodlands throughout the study area in particular provide habitat for an array of skink species, with a total of nine species recorded over the two survey events. Schmeltz's Rainbow Skink (*Carlia schmeltzi*) and the Lively Rainbow Skink (*Carlia vivax*) were recorded commonly throughout a variety of habitats within the study area. The Major Skink (*Bellatorias frerei*) was recorded in more dense vegetation on hill slopes dominated by RE 8.12.14c in the surrounding National Park areas. The Northern Bar-sided Skink (*Concinnia brachyscoma*) was recorded in rocky habitats, generally associated with vine thicket vegetation. While the Fine Spotted Mulch Skink (*Glaphyromorphus punctulatus*) was only recorded at sites 3 and 4, this is a cryptic species sheltering beneath leaf litter and soft soils and likely occurs in a variety of habitats throughout the study area. Brown Tree Snakes (*Boiga irregularis*) were recorded during both survey events near the intertidal zone where a drainage line occurs within rocky vine thicket habitat. A single Lesser Black Whipsnake (*Demansia vestigiata*) was captured within Broad-leaf Tea-tree woodland, and this capture is notable as there are very few records of this species from Lindeman Island.

No evidence of any reptiles listed as near threatened or threatened was observed within the study area.

### 10.6.3.2 Amphibians

The only native amphibian species recorded within the study area was the Green tree frog (*Litoria caerulea*). There are no records of any other native amphibian species occurring on Lindeman Island. The introduced pest species, Cane toad (*Rhinella marina*) was observed to be abundant within drainage lines throughout the study area as well as habitat surrounding Gap Creek Dam. However, this pest species was observed in virtually all habitat types throughout the study area.

There are no threatened amphibian species known to occur in the region, and this was supported by the outcomes of the desktop analyses.

#### 10.6.3.3 Birds

A total of 47 species of birds from 30 families were observed within the study area over the two survey periods. This species assemblage includes a number of sedentary, nomadic, and migratory species. The majority of species observed are common in eucalypt woodland habitats throughout the region. The wetland habitat associated with Gap Creek Dam also supports a variety of common wetland bird species.

Both fauna survey events included shoreline surveys for shorebirds, and focussed on identifying their presence and habitat use in the study area and surrounding National Park land. These surveys were also performed to target threatened shorebird species, identified during desktop analyses as likely to be present. These include the Beach Stone-curlew (*Esacus magnirostris*) and the Eastern Curlew (*Numenius madagascariensis*). The only shorebird species identified during these targeted surveys was the Sooty Oystercatcher (*Haematopus fuliginosus*). A pair of Sooty Oystercatchers were observed flying south along the shoreline in the bay to the south of Coconut Beach during the May 2015 survey period. This species has a 'least concern' conservation status and occurs on coasts and islands throughout Australia.



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Four species listed as migratory under the EPBC Act were recorded in the study area. White-bellied Sea-eagle (*Haliaeetus leucogaster*), and Eastern Osprey (*Pandion haliaetus*) were recorded flying above the coastline in the study area. These species occur over a broad distribution comprising much of coastal Australia. The Brown Booby (*Sula leucogaster*) was observed flying over water between Lindeman Island and Shaw Island. One Spectacled Monarch (*Monarcha trivirgatus*) was recorded in the Eucalyptus and Pandanus forest at Site 3. This species occurs throughout many habitats on the east coast of Australia. While not specifically identified as migratory in the species lists under the EPBC Act, the Crested Tern (*Thalasseus bergii*) is listed in the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). The Crested Tern was observed roosting on channel markers for the existing jetty. The likelihood of impacts to these species and other migratory species listed under the EPBC Act are discussed in the Impact Assessment section of this report.

#### 10.6.3.4 Pest Animal Species

Evidence or direct observation of three pest species was detected during the fauna surveys, all of which commonly occur in disturbed habitats throughout Queensland. The following species were observed within the study area Cane toad (*\*Rhinella marina*), Black rat (*\*Rattus rattus*) and Asian house gecko (*\*Hemidactylus frenata*). A biosecurity assessment has been prepared for the project which addresses the management of these species (refer to **Chapter 20**).

# 10.7 Potential Impacts

#### **10.7.1** Matters of State Environmental Significance

The following sections detail the presence of MSES, as identified in the *Environmental Offsets Regulation* 2014 (Qld). The potential for impacts to these matters is discussed with reference to the *Queensland Environmental Offsets Policy – Significant Residual Impact Guideline.* 

#### 10.7.1.1 Regulated Vegetation

The majority of the regulated vegetation within the study area is RE 8.12.12d, which has a 'least concern' VM Act class and a 'no concern at present' biodiversity status. Under the current design concept (dated November 2016), this community represents the main vegetation type where disturbance to remnant vegetation will occur. The total area of this remnant community to be cleared as a result of the operational disturbance footprint of the proposed action is 4.97 hectares (refer to **Figure 10-6**). Disturbance to this community includes an Asset Protection Zone, as identified in the *Bushfire Hazard and Risk Assessment* prepared by Cardno (2016). This protection zone will involve some disturbance to remnant RE 8.12.12d vegetation as well as management of vegetation to reduce fuel loads. All remnant vegetation disturbance for the Asset Protection Zone is proposed to occur within this 'least concern' RE 8.12.12d community and the total area is 2.0 hectares (refer to **Figure 10-6**). Fuel reduction practices are unlikely to significantly impact the biodiversity values of this community, particularly since key fuel reduction strategies involve removal of environmental weed species such as Guinea Grass and Lantana. This vegetation community is widespread on Lindeman Island and in the broader area, and it is unlikely clearing the small areas of this community. This community does not equate to MSES as defined in the *Environmental Offsets Regulation 2014* (Qld).

Multiple areas containing remnant vegetation consistent with RE 8.12.11a occur within the disturbance footprint of the current design concept (dated November 2016). RE 8.12.11a has a 'least concern' VM Act

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class and 'no concern at present' biodiversity status. However, it is listed as a TEC under the EPBC Act, and is therefore discussed as a MNES below. The ground-truthed extent of this community has been incorporated into the current design concept and impacts to this community have been avoided by design (refer to **Figure 10-6**). Locations where this community occurs in close proximity to vegetation clearing areas will include buffers and will be managed to ensure the maintenance of the biodiversity values they support. RE 8.12.11 is not a MSES under the Queensland environmental offsets framework, but this community is listed as a TEC under the EPBC Act and potential impacts to this community and relevant impact mitigation and management strategies are discussed in the following sections of this chapter.

In the current design (dated November 2016) a small extension of the disturbance area at the northern end of the runway strip may impact some vegetation at the ecotone of RE 8.12.12d and RE 8.12.14c. This is the only location where disturbance to RE 8.12.14c vegetation may occur, although no direct disturbance to this community is proposed. RE 8.12.14c has a 'least concern' VM Act class and 'no concern at present' biodiversity status. All other areas of RE 8.12.14c are located within the lease area to be surrendered or the current National Park land. This vegetation community is widespread on Lindeman Island and in the broader area, and it is unlikely the small disturbance area proposed for this community will result in a significant impact to the community at any scale. This community does not equate to a matter of state environmental significance as defined in the *Environmental Offsets Regulation 2014* (Qld).





#### Endangered Regional Ecosystem 8.3.2

RE 8.3.2 is an endangered community under the VM Act, which is dominated by Broad leaf tea tree, and occurs in the area surrounding the existing runway strip. The current development design (dated November 2016) includes an expansion of the disturbance area relating to the runway strip. Consequently some disturbance to RE 8.3.2 vegetation will occur as part of this expansion (see **Figure 10-7** and **Figure 10-8**). The proposed disturbance to this community involves a small expansion of the cleared area for the runway and some lopping of vegetation beyond the cleared areas to heights appropriate for compliance with relevant aviation standards and codes. Vegetation trimming/lopping will need to occur as a height gradient, with a 20° transitional surface commencing at the edge of the 60 metre wide runway strip (refer **Figure 10-8**).

Vegetation assessments conducted throughout various sections of this community revealed the mean undisturbed canopy height to be 9.9 metres. This canopy height is consistent with the technical description published by the Queensland Herbarium, which identifies the mean height for this community as 9.8 metres. In applying the criteria for remnant vegetation status under the VM Act, the predominant canopy must average greater than 70% of the vegetation's undisturbed height. Any lopping of vegetation that does not retain greater than 70% (>7 metres) of the mean height for this community will result in a significant change to the structure of the community and should be regarded as 'clearing' for the purposes of impact assessment.

Lopping of vegetation that retains greater than 70% of the mean height is unlikely to result in changes to the structure and composition of this community to an extent that remnant status will be affected, and this activity is not classified as clearing in the following impact assessment. This is consistent with the definitions provided in the VM Act, whereby *"lopping a tree, means cutting or pruning its branches, but does not include –* 

- removing its trunk; and
- cutting or pruning its branches so severely that it is likely to die."

The areas where 'clearing' (vegetation trimmed to <7 metres height) and 'lopping' (vegetation retained to >7 metres height) of RE 8.3.2 are proposed are shown on **Figure 10-8**. This figure also shows the areas of this community that will remain undisturbed. **Figure 10-8** shows a cross section of the runway strip and the ground-truthed extent of RE 8.3.2 as it relates to the proposed disturbance areas including the transitional surface from the edge of the runway strip (DBI 2016).

The total ground-truthed area of RE 8.3.2 is 12.85 hectares and, under the current design concept (November 2016), 7.71 hectares are to be retained undisturbed. In addition to the undisturbed areas, a further 1.94 hectares will have the canopy trimmed only and will be retained as a buffer zone to the remnant community. The 7.71 hectares of RE 8.3.2 to be retained outside the clearing area equates to 60% of the total ground-truthed extent of this community within the study area. The proposed disturbance area for clearing of RE 8.3.2 is 3.18 hectares, which equates to 24.7% of the ground-truthed extent of this community in the study area. The trimmed vegetation to be retained as a buffer zone (1.96 hectares) equates to 15.3% of the ground-truthed extent of this community. The combined footprint for clearing and trimming of this community is 5.14 hectares and this forms the 'impact area' for the purposes of this impact assessment

RE 8.3.2 is not known from other islands in the Lindeman-Whitsunday area, but is present in coastal areas on the mainland. Data provided by the Queensland Herbarium (2011), and published in the Commonwealth Listing Advice for this community (TSSC 2012), identifies the extent of RE 8.3.2 (in 2009) as 7,758 hectares. The proposed clearing disturbance area (including vegetation to be trimmed) for this community therefore represents a 0.066% loss to the extent of this community in the Central Queensland Coast bioregion.



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The location options for a runway strip on Lindeman Island are limited by topographical constraints, and utilising the existing disturbance area represents the most appropriate way to minimise vegetation clearing. The proposed expansion of the runway strip has minimised the disturbance to RE 8.3.2 where possible by aligning construction with the western edge of the existing disturbance area. As discussed previously, ground-truthing and vegetation condition assessments revealed the full extent of the community on the western side of the runway strip is subject to significant disturbance from exotic species, particularly Guinea grass, which has considerably reduced the biodiversity values for this area. The proposed expansion has been aligned such that disturbance to remnant vegetation is concentrated on areas of poorer condition. Disturbance where the community is relatively intact is minimised.

The approach to vegetation clearing for the runway strip expansion includes methods to minimise the total disturbance as much as possible. In this regard, trimming, rather than complete removal of vegetation, is proposed to meet the requirements of relevant aviation codes. While this approach will affect the remnant status of some areas and result in some changes to the community structure, it allows for at least some retention of biodiversity values associated with this community.

The proposed alignment of the runway strip also represents the minimum possible disturbance to National Park tenure for a runway strip compliant with relevant codes and standards. By aligning the proposed runway strip to the western side of the existing disturbance area, the proposed clearing area, including vegetation to be trimmed to less than seven metres height, primarily occurs within the existing perpetual lease tenure. Clearing within National Park land, including areas subject to a current term lease has been avoided to the fullest possible extent.

The extent of this community to be retained is located in lease areas intended to be surrendered to National Park land under new tenure arrangements. This approach ensures the long-term protection of this community and the biodiversity values it supports. One of the key approaches to ensuring the long-term maintenance of biodiversity values will be the implementation of a weed management and control program. This will ensure the maintenance of biodiversity values for retained vegetation, as well as improving the condition of areas that have existing weed invasion. While these approaches may result in increased protection and improved condition for the retained areas, assessment against the significant residual impact guideline under the Queensland environmental offsets framework is required in the context of the scale of disturbance.

The significant residual impact guideline identifies two hectares as the relevant threshold for disturbance to RE 8.3.2 (which has a 'sparse' structural category). Therefore, significant residual impacts to this community resulting from the 5.14 hectare impact area will be mitigated by way of an environmental offset in accordance with the requirements under the Queensland environmental offsets framework subject to confirmation from DNRM. The proposed environmental offset delivery mechanism is discussed in the following Environmental Offsets section.







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ISLAND GREAT BARRIER REEF ΛΝ



#### Of Concern Regional Ecosystem 8.12.13a

Scattered areas of the native grassland community RE 8.12.13a are located within the study area. Under the current design concept (November 2016) some areas of these grassland communities have the potential to be impacted by direct disturbance from development in these areas. RE 8.12.13a has an 'of concern' VM Act class and biodiversity status and is therefore a MSES under the Queensland environmental offsets framework.

There are five patches of this grassland community with relevance to the proposed disturbance footprint, including two at the southeast extent and two at the southwest extent of the current lease area (refer to **Figure 10-8**). A glamping area has also been proposed in an area supporting a patch of native grassland vegetation in in the adjacent National Park. The development design has avoided areas of the critically endangered Littoral Rainforest and Coastal Vine Thickets of Eastern Australia community listed under the EPBC Act. However, partly as a consequence of this, the development disturbance footprint includes some small areas of native grassland. As discussed in previous sections, the biodiversity values of the native grassland areas within the lease areas have been significantly impacted by historical land uses and consequently non-native species are abundant and remnant areas are highly fragmented. Rapid assessments and observations in the adjacent National Park, and in general these areas are less fragmented and degraded by exotic species invasion. Overall, the disturbance to native grassland has been restricted to small fragments with low biodiversity value, while larger more intact areas will remain in the surrounding National park land.

The location of proposed resort infrastructure with respect to the extent of RE 8.12.13a is depicted in the Native Grassland Disturbance Areas Map (refer to **Figure 10-9**). The total ground truthed extent of this community in areas where resort infrastructure is proposed is 4.19 hectares. The disturbance footprint for the resort infrastructure at each of the four patches in the existing lease area encompasses these patches in such a way that the biodiversity values of the grassland community cannot be retained. These areas form a total of 4.19 hectares of native grassland disturbance area. However, the proposed camping-style infrastructure in the National Park land on the western point has been designed to avoid remnant areas of RE 8.12.13a and retain the native grassland values in this area.

Spatial interrogation of the vegetation management regional ecosystem and remnant map (DNRM 2015) identified the total area where RE 8.12.13a occurs as a single unity polygon is 2,014 hectares. This is the most conservative area estimate possible for RE 8.12.13a, because this community also occurs commonly as part of mixed polygons. Therefore, as a generous estimate, the proposed disturbance to RE 8.12.13a represents a 0.21% loss at the regional scale. However, the actual loss is likely to be significantly less than this figure. For example, this community is mapped over an additional 2,230 hectares where it occurs as the primary RE unit in mixed polygons. Furthermore, this approach has also excluded areas where vegetation is mapped as RE 8.12.13 without specifying the community type ('a' or 'b').

The Queensland Environmental Offsets Policy – Significant Residual Impacts Guideline identifies a disturbance area threshold of two hectares for significant residual impacts to REs with a 'sparse' structural category. The proposed disturbance to RE 8.12.13a is in excess of the two hectare threshold, and therefore the proposed disturbance equates to a significant residual impact under the Queensland environmental offsets framework. Significant residual impacts to this community will be mitigated by way of an environmental offset in accordance with the requirements under the Queensland environmental offsets framework. The proposed environmental offset delivery mechanism is discussed in the Environmental Offsets section below.





Coordinate System: GDA 1994 MGA Zone 55



# 10.7.1.2 Connectivity Areas

The study area itself does not form a critical link between any habitat areas, and therefore the connectivity value of the vegetation communities within the study area is generally low. The majority of native vegetation clearing associated with the proposed action is to occur within or immediately adjacent to areas of existing disturbance for the current resort development. The current design concept (November 2016) will not result in significant fragmentation or isolation of any habitat areas. Consequently, movement of fauna and other factors affecting biodiversity (such as plant propagation, vegetation community structure, feeding patterns and genetic flow) in the area are unlikely to be any further impacted by the small loss of habitat associated with the current design concept. It is unlikely the function of connectivity will be affected significantly at any scale.

Given the proposed actions is primarily limited to the existing disturbance footprint and will not result in the fragmentation or isolation of any habitat areas, the establishment of movement corridors within the development footprint is unwarranted. There is no advantage to biodiversity values to be gained by encouraging wildlife to move through the resort area through the establishment of corridors.

#### 10.7.1.3 <u>Watercourses and Wetlands</u>

Gap Creek Dam is located within the study area and this feature supports a permanent water body, aquatic vegetation and a variety of wetland associated fauna species. This water body is to be retained as part of the proposed action, with a minor increase in size due to the addition of a drainage diversion northeast of the existing footprint. While there is some resort infrastructure proposed along the western margin of the dam, development in this area is unlikely to impact the habitat or lifecycle of any wetland species. The proposed drainage diversion represents a minor alteration to increase surface flows to the dam. This modification will not significantly alter the hydrological regime of the existing wetland habitat. The proposed drainage diversion channel is located within perpetual lease land. The excavation work is proposed to be undertaken while the land is still under perpetual lease and once completed it is proposed to be converted to National Park as part of an overall land tenure package addressed in **Chapter 6**. There will be no need for ongoing work within this area and there will be no permanent area of inundation within the proposed National Park.

There are no wetlands of international significance (e.g. Ramsar wetlands) within or near the study area. No wetland protection areas are shown on the Queensland Map of Referrable Wetlands within the study area. However, some areas of the shoreline contain mapped areas of 'General Ecological Significance' wetlands, including the southern portion of the study area and other revetment works. There are no significant or critical terrestrial flora and fauna biodiversity values associated with these shoreline areas. Increased visitation on shoreline areas associated with the resort may reduce the suitability of these habitat areas for shorebird species. However, the majority of shoreline areas involving visitation relevant to the proposed action are the same as those utilised by the existing resort development. The shoreline habitat relevant to the proposed action is not an important area of habitat for shorebirds or other migratory species. There are substantial areas of similar or better quality habitat for shorebirds at the locality and in the broader region. The proposed action is unlikely to impact the lifecycle of an ecologically significant proportion of any shorebird species with potential to occur in the area.

There are some minor drainage features within the study area and surrounding landscape, but none of these features retain water in such a way as to provide significant aquatic habitat. The drainage features do not support riparian vegetation communities and in general they do not contain any significant additional biodiversity to the surrounding landscape. The vegetation in these drainage areas is a continuation of the non-riparian eucalypt woodland and coastal vine thicket communities of the surrounding area. None of the drainage

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features in close proximity to the study area are shown on a Vegetation Management Watercourse Map, and therefore the vegetation associated with these features does not represent a MSES under the Queensland environmental offsets framework.

The proposed development will not have an impact on riparian vegetation with no alterations to the vegetation or channel morphology proposed.

# 10.7.1.4 Protected Wildlife Habitat

Essential habitat is mapped within the project area for the Coastal Sheathtail Bat, as shown on the State regulated vegetation mapping. All mapped remnant vegetation on Lindeman Island is identified as essential habitat for this species on the State published regulated vegetation map. The conservation status of this species was changed to near threatened on 12 December 2014 and therefore this species is not considered protected wildlife in accordance with the VM Act.

While habitat for this species does not equate to a MSES, potential impacts to this conservation significant species have been evaluated to ensure appropriate impact avoidance and management strategies are employed. Most of the vegetation communities in the study area support suitable foraging habitat for this species and similar habitat is abundant in the surrounding landscape. It is unlikely the proposed action will cause significant impacts to foraging habitat for the Coastal Sheathtail Bat.

Rocky areas within the large polygon of coastal vine thicket on the west coast of the study area provide potential roosting habitat for this species. The 'Targeted Species Survey Guidelines: *Taphozous australis*' published by the State of Queensland identifies this species depends on coastal roosts, preferring sea caves and rocky clefts. Rocky areas are present along various parts of the shoreline within the study area, particularly within the western portion mapped as RE 8.12.11a and these areas provide some potential roosting habitat for this species was not detected during targeted roost searches within this habitat.

Echolocation call data potentially attributable to this species (identifiable to the genus level only) was recorded from an Anabat detector located on Gap Creek Dam wall on 11 May 2015. Only a very small proportion of the files recorded (three of the 687) at that location were attributed to *Taphozous*. Call data from this genus was not recorded at any other locations or habitat types during the remainder of the May 2015 survey and no call data from this genus was recorded during the December 2015 survey. The main area of rocky habitat containing potentially suitable roosting habitat near the study area is located outside the current lease area. Disturbance to this habitat will be avoided and a substantial buffer will be implemented. On the basis of this avoidance approach, it is unlikely there will be a significant impact on roosting habitat for this species.

The Coastal Sheathtail Bat is listed as near threatened under the NC Reg and is not listed under the EPBC Act. Habitat for near threatened species is not a prescribed matter in the *Environmental Offsets Regulation 2014*. Therefore, an assessment against the significant residual impact criteria is not required for this species. However, as discussed previously, it is unlikely the proposed action will result in a significant impact to this species or its habitat.



#### 10.7.1.5 Protected Areas

Some of the current perpetual lease and term lease areas are proposed to be returned or dedicated to National Park. These areas are depicted as A<sup>1</sup>, A<sup>2</sup> and A<sup>3</sup> on the proposed tenure plan arrangements map as included on **Figure 10-10**.

Area 'A<sup>1'</sup> is National Park land subject to a current term lease that is to be surrendered under the proposed tenure plan. This land supports multiple remnant vegetation communities that are generally highly intact and consistent with the biodiversity values and ecological condition of the surrounding protected area estate. This land supports a Broad-leaf Tea Tree community (RE 8.3.2), which has an 'endangered' VM Act class and biodiversity status and part of this community is equivalent to a TEC listed under the EPBC Act. The full extent of the community that equates to the TEC listed under the EPBC Act (minus a small section of vegetation proposed to be cleared for expansion of the runway strip) occurs within the land proposed for surrender to the National Park. The Broad-leaf Tea Tree community is currently poorly represented within protected areas in the sub-region. Lindeman Island is also the only location in which this community contained within Area A<sup>1</sup> are therefore consistent with, or higher than, the values represented within the surrounding National Park land.

The other vegetation communities present within Area A<sup>1</sup> are Eucalypt woodland (RE 8.12.12d) and Brush Box open forest (RE 8.12.14c). These communities characterise the vast majority of vegetated areas on Lindeman Island and are broadly represented in the surrounding protected area estate. The values supported by these communities in Area A<sup>1</sup> are consistent with those of the communities located in the National Park. Overall these communities are generally intact, but there is some disturbance from invasion by exotic ground cover species in the southern portion of Area A<sup>1</sup> on the eastern side of the runway strip. There are also edge effects in the form of exotic ground cover species present in Area A<sup>1</sup> on the western side of the runway strip. This disturbance is representative of conditions in the surrounding area, including National Park tenure, which includes a history of grazing by introduced species.

Area A<sup>2</sup> supports Eucalypt woodland (RE 8.12.12d) and Broad-leaf Tea Tree vegetation communities (RE 8.3.2) similar to those described previously for Area A<sup>1</sup>. The eucalypt woodland community is intact and represents equivalent condition and habitat value to the same community in the surrounding National Park land. The Broad-leaf Tea Tree community is subject to significant disturbance from exotic ground cover species invasion, as described previously. While the full extent of this community in Area A<sup>2</sup> represents an endangered RE, the biodiversity value is somewhat compromised by the abundance of these exotic species. A restoration program in conjunction with delivery of an environmental offset is proposed for the full spatial extent of this community in Area A<sup>2</sup>. The proposed drainage diversion for Gap Creek Dam is located in Area A<sup>2</sup>. All disturbance resulting from the construction of this drainage diversion will be rehabilitated prior to the surrender of this land. While there is some existing and proposed disturbance in Area A<sup>2</sup>, the rehabilitation and restoration works for the vegetation communities in this area will be determined in consultation with QPWS and will seek to restore the ecological condition to a state consistent with National Park values.

Some areas containing the endangered Broad Leaf Tea-tree community may be held under a term lease to enable vegetation management and environmental offset activities to occur, including improvements to the condition of this community through the eradication of weed species. These works will improve the ecological condition of impacted areas of this community and restore ecological function to ensure the long-term maintenance of biodiversity values. Further details on approach to environmental offset deliver and rehabilitation are provided in the following sections of this report.

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Area A<sup>3</sup> supports a mosaic of native and non-native grassland vegetation, which has been impacted by historical land uses in such a way that some areas are dominated by non-native species. While this disturbance reflects a habitat condition similar to much of the adjacent land located within the National Park tenure, a vegetation management program to restore the ecological condition of this community is proposed as part of the tenure swap.. Overall Area A<sup>3</sup> supports values consistent with those located within the surrounding National Park land, and the ultimate protection of the 'of concern' grassland community within the protected area estate represents a positive conservation outcome.

An area on the western coastline is proposed for a commercial camping facility and will be subject to a term lease, and therefore not removed from National Park tenure. A commercial operator permit will be required for activities conducted in this National Park area. The siting of this infrastructure has been designed to avoid disturbance to the 'of-concern' grassland community present at this location. The facility is located within disturbed areas of non-remnant vegetation with access from the existing resort disturbance footprint via an area of 'least-concern' (RE 8.12.12d) eucalypt woodland vegetation. The biodiversity value of the non-remnant area is low due to the abundance of invasive (non-native) ground cover and shrub species. The biodiversity value of the eucalypt woodland vegetation is similar to that of the remaining extent of this community within the National Park tenure, and this community is broadly represented in the surrounding landscape.

Some of the existing and proposed resort infrastructure is located within a current term lease area. This land is intended to be removed from the National Park and placed under a perpetual lease. Areas proposed to be removed from National Park land will need to be compensated through a mixture of tenure swaps and boundary realignments with the outstanding compensation shortfall achieved through contributions towards management of the island's protected areas.

Disturbance to certain areas of the protected area estate are unavoidable for reasons such as aviation safety. Detailed descriptions of proposed land tenure arrangements are provided in **Chapter 6** of the EIS and include requirements for protected area revocation and proposed compensation arrangements. Areas proposed for revocation largely encompass areas of existing disturbance from the current resort infrastructure footprint such as the golf course.

There is one larger area of native habitat located in the area to be revoked and this is intended to be subject to a Nature Refuge agreement (see **Chapter 6** of EIS – identified as Area 'C<sup>2</sup>' on the Tenure Plan Arrangements Map). This area (C2) supports a remnant Eucalypt woodland community (RE 8.12.12d) and associated habitat values. This community provides potential foraging habitat for the near threatened Coastal Sheathtail Bat and there is a record and potential call data from this species in the local area. The remnant community is adjacent to Gap Creek Dam and provides generic foraging, roosting and nesting habitat for fauna species in the local area. The habitat at this location is generally intact, remnant woodland vegetation dominated by eucalypt species such as Poplar Gum and Narrow-leaved Ironbark. There is relatively minimal invasion by exotic species, and a similar composition of microhabitat features to those found in the same habitat types in the surrounding protected area estate.

Potential impacts to various biodiversity values of the protected area estate and relevant management strategies have been identified and discussed in the Impact Assessment and Impact Management sections of this chapter.



LEGEND Land to	be 'retu	rned' to National Park		
	Nationa be surre	l Park land (subject to current term lease) to endered : <b>25.144 ha</b>		
A <sup>2</sup>	Existing Park (fo and extend Note: De and rehalt with drain	Perpetual Lease to be dedicated as National llowing operational works to extend catchment ent of dam) : <b>5.299 ha</b> layed surrender to allow for environmental offset delivery pilitation of temporary construction zone associated lage diversion		
<b>€</b> A	Nationa of grass	I Park to be surrendered (following rehabilitation land community) : <b>4.262 ha</b>		
Land to	<b>'remain</b> Nationa under so 'glampin	' <b>in National Park</b> I Park land to be subject to a specific authority ection 35 of the Nature Conservation Act for ng facility' : <b>9.473 ha</b>		
Land to be 'revoked' from National Park				
C	Land pr added t lease) :	nd proposed to be revoked from National Park and ded to Perpetual Lease (subject to a current term se) : <b>29.796 ha</b>		
	Land pr subject	proposed to be added to Perpetual Lease and to Nature Refuge Agreement : <b>5.919 ha</b>		
Ca	Land pr and add reasons	Land proposed to be revoked from National Park and added to Perpetual Lease (for aircraft safety reasons) : <b>1.216 ha</b>		
Other la	nd			
D	Perpetu	Perpetual Lease : 65.487 ha		
and the second s	Road : <b>1.295 ha</b>			
E	Area subject to a proposed term lease : 0.332 ha			
F	Area subject to a proposed sea bed lease : 0.265 ha			
	Lot area based o	s shown have been derived with gis software n GDA94 and using the cartesian method.		
Other				
$\square$	Proposed Site Boundary			
	Existing Site Boundary			
Existing Cadastral Boundaries				
DRAWING TITLE		Map 6-2: Site Plan with Proposed Tenure Arrangements		
DRAWING DATE		08 June 2017		
DRAWING VERSION		2.0		
COORDINATE SYSTEM		GDA 94; MGA Zone 55		

DATA SOURCE

Cadastral data: State of Queensland (Department of Natural Resources and Mines) 2015; Property Boundaries Queensland; Publication date: 02/04/2015. Basemap: DBI Masterplan; Date: 04/05/2016.

# Lindeman Great Barrier Reef Resort & Spa ENVIRONMENTAL IMPACT STATEMENT

Cardno QLD Pty Ltd

HRP15078



Figure 10-10

# 10.7.2 Matters of National Environmental Significance

The following sections detail the presence of MNES and potential impacts to these matters as assessed with reference to the *Matters of National Environmental Significance - Significant Impact Guidelines 1.1* (Commonwealth of Australia, 2013).

#### 10.7.2.1 Listed Threatened Species

No evidence of any threatened flora or fauna species was detected during the systematic and targeted survey approaches conducted within the lease areas and surrounding National Park land. The flora and fauna surveys included substantial coverage of the habitat types and general spatial variability within the study area, as well as incorporating multiple seasonal conditions into the survey. It is possible that some threatened species with potential to occur in the area, particularly non-resident species, may go undetected during field surveys. To account for this, desktop analyses including database searches were employed in conjunction with the field survey programs to assess the likelihood of occurrence of threatened species including those not detected during field surveys. This approach ensures consideration is given to all threatened species that may occur within the study area. The outcome of the desktop analysis and field surveys is that it is unlikely the proposed action will result in significant impacts to any terrestrial threatened flora or fauna species listed under the EPBC Act. Further details on assessments of significance for threatened species are provided in **Appendix I**.

#### 10.7.2.2 Listed Threatened Ecological Communities

### Littoral Rainforest and Coastal Vine Thickets of Eastern Australia Community

The EPBC Act listed Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC occurs in multiple sections of the study area. Small areas of this community are located along the southern and south-western coastline and a larger continuous tract occurs along rocky slopes of the western coastline. The current design concept (November 2016) avoids disturbance to all ground-truthed areas where this community occurs. On the basis of this approach, direct disturbance to this community has been avoided entirely.

This community should be buffered with a hazard reduction zone of at least five metres. This buffer zone will allow for the management of indirect impacts, such as invasion by pest plant species on the margins of these communities. Invasion by weeds has the potential to structurally transform and reduce the biodiversity values of these communities (DEWHA, 2009). The implementation of a hazard reduction zone will also allow for the prevention of disturbance from inappropriate fire regimes and visitor impacts.

# Broad Leaf Tea-tree (Melaleuca viridiflora) Woodlands in High Rainfall Coastal North Queensland Community

As discussed in previous sections, not all of the Broad leaf tea-tree vegetation within the study area equates to the TEC listed under the EPBC Act. Only the high-value vegetation that meets the condition thresholds for protection under the EPBC Act has been included in the community mapping and impacts assessment. Highly degraded patches of Broad leaf tea-tree woodland have been excluded from the mapping and impact assessment (refer to **Figure 10-2**).

The full extent of vegetation consistent with the Broad leaf tea-tree woodland TEC is restricted to a single patch on the eastern side of the runway strip (refer to **Figure 10-4**). The total patch size for this area of the Broad leaf tea-tree woodland TEC is 5.38 hectares. Under the current design concept (November 2016), there is a proposed expansion of the runway strip and some vegetation clearing and lopping is required to comply with relevant aviation codes. The extent of this disturbance, as it relates to MNES, has been minimised by

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aligning the runway upgrade to the western edge of the existing disturbance area. This approach has resulted in the majority of vegetation disturbance occurring in areas of degraded habitat, and minimised disturbance to the mapped area of the TEC. However, some disturbance to this community is unavoidable.

As discussed in previous sections, the approach to vegetation clearing for the runway strip expansion includes methods to minimise the total disturbance as much as possible. In this regard, trimming, rather than complete removal, of vegetation is proposed to meet the requirements of relevant aviation codes. While this approach will result in some changes to the community structure, it allows for the retention of biodiversity values associated with this community.

As discussed for RE 8.3.2, the extent of this community to be retained is located in lease areas intended for surrender to National Park land under new tenure arrangements. This approach ensures the long-term protection of this community and the biodiversity values it supports. One of the key approaches to ensuring the long-term maintenance of biodiversity values will be the implementation of a weed management and control program. This will ensure the maintenance of biodiversity values for the community and prevent degradation from weed invasion. While these approaches may result in increased protection and improved condition for the TEC, consideration must be given to the scale of the impact from direct and indirect disturbances resulting from the proposed action.

### Assessment of Significance

In accordance with the MNES Significant Impact Guidelines, an action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of an ecological community;
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- adversely affect habitat critical to the survival of an ecological community;
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an
  ecological community's survival, including reduction of groundwater levels, or substantial alteration of
  surface water drainage patterns;
- cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - i. assisting invasive species, that are harmful to the listed ecological community, to become established, or
  - ii. causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
  - iii. interfere with the recovery of an ecological community.

The following sections detail an assessment of significance for impacts to the Broad leaf tea-tree woodland with specific reference to the criteria identified in the MNES Significant Impact Guidelines.



#### Reduction in extent

The disturbance area for the proposed runway strip expansion includes 1.5 hectares of the Broad leaf tea-tree woodland TEC. This area includes all vegetation to be trimmed as part of the transitional surface requirements associated with the runway strip. As discussed previously for RE 8.3.2, it is unlikely areas where trimming will still retain greater than 70% of the mean height of the community will be significantly impacted, as the species composition and structure will be retained. Nonetheless, as a precautionary approach, the impact area for the purposes of this assessment is the full 1.5 hectare disturbance area (including 0.69 hectares that it to be trimmed only). The proposed disturbance area will result in a 27.9% reduction in the extent of this TEC on Lindeman Island. The Broad leaf tea-tree woodland TEC occurs across the central Queensland coast and wet tropics bioregions. The Commonwealth listing advice for this community (TSSC 2012) provides estimates on the current extent (2009) of this community, based on data from the Queensland Herbarium (2011). The estimated extent of this community in the listing advice (TSSC 2012) is 28,396 hectares. The proposed disturbance area equates to less than a 0.003% reduction in the total extent of this community. Experts from the Queensland Herbarium put forward estimates of the extent to which this community remains in an ecologically functional state (Queensland Herbarium 2011). These estimates identified the current 'functional' area of this community as 16,175 hectares. Therefore, using this more conservative figure, the proposed disturbance area represents a 0.0049% reduction in the total extent of this community. The reduction in extent at the regional scale is very minor; however, this community has a very limited distribution at the local scale. While the proposed action will only result in significant disturbance to 1.5 hectares of the community, this reduction in extent will require provision of an environmental offset for impacts at the local scale. Environmental offset delivery mechanisms are discussed in the impact management and recommendations section below.

### Fragmentation

The relevant disturbance footprint is restricted to one edge of the TEC polygon and will not cause increased fragmentation of the community (refer to **Figure 10-4**).

#### Critical Habitat

Other than the previously identified 1.5 hectare clearing area, the proposed action is not likely to adversely affect habitat critical to the survival of the community. Impacts to relevant habitat will be restricted to the disturbance footprint. This small disturbance area is unlikely to significantly impact the survival of this community at any scale.

#### Abiotic factors

The nature of the proposed disturbance to the community will be minimised as much as possible, and will not involve significant alteration to abiotic factors relevant to the survival of the community.

#### Species Composition

As discussed previously for RE 8.3.2, trimming of vegetation in some areas may result in changes to the species composition, but this disturbance has been incorporated into the 1.5 hectare impact area discussed above. Any significant impacts to species composition will be restricted to the disturbance area discussed previously in Reduction in extent.



#### Ecological integrity

The proposed disturbance involves clearing or trimming vegetation along the margin of the community. The vegetation condition assessments and community surveys revealed edge effects from exotic species invasion are currently present within the community. As noted in previous sections, invasion by exotic grass species represents the most significant threat to this community, and has significantly impacted other patches of Broad leaf tea-tree woodland in the study area. The proposed disturbance will not result in a greater perimeter exposed to edge effects, and the extent to which the margin of the community is exposed to potential edge effects will be approximately the same. The trimmed vegetation area provides a buffer zone with a minimum of 15 metres where vegetation will be retained and managed to prevent impacts from edge effects to the retained areas of the listed community. The main focus of this buffer zone will be to prevent impacts from exotic species invasion in the ground layer which is a known local threat to this community. Weed management practices specific to preventing degradation of this community should be implemented during the construction phase and ongoing monitoring should be conducted to ensure the maintenance of biodiversity values. The potential for impacts to the ecological integrity of the community will be mitigated through the implementation of a Vegetation Management Plan. This plan will incorporate specific measures to manage exotic species invasion, particularly exotic grass species that pose a threat to the ecological integrity of the Broad leaf teatree TEC.

#### Recovery

There is no recovery plan currently in place for the Broad leaf tea-tree woodlands TEC. Given the small size of the proposed disturbance area relevant to this TEC, and that the remaining extent of this community on Lindeman Island is unlikely to be impacted, it is unlikely the proposed action will negatively affect the recovery of this community at any scale. The implementation of weed control measures in the degraded patches of this community could result in the increased recovery of this community at the local scale.

#### 10.7.2.3 Listed Migratory Species

Four migratory bird species listed under the EPBC Act as migratory were observed during the survey. These included:

- White-bellied Sea-Eagle (Haliaeetus leucogaster);
- Eastern Osprey (Pandion haliaetus);
- Spectacled Monarch (Monarcha trivirgatus); and
- Brown Booby (Sula leucogaster).

These observed species are relatively common throughout their distribution and suitable habitat is found throughout the local area. No habitat features unique to the study area and no nesting sites for these species were detected during the filed surveys. Given the broad distribution and highly mobile nature of these species, it is unlikely the proposed action will have a significant impact on any the migratory species observed within the study area.

Table D3 in **Appendix I** provides a list of all migratory species that have the potential to occur within the study area and an assessment of their likelihood of occurrence. Of these 42 listed migratory bird species, the majority are widespread throughout coastal Australia. These species occur in a broad range of habitats including those

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present on the shorelines as well those associated with Gap Creek Dam. However, none of the habitat features present are unique to the study area, but rather, these features are abundant in the local area and throughout the region.

No nesting sites for any listed migratory bird species were observed during the surveys. The habitat within the study area may provide foraging opportunities for migratory species, particularly intertidal zones and sandy shorelines. Disturbance from increased visitation on shoreline areas may restrict the suitability of these habitats for foraging by bird species. However, the shoreline habitat relevant to the proposed action is not an important area of habitat for shorebirds or other migratory species. There are substantial areas of similar or better quality habitat for shorebirds at the locality and the broader region. Therefore, the proposed action will not cause a significant decline in the availability and quality of the habitat for these species. The proposed action is unlikely to impact the lifecycle of an ecologically significant proportion of any shorebird species with potential to occur in the area.

### 10.7.2.4 Wetlands of International Importance

There are no declared Ramsar wetland areas or other wetlands of international importance within the study area or the broader area. It is therefore unlikely there will be any significant impacts to wetlands of international importance as a consequence of the proposed action.

### 10.7.2.5 Great Barrier Reef World Heritage Area

The terrestrial ecological values within the study area relevant to the Great Barrier Reef World Heritage Area (WHA) have been discussed in the above Results and Impact Assessment sections. There are no additional biodiversity values relevant to the Great Barrier Reef WHA. With respect to ecological values for World Heritage properties, the proposed action will not:

- Reduce the diversity or modify the composition of plant and animal species in all or part of the WHA
- Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in the WHA
- Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in the WHA, or
- Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in the WHA.

# 10.7.3 Conservation Significant Flora Species

No threatened or near threatened flora species were detected within the study area, despite extensive flora surveys over three different survey periods and a variety of seasonal conditions. A total of 17 conservation significant flora species with relevance to the study area were identified in the desktop analyses, based on a 50km buffer for the search area. The likelihood of occurrence within the study area for each of these species was assessed during desktop analyses using key criteria such as presence of local records, and habitat suitability/quality. From this assessment, ten species were considered to have a moderate or high likelihood of occurrence are discussed below. The remaining seven conservation significant flora species identified in the desktop analyses were considered to have a low likelihood of occurring within the study area, and are not discussed further. However, details of the likelihood

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of occurrence assessments conducted as part of the desktop analyses are provided **Appendix I**, including those species identified as having a low likelihood of occurring within the study area.

Species considered to have a moderate or high likelihood of occurring within the study area as a results of the desktop analyses were as follows:

- Trigonostemon inopinatus (Moderate);
- Xylosma ovata (Moderate);
- Callicarpa thozetti (High);
- Ristantia waterhousei (High);
- Rhodamnia glabrescens (Moderate);
- Solanum sporadotrichum (High);
- Brachychiton compactus (High);
- Hernandia bivalvis (High);
- Livistona drudei (High); and
- Aphyllorchis anomala (High).

With the exception of *Ristantia waterhousei, Rhodamnia glabrescens,* and *Brachychiton compactus* all other species listed above are known from only one or two records within the 50 kilometre radius search area. Many of these species were given 'moderate' likelihood of occurrence in the desktop analyses as a conservative approach based on the limited information available on their distribution and habitat requirements. Targeted field-based surveys were therefore a key aspect for the determining the presence and potential for impacts to those species.

The distribution of *Ristantia waterhousei* is restricted to the area of Dryander National Park approximately 50km northwest of the study area on the mainland. Herbarium specimen records obtained from the Atlas of Living Australia show this species has been recorded in complex notophyll vine forests with one record specifying the landzone type as an alluvial flat. While the study area is outside the known distribution for this species, the study area does contain notophyll vine forest habitat that is potentially suitable for this species. However, despite targeted searches in suitable habitat, *Ristantia waterhousei* was not detected anywhere within the study area.

Specimen records for *Rhodamnia glabrescens* show this species occurs in two main areas, with a substantial distance between these areas. One area is located in the region surrounding Miriam Vale, which is approximately 500km south of the study area. However, another population of this species is located in Dryander National Park. There is little information available on the habitat requirements for this species, but herbarium records from specimens collected form Dryander National Park show this species has been recorded in complex notophyll vine forest on the southern slopes of Mt Dryander. The study area contains potentially suitable habitat for this species, but targeted searches in such habitat areas did not reveal any evidence of this species.

Extensive surveys have been carried out for *Brachychiton compactus* throughout the Whitsunday region and trees have only been recorded within a radius of 40km from Airlie beach. Herbarium specimen records on the Atlas of Living Australia show this species has been recorded on a number of the Whitsunday Islands and potentially suitable habitat is available in the coastal vine thicket on the western coast of the study area. This



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species is a conspicuous and distinctive tree and given it has not been detected over multiple survey periods, it is unlikely this species is present within the study area.

Multiple survey and targeted search techniques were conducted throughout the study area over the three survey periods and different seasonal conditions to maximise the likelihood of detecting conservation significant flora species. Numerous flora transects were conducted throughout the study area, with an emphasis on encompassing all of the vegetation communities present in the study area, and random meanders were performed to further increase the likelihood of detecting threatened flora. Despite these efforts, no threatened or near threatened flora species were found within the study are. Given the extent of the study area covered over the survey periods, and the fact that surveys were conducted during the optimal timing for the detection of these species suggests that these species are unlikely to be present with the study area. Furthermore, many of the conservation significant species considered to have potential to occur within the study during the desktop analyses are found in vine forest habitat types. The vast majority of vine forest habitat located within the study area is to be retained as part of the proposed action. Given the lack of evidence for any conservation significant flora species and the retention of potential habitat areas, it is unlikely there will be a significant impact to any threatened or near threatened flora species as a result of the proposed development.

### 10.7.4 Conservation Significant Fauna Species

No threatened fauna species were observed within the study area during any of the surveys conducted to date. Potential call data from the near-threatened Coastal Sheathtail Bat was recorded on one night during the fauna survey in May 2015. The potential for impacts to this species and species habitat is discussed in the following sections, as well as other conservation significant species determined to have a moderate or high likelihood of occurrence during the desktop assessment. Conservation significant species with a low likelihood of occurrence are not included in the following impact assessment. However, justification regarding the low likelihood of occurrence determination for each species is provided in **Appendix I**.

#### 10.7.4.1 Australian Painted Snipe

The Australian Painted Snipe (*Rostratula australis*) is listed as endangered under the EPBC Act and vulnerable under the NC Act. This species has been recorded at wetland sites throughout much of Australia, and is most common in the eastern states. It is a distinct species, but is rarely seen due to its cryptic and crepuscular behaviour. This species typically occurs in shallow freshwater wetlands and other permanently or temporarily inundated areas, particularly where rank tussocks of grasses, sedges, rushes, or reeds are present (DoE 2015b). It forages in shallow freshwater areas and will disperse if conditions become unsuitable.

There are no records of the Australian Painted Snipe in the study area or within the Whitsunday and Lindeman Island groups. The nearest record identified in the desktop analyses is around Proserpine, approximately 50km from the survey site (as shown in the Birdlife Australia Birdata database).

No evidence of this species was detected during the fauna surveys. The margins of the artificial water body located in the centre of the study area provide potentially suitable habitat for this species. Given this species is highly cryptic in behaviour, and has migratory/dispersive movements, it is possible it could occur in the study area from time to time. The current design concept (May 2016) involves minimal disturbance to the existing water body and surrounding remnant vegetation. Given this species has not been recorded in the study area and the proposed action will result in minimal disturbance to the habitat associated with the water body, it is unlikely this species would be significantly impacted by the proposed action.



#### 10.7.4.2 Beach Stone-curlew

The Beach Stone-curlew (*Esacus magnirostris*) is listed as vulnerable under the NC Act and it is ranked as a high priority under the Department of Environment and Heritage Protection Back on Track species prioritisation framework. In Queensland, this species occurs throughout the coastline and surrounding islands. The Beach Stone-curlew is usually found on open, undisturbed beaches, islands, reefs, and estuarine intertidal sand and mudflats, preferring beaches with estuaries or mangroves nearby (EHP 2015c).

There are multiple records of this species from Lindeman Island (Atlas of Living Australia) and over 200 sightings are within a 50km radius of the study area (Wildlife Online Extract). While this species was not observed during the fauna surveys, which included targeted searches, it is likely this species would occur on shoreline areas on Lindeman Island. Increased visitation and shore-based activities associated with the proposed action may impact the natural behaviour of this species within the study area. However, the extent of habitat for this species within the study area is minimal compared with habitat available in the Lindeman Islands National Park and broader region. The proposed action is unlikely to lead to a long term decrease in the size of the local population or reduce the extent of occurrence for this species. It is therefore unlikely there will be a significant impact on this species as a result of the proposed action.

#### 10.7.4.3 Eastern Curlew

The Eastern Curlew (*Numenius madagascariensis*) is listed as critically endangered under the EPBC Act and near threatened under the NC Act. The largest wader in Australia, the Eastern Curlew is a migrant to Australia and found along the coast from August to March. This species is found along the coast in every state of Australia with a continuous distribution from mid Western Australia, through the Northern Territory and along the east coast of Queensland. This species is a cautious wader, which is quick to take flight when disturbed. It prefers sheltered coasts, especially estuaries, bays, harbour, inlets, and coastal lagoons with large intertidal mudflats or sandflats (DoE, 2015b).

There are several areas of suitable habitat in the form of coastal beaches around Lindeman Island. There are numerous records of this species within 50km of the study area (Wildlife Online extract) including a single record on Lindeman Island (as shown on the Atlas of Living Australia). Due to the small scale of disturbance to potential habitat areas, and the availability of undisturbed habitat in the locality, it is unlikely that the proposed project will have a significant impact on the Eastern Curlew.

#### 10.7.4.4 Coastal Sheathtail Bat

The Coastal Sheathtail Bat is listed as near threatened under the NC Act. This species occurs only in coastal east Queensland, from the Cape York Peninsula southwards to Shoalwater Bay. This species is distributed along the Queensland coast from Shoalwater Bay to Cape York, extending no more than a few kilometres inland and is believed to be unevenly distributed throughout its range, due to its reliance on coastal roosts (EHP 2015c). This species forages over most coastal vegetation types including open forests, mangroves, scrub, heath, and swamps (Menkhorst and Knight, 2010).

Preferred roosting habitat such as rocky clefts and boulder piles are present along various parts of the Lindeman Island coastline. There are numerous records within 50km of the study area (Wildlife Online extract) as well as one record within the study area (Australian Museum). While this species was not detected during targeted searches, some of the echolocation call data collected is potentially attributable to this species. This call data was identified to genus level only (*Taphozous*), as calls from the Coastal Sheathtail Bat and Troughton's Sheathtail Bat (*T. troughtoni*) are indistinguishable.

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No roosting areas were recorded with the study area. The proposed nature refuge encompassing the coastal vine thicket TEC will maintain potential roosting habitat for this species as boulder piles occur throughout the area. Given that potential roosting habitat for this species will be retained and there is an abundance of similar foraging habitat in the locality, it is unlikely the proposed action will have a significant impact on the Coastal Sheathtail Bat.

# 10.7.4.5 Common Death Adder

The Common Death Adder (*Acanthophis antarcticus*) is listed as near threatened under the NC Act. This is a slow-moving cryptic snake that lies motionless and partly concealed under heavy leaf litter and low vegetation (Wilson and Swan, 2010), and is found in a variety of habitats across central and eastern Queensland. The Common Death Adder is found in a wide variety of habitats in association with deep leaf litter, including rainforests, wet sclerophyll forests, woodland, grasslands, chenopod dominated shrublands, and coastal heathlands (EHP 2015c). This species is declining in many areas due to habitat loss and altered fire regimes.

This species is considered to have a moderate likelihood of occurring in the study area. There are records of Common Death Adders on two islands in the Whitsunday group and suitable habitat that falls within the broad habitat preference descriptions is available throughout Lindeman Island. This species was not detected during the field surveys, but it is quite cryptic and can be difficult to detect in the field, and therefore its absence in survey data does not necessarily confirm its absence from the study area. However, the prevalence of Cane Toads on the island is likely to have had a significant impact on the population of this species on the island if it is present. Nonetheless, the study area does not contain any unique habitat features for this species. Habitat of a similar nature is abundant in the surrounding National Park and the broader region. It is unlikely this species would be significantly impacted by any disturbance to the potential habitat within the study area.

# 10.7.5 Contamination

Sources of land contamination from historical activities within the project area as well as during the construction and operation of the proposed action are identified in **Chapter 23** of the EIS. **Chapter 26** also details the management framework for land contaminants, including site investigations and relevant impact mitigation measures. The implementation of the relevant impact mitigation measures within this management framework will avoid an inappropriate level of risk of land contamination. It is therefore unlikely there will be significant impacts to terrestrial biodiversity values from contamination.

# 10.7.6 Noise and Vibration

Noise and vibration sources associated with the construction and operation phases of the proposed actions are identified and quantified in **Chapter 16** of the EIS along with relevant mitigation measures. The only substantial vibration levels identified will be during the construction phase when driven piling and general construction works are occurring. These impacts are temporary in nature and therefore unlikely to result in significant impacts to terrestrial biodiversity values.

There are no native ground-dwelling or arboreal mammals present on Lindeman Island and the only native mammal species are bats. The more major noise sources such aircraft arrivals and departures will be restricted daytime periods only, in accordance with the relevant aviation codes. Any bats roosting in close proximity to the development area are unlikely to be significantly affected by these noise sources during the day. Noise sources during night hours will be low and permanent sources will be mitigated through the use of noise screening or enclosures. Bats foraging at night are unlikely to be significantly affected by the lower level noise sources. Potential noise impacts on reptiles are not well studied, but it is unlikely noise levels associated with construction and operation would significantly affect any reptile species present on the island.



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Terrestrial bird species may be deterred from foraging or nesting within the local area from noise levels associated with construction and operation of the site. However, there are no critical habitat areas within close proximity to the development for any terrestrial bird species. It is unlikely there will be significant impacts from potential noise sources to the local population of any terrestrial bird species. Marine and shorebird species and potential impacts to those species are discussed in **Chapter 9** of the EIS – Marine Ecology.

# 10.8 Impact Management

# 10.8.1 Conservation Significant Vegetation Communities

### 10.8.1.1 Coastal Vine Thicket

The Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC is scattered throughout the rocky slopes of the shorelines within the study area. While this community is classed as a 'least concern' RE under the Queensland vegetation management framework, the full extent of this community equates to the critically endangered community listed under the EPBC Act. This community is therefore a MNES.

The current design concept (November 2016) includes resort infrastructure areas that occur in close proximity to this community. It is recommended a buffer zone of at least five metres be applied to all areas of this community. While small patches of this community can be resilient, invasion by exotic plant species represents a significant threat to this community. A pest plant management plan and the implementation of a five metre buffer zone will support the maintenance of biodiversity values for this community.

# 10.8.1.2 Broad Leaved Tea-Tree Woodland

Vegetation consistent with the Broad Leaf Tea-tree (Melaleuca viridiflora) Woodlands in High Rainfall Coastal North Queensland TEC is present within the current lease areas of the resort. The current design concept (November 2016) includes disturbance to this community through the proposed expansion of the runway strip footprint. Impacts to this community will be mitigated through the implementation of an environmental offset strategy as detailed in **section 10.12.3**. Overall, the key construction/operation impact mitigation approach for disturbance to this community (in addition to or in combination with any environmental offset delivery requirements) is the implementation of a pest plant management plan. It is recommended that a management plan be prepared specific to managing vegetation, particularly pest plants, within this community. The management plan should focus on minimising the potential for impacts to this community outside the proposed disturbance area from exotic species invasion and other edge effects. The management plan will need to include routine monitoring within the management area for weed cover and condition assessments, particularly if the existing degraded areas are incorporated into an offset strategy. The management plan should also incorporate specific methodology relating to ongoing maintenance of the trimmed vegetation and buffer areas, and managing the visual amenity of these.

The majority of the Broad leaf tea-tree community is located within current lease areas that are proposed for surrender to the National Park. Pest plant management activities in degraded areas of this community could allow for significant improvement to the current condition and restore biodiversity values. Lindeman Island is the only location in the Whitsunday Islands group supporting this community. The conservation significance of the vegetation community present on land to be surrendered should be recognised during tenure negotiations and future management approaches specific to this community should be coordinated across the different tenures. A term lease covering areas of this community may be required as part of environmental offset and pest management commitments.



### 10.8.2 Native Grassland

Multiple areas of the native grassland community, RE 8.12.13a, occur within the study area. This community has an 'of concern' status under the Queensland vegetation management framework. Disturbance to this community should be avoided where possible, but it is noted the current design concept (November 2016) includes areas where this community is present. Where unavoidable, the provision of an environmental offset will be required for significant residual impacts to this community, in accordance with the Queensland environmental offsets framework (see **section 10.12.3** below). In addition to (or in combination with) environmental offset delivery requirements (see below), there are some general impact management approaches relevant to marinating the biodiversity values of this community. Invasion by pest plant species represents a significant threat to this community, although the geology and exposure in some locations favours the native species composition. The pest plant management strategies detailed in the following sections will be important for maintaining the biodiversity values of this community.

### 10.8.3 Environmental Offsets

#### 10.8.3.1 Broad-leaf Tea Tree Woodland

The Broad-leaf tea tree woodland community occurs in two forms on Lindeman Island and the conservation status of the communities is different between these forms. The majority of the form on the eastern side of the runway strip is intact, whereas the form on the western side of the runway strip has been significantly degraded by exotic species invasion. The full ground-truthed extent of the Broad-leaf tea tree community equates to RE 8.3.2, which is an endangered community under the VM Act (Qld). However, only part of the ground-truthed extent meets condition thresholds for the endangered ecological community listed under the EPBC Act (Commonwealth). The scale of residual impacts and environmental offset liability is therefore different for these two forms.

# Endangered Ecological Community – EPBC Act

The majority of the Broad-leaf tea tree woodland on the eastern side of the runway strip is consistent with the community listed under the EPBC Act, and is therefore a MNES (refer to **Figure 10-4**). As detailed in the sections above, a number of approaches have been adopted through the design phase to avoid and minimise impacts to this community. Despite these impact avoidance and minimisation approaches, there is a significant residual impact to this community in the form of a 1.5 hectare reduction in the extent resulting from vegetation clearing and trimming requirements from the runway upgrade. This significant residual impact triggers the requirement for the provision of an environmental offset under the EPBC Act.

The 1.5 hectare clearing area will need to be offset by delivering a direct, on-the-ground, conservation outcome that improves or maintains the viability of this community. The most suitable mechanism for delivering an appropriate conservation outcome is the restoration of degraded areas of this community, such as the section that is to be retained on the western side of the runway. Under the current design concept (November 2016), there are at least 3.66 hectares of degraded Broad leaf tea-tree woodland to be retained that could be restored to an ecological condition consistent with the listed community. The net outcome of restoring this area would be an increase of more than 40% to the current extent of the listed community on Lindeman Island.

The 3.66 hectare area to be retained on the western side of the runway strip supporting degraded Broad-leaf tea tree woodland forms the proposed environmental offset area for impacts to this MNES. The proposed offset area is degraded through invasion by exotic ground cover species to the point that it does not meet condition thresholds for the listed community. The proposed restoration works for delivering the environmental offset will involve control of exotic ground cover species to promote native species regeneration within this area. The



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management objective of the offset area will be to reduce exotic ground cover abundance and promote native ground cover regeneration to establish an ecological condition consistent with the listed ecological community.

The areas on each side of the runway strip to be trimmed for aircraft safety code compliance will be managed as buffer zones to the endangered ecological community. While included in the 'impact area' calculations, these buffer zones will retain many of the biodiversity values associated with the ecological community. Vegetation management activities will also be conducted in these buffer zones to supplement the environmental offset restoration works and ensure the ongoing viability of the community. The Commonwealth Listing Advice (TSSC 2012) for this community identifies invasive species as one of the most significant threats to this community. The significance of this threat at the local scale is evident from existing disturbance. The vegetation management works proposed as part of the environmental offset delivery and buffer zones represent the optimal mechanism for maintaining and increasing the extent of this community and the biodiversity values within it.

Control of exotic ground cover species should allow for natural regeneration of native species. However, regeneration of native ground cover species could be supplemented through a seeding and planting program for locally occurring native ground cover species. This program could be supported by the establishment of an on-site nursery stocked from seed collection within the project lease area.

The suitability of this offset delivery mechanism will be demonstrated through field-based habitat assessments, systematically comparing values between the proposed impact and offset areas. The offset mechanism will be able to restore the community to similar condition to the impact area, and given the proposed offset area is more than twice the size of the impact area, the proposed offset mechanism will deliver a 100% direct (land-based) environmental offset for impact to the EPBC Act listed community.

The ultimate intent for land supporting the listed community, including the proposed offset area once restoration works are complete, is for inclusion in National Park tenure for protection under the NC Act. This will ensure the long-term protection of the biodiversity values supported by the community. The approach will also enhance the biodiversity values of the National Park and ensure that leasehold land proposed for surrender is in good condition and consistent with National Park values. Land intended for surrender to the National Park will need to be staged to allow for restoration works to be completed.

#### Endangered Regional Ecosystem 8.3.2 – VM Act

The full extent of the Broad-leaf tea tee woodland on Lindeman Island equates to endangered RE 8.3.2. This is because the definitions for remnant vegetation under the VM Act are based on canopy attributes and to not take ground-cover attributes and condition into consideration. The community on both sides of the runway strip therefore equates to a MSES. As discussed in previous sections, the disturbance footprint has been aligned to minimise disturbance as much as possible, and therefore, where possible, the disturbance has been located in the degraded habitat on the western side of the runway strip. The total disturbance footprint for RE 8.3.2, including areas to be cleared or trimmed, is 5.14 hectares. The Queensland Environmental Offsets Policy – Significant Residual Impacts Guideline identifies the relevant impact area threshold for 'significant' impacts as 2 hectares (for communities with a sparse structural category). The 5.14 hectare disturbance footprint therefore equates to a significant residual impact to a MSES, which triggers the requirement for provision of an environmental offset under the Queensland Environmental Offsets Framework.

The total environmental offset liability for significant residual impacts to RE 8.3.2 will be determined through field-based habitat assessments of the proposed impact areas, as described for MNES. However, it is noted there is a maximum impact-offset ration of 4:1.



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Suitable land and habitat for delivering land-based environmental offsets for this community on Lindeman Island is limited. Therefore, the environmental offset delivery mechanism for significant residual impacts to RE 8.3.2 will need to include a land-based and financial settlement approach. The land-based approach will be delivered as described previously for the Broad-leaf tea tree community listed under the EPBC Act. The degraded areas of RE 8.3.2 to be retained as part of the development design will be managed to reduce exotic species cover and promote restoration of native ground and shrub layer species. The proposed impact area for RE 8.3.2 is 5.14 hectares and the area to be retained and managed through the implementation of a restoration program is 3.66 hectares. Given the limited extent of habitat available for restoration works, an additional financial compensation payment will be required to deliver the residual environmental offset liability in addition to the land-based approach. The magnitude of this residual offset liability compensation payment will be determined through the field-based habitat condition assessments.

### 10.8.4 Native Grassland – Regional Ecosystem 8.12.13

RE 8.12.13 has an 'of concern' status under the VM Act and is therefore a MSES, but is not listed as threatened under the EPBC Act. This community occurs on slopes and headlands surrounding various sections of the existing resort infrastructure. It also occurs on the western headland in the area nominated for the proposed 'glamping facility'.

Disturbance to this community has been avoided by design where possible by locating infrastructure in areas of existing disturbance. The proposed glamping facility has been designed to avoid disturbance to the grassland community in this area, with the disturbance footprint focussed on degraded (non-remnant) areas of existing disturbance. Similarly, some of the habitat supporting relatively intact grassland on the slopes of the southern headland are to be retained as part of the development design. The total disturbance footprint within RE 8.12.3 is 4.19 hectares.

Although RE 8.12.13 is described as a grassland community in the Regional Ecosystem Description Database (Queensland Herbarium 2015), the structural category for this community is defined as a 'sparse'. The *Queensland Biodiversity Offset Policy – Significant Residual Impact Guidelines* identify the relevant significant residual impact criteria for regulated vegetation. The clearing threshold for a sparse (structural category) RE, such as 8.12.13, is two hectares. Any clearing above this threshold is classified as a significant residual impact and requires provision of an environmental offset.

There are multiple areas of degraded grassland communities present within the existing resort lease area. There are also substantial areas of degraded grassland located within the surrounding National Park tenure, some of which are continuous with the communities within the lease. These degraded grassland areas have been impacted by historical land uses and have been subject to very substantial invasion by exotic grass and forb species. The biodiversity values of these degraded grassland areas have been significantly depleted and therefore restoration works will form a suitable land-based offset delivery mechanism for maintaining the extent of RE 8.12.13 and promoting associated biodiversity values. The total offset liability for land-based offsets will be determined through field-based habitat condition assessments. The extent of degraded grassland areas outside the development disturbance footprint likely provides ample habitat for inclusion in environmental offset delivery. However, any significant residual impacts beyond those that can be offset through a land-based approach could be offset through a combined approach that includes a financial compensation payment.



#### 10.8.5 Rehabilitation of Native Vegetation

The only significant area of native vegetation that will be disturbed during the construction phase and consequently require rehabilitation during operation is an area associated with a minor drainage diversion. Gap Creek dam will provide the water supply for the resort and the current masterplan design includes an increase to shape and configuration of the existing dam to increase inflows from adjacent catchment area. Upon completion of these works during the construction phase, impacted areas of the remnant vegetation (0.46 hectares) will need to be rehabilitated to minimise impacts to the impacted communities. The balance of the extent of the Broad leaf tea-tree community on the western side of the runway is also proposed for restoration works to offset disturbance to other areas of this community. The area on the western side is subject to substantial degradation from invasion by the exotic grass species Guinea grass and subsequent loss of ground layer flora diversity. The remnant vegetation disturbance footprint and restoration areas are indicated on **Figure 10-6**.

The rehabilitation approach and monitoring of rehabilitation progress should be included in the project Environmental Management Plan.

Vegetation characteristics should be monitored at control (analogue) sites in nearby habitat areas within the same community that are relatively intact (e.g. on the eastern side of the runway). The data collected from these control sites will form the basis for assessing rehabilitation progress and success. This control-impact monitoring design is a standard scientific approach to environmental monitoring and conforms to best practice principles for rehabilitation monitoring.

The monitoring design should incorporate sufficient effort to facilitate appropriately robust statistical analysis for comparing between control and rehabilitated impact areas. A minimum of three control and three rehabilitation sites should be established.

Monitoring of vegetation characteristics and condition at each site will involve a transect survey approach. Transects comprising a 25 metre by 20 metre permanent monitoring area should be established. Within these transect areas the following attributes should be measured:

- Ground layer cover (vegetated);
- Diversity of ground layer species;
- Canopy height;
- Crown cover;
- Tree and shrub species richness;
- Exotic species cover; and
- Exotic species richness.

These attributes should be compared between control and rehabilitated sites using relevant statistical analysis, such as Analysis of Variance (ANOVA). Rehabilitation progress and success will be evaluated through temporal comparisons and assessment against rehabilitation success criteria based on vegetation characteristics such as those outlined below.

- Native vegetative groundcover is greater than 70% of the average cover measured within the corresponding control sites;
- Native groundcover species diversity must be greater than 70% control sites;



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- Canopy cover is greater than 50% of the average cover measured within the corresponding land unit control sites; and
- Canopy cover must be dominated by *Melaleuca viridiflora* (>50%).

# 10.8.6 Conservation Significant Fauna Species

No threatened or near threatened fauna species were observed during the fauna survey period. However, some of the bat echolocation call data obtained is potentially from the Coastal Sheathtail Bat, and it is likely this species would forage over the study area from time to time. The study area does not support any unique terrestrial habitat values for this species, and similar habitat is available in the surrounding National Park areas. The steep rocky slopes along some of the shorelines within the study area represent potential roosting habitat for this species. It is recommended disturbance to these areas is minimised. In general, potential roosting habitat correlates strongly with the presence of the coastal vine thicket TEC, and therefore avoidance of this community will also result in avoidance of potential Coastal Sheathtail Bat roosting habitat.

### 10.8.7 General Vegetation Management and Clearing

During construction activities, the following measures should be implemented to minimise disturbance impacts and the potential harm to habitat values and flora present within the area:

- The boundary of areas to be cleared should be clearly marked, to ensure the disturbance footprint is minimised;
- Cleared vegetation should be managed according to the following best practice principles:
  - i. Where possible, logs and large branches with hollows should be reserved, and stockpiled separately (at the edge of the site) to maintain habitat values;
  - ii. Any mulching should occur as near as possible to the time of clearing to prevent the establishment of stockpiles as fauna habitat.

The following measures are recommended to maintain and improve the biodiversity values for the aforementioned conservation significant vegetation communities:

- Remove key problem species (particularly Lantana for many of these patches) to reduce competition and smothering of native species;
- Implement hazard reduction zones in the vicinity of the remnant patches to prevent disturbance from inappropriate fire regimes;
- Ensure proper placement of paths/tracks and other infrastructure around the community to avoid direct damage and fragmentation; and
- Restoring native grasslands by promoting native grass and shrub species, controlling non-native species, and implementing appropriate fire management strategies.

#### 10.8.8 Soil Management

During construction, soil stockpiles should be managed to maximise suitability for future use in landscaping processes. Topsoil should be stockpiled separately from sub-soils, and stockpiled to a maximum height of two metres. This will maintain the quality of the soil and suitability for use in landscaping. Stockpiles should also be managed to allow passage for fauna by leaving a sufficient gap between stockpiles.

# 10.8.9 Pest Management

A number of pest plant species including Leucaena, Lantana, Guinea grass, Grader grass, Bidens and Singapore daisy were identified during the flora surveys. These species represent a significant threat to the biodiversity values of the various vegetation communities present. In particular, exotic grasses and Lantana are impacting the integrity of some native grassland areas and the Broad leaf tea-tree community. Pest plant management activities should be conducted in consultation with the relevant National Park management authority to ensure strategies are consistent with approaches for the surrounding National Park.

Several restricted pest species were identified within the study area. Given the proposed action occurs immediately adjacent to National Park land, it will be important to manage pest species to minimise potential impacts to the surrounding protected areas.

The following recommendations are relevant to the construction phase as well as ongoing monitoring and management post-construction to minimise weed distribution and abundance:

- Wherever possible construction activities should work from areas with fewer weed species and smaller infestations towards areas where there is a greater abundance of weeds;
- Vehicles and machinery brought on site should be clean and free of weeds, dirt and other material that may contain weed seeds and cause exotic species to become established within the works areas;
- Weed spread should be minimised by implementing some control measures within the proposed works areas prior to construction;
- Disturbance sites and stockpiles should be regularly examined for incidence of weed species; and
- Where any weed establishment is identified, appropriate control measures should be implemented to minimise the impacts of weeds on native habitat.

It is recommended a specific vegetation management plan be developed for the Broad-leaf tea-tree community to prevent indirect impacts form edge effects such as exotic species invasion. This will also allow for the restoration of degraded patches of this community where the ground layer is dominated by exotic species. However, management approaches will need to be coordinated across the different land tenures, as the majority of the land supporting this community is proposed for surrender to the National Park.

Non-native fauna species were recorded throughout the study area including Cane toads, Asian house geckos and Black rats. It is recommended a pest animal management program be put in place to reduce numbers of Black rats before, during, and after the construction phase. Refer to **Chapter 20 - Biosecurity** for further information on this issue.

#### 10.8.10 Dust Management

Excavation and vehicle movements produce increased levels of dust, which can have a cumulative impact on plant function. Dust suppression techniques should be implemented where significant dust is being produced, including (but not limited to):

- application of water on trafficable surfaces;
- limiting activities in high wind conditions; and
- application of water/ binding agent to construction sites during construction.


### 10.8.11 Fauna Management

Excavated areas can pose a risk to native fauna through entrapment and exposure. Excavated areas should be checked regularly for trapped fauna, with inspection occurring at least twice daily. These areas should be checked early in the morning for fauna that has become trapped overnight, and again in the late afternoon for fauna that has become trapped over the course of the day.

Safe egress points should be included to allow fauna to escape of their own accord. Any fauna that cannot escape of its own accord should be removed in a manner that is safe for both the animal and the person handling the animal. Dangerous fauna species, such as snakes, should only be handled by a suitably qualified and experienced person.

The use of a fauna spotter-catcher during the vegetation-clearing and construction period is recommended to minimise the chances of injury to native fauna. The fauna spotter-catcher should have a current rehabilitation permit, and should be present during clearing activities. The role of the spotter-catcher would be to advise on appropriate clearing methods to ensure animal escape paths are maintained and relocate fauna located within the disturbance area.

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#### 10.9 **Risk Assessment for Potential Impacts and Mitigation Measures**

In accordance with the requirements of the EIS Terms of Reference, whereby impact mitigation and management measures must be identified, a risk assessment has been performed for the potential impacts to terrestrial flora and fauna biodiversity values discussed previously in this section. The risk assessment for these matters is presented in Table 10-10.

Potential Impact	Significance of		Mitigation measures		Significance of Impact: Mitigated
unmitigated	Design	Construction	Operation		
Flora Species					
Reduction in flora species diversity	High (12): Possible impacts to areas supporting higher flora species diversity or areas containing flora species with limited spatial distribution on the island.	<ul> <li>Fine scale vegetation community mapping completed as part of approvals process.</li> <li>Avoidance of areas supporting higher flora species diversity (e.g. littoral rainforest and coastal vine thicket community).</li> <li>Use of existing resort infrastructure disturbance footprint.</li> <li>Disturbance footprint centred on areas of existing clearing and disturbance.</li> </ul>	<ul> <li>Approved disturbance footprint clearly marked to prevent unauthorised clearing.</li> <li>Implementation of buffer zones for environmentally sensitive areas.</li> <li>Restricted access to environmentally sensitive areas.</li> <li>Implementation of Pest Management Plan.</li> <li>Locally occurring native species to be used for rehabilitation</li> <li>Contractor induction programs to include education and awareness component for significant biodiversity matters.</li> </ul>	<ul> <li>Implementation of Pest Management Plan</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> <li>Locally occurring native species to be used for rehabilitation and non-invasive species to be used for landscaping purposes.</li> <li>Restricted access for visitors to environmentally sensitive areas.</li> <li>Educational information and signage for visitors and guests regarding environmentally sensitive areas</li> </ul>	Low (4) Residual impacts are unlikely to be significant and will be manageable through the implementation of management plans.
Fauna Species					
Reduction in fauna species diversity	High (12): Possible impacts to areas supporting higher fauna species diversity or habitats with limited spatial distribution on the island.	<ul> <li>Avoidance of areas supporting structurally complex vegetation communities and habitats (e.g. littoral rainforest and coastal vine thicket community).</li> <li>Use of existing resort infrastructure disturbance footprint.</li> </ul>	<ul> <li>Clearing of habitats to occur in a sequentially where possible, to allow fauna to move away from clearing areas.</li> <li>Excavations to include safe egress points and to be checked regularly</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions</li> </ul>	Low (4) Residual impacts are unlikely to be significant and will be manageable through the implementation of management plans.

# Table 10-10. Risk assessment matrix – flora and fauna.

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GREAT BARRIER REEL Potential Impact Significance of **Mitigation measures** Significance of Impact: Impact: unmitigated Mitigated Construction Operation Design ٠ Disturbance footprint for trapped Restricted access individuals. centred on areas of for visitors to existing clearing and environmentally Use of fauna • disturbance. spotter catchers sensitive areas. during vegetation • Educational clearing. information and Significant signage for visitors ٠ and guests microhabitat regarding features such as environmentally large hollow logs to sensitive areas be retained where possible during clearing for use in rehabilitation areas. Implementation of ٠ Pest Management Plan. Contractor • induction programs to include education component for significant biodiversity matters. Mulching of cleared vegetation to occur as soon as possible after clearing to prevent establishment as habitat. Impacts to near -ligh (12): Avoidance of areas As for general As for general .ow (4) • • threatened and supporting potential fauna species ossible fauna species Residual impacts threatened species significant roosting habitat for are unlikely to be Coastal Sheathtail populations impacts to nearsignificant and Bat (e.g. rocky threatened or will be outcrops and threatened fauna manageable crevices in the littoral through the species. rainforest and coastal mplementation vine thicket of management community) plans. Use of existing resort • infrastructure disturbance footprint. • Disturbance footprint centred on areas of existing clearing and disturbance. No essential habitat for threatened species present in disturbance footprint. Use of existing resort Impacts to High (12): As for general As for general Low (4) ٠ ٠ populations of infrastructure fauna species fauna species Possible Residual impacts migratory species disturbance footprint. significant are unlikely to be mpacts to Proposed action not significant and populations of within a 'Significant will be Bird Site'. migratory manageable species. through the Shoreline disturbance • mplementation limited to location of existing resort

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LINDEMAN GREAT BARRIER REEF RESORT PROJECT ENVIRONMENTAL IMPACT STATEMENT

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		GREA			AT BARRIER REEF
Potential Impact	Significance of Impact:	Mitigation measures			Significance of Impact:
	unmitigated	Design	Construction	Operation	Mitigated
		infrastructure and areas included on the masterplan.			of management plans.
Vegetation Comm	unities, Flora and	Fauna Species Habitat and	d Connectivity		
Reduction in the spatial extent and ecological integrity of the critically endangered <i>littoral</i> rainforest and coastal vine thickets of eastern Australia community	High (16): Likely reduction in extent of this community on Lindeman Island	<ul> <li>Terrestrial flora and fauna assessment included detailed mapping of the spatial extent of this community.</li> <li>The full extent of this community has been avoided in the design concept.</li> <li>Buffer zones have been included in the design to avoid direct impacts and allow for pest and fire management.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Construction Environmental Management Plan.</li> <li>Clear delineation of no-go areas and use of appropriate fencing to minimise potential impact</li> <li>Contractor induction programs to include education component for significant biodiversity matters.</li> <li>Implementation of buffer zones.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions</li> <li>Restricted access for visitors to environmentally sensitive areas.</li> <li>Awareness information and signage for visitors and guests regarding environmentally sensitive areas.</li> <li>Bushfire management strategy to prevent inappropriate fire regimes within this community.</li> </ul>	Low (2) Residual impacts are unlikely to be significant and will be manageable through the implementation mitigation measures described.
Reduction in the spatial extent and ecological integrity of the <i>Broad leaf</i> <i>tea-tree</i> ( <i>Melaleuca</i> <i>viridiflora</i> ) woodlands in high rainfall coastal north Queensland endangered ecological community	High (16): Likely reduction in extent of this community on Lindeman Island	<ul> <li>Terrestrial flora and fauna assessment included detailed mapping of the spatial extent of this community.</li> <li>Existing runway strip disturbance footprint and degraded areas of Broad leaf tea-tree to be utilised to the full extent possible.</li> <li>Areas with higher condition values avoided.</li> <li>Environmental offset to be provided for residual impacts to areas unable to be avoided by design.</li> </ul>	<ul> <li>Approved disturbance footprint clearly marked to prevent unauthorised clearing.</li> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Construction Environmental Management Plan.</li> <li>Locally occurring native species to be used for rehabilitation</li> <li>Contractor induction programs to include education and awareness component for significant biodiversity matters.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> <li>Implementation of Environmental Offset Management plan for land-based environmental offsets (if required).</li> <li>Locally occurring native species to be used for rehabilitation and non-invasive species to be used for landscaping purposes.</li> <li>Restricted access for visitors to</li> </ul>	Low (4) Community avoided where possible, with significant residual impacts to be offset through land- based environmental offset approach to maintain the extent and promote the biodiversity values of this community.

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		GREAT E			
Potential Impact	Significance of Impact:	Mitigation measures			Significance of Impact:
	unmitigated	Design	Construction	Operation	Mitigated
Reduction in the spatial extent and	(16) High: Likely reduction	Terrestrial flora and fauna assessment	Approved     disturbance	<ul> <li>environmentally sensitive areas.</li> <li>Awareness information and signage for visitors and guests regarding environmentally sensitive areas</li> <li>Development and implementation of</li> </ul>	Low (2) Community
ecological integrity the native grassland community, regional ecosystem 8.12.13 (of concern status)	in extent of this community on Lindeman Island	<ul> <li>included detailed mapping of the spatial extent of this community.</li> <li>Existing resort disturbance footprint to be utilised for proposed action.</li> <li>Areas with higher condition values avoided where possible.</li> <li>Scale of disturbance minimised where possible.</li> </ul>	<ul> <li>footprint clearly marked to prevent unauthorised clearing.</li> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Construction Environmental Management Plan.</li> <li>Locally occurring native species to be used for rehabilitation</li> <li>Contractor induction programs to include education and awareness component for significant biodiversity matters.</li> </ul>	<ul> <li>Environmental Offset Delivery Plan</li> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> <li>Locally occurring native species to be used for rehabilitation and non-invasive species to be used for landscaping purposes.</li> <li>Restricted access for visitors to environmentally sensitive areas.</li> <li>Awareness information and signage for visitors and guests regarding environmentally sensitive areas</li> </ul>	avoided where possible, with significant residual impacts to be offset through land-based environmental offset approach to maintain the extent and promote the biodiversity values of this community.
Reduction in spatial extent and ecological values of significant flora and fauna habitat areas	(12) High: Possible impacts to significant habitats	<ul> <li>Use of existing resort infrastructure disturbance footprint.</li> <li>No essential habitat for threatened species present in disturbance footprint.</li> <li>No distinct or spatially limited habitat features present in disturbance footprint.</li> <li>Avoidance of areas supporting structurally complex</li> </ul>	<ul> <li>Significant microhabitat features such as large hollow logs to be retained where possible during clearing for use in rehabilitation areas.</li> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Construction Environmental Management Plan.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> <li>Restricted access for visitors to environmentally sepeitive accoss</li> </ul>	(2) Low Residual impacts are unlikely to be significant and will be manageable through the implementation mitigation measures described.

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Potential Impact	Significance of	Mitigation measures			Significance of
	Impact: unmitigated	Dosign	Construction	Operation	Impact: Mitigated
		habitats (e.g. littoral rainforest and coastal vine thicket community).	to include education component for significant biodiversity matters.	<ul> <li>Awareness information and signage for visitors and guests regarding environmentally sensitive areas.</li> <li>Bushfire management strategy to prevent inappropriate fire regimes.</li> </ul>	
Reduction in habitat connectivity values through fragmentation and isolation of habitats	(12) High: Likely impacts to connectivity through fragmentation.	<ul> <li>Use of existing resort infrastructure disturbance footprint.</li> <li>All proposed disturbance outside existing footprint is immediately adjacent to disturbed areas and avoids fragmentation and isolation of habitats</li> </ul>	<ul> <li>Approved disturbance footprint clearly marked to prevent unauthorised clearing.</li> <li>Implementation of Construction Environmental Management Plan</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> <li>Bushfire management strategy to prevent inappropriate fire regimes.</li> </ul>	(2) Low Impacts to connectivity will be avoided by design. Residual impacts will be very low.
Watercourses and	Wetlands				
Loss of riparian habitat values and biodiversity associated with watercourses	(9) Medium: Limited riparian habitat present in study area, but moderate impacts are possible without mitigation.	<ul> <li>No disturbance to vegetation associated with a watercourse shown on the Vegetation Management Watercourse Map.</li> <li>Vegetation in close proximity to drainage features will be retained to prevent erosion issues.</li> </ul>	<ul> <li>Approved disturbance footprint clearly marked to prevent unauthorised clearing.</li> <li>Implementation of Construction Environmental Management Plan</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> <li>Bushfire management strategy to prevent inappropriate fire regimes.</li> </ul>	(2) Low Impacts to riparian habitat values will be avoided by design. Residual impacts will be very low.
Loss of wetland habitat values and biodiversity	(12) High: Likely impacts to wetland habitat and hydrology without mitigation.	<ul> <li>Existing wetland habitat associated with Gap Creek dam to be retained.</li> <li>Minor drainage diversion not likely to significantly alter hydrology of area.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Construction Environmental Management Plan.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of an Environmental Management Plan including a monitoring and auditing program and management of corrective actions.</li> </ul>	(4) Low Residual impacts are unlikely to be significant and will be manageable through the implementation of management plans.



		GREAT BARRIER REEF			
Potential Impact	Impact Significance of Mitigation measures Impact:			Significance of Impact:	
	unmitigated	Design	Construction	Operation	Mitigated
National Park	(16) High: Clearing likely to occur in part of the protected area. Possible reduction in natural values.	<ul> <li>Use of existing resort infrastructure disturbance footprint where possible to minimise additional impact.</li> <li>Proposed resort infrastructure primarily located in existing perpetual lease tenure or disturbed areas of existing short-term lease area.</li> <li>Investment in infrastructure to support public use and enjoyment of the protected area.</li> <li>Financial compensation payment to offset residual impacts associated with revocation of National Park land.</li> </ul>	<ul> <li>Approved disturbance footprint clearly marked to prevent unauthorised clearing.</li> <li>Implementation of buffer zones for environmentally sensitive areas.</li> <li>Restricted access to environmentally sensitive areas.</li> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Construction Environmental Management Plan.</li> <li>Locally occurring native species to be used for rehabilitation.</li> <li>Contractor induction programs to include education and awareness component for significant biodiversity matters.</li> </ul>	<ul> <li>Implementation of Pest Management Plan.</li> <li>Implementation of Environmental Management Plan.</li> <li>Locally occurring native species to be used for rehabilitation and non-invasive species to be used for landscaping purposes.</li> <li>Restricted access for visitors to environmentally sensitive areas.</li> <li>Educational information and signage for visitors and guests regarding environmentally sensitive areas.</li> <li>Maintenance of infrastructure to support public use and enjoyment of the protected area.</li> </ul>	(4) Low Residual impacts after mitigation measures including financial compensation are unlikely to be significant and will be manageable through the implementation of management plans.
Great Barrier Reef World Heritage Area	(16) High: Likely reduction in WHA ecological values on Lindeman Island. All relevant terrestrial ecological values are described previously in this table.	As described previous significance	ly in this table for all matte	rs of environmental	(4) Low Residual impacts after mitigation measures including financial compensation payments and environmental offsets are unlikely to be significant and will be manageable through the implementation of the previously listed management plans.
Pest Species					
Increase in pest species abundance/distribut ion and subsequent decrease in native flora and fauna species diversity	(16) High: Likely reduction of ecological values on Lindeman Island	<ul> <li>Measures to prevent introduction of pests to be incorporated in Environmental Management Plan.</li> <li>Development of Pest Management Plan.</li> </ul>	<ul> <li>Implement Pest Management Plan, including Black Rat eradication program.</li> <li>Implementation of Construction</li> </ul>	<ul> <li>Implement Environmental Management Plan.</li> <li>Implement Pest Management Plan.</li> <li>Implement Black Rat eradication program.</li> </ul>	(6) Medium Possible increase in pest species abundance and/or distribution. Management plans will limit

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Potential Impact	Significance of Impact: unmitigated	Mitigation measures			Significance of
		Design	Construction	Operation	Mitigated
		<ul> <li>Design to include locally occurring native species for rehabilitation and non-invasive species to be used for landscaping purposes.</li> <li>See further details in Biosecurity Assessment contained in Chapter 20.</li> </ul>	<ul> <li>Environmental Management Plan.</li> <li>Pest hygiene protocols for vehicles and materials.</li> <li>See further details in Biosecurity Assessment contained in Chapter 20</li> </ul>	<ul> <li>Pest hygiene protocols for vehicles and materials.</li> <li>Educational information and signage for visitors and guests.</li> <li>See further details in Biosecurity Assessment contained in Chapter 20</li> </ul>	any increases to short term and manageable events.

# 10.10 Environmental Offset Delivery

#### 10.10.1 Broad Leaved Tea-Tree Woodland – EPBC Act

Vegetation consistent with the Broad Leaf Tea-tree (*Melaleuca viridiflora*) Woodlands in High Rainfall Coastal North Queensland TEC is present within the current lease areas of the resort. A number of approaches have been adopted through the design phase to avoid and minimise impacts to this community. Despite these impact avoidance and minimisation approaches, there is a significant residual impact to this community in the form of a 1.5 hectare reduction in the extent resulting from vegetation clearing and trimming requirements from the runway upgrade. This significant residual impact triggers the requirement for the provision of an environmental offset under the EPBC Act.

The 1.5 hectare clearing area will need to be offset by delivering a direct, on-the-ground, conservation outcome that improves or maintains the viability of this community. The most suitable mechanism for delivering an appropriate conservation outcome is the restoration of degraded areas of this community, such as the section that is to be retained on the western side of the runway. Under the current design concept (November 2016), there are at least 3.66 hectares of degraded Broad leaf tea-tree woodland to be retained that could be restored to an ecological condition consistent with the listed community. The net outcome of restoring this area would be an increase of more than 40% to the current extent of the listed community on Lindeman Island.

The 3.66 hectare area to be retained on the western side of the runway strip supporting degraded Broad-leaf tea tree woodland forms the proposed environmental offset area for impacts to this MNES. The proposed offset area is degraded through invasion by exotic ground cover species to the point that it does not meet condition thresholds for the listed community. The proposed restoration works for delivering the environmental offset will involve control of exotic ground cover species to promote native species regeneration within this area. The management objective of the offset area will be to reduce exotic ground cover abundance and promote native ground cover regeneration to establish an ecological condition consistent with the listed ecological community.

The areas on each side of the runway strip to be trimmed for aircraft safety code compliance will be managed as buffer zones to the endangered ecological community. While included in the 'impact area' calculations, these buffer zones will retain many of the biodiversity values associated with the ecological community. Vegetation management activities will also be conducted in these buffer zones to supplement the environmental offset restoration works and ensure the ongoing viability of the community. The Commonwealth



Listing Advice (TSSC 2012) for this community identifies invasive species as one of the most significant threats to this community. The significance of this threat at the local scale is evident from existing disturbance. The vegetation management works proposed as part of the environmental offset delivery and buffer zones represent the optimal mechanism for maintaining and increasing the extent of this community and the biodiversity values within it.

Control of exotic ground cover species should allow for natural regeneration of native species. However, regeneration of native ground cover species could be supplemented through a seeding and planting program for locally occurring native ground cover species. This program could be supported by the establishment of an on-site nursery stocked from seed collection within the project lease area. The suitability of this offset delivery mechanism will be demonstrated through field-based habitat assessments, systematically comparing values between the proposed impact and offset areas. The offset mechanism will be able to restore the community to similar condition to the impact area, and given the proposed offset area is more than twice the size of the impact area, the proposed offset mechanism will deliver a 100% direct (land-based) environmental offset for impact to the EPBC Act listed community. The ultimate intent for land supporting the listed community, including the proposed offset area once restoration works are complete, is for inclusion in National Park tenure for protection under the NC Act. This will ensure the long-term protection of the biodiversity values supported by the community. The approach will also enhance the biodiversity values of the National Park and ensure that leasehold land proposed for surrender is in good condition and consistent with National Park values. Land intended for surrender to the National Park will need to be staged to allow for restoration works to be completed.

### 10.10.2 Broad Leaved Tea-Tree Woodland – VM Act

The full extent of the Broad-leaf tea tee woodland on Lindeman Island equates to endangered RE 8.3.2. This is because the definitions for remnant vegetation under the VM Act are based on canopy attributes and to not take ground-cover attributes and condition into consideration. The community on both sides of the runway strip therefore equates to a MSES. As discussed in previous sections, the disturbance footprint has been aligned to minimise disturbance as much as possible, and therefore, where possible, the disturbance has been located in the degraded habitat on the western side of the runway strip. The total disturbance footprint for RE 8.3.2, including areas to be cleared or trimmed, is 5.14 hectares. The Queensland Environmental Offsets Policy – Significant Residual Impacts Guideline identifies the relevant impact area threshold for 'significant' impacts as 2 hectares (for communities with a sparse structural category). The 5.14 hectare disturbance footprint therefore equates to a significant residual impact to a MSES, which triggers the requirement for provision of an environmental offset under the Queensland Environmental Offsets Framework.

The total environmental offset liability for significant residual impacts to RE 8.3.2 will be determined through field-based habitat assessments of the proposed impact areas, as described for MNES. However, it is noted there is a maximum impact-offset ration of 4:1.

Suitable land and habitat for delivering land-based environmental offsets for this community on Lindeman Island is limited. Therefore, the environmental offset delivery mechanism for significant residual impacts to RE 8.3.2 will need to include a land-based and financial settlement approach. The land-based approach will be delivered as described previously for the Broad-leaf tea tree community listed under the EPBC Act. The degraded areas of RE 8.3.2 to be retained as part of the development design will be managed to reduce exotic species cover and promote restoration of native ground and shrub layer species. The proposed impact area for RE 8.3.2 is 5.14 hectares and the area to be retained and managed through the implementation of a restoration program is 3.66 hectares. Given the limited extent of habitat available for restoration works, an additional financial compensation payment will be required to deliver the residual environmental offset liability

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in addition to the land-based approach. The magnitude of this residual offset liability compensation payment is dependent on the extent to which the land-based mechanism contributes to the overall offset liability, which will be determined through the field-based habitat condition assessments.

# 10.10.3 Native Grassland

Multiple areas of the native grassland community, RE 8.12.13a, occur within the study area. RE 8.12.13 has an 'of concern' status under the VM Act and is therefore a MSES, but is not listed as threatened under the EPBC Act. This community occurs on slopes and headlands surrounding various sections of the existing resort infrastructure. It also occurs on the western headland in the area nominated for the proposed 'glamping facility'. Disturbance to this community has been avoided by design where possible by locating infrastructure in areas of existing disturbance. The proposed glamping facility has been designed to avoid disturbance to the grassland community in this area, with the disturbance footprint focussed on degraded (non-remnant) areas of existing disturbance. Similarly, some of the habitat supporting relatively intact grassland on the slopes of the southern headland are to be retained as part of the development design. The total disturbance footprint within RE 8.12.3 is 4.19 hectares.

Although RE 8.12.13 is described as a grassland community in the Regional Ecosystem Description Database (Queensland Herbarium 2015), the structural category for this community is defined as a 'sparse'. The Queensland Biodiversity Offset Policy – Significant Residual Impact Guidelines identify the relevant significant residual impact criteria for regulated vegetation. The clearing threshold for a sparse (structural category) RE, such as 8.12.13, is two hectares. Any clearing above this threshold is classified as a significant residual impact and requires provision of an environmental offset.

There are multiple areas of degraded grassland communities present within the existing resort lease area. There are also substantial areas of degraded grassland located within the surrounding National Park tenure, some of which are continuous with the communities within the lease. These degraded grassland areas have been impacted by historical land uses and have been subject to very substantial invasion by exotic grass and forb species. The biodiversity values of these degraded grassland areas have been significantly depleted and therefore restoration works will form a suitable land-based offset delivery mechanism for maintaining the extent of RE 8.12.13 and promoting associated biodiversity values. The total offset liability for land-based offsets will be determined through field-based habitat condition assessments. The extent of degraded grassland areas outside the development disturbance footprint likely provides ample habitat for inclusion in environmental offset delivery. However, any significant residual impacts beyond those that can be offset through a land-based approach could be offset through a combined approach that includes a financial compensation payment.



# 10.11 Vegetation Summary

The study area contains a variety of remnant, mature regrowth (non-remnant), and disturbed habitats. Remnant vegetation within the study area mainly consists of mixed eucalypt woodland with a grassy understorey, with some rocky slopes along the coastline containing coastal vine thicket. The east and west margins of the runway strip contain Broad-leaved Tea Tree woodland and the existing resort, golf course and runway strip areas contain non-remnant vegetation. The NRC survey identified two conservation significant vegetation communities in the study area. The broad leaf tea-tree (*Melaleuca viridiflora*) woodland community is listed as endangered under the EPBC Act and the VM Act and the littoral rainforest/vine-thicket community is listed as critically endangered under the EPBC Act. The endangered broad leaf tea-tree woodland occurs on the eastern and western margins of the runway strip. Coastal vine thicket communities were ground-truthed and mapped in a variety of small polygons along the southern extent of the island as well as one large polygon along the western coastline.

No flora species listed as threatened under the EPBC Act or the NC Act were detected during the NRC survey.

### **Coastal Vine Thicket**

The Littoral Rainforest and Coastal Vine Thickets of Eastern Australia TEC is scattered throughout the rocky slopes of the shorelines within the study area. While this community is classed as a 'least concern' RE under the Queensland vegetation management framework, the full extent of this community equates to the critically endangered community listed under the EPBC Act. This community is therefore a MNES. The current design concept (November 2016) includes resort infrastructure areas that occur in close proximity to this community. It is recommended a buffer zone of at least five metres be applied to all areas of this community. While small patches of this community can be resilient, invasion by exotic plant species represents a significant threat to this community. A pest plant management plan and the implementation of a five metre buffer zone will support the maintenance of biodiversity values for this community.

# Broad Leaved Tea-Tree Woodland – EPBC Act

Vegetation consistent with the Broad Leaf Tea-tree (*Melaleuca viridiflora*) Woodlands in High Rainfall Coastal North Queensland TEC is present within the current lease areas of the resort. A number of approaches have been adopted through the design phase to avoid and minimise impacts to this community. Despite these impact avoidance and minimisation approaches, there is a significant residual impact to this community in the form of a 1.5 hectare reduction in the extent resulting from vegetation clearing and trimming requirements from the runway upgrade. This significant residual impact will be offset through the delivery of a site-based restoration program to maintain or increase the extent of this community.

# Broad Leaved Tea-Tree Woodland – Vegetation Management Act

The full extent of the Broad-leaf tea tee woodland on Lindeman Island equates to endangered RE 8.3.2. This is because the definitions for remnant vegetation under the VM Act are based on canopy attributes and to not take ground-cover attributes and condition into consideration. The community on both sides of the runway strip therefore equates to a MSES. The disturbance footprint has been aligned to minimise disturbance as much as possible, and therefore, where possible, the disturbance has been located in the degraded habitat on the western side of the runway strip. The total disturbance footprint for RE 8.3.2, including areas to be cleared or trimmed, is approximately 5.14 hectares. The Queensland Environmental Offsets Policy – Significant Residual Impacts Guideline identifies the relevant impact area threshold for 'significant' impacts as 2 hectares (for communities with a sparse structural category). The 5.14 hectare disturbance footprint will be offset through a

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combined delivery mechanism incorporating a land-based offset and a financial compensation payment. The total environmental offset liability for significant residual impacts to RE 8.3.2 will be determined through field-based habitat assessments of the proposed impact areas.

#### Native Grassland

Multiple areas of the native grassland community, RE 8.12.13a, occur within the study area. RE 8.12.13 has an 'of concern' status under the VM Act and is therefore a MSES, but is not listed as threatened under the EPBC Act. This community occurs on slopes and headlands surrounding various sections of the existing resort infrastructure. It also occurs on the western headland in the area nominated for the proposed 'glamping facility'. Disturbance to this community has been avoided by design where possible by locating infrastructure in areas of existing disturbance. The proposed glamping facility has been designed to avoid disturbance to the grassland community in this area, with the disturbance footprint focussed on degraded (non-remnant) areas of existing disturbance. Similarly, some of the habitat supporting relatively intact grassland on the slopes of the southern headland are to be retained as part of the development design. The total disturbance footprint within RE 8.12.3 is 4.19 hectares. The extent of degraded grassland areas outside the development disturbance footprint will be utilised for land-based environmental offset delivery. However, any significant residual impacts beyond those that can be offset through a land-based approach could be offset through a combined approach that includes a financial compensation payment.

#### Non-remnant Vegetation

Most non-remnant vegetation is located throughout the existing disturbed areas of the resort, runway strip and golf course. Vegetation associated with resort gardens, maintained lawns, the golf course and the runway strip has been excluded from the remnant vegetation mapping due to an absence, or very low cover, of native species. Exotic grasses, particularly Guinea grass, dominated these areas with scattered native and exotic shrubs and trees. Other common exotic species in disturbed areas include Bidens, Lantana, Sensitive weed, Streaked rattlepod and Leucaena (*Leucaena leucocephala*).

#### **Threatened Species**

No threatened or near threatened flora species (as listed under the EPBC Act or NC Act) were identified during the vegetation surveys, despite targeted survey effort in potentially suitable habitat areas.

#### Pest Plant Species

Pest plant species were common throughout the study area, particularly in the non-remnant vegetation communities. Pest species commonly occurring in a variety of habitats within the study area include Guinea grass, Lantana, Sensitive weed, Bidens, Chinese burr (*Triumfetta rhomboidea*\*), Balloon cotton bush (*Gomphocarpus physocarpus*\*), Common centro (*Centrosema molle*\*), and Snake weed (*Stachytarpheta cayennensis*\*). Leucaena is present in eucalypt woodland and native grassland areas along the margins of existing disturbance areas. A control program for this species has recently taken place (early 2015) and has significantly reduced the cover of this species in the resort area. However, some large patches still remain (e.g. at the western end of the cross-strip runway) and regeneration where control has taken place was evident during the December 2015 surveys. Grader grass (*Themeda quadrivalvis*\*) is known to occur in disturbed areas on Lindeman Island, and the field surveys confirmed the presence of this species within the study area. The largest area of Grader grass occurs at the eastern end of the cross-strip runway, surrounding a drainage area on the southern side.

Three restricted species were observed during the field surveys: Giant rat's tail grass (*Sporobolus sp.*\*), Singapore daisy (*Sphagneticola trilobata*\*) and Lantana. Giant rat's tail grass was not recorded anywhere



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within the lease areas, but was observed at a few locations along the National Park track to 'Boat Port' and has likely been introduced by visitors using the track. Giant rat's tail grass is a restricted invasive plant under the *Biosecurity Act 2014*. Lantana is a restricted invasive plant under the *Biosecurity Act 2014*. Lantana is a restricted invasive plant under the *Biosecurity Act 2014* that occurs in all communities surveyed within the study area. Singapore daisy is also a restricted invasive plant that was observed in resort garden areas and adjacent coastal vine thicket vegetation near existing resort infrastructure on the southern coastline. Implications and recommendations regarding the presence of pest species are discussed in the following sections of this report.

# 10.12 Fauna Summary

The study area consists of remnant and non-remnant vegetation, providing habitat features for fauna species in the form of tree hollows, loose bark, coarse woody debris, boulders, crevices and rock piles. The presence of highly mobile fauna species (such as birds and bats) is likely to be influenced by seasonal characteristics such as rainfall, with these species foraging when suitable trees are flowering or fruiting.

### Fauna Species

A total of 76 fauna species from 42 families were identified within the study area using a variety of different observation and trapping techniques. This included 47 species of birds, 14 reptile species, two amphibian species, and 13 mammal species (including 12 bat species). Most of the native fauna recorded are common in coastal habitats throughout much of Queensland.

No threatened or near threatened fauna species were observed during the fauna survey period. However, some of the bat echolocation call data obtained is potentially from the Coastal Sheathtail Bat, and it is likely this species would forage over the study area from time to time. The study area does not support any unique terrestrial habitat values for this species, and similar habitat is available in the surrounding National Park areas. The steep rocky slopes along some of the shorelines within the study area represent potential roosting habitat for this species. It is recommended disturbance to these areas is minimised. In general, potential roosting habitat correlates strongly with the presence of the coastal vine thicket TEC, and therefore avoidance of this community will also result in avoidance of potential Coastal Sheathtail Bat roosting habitat.

#### Watercourse and Wetland Habitat

No Ramsar wetlands are located within the study area or within the broader region. Shoalwater and Corio Bays are the nearest Ramsar Wetlands and these are located over 200 km to the south of the study area. No referrable wetlands areas as shown on the Queensland referrable wetland mapping are located within the study area. However, the Queensland referrable wetland mapping identifies some general ecological significance wetlands along some of the shoreline of Lindeman Island. These areas of shoreline potentially provide habitat and foraging areas for shorebirds.

There is one large permanent water body created by the construction of Gap Creek Dam near the centre of the study area, which contains some aquatic vegetation and wetland habitat values. This water body and associated aquatic vegetation provides habitat for a variety of wetland bird species. There are no watercourses as shown on the vegetation management watercourse map located within the study area, but one feature identified as Gap Creek is mapped on other State mapping layers. There are some ephemeral drainage features located within the study area in remnant and non-remnant areas. These features are located in steep and often rocky terrain with a very small catchment, and consequently they would likely only flow for very short periods of time immediately after rainfall events. These features do not sustain any significant aquatic habitat



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and there is no distinct riparian vegetation or additional biodiversity associated with the features. The vegetation communities surrounding these features represent a continuation of the surrounding non-riparian vegetation communities.

#### Connectivity

The study area is comprised of a mix of remnant and non-remnant areas with connectivity between habitats influenced by natural and artificial processes. Connectivity between most areas of woody vegetation is high, but some areas of vine-thicket occur as isolated patches in gullies and rocky slopes, particularly along the shoreline. These isolated vine thicket patches occur naturally and are known to be resilient even as very small areas (Commonwealth of Australia, 2009). Some woodland areas are bordered by native and non-native grassland and existing resort infrastructure. However, most woodland areas maintain at least some connectivity with larger tracts of remnant vegetation and habitat fragmentation is very low. Overall, connectivity between habitats on Lindeman Island is intact with minimal fragmentation or isolation of remnant vegetation. The study area itself does not form a critical link between any habitat areas and the connectivity value of the vegetation communities within the study area is generally low.

#### Existing Disturbance and Habitat Condition

The main disturbance to remnant vegetation in the study area is the existing resort, runway strip, and golf course. These areas comprise maintained lawns and ornamental flora species, with some native vegetation retained or regenerated throughout. As discussed previously, the existing infrastructure has resulted in the removal and fragmentation of some native vegetation, but the overall viability and connectivity of the native vegetation communities present is generally intact. Lindeman Island has a history of multiple land uses including grazing activities and different resort developments. The grassland around the existing resort has been modified and exotic species dominate much of this area. Native grasslands occur naturally on island headlands in the region, particularly on slopes with a south and southeast aspect. Many of the sloped grassland sites within the study area, particularly those with a southern aspect, remain relatively intact, with minimal exotic species invasion. However, the majority of flat grassland areas are comprised of exotic species, particularly Guinea grass. Disturbance in these areas is likely due to historical grazing activities, and the extent of this disturbance has resulted in the fragmentation of native grassland habitat. While the native grassland contains a low diversity of flora species and low fauna habitat value, invasion by exotic grasses represents a significant threat to the biodiversity values of this community. Exotic species invasion has also significantly impacted the biodiversity values of the Broad leaf tea-tree community. All other communities within the study area are generally intact, with exotic species invasion generally restricted to the margins of previously cleared areas.

#### **Pest Animal Species**

Evidence or direct observation of three pest species was detected during the fauna surveys, all of which commonly occur in disturbed habitats throughout Queensland. The following species were observed within the study area Cane toad (*\*Rhinella marina*), Black rat (*\*Rattus rattus*) and Asian house gecko (*\*Hemidactylus frenata*).