COMMUNICATIONS REPORT

Mount Emerald Wind Farm

October 2013

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1. INTRODUCTION

1.1 Description of Site

Mount Emerald Wind Farm (MEWF) is a “greenfield” wind farm development being pursued as a partnership between RATCH Australia and Port Bajool. The site for MEWF is located on the Atherton Tablelands in Queensland, approximately 20km to the south of the town of Mareeba and 15km north-west of the town of Atherton. The site is approximately 47km north of the operating Windy Hill wind farm.

The estimated generating capacity of the project is approximately 180-210MW. The final configuration for the site will involve between 60 and 70 turbines depending on the WTG manufacturer and the size of the turbine ultimately selected, and on the optimisation of the site layout and configuration which is yet to be finalised.

1.2 Consultation Methodology

The objectives of the community engagement program were to ensure that the community and stakeholders were:

- Informed about the Proposal, through an ongoing commitment by the Proponent to provide information, allowing a good understanding of the proposed development and the likely impacts;
- Actively engaged on issues of concern to them, to identify and consider options for eliminating or reducing impacts; and
- Given ample opportunity to provide views on the proposal.

2. PRELIMINARY CONSULTATION

The landowner, Port Bajool approached Transfield Services to discuss the possibilities of positioning a Wind farm at this location in March 2009.

Preliminary consultation meetings were held with local and state government agencies to identify potential opportunities and constraints associated with locating a wind farm in this locality during the period from July to December 2009.

Additional briefings and meetings were held with Tablelands Regional Council and their Planning Group team, with an application to install monitoring equipment on-site approved in November 2009.

Potentially impacted neighbouring landholders were contacted and informed of the potential project, with some taking the opportunity for a meeting with project developers in the period from May – August 2009.

Further notification to the surrounding region was undertaken through the release of a media statement to the local newspapers in August 2009.

3. STAKEHOLDER IDENTIFICATION AND CONSULTATION

The following organisations have been identified as having a vested interest in the outcome of the proposed MEWF:

- Tablelands Regional Council
- Landholders
- Communities in Atherton Tablelands area, most notably Mareeba, Atherton and Tolga
- Bar Barrum and Muluridji People

- North Queensland Land Council
- Near neighbours
- Department of Employment, Economic Development and Innovation (DEEDI) includes Mines and Energy
- Department of Environment and Resource Management (DERM) includes Environment Protection Authority (EPA)
- Local Rural Fire Brigade
- Civil Aviation Safety Authority, Mareeba Airport and Aerial Agriculture companies
- Tourism Queensland
- Department of Transport and Main Roads
- Network Service Provider ("NSP") operating in the region of the proposed project area - Powerlink
- Electricity Off-taker
- SunWater
- Springmount Waste Disposal Facility

4. CONSULTATION ACTIVITIES

A summary of key stakeholder engagement and consultation activities undertaken throughout the course of the development is outlined in the sections below, with a list of the consultation activities is included as Appendix A – Stakeholder Consultation Program.

A summary of some of the key activities is shown in the table below.

Date	Stakeholder	Description
May 2009	Various neighbouring landowners	Introductory meeting with discussion on general project concept
July 2009	TRC mayor and planning staff	Introductory meeting with discussion on general project concept
September 2009	TRC planning staff	Wind monitoring tower application
January 2011	Landowners meeting Oaky Valley residents	Project information and questions
March 2011	Public Open Day	Public meeting with approx. 60 attendees; also involved media release and advertisement, newsletter #1, information booklet
March 2011	Traditional Owners	Preliminary meeting and discussion with group representatives
July 2011	TRC councillors, planners and media	Site inspection
July 2012	TRC (Mayor, CEO, Planners)	Submissions received on project Key issues – noise, crop dusting, shadow
September 2012	Public Open Day	Public meeting with approx. 150 attendees; also involved media release and advertisement, newsletter #5
September 2012	Public Site Inspection	Guided trips of the actual wind farm site

Date	Stakeholder	Description
Sep/Oct 2012	Media releases	Addressing issues and questions raised at the September 2012 Open Day
November 2012	Website	Launch of dedicated website www.mtemeraldwindfarm.com.au
February 2013	Traditional owners	Initial meeting in respect of cultural heritage management plan

4.1 Local Council

Preliminary discussions were held with Tablelands Regional Council (Mayor and Planning Staff) in mid-2009, regarding the general concept of the wind farm and particular issues and requirements which may arise.

Ongoing informal meetings and communications have occurred throughout the development, primarily with planning staff, to provide updates on development progress and address general issues as they arise.

A formal presentation was given at the TRC meeting in September 2012.

4.2 Government Stakeholders

State

Department of Employment, Economic Development and Innovation (DEEDI) – regional development, employment opportunities,

Department of State Development Infrastructure and Planning (DSDIP) – Planning Scheme, State Planning Policy

Office of Clean Energy (OCE) – renewable generation, project brief - updates

SunWater – protection of irrigation assets,

Department of Energy and Resource Management (DERM) – project briefing, land management

Department of Science Information Technology Innovation and Arts (DSITIA) – vegetation

Premier and Ministers – general briefing

Federal

Department of Sustainablity Environment Water Population and Communities (SEWPAC) – environmental approval

Australian Trade Commission (AUSTRADE) – opportunities for services and investment

Ministers – general briefing

4.3 Traditional Owners

The North Queensland land Council Aboriginal Corporation (NQLC) is the native title representative body for this area. They have indicated both the Bar Burrum and Muluridji Peoples should be contacted in regard to identifying the appropriate party for the area. Following preliminary discussions with these groups it was determined the Bar Burrum People be identified as the traditional owners of the site land.

Further meetings and discussions have occurred and will continue in respect of entering a formal Cultural Heritage Management Plan between the parties.

4.4 Community Groups

Mareeba chamber of Commerce – project economics, opportunities

Atherton Chamber of Commerce – project economics, opportunities

Tourism Tropical Tablelands – project economics, opportunities

Regional development Association of Far North Queensland and Torres Strait (RDAFNQTS) - Tropical North Queensland Regional Economic Plan

Advance Cairns – project economics, opportunities

4.5 Community Consultation

Throughout the development of the project a number of consultation activities have occurred to disseminate as much information to as wide an audience as possible.

During the development a formal Community Engagement Plan was developed to identify key stakeholders, appropriate engagement opportunities and resources required to support this flow of information.

The provision of information about the project has been undertaken in a number of ways as outlined in the sections below.

Throughout the consultation process a contacts register has been maintained where members of the public and business community are able to register themselves and directly receive any information releases regarding the project. The business register will also serve as a list of potential services to be supplied to prospective contractors required to build the project should it proceed. Currently there are 63 community and 47 business registers recorded.

4.5.1. Media, Newsletters and Information

The proponent of the wind farm is committed to maintaining communications with the local community via regular provision of information throughout the development process to as many near residents of the project site as possible.

An initial media release was issued by Port Bajool in August 2009 stating their intention to jointly investigate the potential for a wind farm. Further media releases have been issued at regular intervals since this time.

Concurrent with the invitation to attend the community Open House, advertisements were taken out in local print media including the Tablelands Advertiser and Mareeba Express.

A specific media release was issued in June 2011 to local media outlets and many media articles have been published in the local Tablelands media and Cairns Post since August 2009.

In addition to formal media advertising, MEWF has responded via journalists requests for interview (radio, TV and the print media) and via 'Letters to the Editor' to issues raised by 'the community'.

These requests average approximately one per month.

The first edition of a project newsletter was released in March 2011 and included an invitation to attend a preliminary consultation open day.

Newsletters were initially sent to immediate neighbours and placed in post offices and newsagents of nearby towns.

Further newsletters were directly sent to those members of the community who had registered an interest in the project as well as using nearby post offices and newsagents and posted to the project website.

A list of all the formal information releases is shown below, with copies of the information included as Appendix B.

Announcement of Joint Venture and commencement of investigation	August 2009
Mt Emerald Wind Farm Community Newsletter 1 – Information Day	March 2011
Mt Emerald Wind Farm - Information Booklet	March 2011
Mt Emerald Wind Farm Community Newsletter 2	June 2011
Mt Emerald Wind Farm – Summary of Development Application	August 2011
Mt Emerald Wind Farm Community Newsletter 3	September 2011
Update of Investigation and key issues	October 2011
Mt Emerald Wind Farm Community Newsletter 4	March 2012
Announcement of Community Open Day	September 2012
Summary of issues – post community “open day”	September 2012
Addressing issues – post community “open day”	September 2012
Addressing issues – post community “open day”	October 2012
Addressing issues – post community “open day”	October 2012
Addressing issues – post community “open day”	October 2012

4.5.2. Community Open House

MARCH 2011

An Open House was held at the Mareeba Heritage Centre on 31 March 2011 and attended by approximately 60 local residents. This forum introduced the project to the community and facilitated one-on-one discussion with the proponent’s representatives. Concerns and issues raised by the community in these discussions were recorded to allow these matters to be considered.

Project information displayed throughout the centre during the event, providing information and talking points for those present. Information displayed at the open house was consolidated into a booklet made available to all in attendance. A further Open House is planned to update the community on progress through the environmental assessment process and provide a summary of the outcomes of the assessment, with feedback assisting in forming a response to council’s information request.

SEPTEMBER 2012

Meeting held at the Mareeba Heritage Centre on 19th September 2012. This event was attended by approximately 150 visitors. Expert consultants in fields of environment, noise and visual were available to answer questions throughout the day.

Information displayed included over 40 posters showing information specific to MEWF and wind farms in general. A detailed visual display was available to show actual scale views of the wind farm from various locations around the region including individual resident locations.

4.5.3. Site Inspections

As part of the September 2012 Open Day, visitors were offered the opportunity to tour the wind farm site. Approximately 60 visitors used this opportunity to help them to locate the site within the region and obtain a better understanding of site conditions and its surrounds.

In October 11 2012, as a follow up to the Open House inspections the public was given the opportunity to visit the nearby operating Windy Hill wind farm. 40 people visited the site where they were able to access the base of an operating turbine and gauge for themselves potential impacts at close range.

The opportunity to visit the operating Windy Hill Wind Farm was repeated October 12, 2013 with a similar number of people attending.

4.5.4. One-on-one Meetings

Throughout the development process the proponents have engaged in numerous one-on-one consultation activities with interested or concerned residents. These activities have ranged from face-to-face discussions with individuals and groups, written correspondence and electronic and telephone conversations.

A correspondence register outlining electronic (e-mail) correspondence has been maintained with a summary of this register showing a total of 230 contacts being made. It should be noted two individuals are responsible for approximately 70% of these contacts.

4.5.5. Website

The proponent's website (www.windfarms.net.au) has been noted as a key source for information. Whist covering the full scope of wind farms under development throughout the country, the website provides detailed project information on the Mount Emerald project as it is published.

A specific Mount Emerald website (www.mtemeraldwindfarm.com.au) has been available since November 2012. This site contains all posters generated for community meetings and relevant information as it becomes available with links to other pertinent sites.

Furthermore, the website provides a mechanism for people to provide feedback as well as contact the Proponent. The website continues to be updated on a regular basis in conjunction with key project milestones.

Posters and website were updated to reflect this updated information.

4.6 Issues of Concern

Following the acceptance of the Development Application by TRC in March 2012, an information request was issued in April 2012 listing 68 items requiring further information. The information request is an amalgam of submissions received from the public, council requests and those from referral agencies.

The number of questions and the detailed research, including in some instances, detailed scientific studies and the replication of previously completed studies, particularly the visual amenity studies, required to adequately answer them has necessitated an increase to the response period. It is intended all questions will be answered once the full information is available.

The issues raised by the community at the "Open Day" in September 2012 have been addressed in the advertisements placed in the Tablelands newspapers during October - December 2012 and in the content of the Mt Emerald Wind Farm website.

4.7 Community Survey

A community survey was conducted by Auspoll in March 2012 at an early stage in the community consultation process to identify community attitudes to the proposed Mt Emerald Wind Farm. The results of this survey are provided in Appendix C.

Key outcomes of this survey were:

Overall, there is both high awareness and strong support for the Mount Emerald Wind Farm development.

- Over 80% of respondents are aware of the proposed development.
- Around three quarters of respondents (76%) support the project, with only 13% opposed to it.

There is a strong recognition of the environmental benefits of wind farms in general and this is the main reason people support the development.

- Around 90% of respondents agree that wind farms are a good option for Australia's energy needs and a good option for the environment.
- 56% of supporters say they support the Mount Emerald project because it is environmentally friendly.
- In contrast only 10% of supporters identify the local jobs and benefits it could bring to the community as a reason for their support.

There is also considerable synergy between the importance of various local factors and the positive impact that the wind farm will have on these factors.

- The local economy and local employment opportunities are the factors that are considered most important by respondents and they are also the factors that are most likely to be seen as being positively impacted on by the wind farm.

Being an eyesore and being too close to homes are the main unprompted reasons for opposition.

- 32% of opponents say it will be an eyesore or unattractive
- 29% of opponents say it is too close to residences
- 23% of opponents mention noise levels as a reason for their opposition.

The vast majority of respondents believe that the wind farm will not have a negative impact on their favourite aspect of the local landscape or on the most important local historical or culturally significant sites.

- Less than 30% of respondents think the wind farm will have a negative impact on their favourite aspect of the local landscape.
- Most respondents are not aware of any local historical or culturally significant sites, but of those that are, less than 30% think the wind farm will have a negative impact on these sites.

People generally don't know very much about the project but most would like to know more.

- 79% of respondents say they only know a little about the wind farm, while 61% say that they would like to know more.
- People would like information about a whole range of issues, from basic location and size details to information on who benefits, impacts on wildlife, and employment opportunities.

- Three quarters of respondents identify local newspapers as their preferred information channel for the project.

The project is also seen as being managed in a responsible way that takes care of the environment and needs of local community.

- 58% of people agree that the project is taking care to consider the needs of the local community while only 12% disagree.
- Similarly, 56% of people agree that the project is taking care to protect the environment while only 7% disagree.

4.8 Community Consultative Committee

MEWF have proposed a Community Consultative Committee for Mt Emerald similar to that developed and implemented at other wind farms around the country.

The structure of this committee has been developed in conjunction with other companies and the Clean Energy Council's Engagement Officer to ensure the committee charter and proposed operating regime provide the best possible outcomes.

A possible Chair has been approached and potential members identified, along with a timeline for commencement initiated.

APPENDIX A – STAKEHOLDER CONSULTATION PROGRAM

DATE	STAKEHOLDER	ATTENDEES	DESCRIPTION
29/01/2008	Landowner	Volker & Lee Schwerdtfeger	Discussion at time of property purchase (Port Bajool)
8-9/5/2009	Landowner	Jack Krikorian & Jenny Disley Robert & Sue Galvin Bill & Maria Sheppard Owen Davies & Eugene Zwyer Crystal Collomb Janelle Menetti Noel Adams Peter Charles	Introductory meeting General discussion on project concept
July 2009	TRC	Tom Gilmore (Mayor); Brain Millard, Brett Nancarrow (Planners)	Introductory brief and discussion on concept (at time of land purchase)
August 2009	Landowner	Roy Willets & Doon McColl	Introductory meeting General discussion
September 2009	OCE (Govt - State)	Office of Clean Energy - Andrew Chamberlain	Presentation at Clean Energy Summit (Cairns)
September 2009	TRC	B Millard, B Pead-Lewis	Wind Monitoring tower application Aviation concerns
November 2009	JCU Alumni	40 various attendees	Presentation on wind farm economics
November 2009	Advance Cairns	Various	Presentation - General concept
November 2009	Cairns Chamber of Commerce	Various	Presentation - General concept
12/11/2009	DEEDI (Govt - State)	Darren Cleland, Ian McKirdy, Andrew Broadbent	General Discussion & Site Inspection
4/12/2009	TRC	B Millard	Wind Monitoring tower application/approval/installation requirements
April 2010	DEEDI (Govt - State)	Ian McKirdy	General Discussion - update
July 2010	Mareeba Chamber of Commerce	Various	General presentation
29/09/2010	OCE (Govt - State)	Andrew Chamberlain	General project information
September 2010	DEEDI (Govt - State)	Various	General Discussion - update
September 2010	MP (Leichardt)	MP (Leichardt) - Warren Entsch	General Briefing
September 2010	MP (Cook-QLD) MP (Barron River) MP (Cairns)	Jason O'Brien Steve Wettenhall Desley Boyle	General Briefing
September 2010	Cairns Regional Council	Val Schier (Mayor)	General Briefing
October 2010	TRC	Tom Gilmore (Mayor)	General Discussion - update
October 2010	MP (Cook - AUST)	Bob Katter	General Briefing; Site Inspection
November 2010	TRC	Councillors	Council Presentation - update
November 2010	QLD Premier	Anna Bligh	General Briefing
2/12/2010	TRC	Tom Gilmore (Mayor)	General project information and update

DATE	STAKEHOLDER	ATTENDEES	DESCRIPTION
13/01/2011	Landowner	Landowners Group – Oaky Creek Residents	General project information and questions
February 2011	Tourism Tropical Tablelands	Board	General presentation
February 2011	Advance Cairns	Nicky Swan, Margaret Darvenezia	General Discussion - update
24/03/2011	Traditional Owners	BarBurrum People (Tom Congoo John Wason)	Introductory meeting – general project information Cultural Heritage Management Plan
31/03/2011	General Public	Public Open Day - Mareeba Heritage Centre - approx 60 attendees	Presentation of project concept and infromation available at the time
March 2011	DEEDI (Govt - State)	Kathy Rankin, Paul Fagg	General Discussion - update
March 2011	Troplinks	Ken Ash	General presentation
March 2011	AUSTRADE	(Cairns) - John Bissel	General Briefing
April 2011	DEEDI (Govt - State)	Various	General Discussion - update
April 2011	OCE (Govt - State)	Tim Quirey, Matt Brown, Matt Peel, Andrew Chamberlain	General Discussion - update
14/04/2011	Landowner	Jack Krikorian & Jenny Disley	Introductory meeting – general project information Inspection of property with view to possible purchase
14/04/2011	Landowner	Pat & Sue Iraci	Introductory meeting – general project information Concerns regarding noise, visual Modelling to show reduction of turbine visible by moving turbines further into site land
14/04/2011	Landowner	Roy Willets & Doon McColl	General project information Concerns regarding noise, visual Amendments to layout to reduce impacts – removal of close turbines
5/07/2011	TRC Media	Councillors and Planners Cairns Post - Tony Stickley	Site Inspection
August 2011	Cairns Regional Council	Economic Development Group	General Briefing
August 2011	Tourism Tropical Tablelands	Various	General Discussion - update
August 2011	Regional Development Association Far North Qld & Torres Strait (RDAFNQTS)	Various	General Briefing Tropical North Queensland Regional Economic Plan (TNQ REP)
August 2011	Dept. Sustainability Environment Water Population and Communities (SEWPAC)	Various	Initial meeting to discuss approach prior to submission. Indication of likely outcome being "controlled action" with specific conditions.
20/09/2011	Atherton Tablelands Air Services	Mark & Kerry McDonald	Concerns regarding impacts on aviation in the surrounds of the wind farm
September 2011	Landowner	Colin & Sue	Specific questions related to reports - particularly noise

DATE	STAKEHOLDER	ATTENDEES	DESCRIPTION
September 2011	SunWater DERM	Property Group (Brisbane) State Land Administration	Road crossing of SunWater Irrigation Assets
November 2011	DEEDI (Govt - State)	Barry Hopkins, Kathy Rankin	Site Inspection
December 2011	Advance Carins Cairns Post TRC Mayoral candidate	Cam Charlton Nick Trompf, Neil Molloy Rosa Lee Long	Site Inspection
January 2012	TRC	Council Candidates	General discussion; Site Inspection
February 2012	ERGON	James Archer	General discussion; Site Inspection
February 2012	SEWPAC	Celeste Powell (Director)	Site Inspection
1/02/2012	SunWater	Property Group (Brisbane) Engineering (Mareeba)	Road crossing of SunWater Irrigation Assets
March 2012	DEEDI (Govt - State)	Barry Hopkins, Maree Storer, Anne Clarke	General Discussion - update
March 2012	Regional Development Association Far North Qld & Torres Strait (RDAFNQTS)	Various	Presentation at meeting
1/03/2012	SunWater TRC	Neil Enderlin Brian Millard (Planner)	Site Inspection - road crossing of SunWater assets
April 2012	SEWPAC	Assessments Group - Mick Fallon, Jordan Crabbe, Danielle Carman	Discussion and clarification of assessment criteria and specific threatened species of concern
May 2012	Advance Cairns	Cam Charlton, Stewart Christie	General Discussion - update
May 2012	North Queensland Airports	Kevin Brown, Kerry Evans	General Discussion. Interest in Cairns Airport for part power offtake.
June 2012	DSITIA - Qld Herbarium	Jeanette Kemp	Site Inspection - vegetation and vegetation mapping
June 2012	Mareeba Chamber of Commerce	Various	General Discussion - update

DATE	STAKEHOLDER	ATTENDEES	DESCRIPTION
12/07/2012	TRC	Rosa Lee Long (Mayor) Ian Church (CEO) Brett Nancarrow (Planner) Peter Pattison (Planner)	Submissions received by council on project; Key issues mentioned - noise, crop dusting, shadow
20/09/2012	General Public	Public Open Day - Mareeba Heritage Centre - approx 150 attendees	Presentation of project details
29/09/2012	General Public	Public Open Day - Site Inspection - Mt Emerald wind farm - approx 60 attendees	Site Inspection
11/10/2012	General Public	Public Open Day - Site Inspection - Windy Hill wind farm - approx 40 attendees	Site Inspection
15/10/2012	TRC	Peter Pattison (Planner)	Planning process; extension of time for information request; timeline
October 2012	Atherton Chamber of Commerce	Various	General Briefing
November 2012	Regional Development Association Far North Qld & Torres Strait (RDAFNQTS)	Various	General Discussion - update Tropical North Queensland Regional Economic Plan (TNQ REP)
2/11/2012	Mareeba Chamber of Commerce	Various	Presentation provided to members of the CoC Presentation provided by opponents of project
20/02/2013	Traditional Owners	BarBurrum People Nth Qld Land Council	Meeting for negotiation of Cultural Heritage Mangement Plan
21/02/2013	Tolga School	Kayleen Wright (Principal)	Potential for support/sponsorship - part of community benefits Initial concept to pass P&C first
June 2013	Landowner	Ray & Dulcie Ramm Jack Krikorian & Jenny Disley Peter Charles Sacha & Tammy Lackner Springmount Waste Facility	Visual amenity photographs
September 2013	Landowner	Springmount Waste Facility	Alternative Site Access

APPENDIX B – COMMUNITY INFORMATION RELEASES

Release Date: Monday 17 August 2009

MEDIA ANNOUNCEMENT

PORT BAJOOL TO ENTER RENEWABLE ENERGY INDUSTRY

Port Bajool has recently signed a Memorandum of Understanding (MOU) with Transfield Services to jointly develop the Arriga Wind Farm South West of Mareeba, Tropical North Queensland.

Preliminary studies of the 2700 hectare Arriga Wind Farm site owned by Port Bajool suggest the site could provide up to 130MW of renewable wind energy for Tropical North Queensland electricity users.

Port Bajool Director, John Morris said today "The development of the site has real potential to provide significant local generation of sustainable energy so essential for the economic development of TNQ. Power transmitted long distances from central Queensland has a significant marginal loss factor which considerably increases our electricity costs in the north. As well the project will provide local jobs and encourage diversification of the regional economy."

Mr Morris said Transfield Service's experience and expertise in the wind-energy sector along with the obvious synergies of their nearby Windy Hill and High Roads developments made them the ideal partner to develop the site. "Port Bajool's local presence and development experience in the area will work well to complement Transfield's technical know-how and intimate understanding of the sector" Mr. Morris said.

Port Bajool is currently involved in a number of other land developments on the Tablelands including Oaky Creek Farms and Springmount Park, which are quite close to the Arriga Wind Farm site as well as Sunbird Park in nearby Mareeba. In association with Lascorp Development Group, Port Bajool is also presently finalizing approval applications for the establishment of a Woolworths shopping centre on the Kennedy Highway, Mareeba.

Port Bajool and its directors, John Morris and Jim Noli, have a combined 50 years of business and development experience in the North Queensland area. Some prominent past projects include tourism developments in Port Douglas such as Treetops & the resorts now known as Sabaya & Rendezvous, Reef Links Golf Course and the Rainforest Habitat as well as a large number of residential property developments.

-ends-

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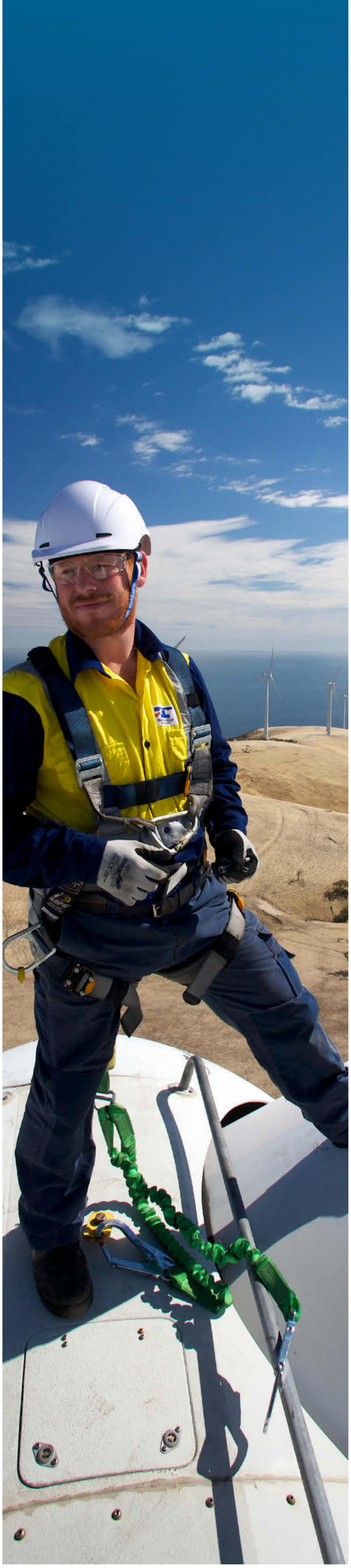
PORT BAJOOL

TRANSFIELD SERVICES



Mt Emerald Wind Farm
Community Newsletter

Issue 1 – March 2011

Welcome to the first edition of the Mt Emerald Wind Farm newsletter. Transfield Services and Port Bajool have formed a joint company, Mt Emerald Wind Farm Pty Ltd, that is currently assessing the potential for a wind farm to be developed on the plateau adjacent to Mt Emerald near Oaky Creek west of Walkamin. The project is in the assessment phase and this newsletter is the first in a series that will keep you informed of progress.

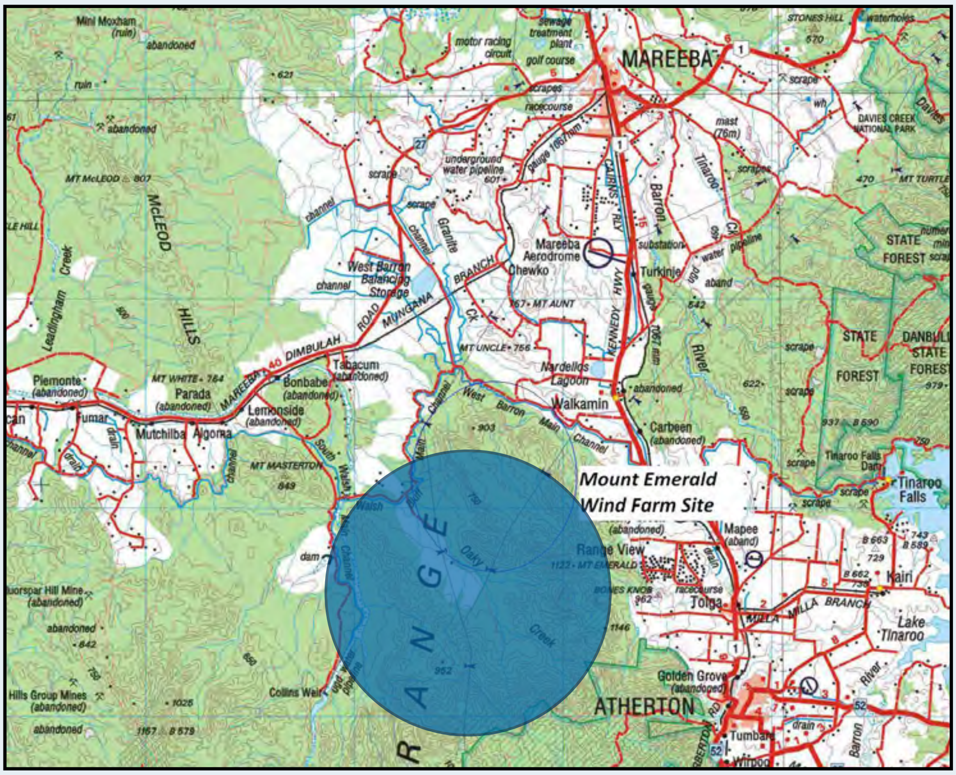
We also invite those interested in the project to attend a community open house. The details are:

Mareeba Heritage Centre
345 Byrnes Street
Mareeba
Thursday 31st March 2011, between 4pm and 7pm

Community members are welcome to drop in at any time to discuss the project with Mt Emerald Wind Farm representatives.

The project

The current proposal is to install around 70 to 80 wind turbines on land of some 2400 hectares, whose orientation and elevation make it ideal for this purpose. The site land is a rough plateau (el. 900m) elevated some 300m above the surrounding plains and is comprised of largely sparse natural scrub land with some rocky outcrops. The property is currently not used for any particular farming activity. The surrounding land is predominantly used for grazing and agriculture. The local landmark, Mount Emerald (el. 1122m) is located roughly 2km from the southern boundary of the site.



Highlighted above is the proposed site of the wind farm.

Why a wind farm?

A recent report has clearly identified the need for locally generated power for the region of Far North Queensland. This region does not have access to more traditional power sources such as coal or gas but rather tends to rely on power imports from the south to supplement local generation from hydro and sugar mills (bagasse). Further renewable power such as wind farms, is seen to complement the existing generation of the area.

Recent wind resource mapping has shown that Mt Emerald has an excellent wind resource, comparable to some of the best in the country. The site is also traversed by a major powerline allowing for a simple and cost effective connection into the electricity grid.

Wind farms produce clean energy, have minimal environmental impact and generate jobs and income in regional areas. In addition, this project would contribute to the Australian Government's target of 20 per cent renewable energy by 2020.

The proposed project represents a $550 million investment in the region and has the potential to supply the annual electricity needs of approximately 75,000 Tablelands and Cairns region homes.

What opportunities are there for community input into this proposal?

Transfield Services have a proud history of developing positive long-term relationships with the communities in which we work, as does Port Bajool in the local area.

We see this is a two-way process. Gaining local knowledge and understanding community views will be important considerations as we continue to undertake the various environmental and other studies culminating in a Development Application to Tablelands Regional Council in the early part of this year.

In turn, Mt Emerald Wind Farm is committed to involving the community throughout the development process and we undertake to provide information in a timely and transparent manner. We expect that the local community will have a range of views about this project and we anticipate that these views will allow us to develop the best project possible.

There are a number of ways that you can gain information on the project and contribute to the development process, including:

- a community "open house" to allow a two-way exchange of information between the proponents and the local community;
- regular community newsletters, such as this one, throughout the development phase;
- one-on-one meetings;
- correspondence via telephone, email or letter to the Mt Emerald Wind Farm Project Manager (details below); and
- Mt Emerald Wind Farm wind farm website – **www.windfarms.net.au**

Mt Emerald Wind Farm has also made a commitment to Tablelands Regional Council and other key stakeholders to keep them informed throughout the project.

What are we investigating?

Over the next six months, Mt Emerald Wind Farm will investigate the potential impact of the wind farm on your environment and community. This includes:

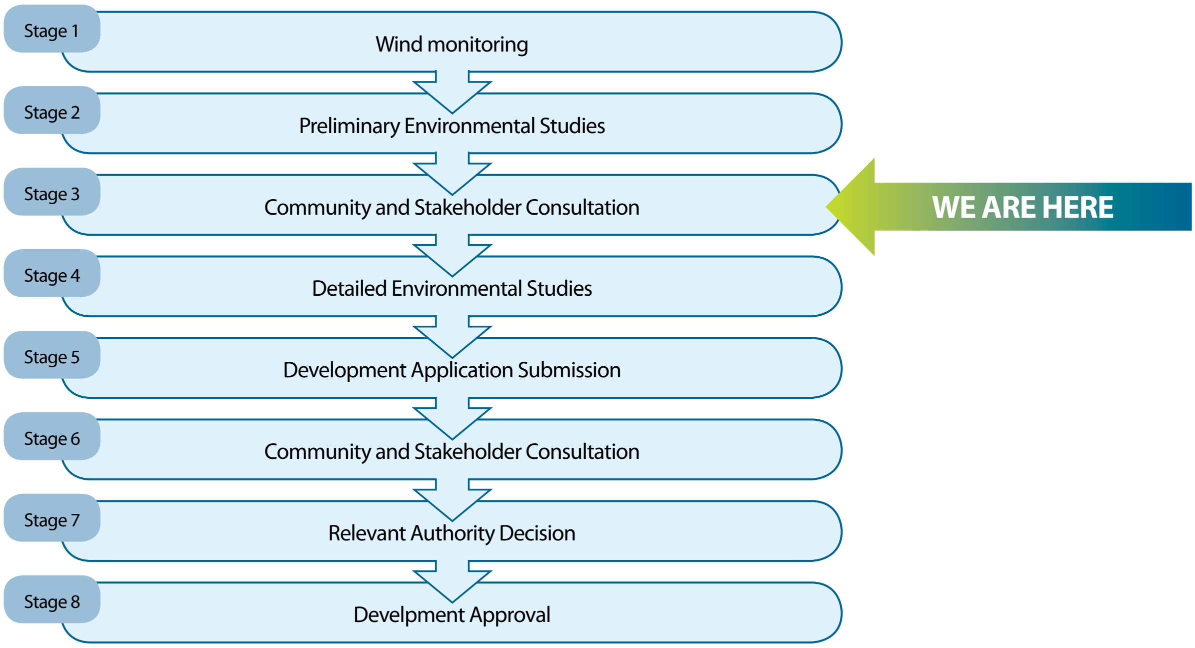
- flora and fauna assessments, including the potential for impacts on birds and bats;
- noise assessment to understand the potential impacts on neighbouring residences;
- visual impact assessment, including preparation of photomontages;
- aeronautical impact assessment;
- telecommunications interference studies; and
- cultural heritage significance, including consultation with the local Aboriginal community.

The scope of this work will be guided by the Environmental Protection and Heritage Council National Wind Farm Development Guidelines (Draft - July 2010), and best practice.

These investigations, together with the information and views gathered from community and government, will be considered in the design of the wind farm and the associated access tracks, substation and transmission line.

What is the planning process?

Following the investigations, and consultation with the community and government agencies, Mt Emerald Wind Farm will commence the planning process.



Who is Mt Emerald Wind Farm?

Mt Emerald Wind Farm is a company with equal shares held between Transfield Services and Port Bajool.

Port Bajool, with directors John Morris and Jim Noli, have developed property in the Port Douglas and Tablelands areas for over 30 years. They remain the major landholders at Oaky Creek Farms and are keen to ensure that all neighbours views are considered and that the wind farm makes a positive contribution to the neighbourhood as well as the general Cairns/Tablelands region.

Transfield Services is an Australian-owned company and is a leading provider of operations, maintenance, asset and project management services. The company – with a workforce in excess of 28,000 employees - works across diverse industries including mining, hydrocarbons, transport, water, energy, telecommunications and defence.

Transfield Services owns and operates a portfolio of power stations across Australia with a total generating capacity of 1,000 megawatts (MW). The company owns and operates three wind farms, including the Windy Hill project which has been operating successfully in the region for over 10 years, and has an interest in a number of wind farm development sites. These assets and sites were acquired from Queensland Government-owned Stanwell Corporation in December 2007.

Transfield also has extensive experience in project development and delivery across Australia, and has fostered close relationships with landowners and host communities. The company has an enviable track record of working with communities to develop solutions to community issues.

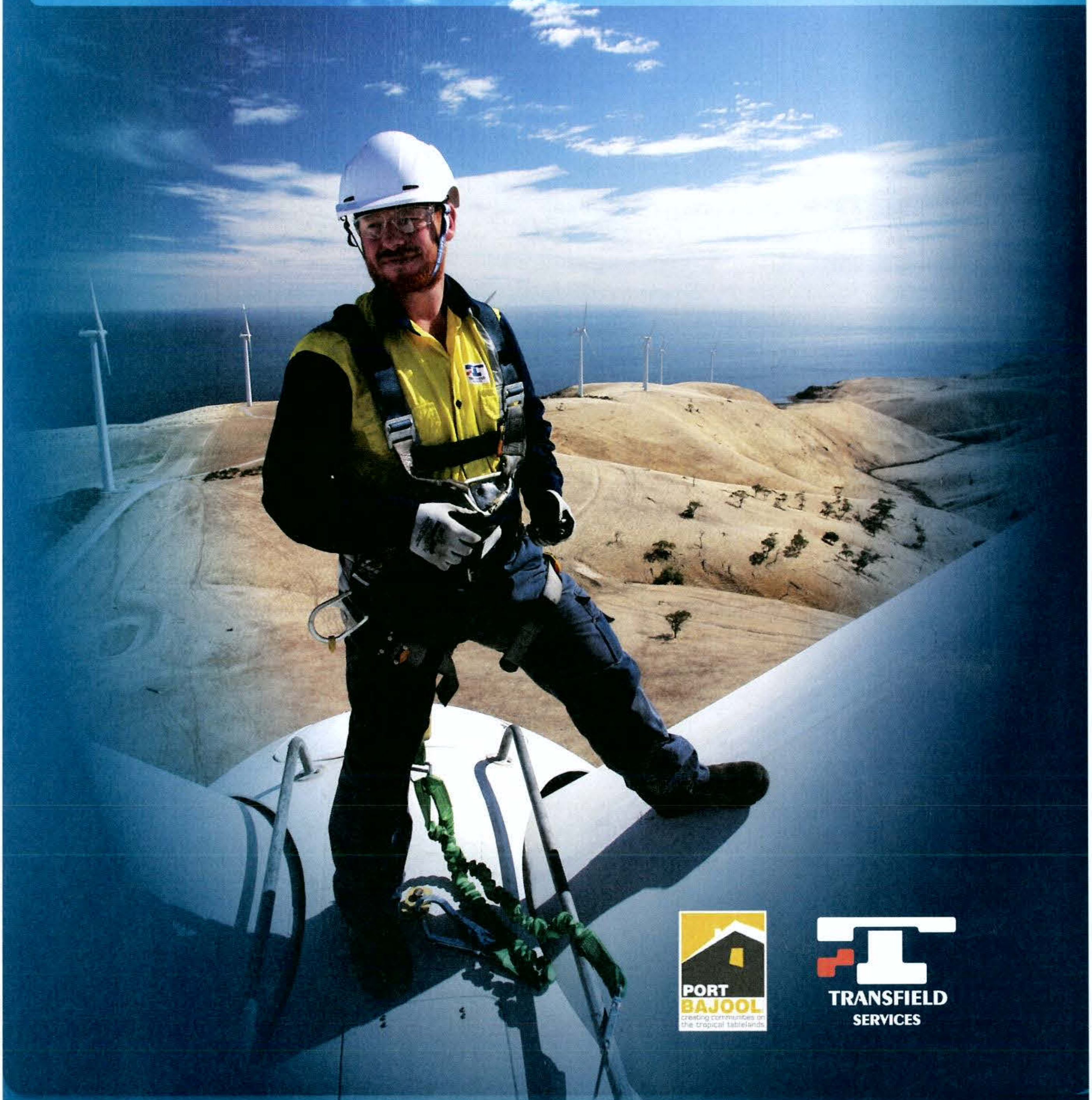
For more information

We invite you to attend our community open house on Thursday 31st March 2011,
or to contact Mt Emerald Wind Farm Project Manager, Terry Johannesen on **(07) 3248 8765**
or **johannesent@transfieldservices.com** with any questions.

Information about wind energy is available at **www.windfarms.net.au**

PORT BAJOOL creating communities on the tropical tablelands

TRANSFIELD SERVICES



Mount Emerald Wind Farm

www.windfarms.net.au

{ renewable energy }

Transfield Services home grown and growing

Who is Mt Emerald Wind Farm?

Mt Emerald Wind Farm is a company with equal shares held between Transfield Services and Port Bajool.

Port Bajool, with directors John Morris and Jim Noli, have developed property in the Port Douglas and Tablelands areas for over 30 years. They remain the major landholders at Oaky Creek Farms and are keen to ensure that all neighbours views are considered and that the wind farm makes a positive contribution to the neighbourhood as well as the general Cairns/Tablelands region.

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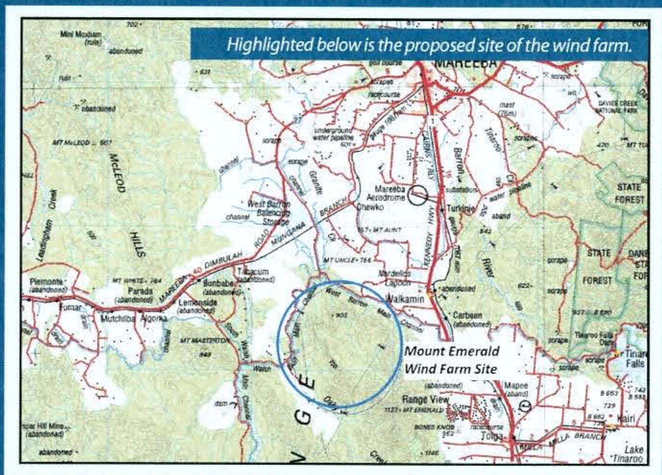
Transfield Services and Port Bajool, together as Mount Emerald Wind Farm Pty Ltd, is assessing the potential for establishing a wind farm on the Atherton Tablelands along the range between the towns of Atherton and Mareeba.

The Site

The land on which the wind farm would be developed is privately owned and comprises a rough plateau (el. 900m) of largely sparse natural scrub land with some rocky outcrops not currently used for any particular purpose. The plateau is elevated some 300m above the surrounding plains which are predominantly used for grazing and agriculture.

The site has been chosen for the following reasons:

- It has an excellent wind resource
- There are few residences in close proximity to the site
- The site is close to the electricity grid, reducing the length of the transmission line
- Preliminary environmental studies indicate a low impact on the environment
- Support for the development from local communities



Wind Monitoring

Wind data has been collected at Mount Emerald for over six months from two wind monitoring towers. Each tower measures wind speed and direction at various heights above the ground as well as recording other standard weather observations. The data collected to date indicates a viable wind resource that could be harnessed to produce clean renewable energy.

Number of Turbines: 70 to 80, depending on the capacity of the individual wind turbine generators.

Wind Turbine Size: The turbine blades are mounted on tubular steel towers up to 90 metres high, with each blade up to 50m long.

Energy Produced: Approximately 500,000 megawatt hours: enough renewable energy to power the equivalent annual needs of approximately 75,000 North Queensland homes.

Environmental Benefits

The Mount Emerald Wind Farm would reduce Australia's greenhouse gas emissions by 14 million tonnes of CO_2 equivalent during a 25-year operating life. This reduction is achieved by replacing fossil fuel energy production with clean renewable wind energy.

Investments in renewable energy are environmentally and commercially sustainable. The Australian Government's renewable energy scheme allows producers of renewable energy to sell the power generated and obtain renewable energy certificates (RECs). Energy retailers are required to purchase RECs to support the generation of renewable energy and achieve renewable energy targets.

Environment & Planning

What is the Planning Process?

The planning process for a wind farm involves several stages as summarised below.

The Mount Emerald Wind Farm is currently at Stage 3. We anticipate the remainder of the process will take up to 12 months to complete.

Environmental Investigations

Mount Emerald Wind Farm has undertaken a range of preliminary environmental investigations of the wind farm site over the last six months. The scope of these studies was guided by the Federal Government's Environmental Protection and Heritage Council National Wind Farm Development Guidelines (Draft - July 2010), and other best practice guidance. The key findings of these preliminary investigations are summarised below.

Ecology

Flora and fauna investigations and surveys (including birds and bats) undertaken by independent consultants in May 2010 identified a number of significant flora and fauna species having the potential to be found at the Mount Emerald site.

An actual on site investigation identified two plant species and one bat species of significant interest.

The conclusion of the environmental assessment to date is that with careful turbine placement and consideration given to the routing of the road and cabling network, the impacts of the wind farm are expected to be of relatively low intensity.

Further studies are planned following the wet-season in 2011 to further quantify the utilisation of the site.

Aboriginal and European Heritage

Preliminary heritage investigations have identified no items of cultural heritage significance at the wind farm site.

However, noting there has been little previous significant ground disturbance over the majority of the area, the potential for aboriginal cultural heritage being present within the study area is considered to be moderate.

A detailed archaeological assessment in now proposed and will include consultation with the Bar Barrum and Muluridji peoples.

It is expected consultation would result in a cultural heritage survey and a cultural heritage management plan (CHMP) or agreement pursuant to the Aboriginal Cultural Heritage Act 2003.

Aeronautical Risk

Given the wind turbines are likely to have an overall height greater than 110m it will be necessary to investigate the impacts the wind farm will have on aviation activities in the area both during daylight and night-time hours.

The Mareeba Airport is located approximately 11km to the northeast of the proposed wind farm and as such impacts on aviation in the area should be further investigated.

Noise and Visual Impact

Please refer to the separate fact sheets for noise and visual.

Noise

The widely accepted requirements for wind farms is that noise levels at residential dwellings not exceed the background noise level by more than 5 decibels or a level of 40 decibels (similar to standing in a quiet household).

These limits are in place such that the noise from a wind farm is not considered annoying by the average person. Before it can commence operation a wind farm must demonstrate that noise levels at neighbouring residences will meet these prescribed noise limits.

The simplest way to manage noise levels at nearby residences is to provide a sufficient "buffer" distance between the turbines and the residence.

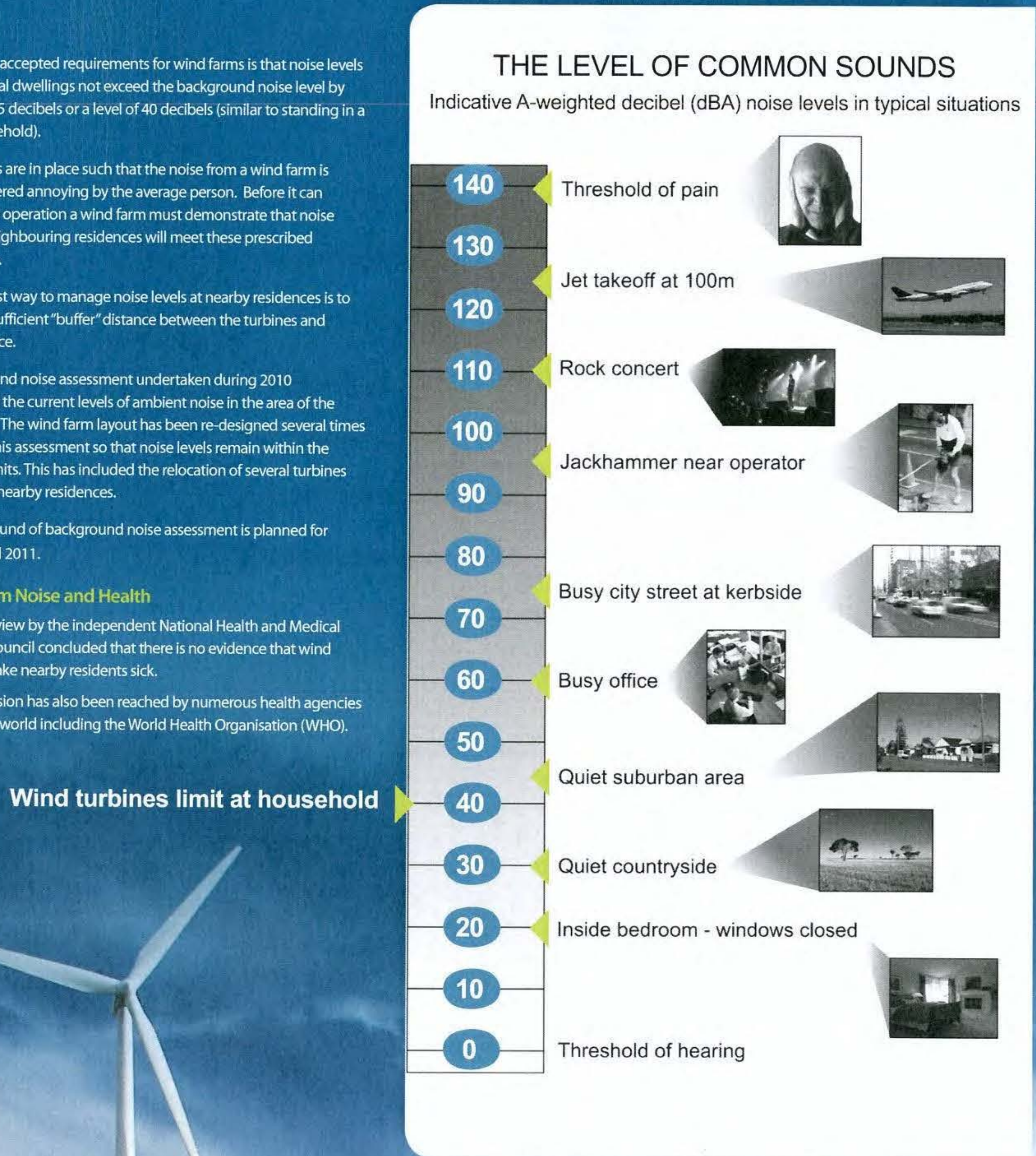
A background noise assessment undertaken during 2010 established the current levels of ambient noise in the area of the wind farm. The wind farm layout has been re-designed several times based on this assessment so that noise levels remain within the required limits. This has included the relocation of several turbines away from nearby residences.

A further round of background noise assessment is planned for March/April 2011.

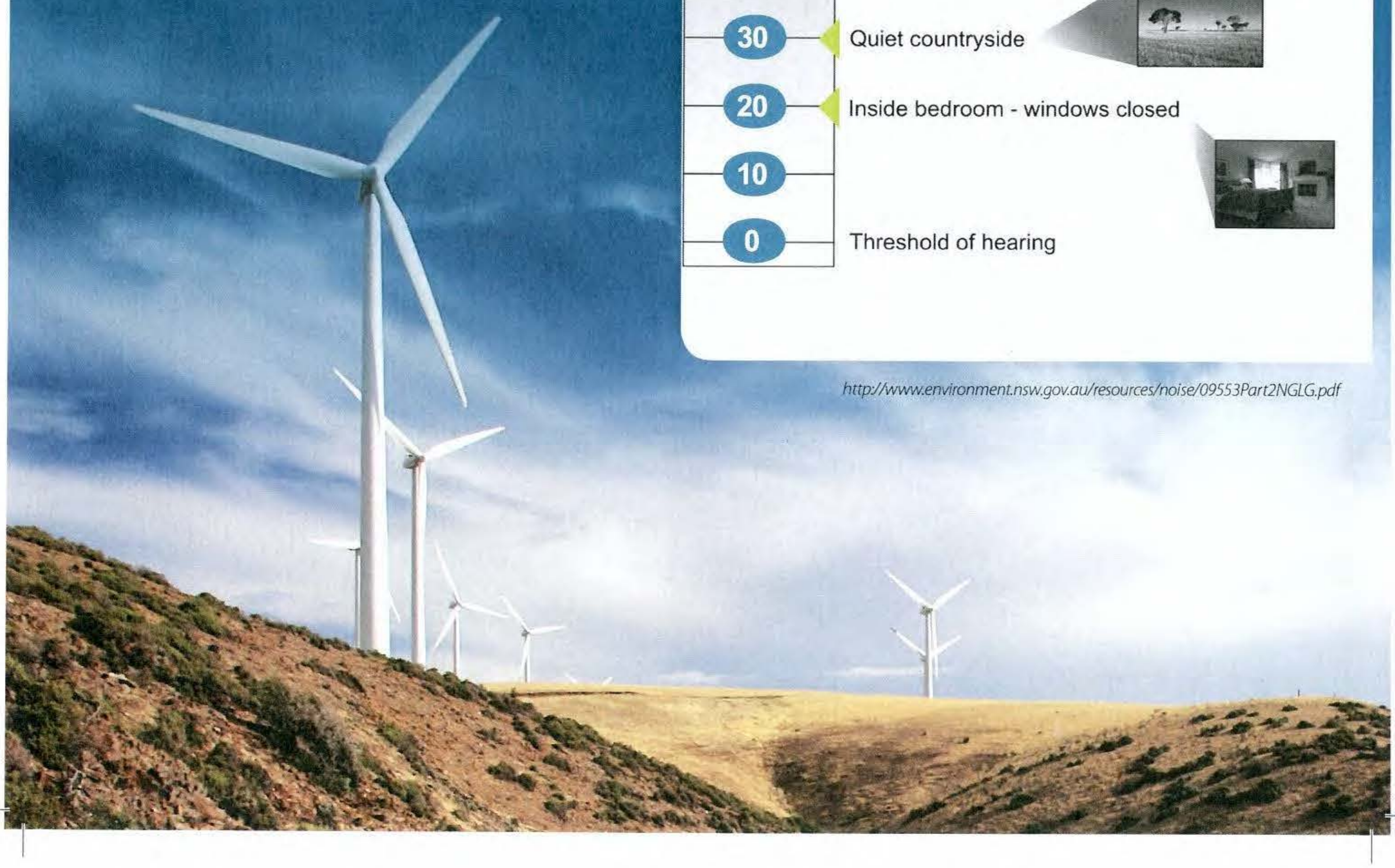
Wind Farm Noise and Health

A recent review by the independent National Health and Medical Research Council concluded that there is no evidence that wind turbines make nearby residents sick.

This conclusion has also been reached by numerous health agencies around the world including the World Health Organisation (WHO).



http://www.environment.nsw.gov.au/resources/noise/09553Part2NGLG.pdf



(A) Before

(A) After

(B) Before

(B) After

Visual

A preliminary landscape assessment of the wind farm and its impacts was undertaken in accordance with the Wind Farms and Landscape Values National Assessment Framework, produced by the Australian Council of National Trusts.

It is acknowledged that due to the nature of the landscape in which they are proposed to sit i.e. on a ridgeline surrounded by a relatively flat landscape, the towers will be visible from many locations and little can be done to screen them using natural vegetation and landform. However, it is important to note that the towers will have a low visual prominence from the Kennedy Highway and it can be reasonably assumed the majority of regional traffic will utilise this route.

This apparent change in the visual character of the landscape could be embraced by the local community with the new scheme potentially enhancing a tourist trade, creating an additional attraction to the area. Given the main tourist route is exposed to only minor visual impacts it can be said that the new infrastructure would give visitors a choice of tourist journeys, taking them either along the Kennedy Highway with relatively untouched landscape character in keeping with the current values of the site or alternatively, the visitor can experience the full scale of this renewable energy project from Channel Road while travelling to existing local tourist attractions such as Mount Uncle Distillery or Granite Gorge Nature Park, or the potential new Renewable Energy Centre located adjacent to the wind farm.

The wind farm will be visible from various locations in the surrounding area, including from residences and roads. Two photomontages have been prepared showing potential views of the wind farm.

A - from the Kennedy Highway Chewko Road intersection near Walkamin (viewpoint 14)

B – near the intersection of Chettle Road and Springmount Road (viewpoint 6)

These montages are a close approximation of the appearance of the wind farm from these two viewpoints. The visual significance of the wind farm will vary from person to person and is largely subjective.

How Wind Farms Work

How Wind Farms Work

Wind turbines convert the energy of the wind into electricity. The turbine blades are turned slowly by the wind, and this rotation spins a generator to produce electricity. The electricity travels through transformers and a transmission line into the local electricity network for distribution to consumers.

Almost all commercial wind turbines producing electricity consist of three blades connected to a hub that rotates around a horizontal axis.

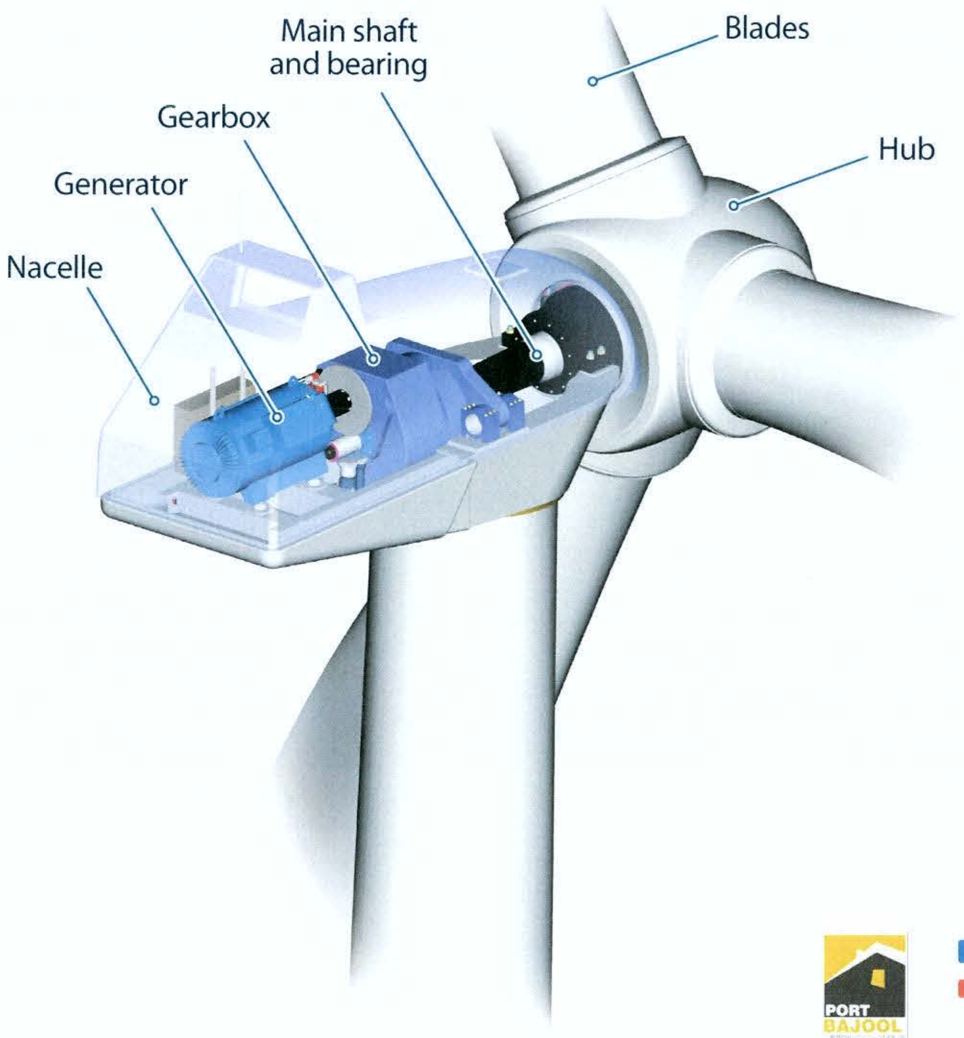
The hub is connected to the gearbox and generator which are located inside the nacelle, the large part at the top of the tower.

The turbine blades and rotor drive a high speed generator via a step-up gearbox.

The generated electricity passes through cables from the nacelle to the base of the tower. Here it is stepped up to high voltage in a generator transformer for supply to the transmission system.

Each of the turbines connects to the transmission system via the on site substation.

The wind turbines start operating at wind speeds of around 13 kilometres per hour and reach maximum power output at around 49 kilometres per hour. At very high wind speeds, such as gale force winds, the wind turbines shut down to avoid damage to the equipment.



PORT BAJOOL

TRANSFIELD SERVICES

Community and Stakeholder Engagement

Mount Emerald Wind Farm is committed to engaging with the community and other stakeholders on all its projects; from inception through to operation and decommissioning. Our approach includes the following elements:

- Early and inclusive engagement - our community engagement activities for the Mount Emerald project started at the inception of the development approval process, allowing us to incorporate community feedback into the wind farm design and scoping of the detailed environmental studies
- Open and transparent consultation - Mount Emerald Wind Farm will provide the local community with all relevant information about the project so that they may actively and constructively participate in the project development phase
- Timely and responsive feedback - we have established a stakeholder database, whereby comments are recorded and responded to in a timely manner. We commit to providing feedback to the community on how their comments have influenced the project
- Maximise community benefits – Mount Emerald Wind Farm will work closely with the community and Tablelands Regional Council and other key government departments
- Conflict resolution - Mount Emerald Wind Farm will engage with groups/individuals in an effort to understand concerns and resolve conflict.

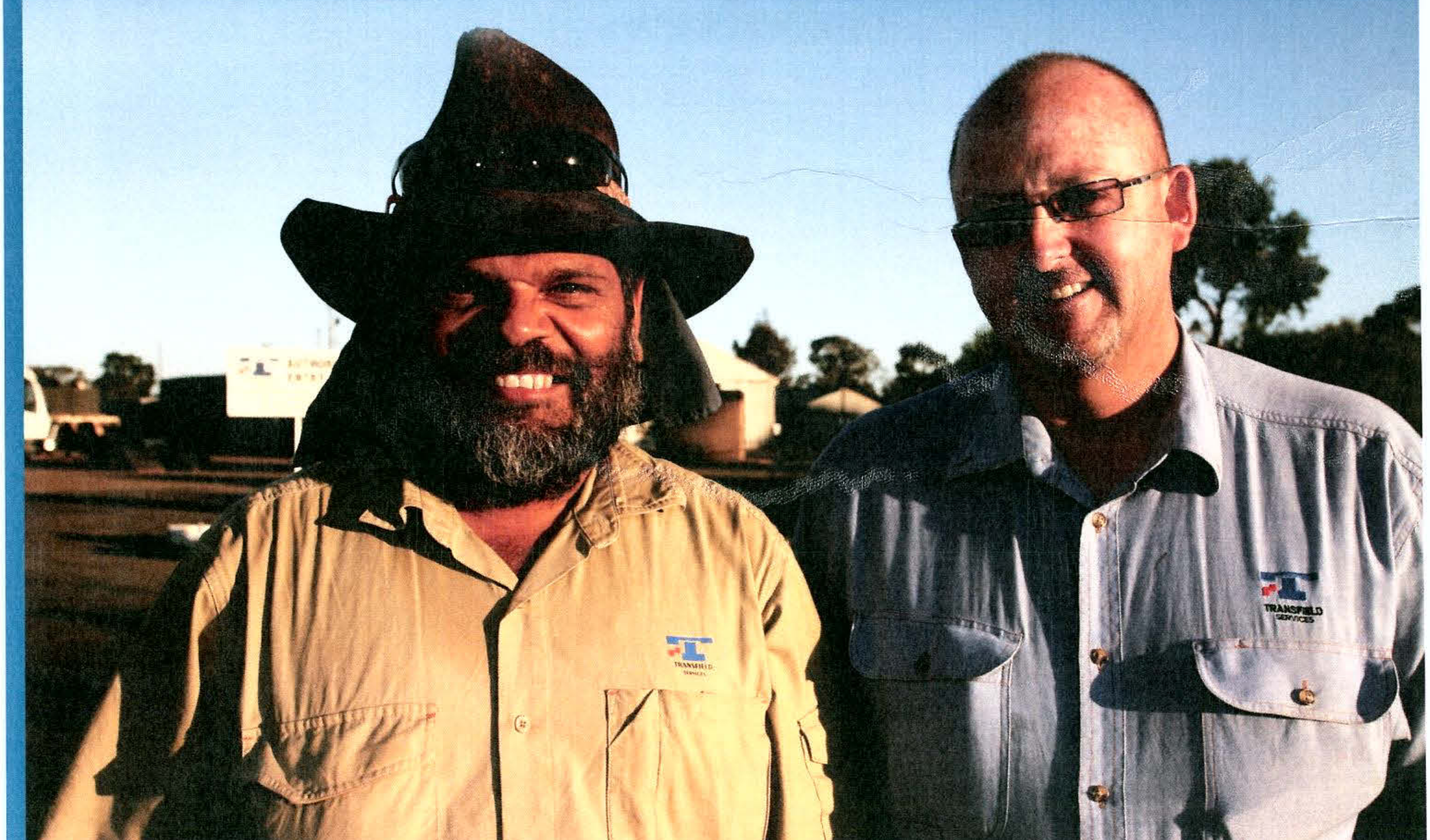
Aboriginal Community Engagement

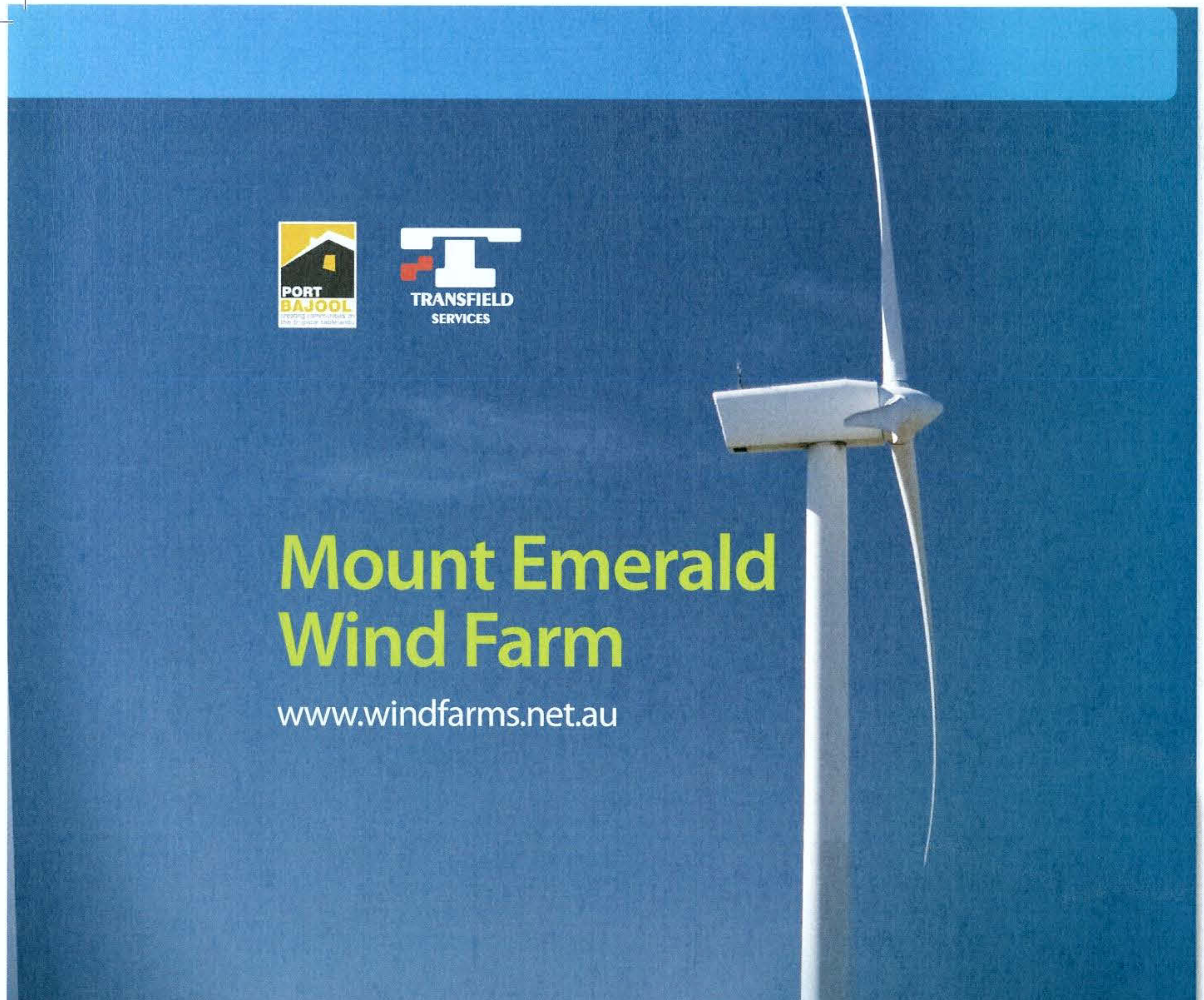
Mount Emerald Wind Farm recognises the local customary needs of Aboriginal people and the significant importance of preserving their culture and customs. The Company is committed to:

- Respecting the values and beliefs of Aboriginal people by creating a Company culture that respects and acknowledges Aboriginal culture, heritage, values and beliefs;
- Understanding the potential impact our business can have on Aboriginal people and their communities by encouraging and building our peoples awareness and understanding of Aboriginal relations and culture;
- Listening to Aboriginal people and together partnering to ensure mutually beneficial outcomes for Aboriginal communities, our clients, our partners and our business.

Mount Emerald Wind Farm acknowledges Aboriginal people as the original carers of their lands and therefore their involvement in our business is vital to our success.

Transfield Services Project Manager, Terry Johannesen, can be contacted on (07) 3248 8765 or johannesent@transfieldservices.com.





For more information

Contact Transfield Services Project Manager Terry Johannesen on **(07) 3248 8765** or **johannesent@transfieldservices.com** with any questions.

Mt Emerald Wind Farm
Community Newsletter

Issue 2 – June 2011

Welcome to Issue 2 of the Mt Emerald Wind Farm newsletter.

This newsletter will provide you with an update on the environmental and planning investigations currently underway and further information on the proposed wind farm.

This newsletter follows our first issue circulated in March 2011. Since that time we have undertaken a community open house on 31 March 2011 at the Mareeba Heritage Centre where information on the project was provided to approximately 60 attendees.

Mount Emerald Wind Farm is a Joint venture between Transfield Services and Port Bajool.

Current Activities

A range of detailed studies are currently underway, with investigations being undertaken by expert consultants engaged to perform the work.

These investigations cover areas such as;

- Flora and fauna
- Noise
- Visual
- Aeronautical
- Telecommunications
- Traffic
- Cultural Heritage

It is hoped all of these studies can be completed over the coming months. The information obtained through these reports can then be used to adjust the design of the wind farm and hence ensure the design conforms to the required guidelines.

Community Consultation Update

Thank you to all who attended the Community Open House in March. Since the meeting a number of residents have taken the opportunity to contact us requesting further information or to provide additional feedback. The local community expressed a range of views about the project. This feedback has already proved invaluable with suggested changes incorporated into the layout to reduce the visual impact of the wind farm.

Questions and Answers

At the recent open house and over the past months there have been a number of questions raised regarding the proposed wind farm project. Whilst some of the exact answers cannot be given at this stage as we await the completion of the detailed environmental studies we have tried to provide as best we can to some of the more common requests.

Will aviation lighting (red lights) be required at the Mount Emerald Wind Farm?

Preliminary advice from aviation consultants suggest there is no requirement for night time aviation lighting at Mount Emerald wind farm. However, they do advise that under a general duty of care to aviation, hazard lighting should be installed on sufficient turbines to define the extremities of the site during the period 30 minutes before and after sunrise and sunset, and during conditions of reduced visibility caused by smoke, dust or haze (i.e. lights are NOT generally on overnight). The number of turbines needed to have lights installed to meet this requirement is thought to be approximately 8.

Further work is being undertaken to determine the necessity of this requirement.

What is the proposed construction access route to the wind farm site and how will damage to local roads be repaired?

A traffic and transport assessment is currently being undertaken to examine potential access routes to the wind farm. Preliminary assessment suggests the preferred site access to be from the Kennedy Highway along Hansen Road and Kippin Drive. Expected planning approval conditions will require the wind farm to repair any damage caused to local roads during the construction phase.

How will the visual impact of the wind farm be assessed?

The wind farm will be visible from various locations in the surrounding area. The visual significance of the wind farm will vary from person to person and is largely subjective.

A comprehensive visual impact assessment will be undertaken, including a landscape character assessment, consideration of the visual impact of the wind farm on the local landscape and assessment of any cumulative effects. A series of photomontages will be prepared simulating the appearance of the wind farm from various viewpoints.

Contrary to recent media there are no residences underneath the turbines; with no houses within 1.5 kilometres of a proposed wind turbine.

Will construction and maintenance workers be employed from the local area?

Mount Emerald wind farm will look to recruit skilled construction and maintenance workers from the local area and involve local contractors and suppliers wherever feasible.

The project would generate employment in the local area during construction and operation. Workers required for the project would include plant operators, truck drivers mechanics, fencers, electricians, labourers and other trades typically used in civil construction. It is estimated the onsite workforce would peak at around 120 employees.

Will property values decrease as a result of the wind farm?

A recent study by the NSW Valuer General into the impacts of wind farms on property values concluded that in most cases wind farms do not appear to negatively affect property value.

Who would be responsible for decommissioning the wind farm at the end of its operating life?

The owner of the wind farm will be responsible for the removal at the end of the operating life. Conditions in lease agreements and development approval conditions require the infrastructure to be removed at the end of its life.

How does the noise assessment demonstrate whether the noise level at neighbouring properties is at a safe level prior to installing any turbines?

A computer model of the wind farm site is created using detailed contour data. The locations of the turbines and the residences around the wind farm are added to this model. The noise level emitted by the wind turbine is known and is guaranteed by the manufacturer. This information allows the prediction of the noise at the residences to be made. Depending on the outcome ofthe modelling the layout of the wind turbines is altered to ensure the predicted noise level at the residences is below the required noise limits.

It is proposed for the noise assessment to be undertaken in accordance with the SA Environmental Protection Authority – Wind Farms Environmental Noise Guidelines (2009). Under these guidelines the noise from the wind farm must be below a noise limit that is the greater of 40dBA or background noise plus 5dB.

Background noise is a measure of the existing noise in the environment. Background noise levels are obtained from actual measurements undertaken at residences in the closest proximity to the wind farm.

It should be noted that the above noise limits apply to the area outside of the residence. In Queensland, the Environmental Protection Agency (EPA) implements a policy to protect the noise levels within a residence. This policy must also be conformed to.

Do noise levels change with wind speed?

Yes, both the noise emitted by the wind turbine and the background noise change with wind speed. If there is no wind then the wind turbine will not operate and hence make no noise. As the wind speed increases the sound level of the operating wind turbine will also increase. However, the background noise also increases with wind speed and normally at a rate faster than the noise of the wind turbine.

How will noise levels be monitored during the operational phase of the wind farm and what enforcement is there if levels are exceeded?

The conditions of approval for the development will require the preparation of a Noise Compliance Plan for the operational phase of the project. This would require monitoring of noise levels at nearby residences in the first months of operation to confirm the results of the pre-construction modelling are not exceeded. If noise limits are exceeded, the wind farm is required to take steps to reduce noise levels to comply with the limits. If noise compliance cannot be achieved in a reasonable timeframe then the offending turbines will be removed from operation, under certain conditons.

What studies are being conducted into the health impacts on the community?

A review in July 2010 by the National Health and Medical Research council (NHMRC) concluded that;

> *“There is currently no published scientific evidence to positively link wind turbines with adverse health effects.”*

They further recommended that authorities in determining their approval of wind farm projects comply with standards relating to wind turbine design, manufacture and site evaluation to minimise any potential impacts on surrounding areas.

For example, the SA Environmental Protection Authority – Wind Farms Environmental Noise Guidelines (2009) should be used as a relevant standard for assessing noise impacts.

At what wind speeds are the turbines activated or stopped?

Wind turbines commence generating electricity at wind speeds of around 10 km/h and will continue to do so until the wind reaches a speed of 100 km/h. For wind speeds above this, the turbines will cease operation and go into lock-down mode. In this mode the turbines are designed to withstand cyclone force wind speeds.

How often will the turbines be inspected and what is the proposed maintenance regime?

Turbines are subject to regular scheduled maintenance activities on a six-monthly cycle. Turbine operation is monitored 24 hours a day either remotely or via the wind farm control room.

Are overheating problems a risk to wind turbine operation?

Modern wind turbines are able to operate through a large temperature range; generally between -20°C and 50°C. Turbines are fitted with sophisticated electronic controllers which monitor each turbine's operating conditions. If the potential for overheating is detected an emergency stop would be activated.

The wind farm has the potential to supply electricity equivalent to the needs of 75,000 homes. Is this amount of electricity produced at all times?

The figure of 75,000 homes is an average figure based on the expected annual energy generated by the wind farm. Energy generation has been calculated using the data gathered from wind monitoring at the site. When wind speeds are too low to generate energy (below 10 km/h – approx. 5% of the time) no power will be generated. On the other hand, when wind speeds allow maximum generation (above 50km/h – approx. 15% of the time) the wind farm could supply the electricity needs of around 250,000 homes.

Is there a risk of bushfire associated with wind turbines?

There have been a small number of wind turbine fires in Australia; however the over all risk is considered to be low according to organisations such as Victorian Country Fire Authority (CFA). The wind turbines are all connected to a control centre which continuously monitors the operation of each turbine and alerts the operator to any issues.

Each turbine has an in-built lightning protection system to safely dissipate any strike to the ground.

In some ways the wind farm can actually provide benefits to combat bushfire in the area; such as providing road access to areas previously unavailable to vehicles and personnel acting as early detection observers.

For more information

Please contact Mt Emerald Wind Farm Project Manager, Terry Johannesen on **(07) 3248 8765** or **johannesent@transfieldservices.com** with any questions.

Information about wind energy is available at **www.windfarms.net.au**

MOUNT EMERALD
WIND FARM

Fact Sheet

Summary of Investigations and Assessments

The information provided below is a summary of the various studies and investigations undertaken as part of the development of the Mount Emerald wind farm project. For the full reports please refer to the Development Application documents available through the Tablelands Regional Council or on the Mount Emerald project website at *www.windfarms.net.au*

PROPOSAL

The project provides for the installation of up 75 wind turbines, each with a nominal capacity of 2 to 3MW. While the actual make and model is yet to be determined, the typical physical characteristics of the turbines include a tapering steel tower supporting a 3 blade rotor with blade lengths up to 50m and a hub height of 80 to 90m. Of the turbines being considered the largest has an overall tip height of 131m (hub height of 80m and blade of 51m).

Investigations have identified 78 representative dwellings in the vicinity of the wind farm, the relative proximity of these dwellings to the nearest wind turbine is

Distance from WTG (m)	No. of Residences
1000	0
2000	10
3000	44
4000	69
5000	78

The townships of Walkamin and Rangeview are located approximately 4.7km and 3.1km from the nearest wind turbine respectively. Representative dwellings have been included in the analysis for these areas.

TRAFFIC

There are two alternative routes being considered for delivery of components to the Kennedy Highway and ultimately the site – one inland route via Kennedy Development Road and the other via the Palmerston Highway. From the Kennedy Highway at Walkamin the recommended route follows Hansen Road and Springmount Road before turning into Kippen Drive to access the entrance to site. The route along Hansen Rd and Springmount Rd is gazetted for large vehicles accessing the Arriga Mill.

The intersection of Springmount Rd and Kippen Dr will warrant upgrade works to accommodate the construction vehicles.

FLORA AND FAUNA

Various site investigations have been undertaken on the site to determine the range of species expected to be encountered. These include;

- Early dry season survey in May 2010
- Late wet season survey March-April 2011
- Targeted survey for Northern Quoll June-July 2011
- Specific bat survey in mid-dry season June-July 2011
- Specific vegetation survey June 2011

Many of the potential impacts on conservation significant species resulting from the construction and operation of the proposed wind farm may be reduced to acceptable levels through the implementation of appropriate controls. In the longer term the operational impacts on these species are not considered likely to be significant provided the recommended monitoring and management programs are implemented.

VISUAL

Considering the elevation of the site, size of the structures and the prominence of the land along public viewpoints, the wind farm will inevitably create an impact on the natural landscape. How the impact is perceived is largely subjective, with both positive and negative elements.

A 3D model has been prepared which replicates the anticipated visual impact from the wind farm from various locations around the site. High quality montages have been prepared for 10 general locations around the site and approximately 130 further simulations for other viewpoints.

SHADOW FLICKER

Wind turbines due to their size cast shadows on their surrounds at specific times of the day. Using simple geometry incorporating the sun's path, topography and wind turbine dimensions, it is possible to calculate the time that a receptor will be subject to shadow flicker. In the simplest of cases (worst case), the turbine is assumed to be operating all the time, is perpendicular to the receptor at all times and the sun is shining at all times of the day. This case will provide an upper bound or maximum to the number of shadow hours expected each year.

The shadow flicker investigation concludes that for the largest wind turbine contemplated, there are four dwellings which it is predicted will experience shadow flicker. Under the worst case scenario the annual amount of time shadow flicker is experienced at these receptors is well below the recommended allowable limit of 30 hours per year, with the most affected dwelling experiencing 7 hours 43 minutes for the year with a longest single incident of 13 minutes. Thus the impact is within allowable limits for all neighbouring dwellings to the wind farm.

NOISE

The noise from the wind farm must remain below prescribed limits. These limits are set out in a range of guidelines and standards. The Mount Emerald wind farm has been designed to conform to the following limits;

- Audible Noise – **the greater of 40dBA or the background noise level plus 5dBA** - Qld Environmental Protection (Noise) Policy 2008 and South Australian EPA Wind Farm Environmental Noise Guidelines 2009
- Infrasound Noise – **85dBG indoors** – Qld Department of Environment and Resource Management (DERM) Assessment of Low Frequency Noise Part A Infrasound
- Low Frequency Noise – **50dB(Linear) indoors** - Qld Department of Environment and Resource Management (DERM) Assessment of Low Frequency Noise Part B Low Frequency Noise

The existing noise levels or background was determined by monitoring the noise levels at six locations in closest proximity to the wind farm.

The results of the noise assessment for audible noise show that noise goals are met at all locations. The predicted wind farm noise levels are well below the background noise levels at most locations, with only 7 receptors having a level above the background. In all of these cases the increase is within the allowable 5dB and all are below the minimum level of 40dBA even under the highest noise emission of the turbines.

The low frequency and infrasound assessment also shows compliance with levels calculated being below the prescribed limits. For Infrasound the maximum calculated level is 66dBG (85dBG limit) and for low frequency the maximum calculated limit is 56dB(Lin) against a 60db(Lin) limit for outdoors.

ELECTROMAGNETIC INTERFERENCE

The potential impact on radio communications services was investigated as part of the development process. The key to this investigation is identifying the existing radio communication sites and services and their associated paths. This data was obtained from the Australian Communication and Media Authority (ACMA).

28 radio communication sites were found within a 10km distance of the wind farm with an associated 222 registered assignments. These locations and their standard exclusion zones were mapped against the proposed wind farm layout. Form the assessment it is considered that one

turbine may intrude on a particular path. Confirmation of the location for the site is being sought prior to any minor modifications to the location of the turbine is undertaken.

AVIATION

Mount Emerald wind farm is located within 13km of the Mareeba Aerodrome, but is not considered to impact upon the operations of this aerodrome. Analysis indicates there will be no impact upon airborne traffic transiting the area.

Current aviation safety guidelines stipulate that objects over 110m should be marked with hazard lighting, however Civil Aviation Safety Authority are presently considering increasing this limit to 150m which would remove the requirement for lighting.

CULTURAL HERITAGE

The history of the land use reduces the likelihood of non-aboriginal cultural significance remaining on the site, although it is noted the area was used for training during World War II. An assessment of the likely indigenous cultural heritage was undertaken including the turbine footprints, road and cable layouts. The investigation, although finding no particular sites being present recommended consultation with the appropriate parties.

The appropriate party has since been identified as the Bar Barrum people and consultation and work is underway to prepare and implement a Cultural Heritage Management Plan with this group.

UNEXPLODED ORDNANCE

Given the sites history in terms of military training in World War II there remains some potential that it contains unexploded ordnance. A search of the Department of Defence website confirms this. It is intended that an investigation of the site be undertaken prior to construction in accordance with relevant guidelines to outline remediation requirements necessary to reduce the risk of exposure to such ordnance.

MOUNT EMERALD
WIND FARM

Fact Sheet

ECONOMIC BENEFITS

It is expected the proposed wind farm will bring positive benefits (direct and indirect) to the local and regional economy throughout the life cycle of the project. The phases can typically be described as development, construction and operation.

At a direct level the procurement of local goods and services will be strongly encouraged. It is anticipated workers and contractors required for the project will include plant operators, truck drivers, mechanics, welders, fencers, electricians, labourers and other individuals typically used in a civil construction context.

At an indirect level, it is expected economic benefit will arise through the provision of short to medium term accommodation, entertainment and goods & services primarily felt during the construction and operational phases. It is expected this expenditure will occur within the local community as a proportion of wages paid to employees associated with the wind farm. Indirect employment opportunities may also be created as a result of meeting increased demand for these services as well as in the area of tourism.

The expected overall cost of the project is estimated to be in the order of $500 million and has the potential to supply the annual electricity needs of approximately 75,000 North Queensland homes. This is roughly equates to all of the power needs for the Tablelands or 60% of Cairns.

For general enquiries, please contact:

Terry Johannesen

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e-mail: terry.johannesent@ratchaustralia.com

PORT BAJOOL creating communities on the tropical tablelands

RAC RATCH-Australia Corporation

Mt Emerald Wind Farm *Community Newsletter*

Issue 3 – September 2011

Welcome to Issue 3 of the Mt Emerald Wind Farm newsletter.

This newsletter will provide you with an update on the progress for the development of the wind farm and to provide factual information in relation to key concerns being raised by the community.

Change in Ownership

In July this year, Transfield Services ownership in the Mount Emerald Wind Farm project was sold to Ratch Australia Corporation Limited (RACL). RACL is 20% owned by Transfield Services Australia and 80% by Ratchburi Electricity Generating Holdings, a Thai based electricity company with over 5,000MW of installed capacity.

As the Transfield Services team have transferred to this new entity these changes will have no impact on the development of the Mount Emerald project and the project manager remains the same.

Status of Development Application

The development application for the Mt Emerald wind farm was finally lodged with the Tablelands Regional Council on 15 August 2011. This was possible only after we spent 18 months investigating a wide range of issues, including the impact on traffic, flora and fauna, view, aeronautics, culture and heritage and creation of shadows and noise around residences in the vicinity of the wind farm.

Shortly thereafter, the Tablelands Regional Council applied to have an amendment made to the planning code to allow them to fully assess wind farm development applications in the region. This amendment is known as a Temporary Local Planning Instrument (TLPI). The TLPI was approved by the State Minister for Planning on the 16th September.

As developers of the Mount Emerald wind farm, we have been in ongoing contact with the Tablelands Regional Council in relation to the proposed requirements of the TLPI and our documentation relating to the project was prepared to address the Council's proposed conditions. As such, **the Development Application addresses the requirements of the proposed TLPI and includes a Statement of Commitments that embraces the conditions outlined in the TLPI**. The application and the supporting studies are available through the local council or can be viewed on the project website.

www.windfarms.net.au/html/development_portfolio/mount_emerald.php

Studies into Visual Impact

The elevation of the site, size of the wind farm structures and the prominence of the land along public viewpoints means that the wind farm will be visible from the surrounding landscape. Because of this, we commissioned a consultant to prepare a 3D model that replicates the anticipated visual impact from the wind farm from various locations. High quality montages have been prepared for 10 general locations around the site while a further 130 computer generated simulations have been prepared for more specific viewpoints such as residences and towns.

The montages and simulations represent the primary human field of view that would be seen from the actual viewpoint position at the same time of day and reflecting the same climatic conditions as those experienced on the day the photograph was taken.

All of these representations have been prepared by Truescape, which is a highly qualified company, expert in the preparation of such images, with views calibrated using on-site survey to ensure the quality and accuracy of the reproductions. Truescape's client base spans many industries, from landscape architecture and engineering firms through to major New Zealand, Australian and US companies. Truescape simulations have been produced as evidence in forums such as the New Zealand Environment and High Courts, Australia's Victorian Civil and Administrative Tribunal and the Supreme Court.

The high quality montages will be available at our next community day but we have a wide variety of other viewpoints available, so to understand what your view of the wind farm will look like, please contact the Project Manager.

Noise

The Mt Emerald wind farm will be designed such that noise emitted by the wind farm remains below specific limits as set out in accepted guidelines and standards in Queensland and Australia.

The following noise limits have been used:

- Audible Noise – the greater of 40dBA or the background noise level plus 5dBA – applicable standards; *Qld Environmental Protection (Noise) Policy 2008 and South Australian EPA Wind Farm Environmental Noise Guidelines 2009*.
- Infrasound Noise – 85dBG indoors – *Qld Department of Environment and Resource Management (DERM) Assessment of Low Frequency Noise, Part A Infrasound*
- Low Frequency Noise – 50dB(Linear) indoors - *Qld Department of Environment and Resource Management (DERM) Assessment of Low Frequency Noise Part B Low Frequency Noise*

The existing noise levels or background was determined by monitoring the noise levels at six locations in close proximity to the proposed wind farm site over a two week period to obtain a collection of data for a range of different conditions and wind speeds.

The levels of background noise recorded range from 26dB to 32dB under a light wind (18km/h) to 30dB to 35dB for a moderate wind of 36km/h. For winds higher than this moderate level the background noise level will continue to increase, however the noise emitted by the wind farm will not increase as the turbines have reached their maximum noise level at this speed.

The results of the noise assessment for audible noise show that noise goals will be met at all locations, with all below the minimum level of 40dBA even under the highest noise emission conditions for the turbines.

Predicted wind farm noise levels are also below the background noise levels at most locations, with only 7 out of the 78 nearby receptors/houses likely to experience a noise level above the existing background. In all of these 7 cases the increase is within the allowable 5dB increase under the guidelines, which is the amount generally accepted to be required for a noticeable change in noise level.

The low frequency and infrasound assessment also shows compliance with the standards, with levels calculated to be below the prescribed limits. For Infrasound the maximum calculated level is 66dBG compared to a 85dBG limit and for low frequency the maximum calculated limit is 56dB(Lin) compared to a 60db(Lin) limit. An outdoor limit for low frequency noise is used at this time due to specific intricacies involved in modelling the low frequency noise within a dwelling, making it too difficult to undertake for all receptors.

Impact on Aviation

Aviation consultant Lambert & Rehbein determined that even though the Mount Emerald wind farm is located within 13km of the Mareeba Aerodrome, it is not considered to impact upon the operations of this aerodrome. Their analysis, which is available on our website, also indicates there will be no impact upon airborne traffic transiting the area.

Lighting

Current aviation safety guidelines stipulate that objects over 110m should be marked with hazard lighting, however Civil Aviation Safety Authority are presently considering increasing this limit to 150m which would remove the requirement for lighting. If the wind farm is determined to require night-time hazard lighting, the lights will be located on the body of the wind turbine and will include shields to limit the lighting to areas above a horizontal plane, level with the hub height of the wind turbine. It is expected that only 8 of the turbines will require lights under such a scenario.

Given the wind farm site is approximately 300m above the surrounding land and allowing for a 1^{O} down angle, the lights will be shielded to a distance of roughly 17km from the wind farm.

Agricultural Spraying

Lambert & Rehbein also evaluated the impact on aerial spraying activities and concluded that under strong wind conditions aerial spraying may be difficult downwind of the wind farm, however it is unlikely aerial applications would occur in such winds.

We have been concerned by the misunderstanding that has occurred as a result of the Lambert & Rehbein Aeronautical Assessment report. We have sought clarification from Lambert & Rehbein in regard to aerial spraying operations and can confirm that spraying operations are very unlikely to be affected by the wind farm for the following reasons:

1. Spraying operations are normally conducted at low altitude and often require calm or very light wind conditions – agricultural operators have stated that generally they operate in wind conditions up to 15km/h. At wind speeds of 15km/h, the proposed wind turbine generators are either not rotating or rotating minimally and hence the agricultural operations would not be affected.
2. The wind turbines are proposed on elevated undeveloped ground and reasonably removed from the surrounding agricultural land. As spraying and spreading operations are normally conducted within a height of 90m above ground level, the aircraft is well below the level of the wind turbines on the wind farm site (roughly 300m above the surround land).

Further, we would like to clarify some statements made in the Aeronautical Assessment conducted by Lambert & Rehbein:

Report statement 1: Low level flying such as aerial spreading and spraying operations or inspection of power transmission lines will no longer be feasible on the downwind side of the turbines over the properties on which the turbines are sited, or over portions of some adjoining properties that are sited downwind from the turbines. Wind shear, turbulence and downdrafts in the wake of the turbine rotors can present a critical hazard to aircraft such as agricultural aircraft operating at low level and high weights during application of chemicals and seeding.

Clarification: Wind shear, turbulence and downdrafts in the wake of the turbine rotors occur when the turbines are operating, which is at wind speeds above the normal operational parameters of aerial spraying. As previously noted aerial spraying generally occurs in winds up to 15km/h, the operating range of the wind turbines is 15km/h to 95km/h.

Report statement 2: "Instead of operating at the usual height of 90 m, pasture seeding or spreading of fertilisers would have to be performed from a height in excess of the turbine rotor zenith in order to maintain a safe vertical distance from the rotors and their wake. Substances being spread would impact the rotors, possibly causing damage.

Clarification: This relates to aerial spraying on the wind farm site land only, not on areas outside the leased land. As the land leased for the wind farm is not used for agriculture, no spraying is done and would not need to be done. This would not be required in adjoining agricultural properties.

Report statement 3: "Spraying in stronger wind conditions would be rendered impractical by the rotor wake which can contain downdrafts that may exceed the performance of the aircraft, particularly at high operating weights. This hazard, combined with the undulating nature of the terrain on the wind farm site, could make aerial application of chemicals difficult on properties in the vicinity of the wind farm, particularly those within 5 km downwind from the site."

Clarification: These stronger wind conditions are not suitable for aerial spraying. For turbulence to be felt at 5km distant, the wind speed would need to be significantly stronger than wind speeds in which aerial spraying normally occurs. Aerial sprayers in the region have indicated that operations generally only occur in winds conditions up to 15km/h. Given the operating wind speed range for the wind turbines is from 15km/h to 95km/h, there should be little, if any, restriction to aerial spraying downwind of the turbines under normal spraying conditions.

Given the location and topography of the Mount Emerald wind farm and the surrounding area it is expected there will be very little disruption to aerial agricultural activities. The alignment of aerial spraying approaches and run lines can be easily adjusted to avoid passing over the project site. Provided the wind farm area is avoided on approach and exit there should be no restriction to normal operating procedures. Areas to the east and west of the site should use a predominantly north-south alignment and areas to the north an east-west line.

Provided a common sense approach to the alignment of aerial runs is adopted there is no reason operation cannot be continued. We would like to work with the industry to understand and alleviate any concerns.

Impact on Property Values

The most comprehensive Australian study to date on land values and wind farms was undertaken by the NSW Department of Lands in 2009 for the NSW Valuer General. This study investigated 8 wind farms (2 in NSW and 6 in Victoria) across varying land uses using conventional property valuation analysis. **The main finding was that the wind farms do not appear to have negatively affected property values in most cases.** This outcome is consistent with the findings of other international studies.

Economic Benefits

It is expected the proposed wind farm will bring significant economic benefits (direct and indirect) to the local and regional economy throughout the life cycle of the project. The phases can typically be described as development, construction and operation.

The expected overall cost of the project is estimated to be in the order of $500 million. **At a direct level, we will strongly encourage our contractors to, procure goods and services from local suppliers and employ people in the local area wherever possible.** It is anticipated workers and contractors required for the project will include plant operators, truck drivers, mechanics, welders, fencers, electricians, labourers and other individuals typically used in a civil construction context.

At an indirect level, it is expected economic benefit will arise through the provision of short to medium term accommodation, entertainment and goods & services primarily during the construction and operational phases. It is expected this expenditure will occur within the local community as a proportion of wages paid to employees associated with the wind farm. Indirect employment opportunities may also be created as a result of meeting increased demand for these services as well as in the area of tourism.

Environmental Benefits

The development has the potential to supply the annual electricity needs of approximately 75,000 North Queensland homes. This is roughly equates to all of the power needs for the Tablelands Region or 60% of Cairns.

More Information

Please contact: Mt Emerald Wind Farm Project Manager, **Terry Johannesen** on **07 3248 8765** or **terry.johannesen@ratchaustralia.com** with any questions.

The application and the supporting studies are available through the local council or can be viewed on the project website.

www.windfarms.net.au/html/development_portfolio/mount_emerald.php

MOUNT EMERALD WIND FARM DEVELOPMENT NEWSLETTER RELEASED

MEDIA RELEASE
5 October 2011

RATCH Australia has today published a community newsletter relating to the proposed Mt Emerald Wind Farm. This is the third such publication and is part of the company's ongoing commitment to engage and consult with local residents and business.

"The newsletter forms part of our commitment to keep the Tablelands community fully informed of all aspects of the proposed Mt Emerald Wind Farm. This includes listening to residents and taking action to address their concerns," said Terry Johannesen, RATCH Australia's project manager for the Mt Emerald development.

The newsletter summarises RATCH's investigation into issues that have been raised by residents, including:

- **Noise**: the results of audible noise and infrasound assessments show that any wind farm noise will be less than the current requirements at all locations, even under the highest noise emission conditions for the turbines;
- **Views**: high quality visual representations have been prepared by an experienced consultant. Montages are available for ten general locations around the site while a further 130 computer generated simulations have been prepared for more specific viewpoints such as residences and towns;
- **Aerial spraying**: operations are highly unlikely to be affected by any turbulence from the wind farm because spraying typically requires low wind speeds in which the turbines are barely moving and the spraying would be at altitudes significantly below the turbines; and
- **Land values**: while no studies have been conducted in Queensland, a study undertaken by the NSW Department of Lands in 2009 for the NSW Valuer General found that wind farms do not appear to have negatively affected property values in most cases.

RATCH Australia will work within the guidelines agreed with the Tablelands Regional Council, including the Temporary Local Planning Instrument (TLPI) adopted by the Council.

"The Development Application includes a Statement of Commitments that addresses and complies with the conditions outlined in the TLPI," stated Mr Johannesen.

Mr Johannesen also said that RATCH Australia will strongly encourage its contractors to procure goods and services wherever possible from local suppliers and employ people in the local area, thus benefiting the local economy.

Mt Emerald Wind Farm is expected to generate enough clean energy for an estimated 75,000 North Queensland homes.

More information, including all newsletters, can be found at www.windfarms.net.au and following the links to the Mt Emerald project.

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For more information, please contact the Project Manager, Terry Johannesen on (07) 3248 8765.

Mt Emerald Wind Farm
Community Newsletter

Issue 4 – March 2012

Welcome to Issue 4 of the Mt Emerald Wind Farm newsletter.

This newsletter will provide you with an update on the progress for the development of the wind farm and provides factual information in relation to key concerns being raised by some members of the community.

Project Approval

The Tablelands Regional Council (TRC) is soon to commence their assessment of the application for the Mount Emerald Wind Farm. The Council will refer various aspects of this assessment to respective government departments and suitable external consultants to ensure the assessment is completed with the utmost diligence.

Our preliminary development application was first published in August 2011 and since then Council, Government departments and interested members of the community have made a number of requests for further information regarding various aspects of the proposal. These have been valuable in assisting us to develop our studies to address areas of concern for our stakeholders.

Some of the key areas where information has already been updated are:

- **Noise** – a greater number of receptors have been included in the study and corrected distances to these receptors
- **Shadow** – a greater number of receptors have been included in the study and corrected distances to these receptors
- **Aviation** – additional detail has been provided regarding the impacts on aerial agriculture activities
- **Land use** – additional land uses around the site have been identified and noted
- **Economic benefits** – incorporating the latest information available from case studies of other wind farms around the country
- **Ecology** – incorporating the latest information from the continued flora and fauna monitoring activities being undertaken on site. This is an on-going process and is planned to continue throughout the development process

The updated application and all the supporting studies are available through the local council or can be viewed on the project website.

www.windfarms.net.au/html/development_portfolio/mount_emerald.php

Community Benefit Fund

In response to a variety of requests from members of the local community, we are pleased to provide further information on the proposed Community Benefit Fund.

While Mt Emerald Wind Farm has the capacity to provide many opportunities for the local community through employment, tourism and use of local businesses, RAC and Port Bajool, as the owners of the Mt Emerald wind farm development, also intend to establish a community fund to provide further benefits from the wind farm to the wider local community.

Purpose: The proposed Community Benefit Fund (the Fund) is intended to fund projects or initiatives that will benefit the local community.

Governance: It is proposed for the Fund to be managed through a special purpose Community Trust. The Trust would be managed by a committee comprising a range of community representatives. The committee would have full control over administration of the Fund.

The committee would be free to use the Fund in whatever manner it feels is appropriate, subject to a basic premise that it will be used to benefit the local community.

Funding Amount: The Fund would provide approximately $200,000 per year to the local community.

Timing: The Fund would begin once the wind farm commences operation.

The Community Trust would be responsible for determining suitable uses for the funds, but these could extend to projects such as:

- Sponsorship of local sporting or social clubs;
- Sponsorship of local festivals or fetes;
- Grants for sporting, musical or educational equipment for locals schools and colleges;
- Grants for equipment for local emergency services organisations;
- Funding for scholarships for local children to attend school, college or university;
- Grants to support local apprenticeships or traineeships;
- Provision of community education such as first aid courses, sustainable farming techniques or other appropriate subjects; and
- Grants for appropriate community projects.

More Information

Please contact: Mt Emerald Wind Farm Project Manager, **Terry Johannesen** on **07 3248 8765** or **terry.johannesen@ratchaustralia.com** with any questions. A range of information, previous newsletters, studies and reports relating to the Mount Emerald Wind Farm are available through the project website.

www.windfarms.net.au/html/development_portfolio/mount_emerald.php

Mt Emerald Wind Farm

COMMUNITY INFORMATION DAY

Wednesday 19 September 2012

2 - 7pm

Mareeba Heritage Museum and Information Centre
345 Byrnes St, Mareeba

Learn about the benefits for the community

- jobs and increased regional income
- Community Benefits Fund
- national, regional and local opportunities

Talk to the experts

- noise and aviation
- visual impacts and shadows
- ecology - flora and fauna
- land values
- engineers and operating regime
- project owners: RATCH and Port Bajool

See what it will look like

- from key viewpoints
- from your house

Sausage sizzle provided!

What will be built?

- between 70 and 80 turbines (depending on siting studies)
- steel tubular towers approx 80-90m high, with 3 blades approx 50m long
- the turbines will generate up to 225MW of power from 3MW machines
- to provide electricity to approx 75,000 homes per year
- best practice wind farm construction techniques and guidelines will be applied – include meeting noise standards and achieving industry acceptable setbacks from neighbouring residences

Why here?

Wind farms require:

- a constant source of wind – the Arriga site has one of the highest proven wind resources in Australia - identified, mapped and monitored to confirm
- proximity to the grid – the North-South 275kVa (Chalumbin-Woree) transmission line runs through the 7,000 acre property
- an area that will require minimal clearing and have minimal impact on surrounding activities - the Arriga site is a 300m high plateau of mostly sparse natural scrub land, currently not used for a specific purpose. Below the surrounding plains are predominantly used for grazing, agriculture and other industrial purposes like the sugar mill and waste disposal facility
- Onground, the imprint of the turbines and access tracks will only be approx 30 acres of the 7,000 acre property

STOP PRESS

Book your Mt Emerald Wind Farm site tour at the information day.
Booked 4WD tours will visit the Test Tower and view the site from 8am-4.30pm on Saturday 29 September. Seats limited.

An equal partnership between
RATCH Australia Corporation (RAC) and Port Bajool Pty Ltd

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Mt Emerald Wind Farm

OUR COMMITMENT TO THE COMMUNITY . . .

At the recent Mt Emerald Wind Farm Information Day and at the meeting of Tablelands Regional Council we undertook to respond within two weeks to questions. In all, we received questions covering five broad issue areas.

The first responses are already being sent direct to those who asked questions but many responses require a high degree of technical detail if they are to meet the expectations of the enquirer. Please bear with us as we generate this information. Over the next several weeks, broader information will appear in summary form in this newspaper on an 'issue by issue' basis. All responses will be accessible in due course on the new Mt Emerald Wind Farm website.

Our first responses to the five main areas of interest and concern are:

Potential impacts on agricultural activities (especially aerial spraying)

Response: We have already undertaken significant research on this subject, however RATCH Australia is commissioning an additional study into aerial spraying to ensure that all issues of local concern are addressed comprehensively.

Noise

Response: An extensive study on noise has been completed that indicates compliance with all regulatory standards. In addition, RATCH Australia will address in more detail questions received concerning noise mitigation, mapping and monitoring. Individual questioners will also be sent direct responses. In the meantime, some generic noise information is provided in this update report and the accompanying noise table might further help understanding.

Flora and fauna/ecological impacts

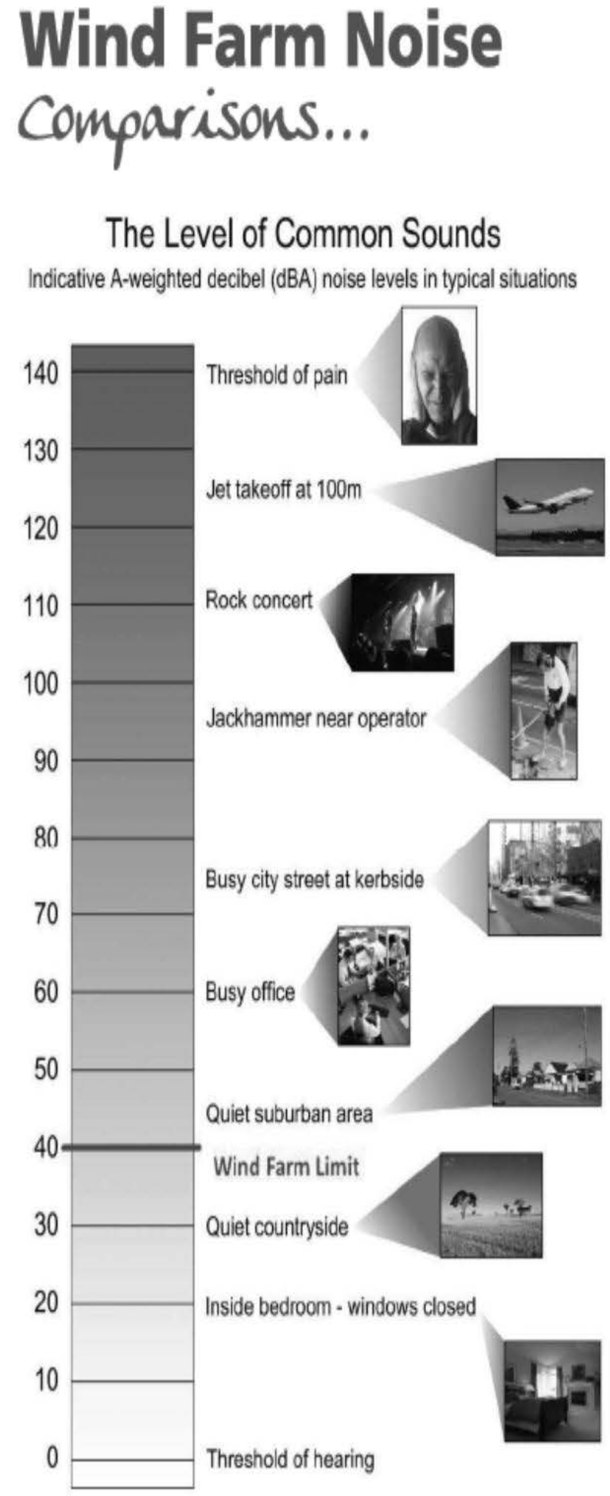
Response: Comprehensive studies have been completed over an 18 month period. RATCH Australia is preparing a detailed Environmental Impact Statement. The EIS is required to address all issues relating to animal and plant life on the site as well as landscape impacts resulting from the turbine construction process (and any necessary remediation).

Property Values

Response: A number of global and Australian studies have been undertaken that indicated property values are not affected by wind farm developments, however RATCH Australia has commissioned a more extensive report on the price impacts on properties in the vicinity of wind farms elsewhere in Australia. This will be completed in the near term and made publicly available.

Turbine lights

Response: RATCH Australia will ensure that turbine illumination is kept to the minimum allowed by CASA and other relevant authorities. Some confusion existed around the need for lights on the existing monitoring towers; however this has now been addressed and lights will be installed soon.



Following the tour of the Mt Emerald Wind Farm site conducted on September 29th, RATCH Australia is planning a hosted tour of the Windy Hill Wind Farm. Details to come.

Wind Farm Noise

As indicated above, some very specific Mt Emerald questions were asked and the information to address these adequately is being assembled. In the meantime, readers may be interested in this general information relating to wind turbine noise. Wind turbines do produce sound - the main sound being the 'swoosh' of turning blades.

Sound output is measurable, can be modelled, and is regulated by strict guidelines to protect residential amenity. The make and model of the turbines, their location and the number of turbines will all be taken into account to ensure the guidelines are complied with.

Actual data collected at sites surrounding the wind farm show existing background noise to be 27-32dBA for low wind speeds and 30-35dBA at wind speeds where the wind farm would be operating at maximum output. (See graphic). **What this shows is that for the majority of locations the existing background level is often louder than the turbines**.

Investigations show few receptors (representing residences or groups of residences) around the wind farm will experience noise levels above background levels. In each of these cases the amount above background is within the allowable limits so as not to cause undue impact.

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RATCH Australia Corporation (RAC) and Port Bajool Pty Ltd

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Mt Emerald Wind Farm

OUR COMMITMENT TO THE COMMUNITY . . .

This is our second Update Report in response to the Information Day on 19 September 2012.

Many people have asked, "Why here? Why not somewhere more remote?"

Every wind farm needs two critical elements to be successful: a plentiful and reliable wind resource and proximity to a high voltage transmission line. Mt Emerald meets both these conditions and, if built, will make a significant difference to the regional power supply picture. At present, most of the region's power comes from Central Queensland. Transmitting electricity over these distances is inefficient and carries power outage risks at various times. Locally generated, clean energy will give the region greater energy security and help manage future electricity costs.

The elevated Mt Emerald site can't be used for much else and certainly not for agriculture. Although the wind farm itself would cover a large area, the turbines, connecting roads and buildings would take up only about 50 hectares on the 2,400 hectare site. Once established, the site's flora and fauna – including weeds and fire control - would be better managed and, in due course, it's hoped to establish walking tracks, mountain bike trails and a visitor interpretive centre.

We believe that Mt Emerald Wind Farm will contribute positively to the region's energy equation, create jobs and diversify the economy.

Here now are the answers to the next tranche of questions under the heading of Noise and Planning.

In 2000, Mt Emerald Wind Farm partner, Port Bajool, purchased some 13,000 acres of land known as 'Oaky Creek Farms' which adjoins the proposed Mt Emerald Wind Farm site. Port Bajool is proud of the development and welcomes interested visitors.

What kind of turbine?

It's too soon to say. We will not simply install generic turbines; different turbines will be carefully assessed and final selection will be based of all-round performance, noise generation and price. At Council's request, we are updating the existing noise report and this will analyse the impact of a number of different turbines. To be precise about turbine selection and positioning at an early stage is difficult, given the unknowns attached to the planning conditions from Council.

Mitigating Noise – what options are there?

The objective is not to exceed noise level goals. When this is achieved, no mitigation will be necessary. Will turbine noise be heard inside homes? It may be at times, but ultimately the extent of noise allowable within a home from external sources is governed by limits set by Queensland's Environmental Protection Policy. We will adhere to those limits. Can we guarantee that noise will not exceed permitted levels? We must comply with the permit conditions imposed by Council. If we don't, turbines may have to be modified or, in some rare circumstances, shut down for a period.

How accurate are the noise predictions?

Ultimately, the noise predictions can only be validated after the wind farm has been built. If compliance testing shows that the wind farm is not meeting its obligations, the way it operates must be changed until it does comply. This is not negotiable. The suggestion in one question that noise will be double what was predicted is not supportable.

Windy Hill characteristics – how do they relate to Mt Emerald Proposal?

You cannot compare one wind farm with another. Because of topography, turbine location, the model of turbine, the length of blades, prevailing wind direction and speed, each wind farm has individual noise characteristics and these are identified through detailed monitoring.

Infrasound/low frequency sound concern

The Queensland Government has strict requirements in respect of this issue. The Noise Report includes an assessment of infrasound/low frequency sound in accordance with these requirements.

Distance between turbines

The current proposed layout is based on turbines with blades around 50m in length. The distance between turbines is based on this dimension with a minimum separation of some 300m.

See an operating wind turbine!

*To see an operating wind turbine at close quarters, the community is invited to drop into Windy Hill Wind Farm car park (Ravenshoe) on **Saturday 13 October**, on their way to the Torimba Festival. RATCH's community engagement staff will conduct escorted walks under a nearby turbine at **10am** and **11am** and be available from **8.30am until 12.30pm** to record any requests for further information.*

Inconsistencies in the Planning Report

The initial Report is confusing when it addresses the number of residences within 5km of the nearest turbine. We will modify the Report to refer to the locations of receptors. A receptor is defined as a location used to represent a single residence or a number of residences closely grouped that can reasonably be expected to experience similar conditions. The modification will also accurately reflect the number of residences.

Effect on Lotus Glen Correctional Centre and Farm

The wind farm is obliged to meet the same noise criteria at the prison as for any other residence.

RATCH-Australia Corporation

PORT BAJOOL

An equal partnership between

RATCH Australia Corporation (RAC) and Port Bajool Pty Ltd

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Mt Emerald Wind Farm

OUR COMMITMENT TO THE COMMUNITY . . .

This is our third Update Report in response to the Information Day on 19 September 2012. In all, 64 questions were asked. We will not spare any effort to address legitimate concerns and we will always engage in a dialogue with the local region – both now and, if built, once the turbines are in operation. We want to be welcomed in the Tablelands region and become regarded as a corporate friend intent on investing in the region for 25 years or longer.

Here now are our answers to a third tranche of questions relating to matters that touch on flora, fauna, ecological and landscape issues. In the meantime, of course, we are also communicating directly with a number of local residents.

Birds and wind turbines
In the natural world, birds must navigate many obstacles, from trees to buildings. Global studies have shown that building strikes cause many more bird deaths than do wind turbines. In addition to work already done, a further detailed investigation is being undertaken as part of a required Environmental Impact Statement (EIS), to be finalised next year. Ultimately, the measures proposed to minimise harm to birds will be assessed by the federal environment department. In general, deaths from birds flying into wind turbines represent only a tiny fraction of those caused by flying into vehicles and buildings or predation by cats.

Quolls – how will the turbines affect them?
Again, this issue must be addressed as part of the EIS and our proposed approach must be assessed by the federal environment department. Our expert advice at this point is that the principal ongoing threats to quoll populations are introduced pest species, including cane toads, feral cats, dogs and pigs; the threat of fire; weeds; and land clearing. It is important to remember that the footprint of the turbines is very small in the overall landscape – only 50ha of a total 2500ha.

Continuing detailed investigation is being undertaken as part of a required EIS, to be finalised in the coming months. Recommended management measures may include weed control, appropriate fire regimes, predator control, and site construction timing and rehabilitation measures. We firmly believe the wind farm, through the implementation of these appropriate management strategies during the construction and operation phase, has the ability to coexist with the existing quoll population.

Changing the landscape
There were several questions about blasting and grading, and the potential for this to affect the landscape and/or the ecosystem on top of the plateau. Any blasting and grading construction work will be conducted according to Council-imposed conditions and be limited in time and duration. The public will be informed of both timing and what to expect.

In summary, the area of disturbance created by blasting and grading will be kept to a minimum, and there will be a comprehensive revegetation plan developed to restore areas disturbed by the construction process.

Roads to, and on the site, will be designed by a qualified expert to address the transport requirements of the turbine manufacturers, with the objective of achieving minimal disturbance of the landscape. The potential impacts on the plateau's ecosystem must also be addressed in detail in the EIS.

Turbine site size
There was some concern expressed that, during assembly the turbine blades, would extend for 100 metres when resting on the ground and that the 40 x 40 metre base would have to be enlarged. This is not an issue as each blade can be connected individually to the rotor.

RATCH-Australia Corporation

PORT BAJOOL creating communities on the tropical tablelands

An equal partnership between
RATCH Australia Corporation (RAC) and Port Bajool Pty Ltd

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Mt Emerald Wind Farm

OUR COMMITMENT TO THE COMMUNITY . . .

This is our fourth public response to questions asked at the Mareeba Community Information Day. In all, 64 questions were asked – many, although differently phrased – were seeking similar information. To date, we have responded on aerial spraying and land values (Week 1); noise and planning issues (Week 2) and fauna, flora and landscape impacts (Week 3). This week our responses will address wind energy economics, including decommissioning costs, power prices and employment issues.

Are wind farms viable without subsidies?

It is important to understand there are no direct government grants or subsidies available for the Mount Emerald wind farm or any wind farm project.

The only assistance available comes in the form of the Renewable Energy Target which is available to all forms of renewable energy generation such as wind, hydro, biomass or solar. Under this target, which has been agreed to by all major political parties, 20% of electricity generation in Australia would come from renewable sources by 2020 and requires electricity retailers to purchase a certain number of Renewable Energy Certificates (RECs) from renewable generation each year.

At present coal sourced generation is the cheapest form of energy in this country, with gas fired slightly more expensive while wind powered generation is roughly twice this cost. However, these prices do not include the cost of pollution and wind power is the only pollution-free option of the three. The intent of the RECs is to provide a mechanism where this cost of pollution is taken into account and to provide a level playing field.

Does wind power impose higher prices on consumers?

Contrary to some recent claims, wind and other large-scale renewable energy sources contribute only a tiny amount to the average power bill – just two per cent. In recent years, power price rises have been mainly driven by increased power grid costs and increasing demand. The cost of power grid upgrades and maintenance are the biggest single driver of power price hikes. Remember too that, over time, polluting technologies will become more expensive and clean technologies will become cheaper.

Wind power electricity cannot be stored.

That's true but wind power is never wasted as it is fed directly into the grid. As an intermittent generator, wind farms form part of a broad mix of energy supply technologies and are not designed to be a sole energy supplier. The power grid is a dynamic system designed to ramp up and down to respond to changing power usage and is sufficiently robust to overcome even the loss of input from the biggest generator to an unexpected fault. Locally produced wind power will enhance the reliability of the region's electricity supply.

Decommissioning

At the completion of the project life, expected to be at least 25 years, options are:

- Consider whether to continue generating from the existing turbines
- Upgrade the turbines
- Decommission the site and remove infrastructure at the developers' cost

This will be determined at that time depending on the condition of turbines and the business case for each option.

New jobs at the wind farm will not compensate for the loss of agricultural jobs: This assumes that there will be jobs lost in the agricultural sector.
We don't believe that will be the case and it is certainly our intention to operate the farm in a way that ensures there are no agricultural jobs lost. Positively, wind turbine construction will create up to 250 jobs while the operating farm will create 15 permanent jobs.

RAC RATCH Australia Corporation
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RATCH Australia Corporation (RAC)
and Port Bajool Pty Ltd

For more information:
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Mt Emerald Wind Farm

OUR COMMITMENT TO THE COMMUNITY . . .

This is the fifth in our series of advertisements summarising responses to the 64 questions asked at the recent Community Information Day on 19 September 2012. This week our focus is on a range of questions – many of them similar in nature – about the proposed wind farm's visual impact, including lighting issues and community opinion.

In reality, how visible will some of the farm's turbines be?

The inescapable reality is that wind turbines, because of their size, are visible. Wind farms must go a) where there is dependable wind, both in strength and direction; and b) where there is a nearby high voltage transmission line. Mt Emerald meets both these non-negotiable requirements.

A general response on the wind farm's visibility is impossible as it is dependent on the observer's location. How a person interprets this view is also difficult, as the perception of their appearance is entirely subjective and what is 'visually intrusive' for one observer, may be acceptable or even majestic to another. Experienced visual consultants have produced images of what a person will see from a range of different vantage points around the wind farm, to allow people to understand what their view may be.

If you would like to see what the wind farm would look like from a location relevant to you please contact the wind farm developers who can arrange for these to be provided.

Specifically, will there be turbines atop Walsh's Bluff and will turbines be visible from the Kennedy Highway?

There will be no turbine located on top of what is generally accepted to be Walsh's Bluff, however we are aware that some people see Walsh's Bluff as a much larger area. So, the answer is; it depends on what area you consider to be the Bluff. For clarity, the distance between the nearest turbine and the peak of Walsh's Bluff is 200m.

Yes, turbines would be visible from the Kennedy Highway – how many will vary as you move along the highway.

Lighting on the towers

At present, it is our understanding there is no specific requirement for lights to be installed on the wind turbines. However, we must be guided by the authorities in respect of this issue, principally those associated with aviation. The safety of aircraft is paramount. If we are required to put obstacle lighting on a number of towers, we will do so and in accordance with the regulations. Please note, these regulations do allow for the lighting to be shielded to an angle of one degree below the horizontal, thus screening neighbours from any lighting impact out to a distance of about 20kms. It's reasonable to suggest that, beyond 20kms, the nuisance from lights will be minimal to non-existent.

Community Support

It has been suggested that most people in the region know little or nothing about the Mt Emerald Wind Farm project and therefore, we could not possibly argue there was community support. Our poll was conducted by AUSPOLL, who are a respected and reputable organisation and conduct a variety of polls for both private and government organisations. In response to the question: "are you aware of the proposed Mt Emerald Wind Farm?" 82% of respondents answered **YES**. As to the issue of support, 31% strongly supported, 45% supported, 11% neither supported nor opposed and 5% strongly opposed. More generally in the nation, the CSIRO has found there is strong community support for the development of wind farms; which increases over time, post construction, as people realise that their initial 'fear of the unknown' was unfounded.

RAC RATCH-Australia Corporation

PORT BAJOOL creating communities on the tropical tablelands

An equal partnership between
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APPENDIX C – COMMUNITY SURVEY

AUSPOLL

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Community Engagement Research for the Mount Emerald Wind Farm Site

REPORT PREPARED FOR:

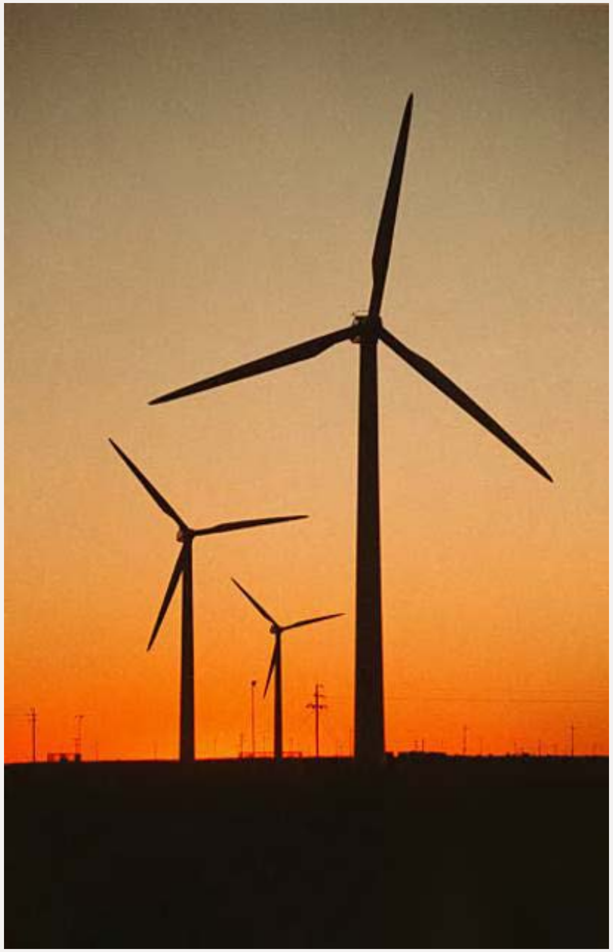
Joe Hallenstein/ Terry Johannesen

Projects & Engineering, Development Group

RATCH-Australia Corporation

March 2012

Contents



Introduction

Background, Objectives and Methodology

Background

RATCH-Australia

- RATCH-Australia is an Australian–run company that is a committed developer and owner of long-term power assets in Australia and New Zealand.
- They invest in and develop both greenfield and brownfield projects and are determined to be a positive contributor to the communities in which they work.

Mount Emerald Project

- RATCH-Australia are currently assessing the potential to develop a wind farm in the Atherton Tablelands in Queensland between the towns of Atherton and Mareeba.
- The farm would contain 70-80 turbines that could produce enough power per year for 75,000 homes.
- It would also provide investment of approx $500m to the area bringing jobs and economic benefits to the area.
- The project is currently in the community and stakeholder consultation stage of development.
- As part of this stage RATCH-Australia wish to understand more clearly the views of the local community about the potential support and opposition to the proposed development.

- This report covers the results and analysis of a community engagement survey carried out to meet these aims.

Research Purpose and Objectives

Research Purpose

- The purpose of the research is to understand and measure community attitudes to the proposed development of the Mount Emerald Wind Farm Site.
- This evidence base will form part of the development application for the project, will provide a baseline measure of project KPI's and will uncover potential issues or concerns that may need to be managed.

Research Objectives

The specific objectives of this research were to understand:

- Awareness and support of the Mount Emerald farm project;
- Attitudes to wind farms and alternative energy in general and to the local project;
- Community sentiment on the impacts of the project on a range of local factors;
- Expectation regarding community engagement; and
- Preferred information channels for the project.

Methodology

Survey method

- The results presented herein are based upon a Computer Assisted Telephone Interviewing (CATI) survey conducted between 27th February and the 1st March 2012.

Sample

- The sample consisted of n=400 residents randomly drawn from a radius of approx. 20km around the Mount Emerald Wind Farm location. This included the towns of Mareeba, Atherton, Tolga, Walkamin, and Dimbulah.
- The sample was weighted to be representative of the local population by age and gender using latest data from the Australian Bureau of Statistics.

Accuracy

- With a sample size of n=400, the accuracy of the results overall is +/- 5% at the 95% confidence interval. This means, for example, that if the survey returns a result of 50%, there is 95% probability that the actual result will be between 45% and 55%.
- The margin error for sub-groups is larger than for the overall results. As a guide, the margin of error for various sub-group sizes within this study are listed below:

Sub-group size	Standard error
300	±5.8%
200	±7.1%
100	±10.0%
50	±14.1%

- Note: All percentage figures in this report are rounded. Accordingly, totals may not add up to 100%.

Key findings and strategic considerations

Key findings – Awareness and Support of the Project

Overall, there is both high awareness and strong support for the Mount Emerald Wind Farm development.

- Over 80% of respondents are aware of the proposed development.
- Around three quarters of respondents (76%) support the project, with only 13% opposed to it.

There is a strong recognition of the environmental benefits of wind farms in general and this is the main reason people support the development.

- Around 90% of respondents agree that wind farms are a good option for Australia's energy needs and a good option for the environment.
- 56% of supporters say they support the Mount Emerald project because it is environmentally friendly.
- In contrast only 10% of supporters identify the local jobs and benefits it could bring to the community as a reason for their support.

There is also considerable synergy between the importance of various local factors and the positive impact that the wind farm will have on these factors.

- The local economy and local employment opportunities are the factors that are considered most important by respondents and they are also the factors that are most likely to be seen as being positively impacted on by the wind farm.

Being an eyesore and being too close to homes are the main unprompted reasons for opposition.

- 32% of opponents say it will be an eyesore or unattractive
- 29% off opponents say it is too close to residences
- 23% of opponents mention noise levels as a reason for their opposition.

Key findings – Impacts on local landscape, information provision, and attitudes to project management

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The vast majority of respondents believe that the wind farm will not have a negative impact on their favourite aspect of the local landscape or on the most important local historical or culturally significant sites.

- Less than 30% of respondents think the wind farm will have a negative impact on their favourite aspect of the local landscape.
- Most respondents are not aware of any local historical or culturally significant sites, but of those that are, less than 30% think the wind farm will have a negative impact on these sites.

People generally don't know very much about the project but most would like to know more.

- 79% of respondents say they only know a little about the wind farm, while 61% say that they would like to know more.
- People would like information about a whole range of issues, from basic location and size details to information on who benefits, impacts on wildlife, and employment opportunities.
- Three quarters of respondents identify local newspapers as their preferred information channel for the project.

The project is also seen as being managed in a responsible way that takes care of the environment and needs of local community.

- 58% of people agree that the project is taking care to consider the needs of the local community while only 12% disagree.
- Similarly, 56% of people agree that the project is taking care to protect the environment while only 7% disagree.

Strategic considerations for further increasing support and minimising opposition to the project

- **There is a strong potential to increase support for the wind farm project by promoting the local benefits that it will bring through wide information channels**
  - Local factors such as the local economy, jobs, tourism, and the reputation of the area are most important to people and are also seen as being positively impacted upon by the wind farm.
  - However, supporters of the project typically mention broad factors, such as the benefits of wind energy, rather than these local factors, as reasons for their support of the project.
  - As such communications promoting the project should reinforce the importance of these local benefits rather than the broad benefits of wind energy, which are already well understood by most.

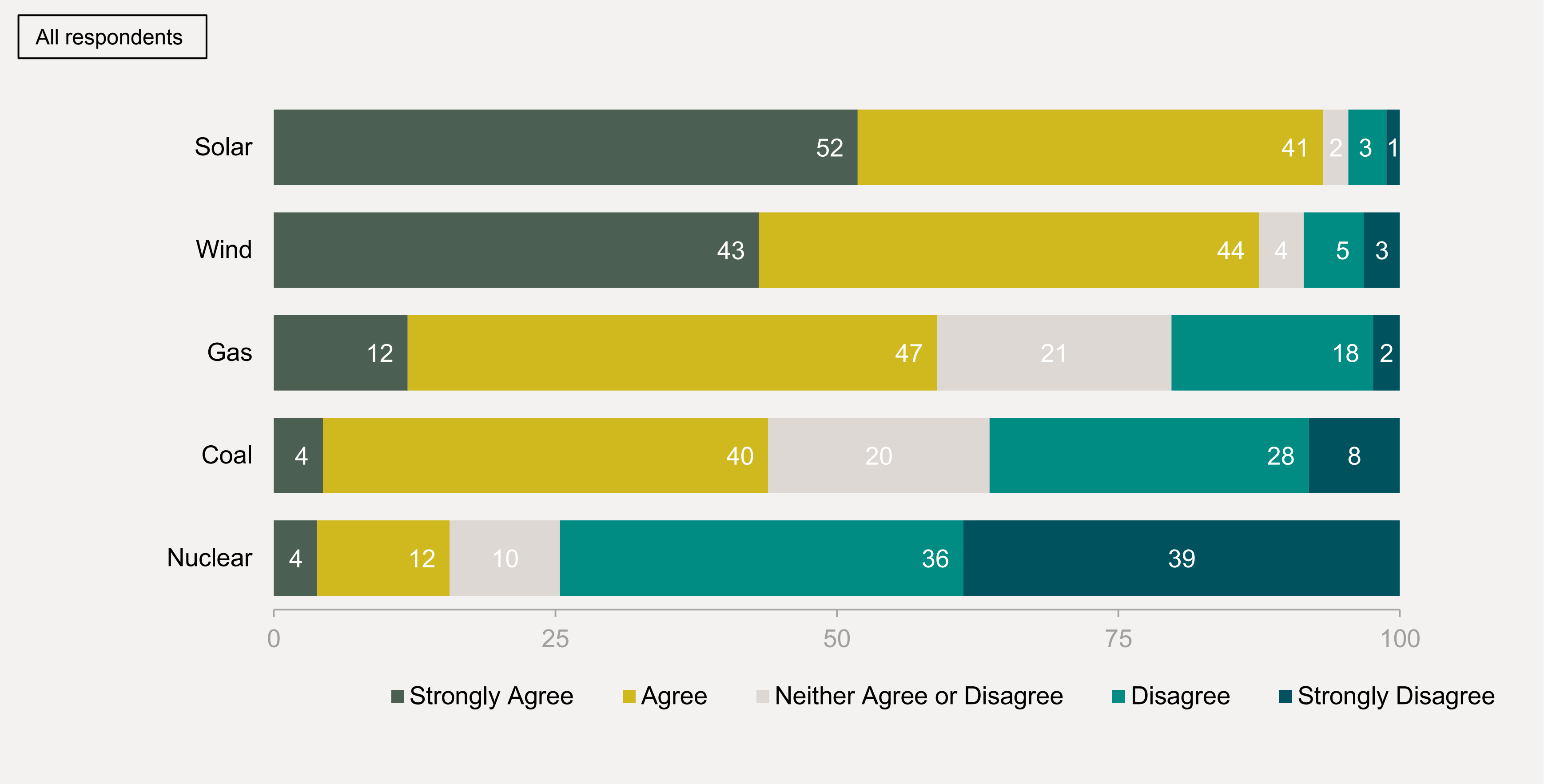
- **The project should engage broadly on the impact that the project will have on the appearance of landscape, the local wildlife and the local farming industry**
  - These factors are considered most important in relation to the project and are also seen as being negatively impacted upon amongst opposers of the project. As such they should be addressed by countering misconceptions or taking direct action to minimise impacts on these factors.
  - Consideration could also be given to weaving the local farm industry into a narrative around the benefits that the project will bring to the local economy.

- **Very local issues including operating noise levels, construction disruption, and impacts on property values, could be addressed through targeted engagement of people living nearby to the site**
  - These factors are more important, and more likely to be seen as being negatively impacted upon, by those living closest to the project site and those who are already opposed to the project.
  - The broader community is less likely to see them as being important and as a result it may be more appropriate to address these factors through more targeted engagement of people living nearby to the site.

Detailed findings

Attitudes to alternative energy

There is strong support for the development of wind energy to meet Australia's energy needs

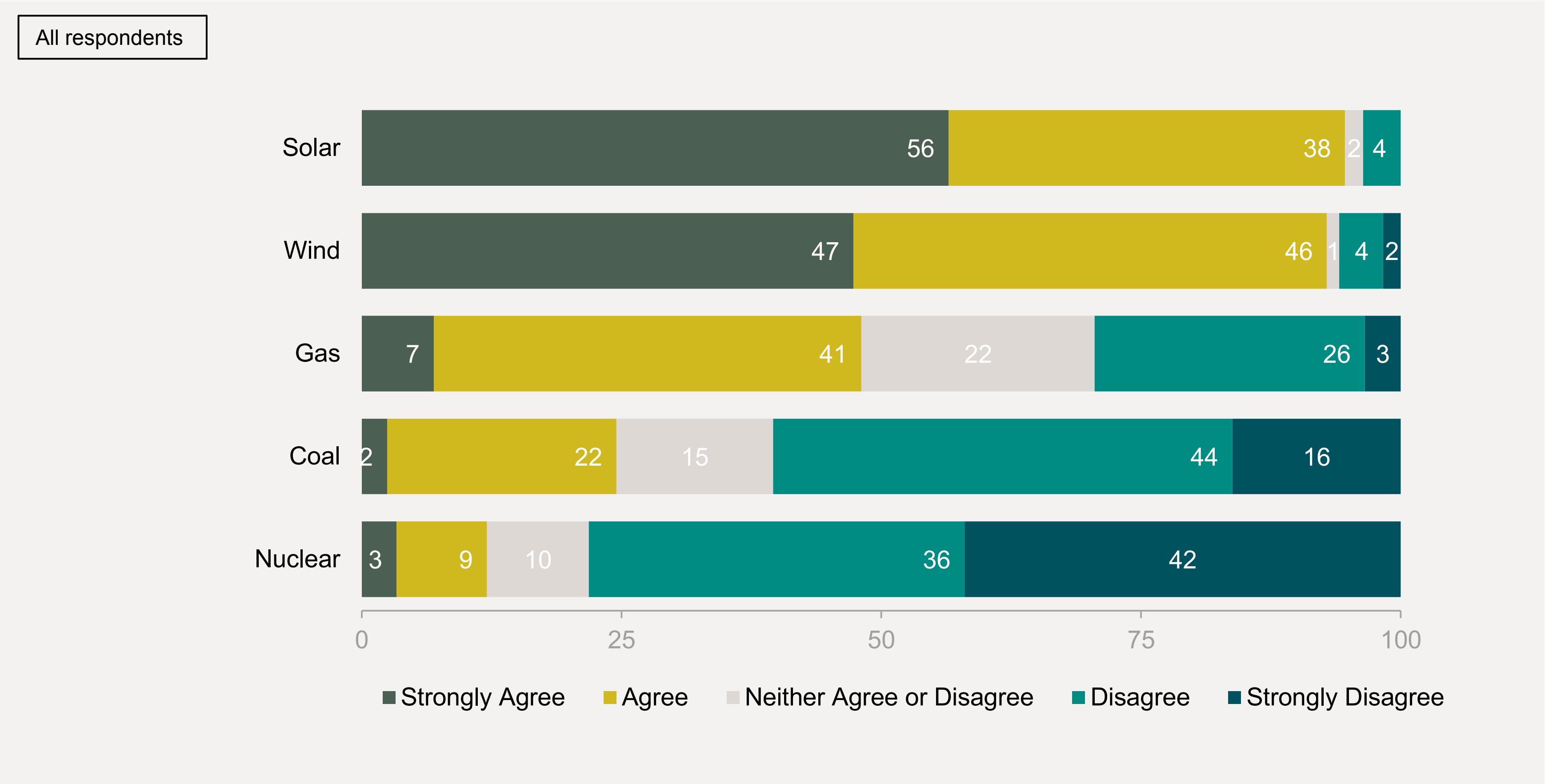


Nearly 90% of respondents agree that wind energy should be developed to meet Australia's energy needs. Only solar power garnered more support.

By comparison only 16% support Nuclear power.

Q. Do you agree or disagree that the following energy sources should be developed to meet Australia's energy needs?

Virtually all respondents also agree that wind energy is a good option for the environment



93% of respondents agree that wind power is a good option for the environment, only solar energy had more support.

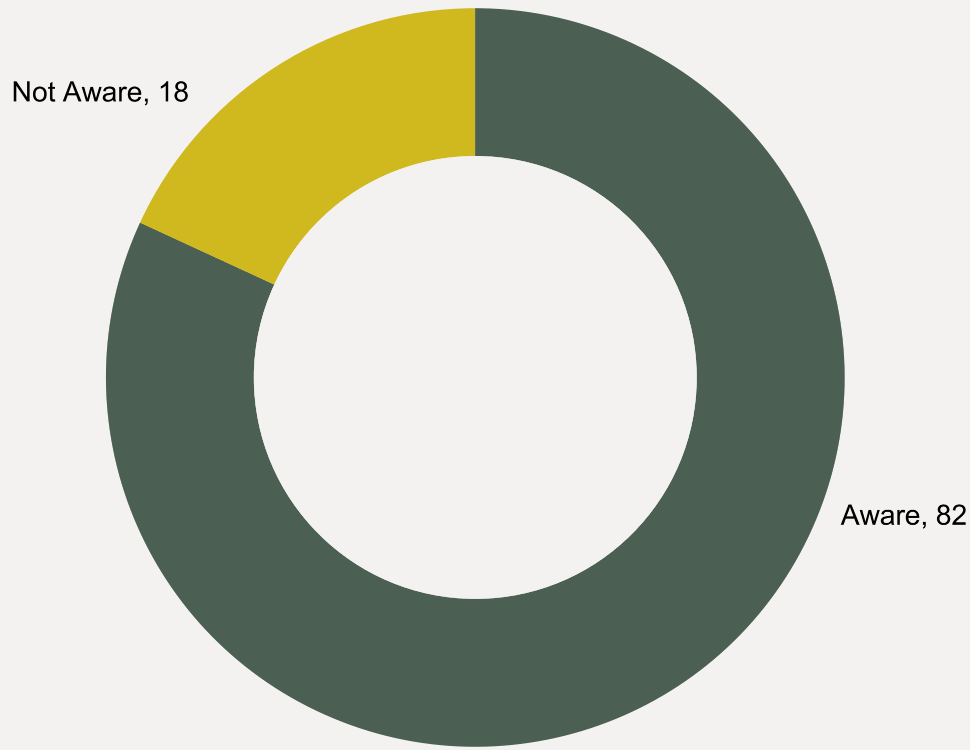
By comparison only 12% feel Nuclear energy is a good option for the environment, and 24% for coal.

Q: Do you agree or disagree that the following energy sources are a good option for the environment?

Overall awareness and support for the Mount Emerald wind farm

Over 80% of local residents are currently aware of the Mount Emerald Wind Farm Project

All respondents

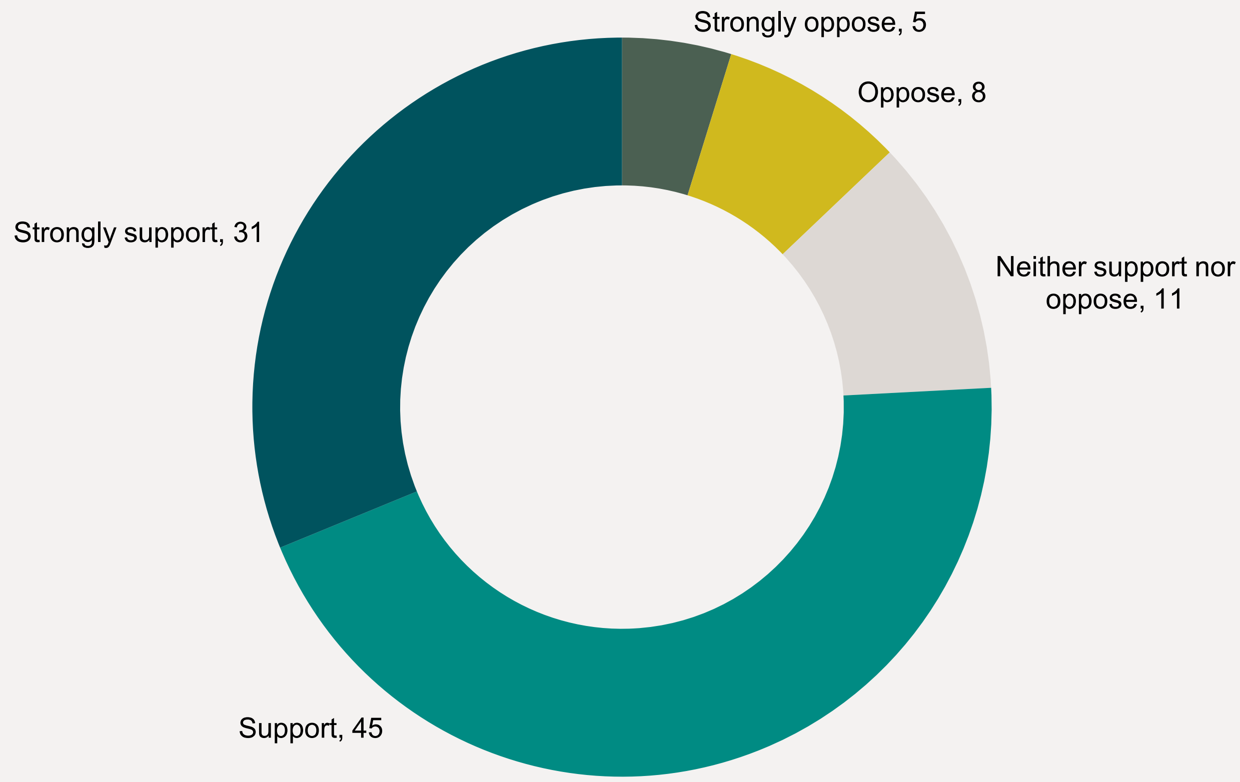


There is lower awareness amongst younger groups with only two thirds of people aged 18-29 aware of the project.

Q. Are you aware of the proposed Mount Emerald Wind Farm?

Over three quarters of the local population currently support the Mount Emerald Project

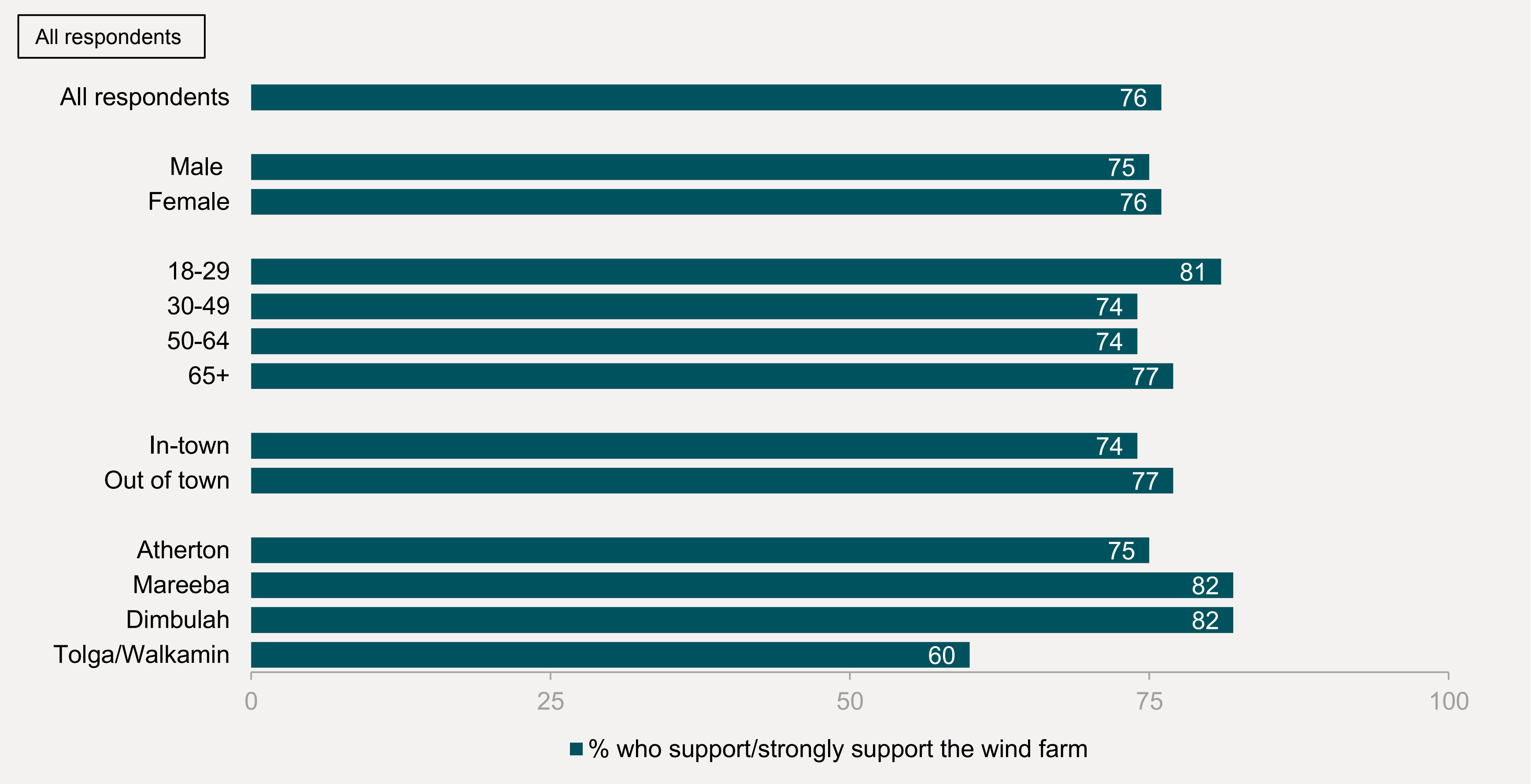
All respondents



Only 13% of residents oppose or strongly oppose the development.

Q. Do you support or oppose the Mount Emerald wind farm development?

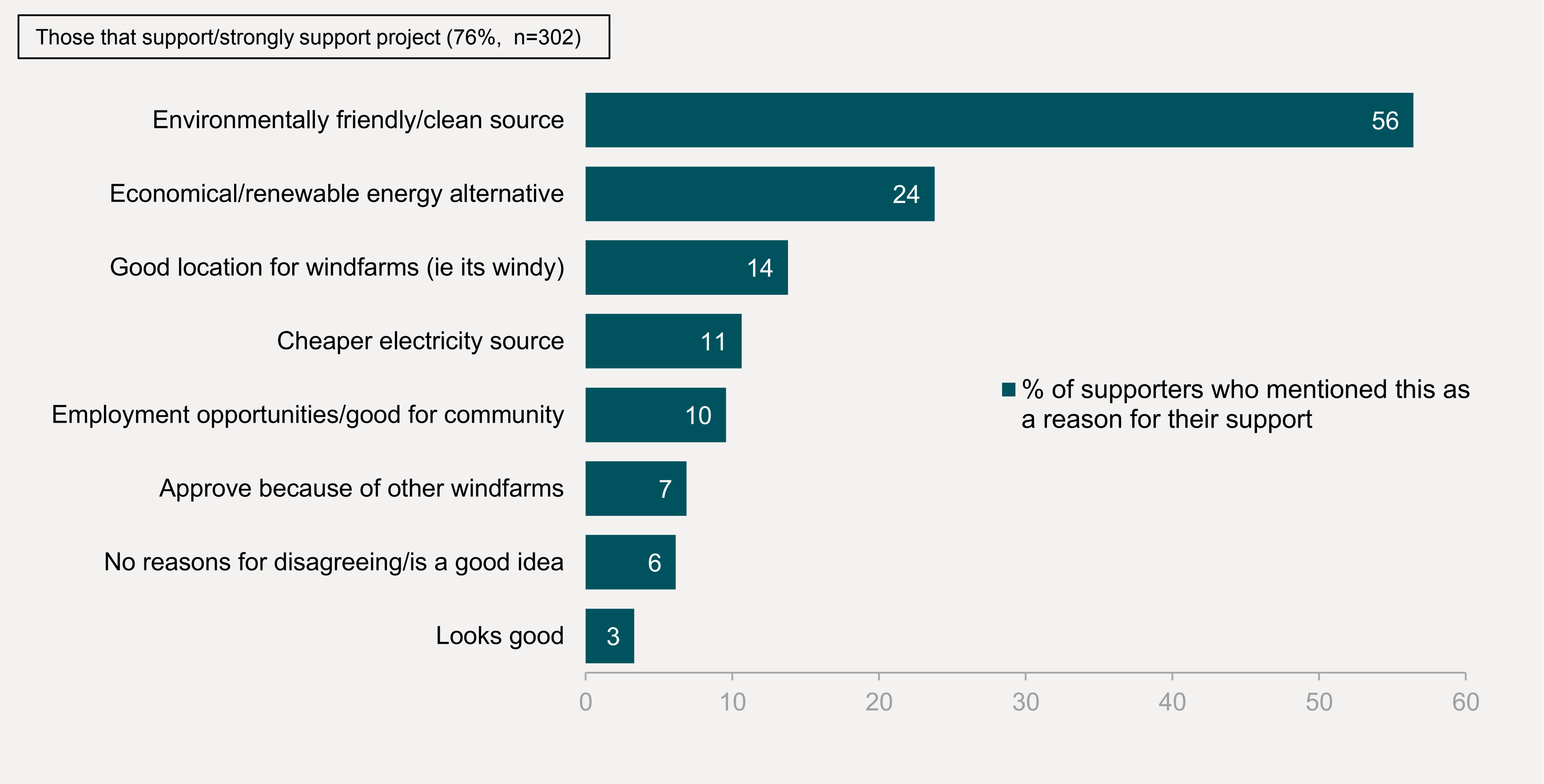
There is strong support for the project across all segments of the local population.



Only those living closest to the wind farm in the towns of Tolga and Walkamin show lower levels of support although support here is still at 60%.

Q. Do you support or oppose the Mount Emerald wind farm development?

The environmental benefits of clean energy is the main reason why people support the project



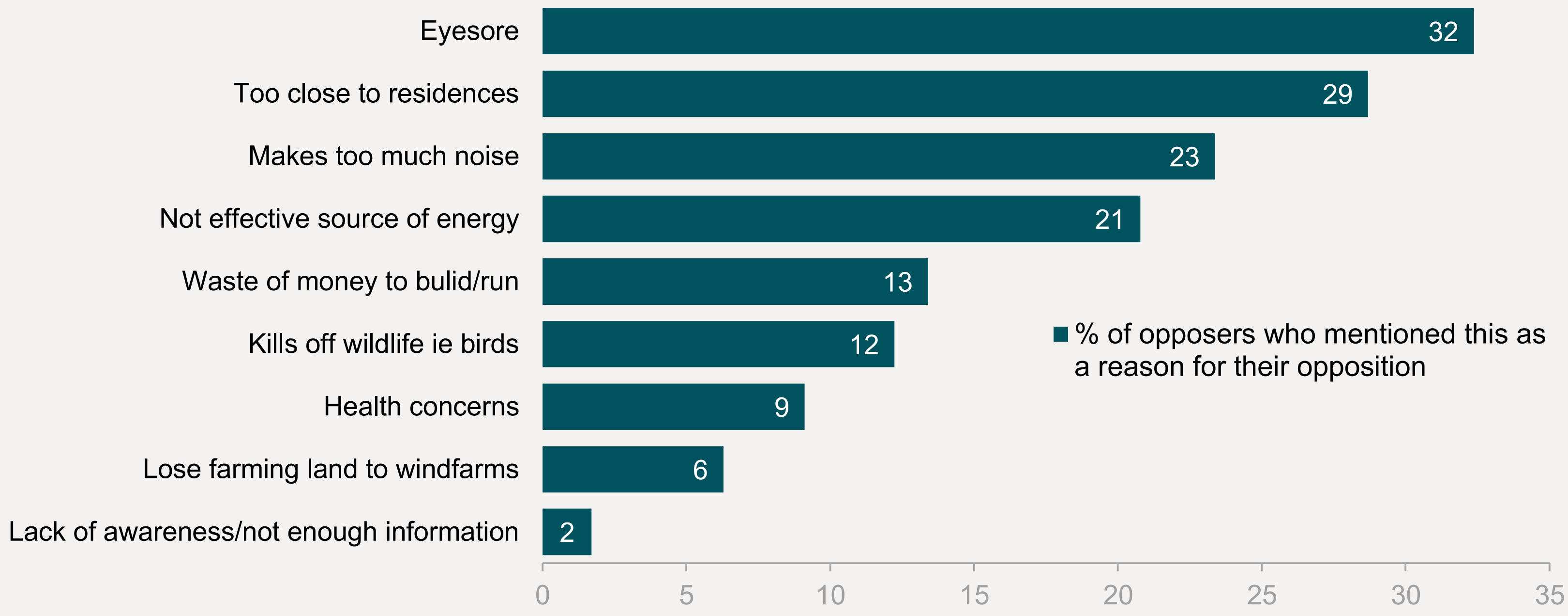
56% of supporters identify that the project is environmentally friendly as the main reason for support. Almost a quarter mention it as an economical/renewable alternative.

Only 10% say because it will provide employment opportunities and be good for the community.

Q. Why do you support the Mount Emerald Wind Farm? Could provide more than one answer.

Being an eyesore and the proximity to homes are the biggest reason why people oppose the project

Those that oppose/strongly oppose project (13%, n=51)

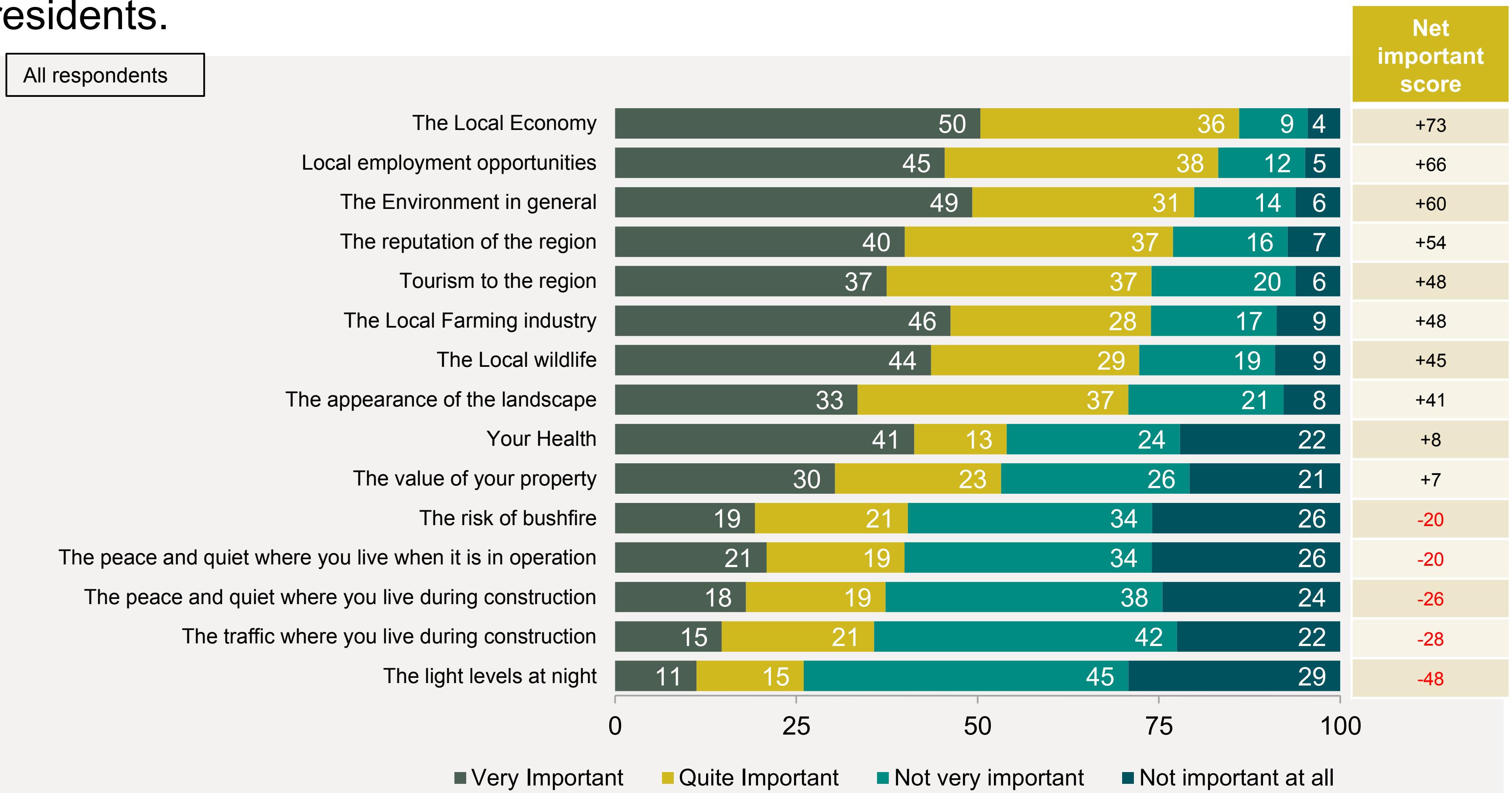


32% of those that oppose the project say it will be an eyesore

Almost 30% mention the proximity to homes.

Q. Why do you oppose the Mount Emerald Wind Farm? Could provide more than one answer.

The local economy and local employment opportunities are the factors the project could affect that are considered the most important to residents.



Over 80% feel the effect of the project on the local economy and jobs is important.

The light levels from the farm, the traffic and the peace and quiet are the factors considered least important.

Q. Thinking about the effects of the Mount Emerald wind farm. Do you consider the following factors important or unimportant.

The project is expected to have positive effects on the local economy, local job opportunities and the reputation of the region

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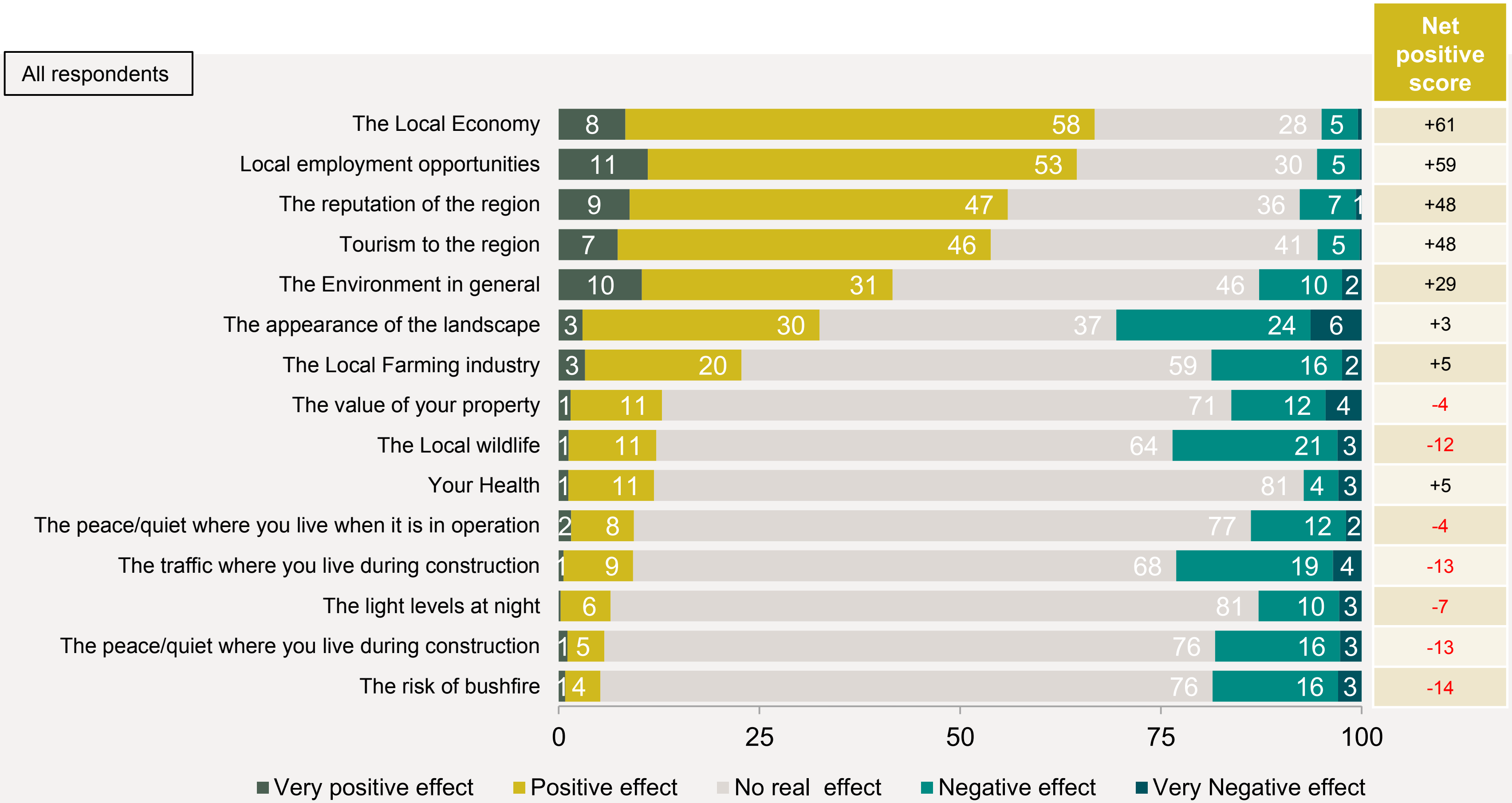


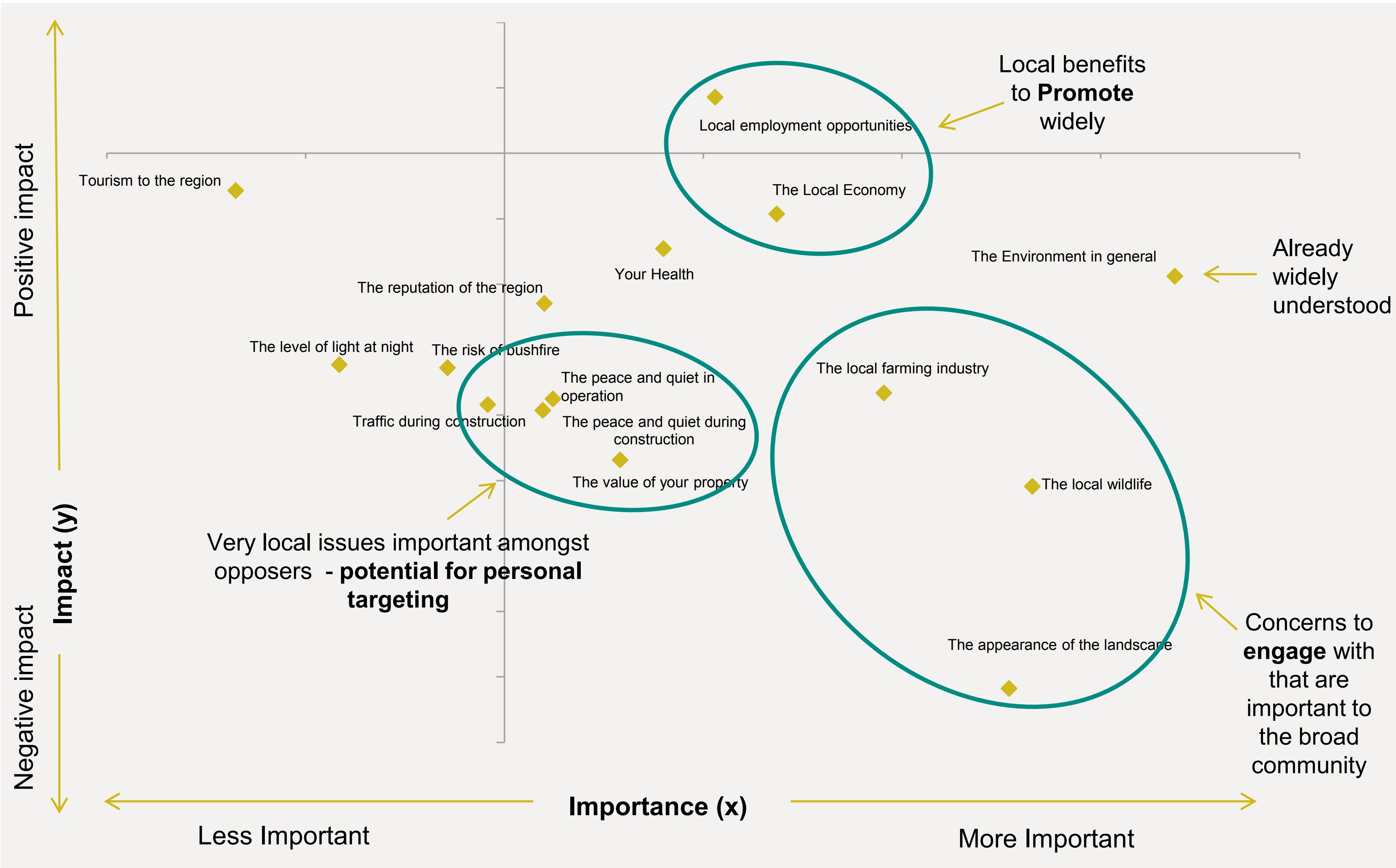
The factors which are most likely to be seen as being negatively impacted on were the appearance of the landscape, the local wildlife and the traffic during construction. Amongst those that oppose the wind farm over 80% feel it will have a negative effect on the appearance of the landscape.

Q. Do you think the Mount Emerald wind farm will have a positive or negative effect on the following factors?

Relating the importance of various factors with the expected impact of the Mount Emerald Wind Farm – **All respondents**

Q. Do you think the Mount Emerald wind farm will have a positive or negative effect on the following factors?
Q. Thinking about the effects of the Mount Emerald wind farm. Do you consider the following factors important or unimportant.

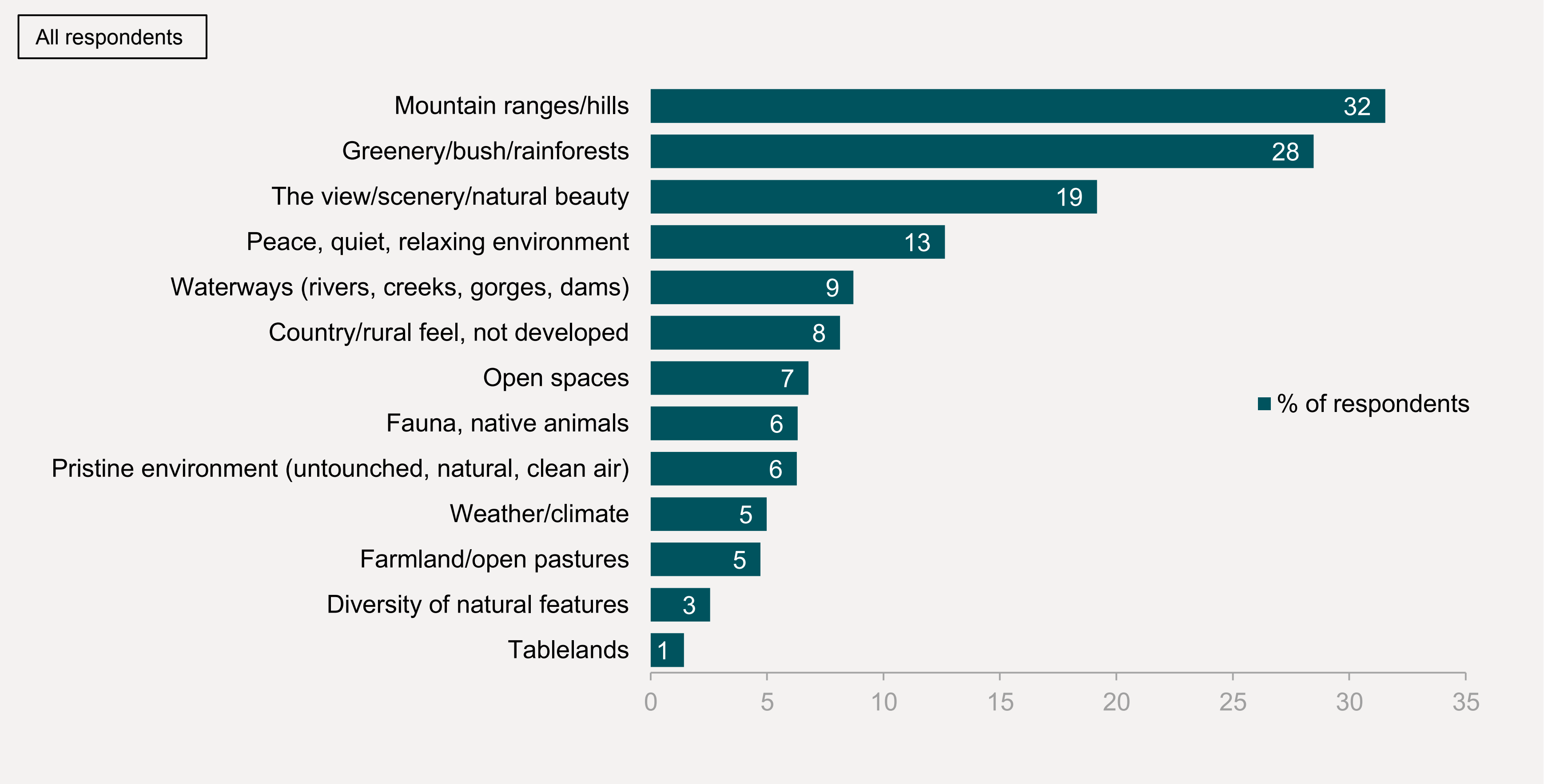
Relating the importance of various factors with the expected impact of the Mount Emerald Wind Farm **amongst opponents of the project**



Q. Do you think the Mount Emerald wind farm will have a positive or negative effect on the following factors?
Q. Thinking about the effects of the Mount Emerald wind farm. Do you consider the following factors important or unimportant.

Landscape values –
Impacts on landscape and landmarks

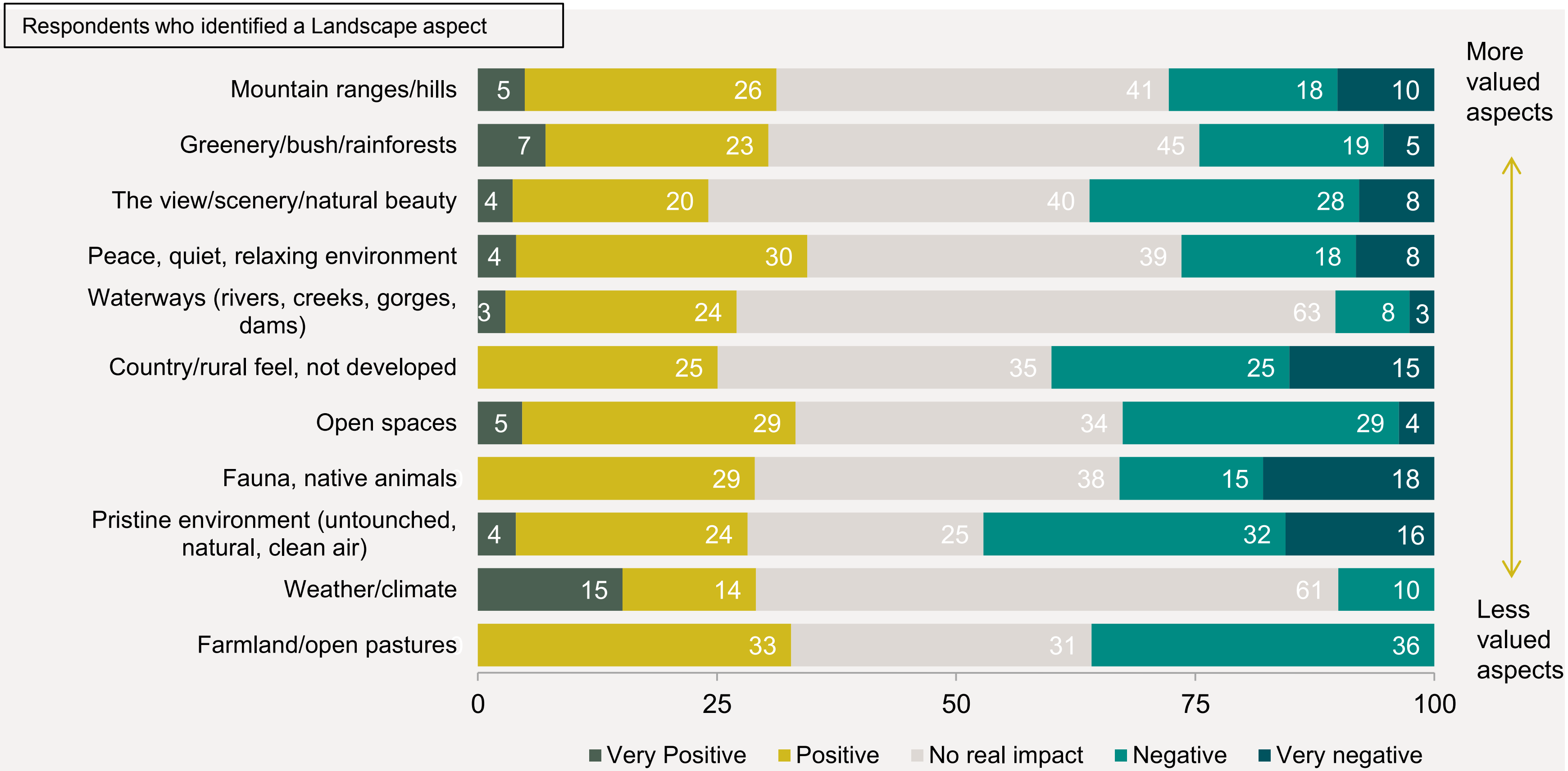
The Mountain ranges/hills are the aspect of the landscape that residents most value



The rainforest and the views also rank highly.

Q.Which particular aspect of the local landscape do you most enjoy?

Respondents generally feel the wind farm will have a positive or no impact on the landscape aspects



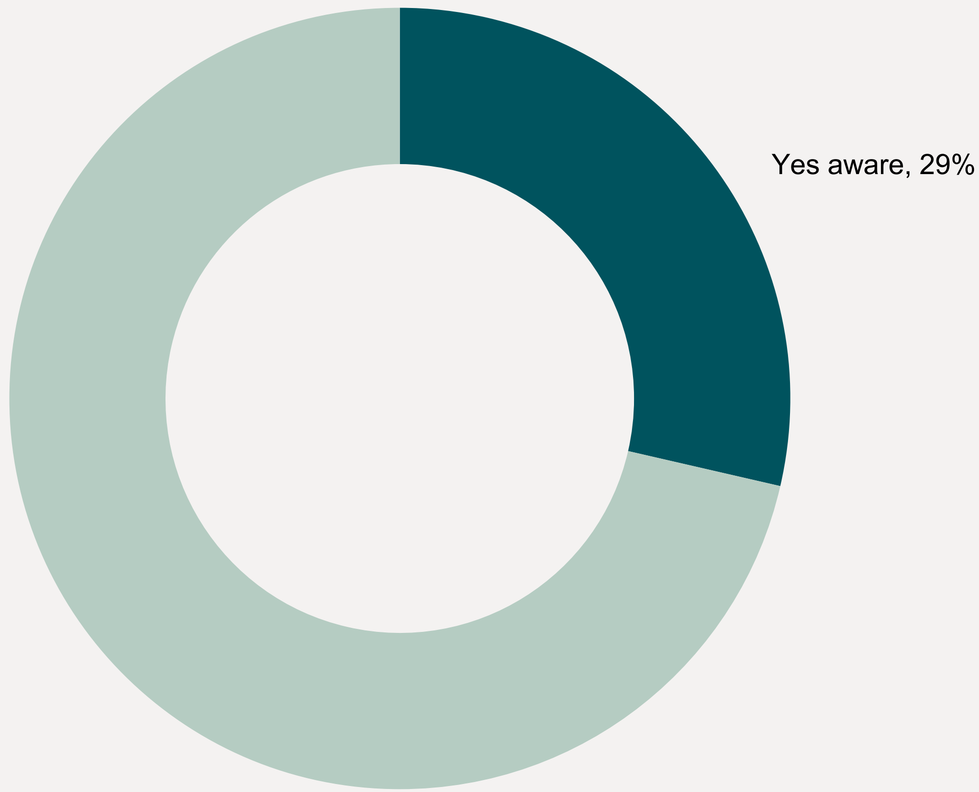
Across all landscape aspects 71% of respondents think the wind farm will have either a positive or no impact.

Only the pristine environment and the country/rural feel have more than 40% saying it will have a negative or very negative impact.

Q. Do you think the Mount Emerald Wind Farm will have a positive or negative impact on this landscape aspect?

The majority of respondents are unaware of any historically or culturally significant local landmarks

All respondents

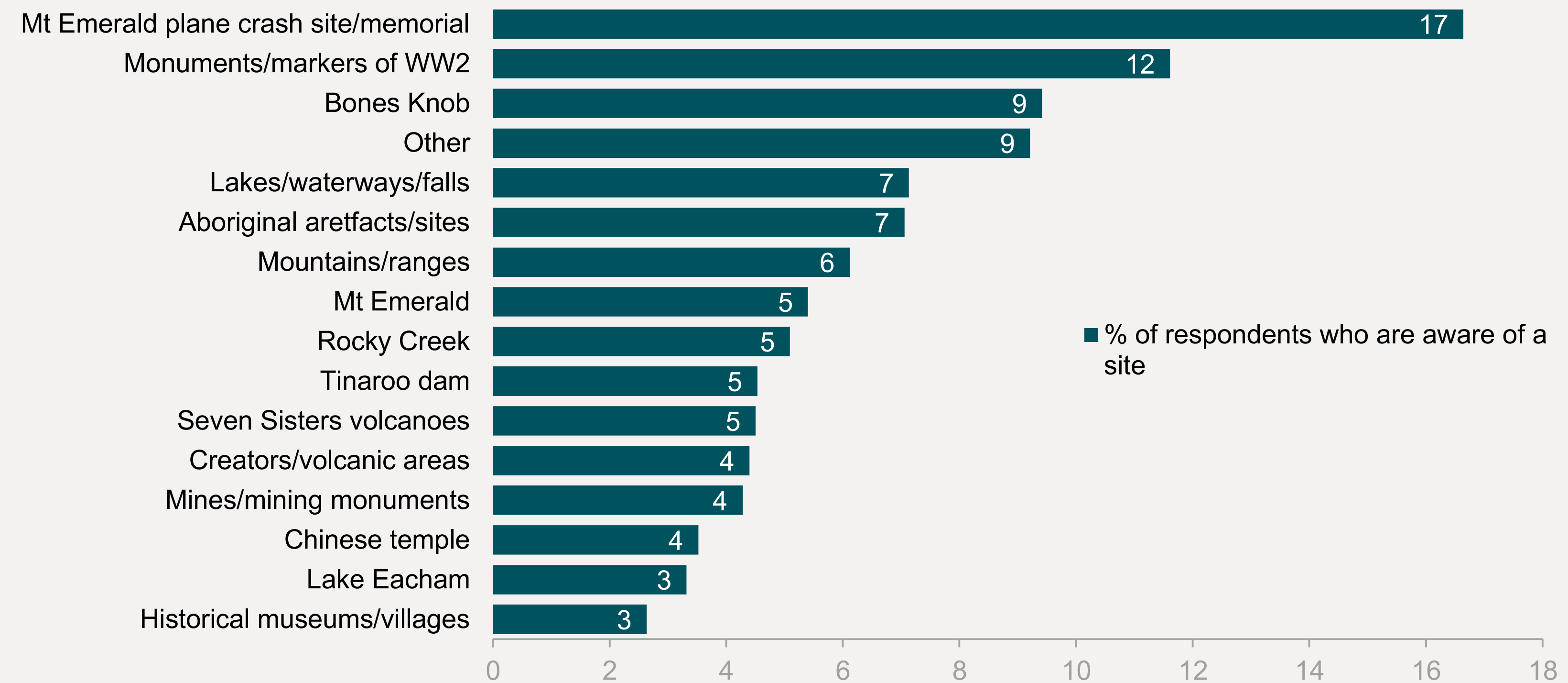


More than two thirds of respondents (71%) say they are unaware of any historically or culturally significant local landmarks.

Q. Are you aware of any historically or culturally significant local landmarks?

The Mount Emerald plane crash site and WW2 monuments are the most well known historical sites

Respondents aware of historical/culturally significant site (29%, n=114)

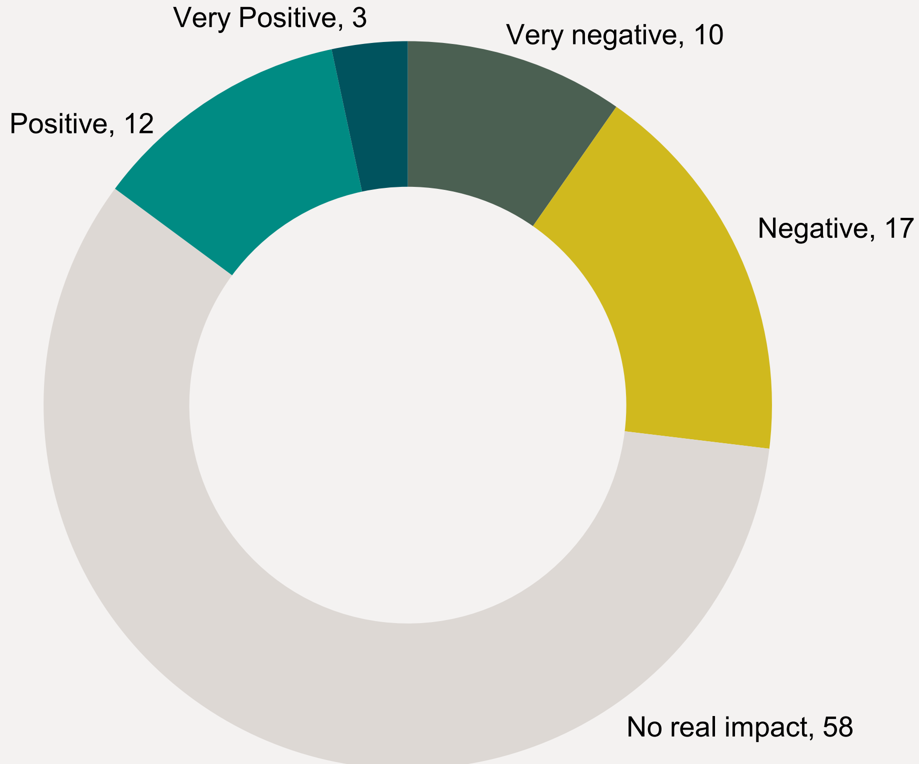


17% of those aware of any sites identified the plane crash site/memorial.

Q. Which local landmark is most historically or culturally significant to you?

Overall, respondents are most likely to rate the impact of the wind farm on cultural and historical landmarks as neither positive nor negative.

Respondents aware of a historical or culturally significant site (29%, n=114)



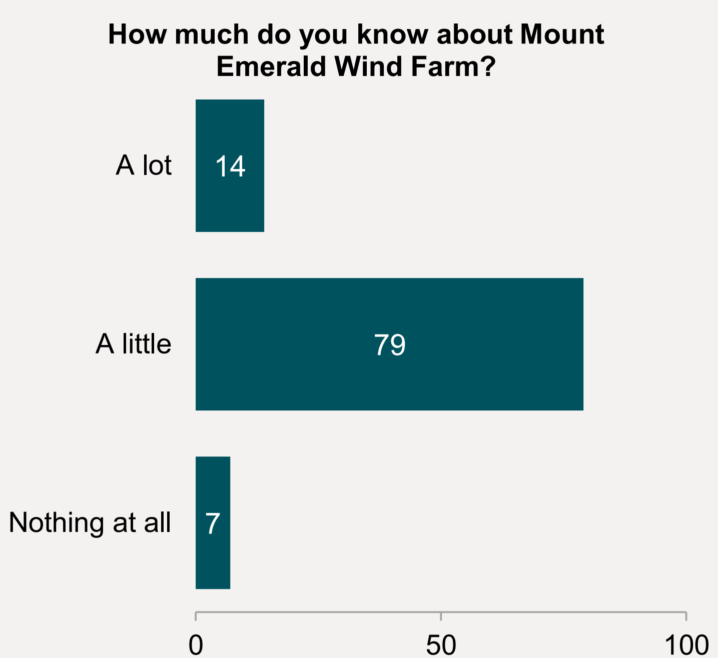
There were though 27% of respondents who felt the impact of the wind farm could be negative or very negative on the historical or culturally significant site.

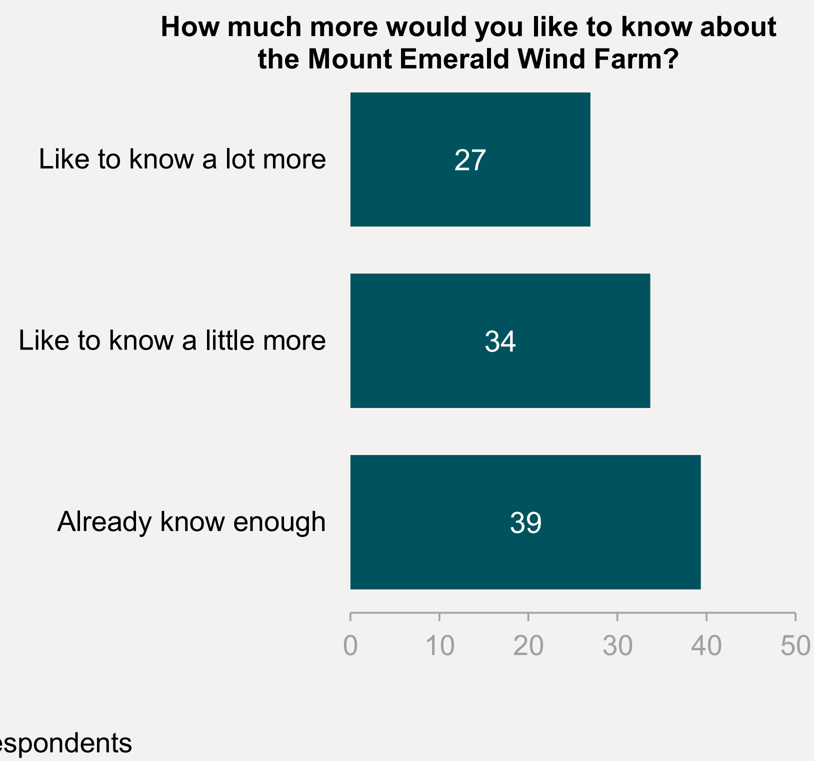
Q. Do you think the Mount Emerald Project will have a positive or negative impact on this landmark?

Information and communication about the Mount Emerald wind farm

Most people do not know very much about the wind farm, and the majority would like to know more.

Respondents aware of the Mount Emerald project





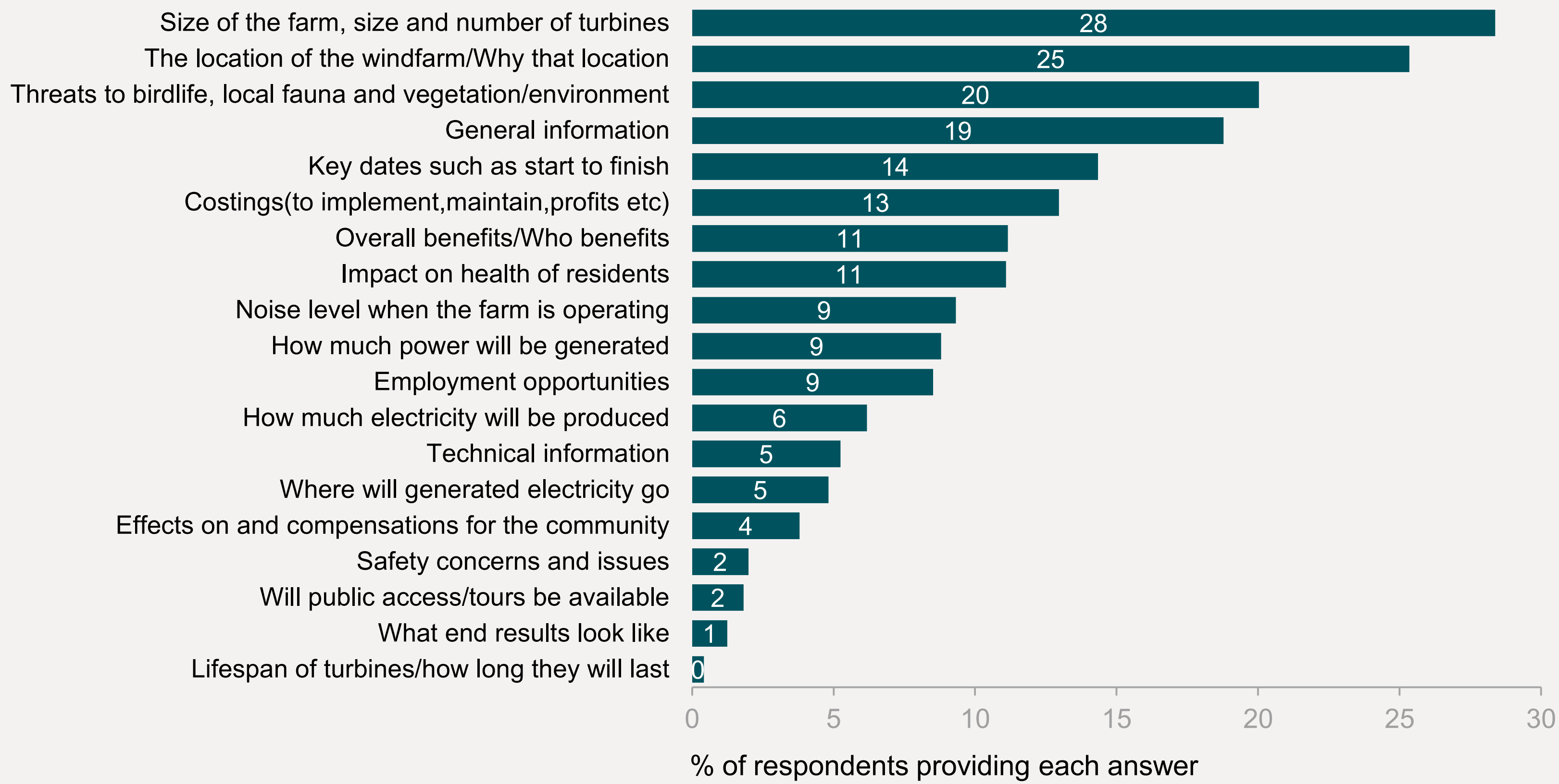
79% of those that are aware of the project said they only knew a little about the project, 14% suggested they knew a lot.

61% said they would like to know more.

Q. How much do you know about the proposed Mount Emerald Wind Farm?
Q. Would you like to know a lot more, a little more or do you already know enough about the Mount Emerald Project?

Most people want basic information such as the location and the size of the proposed wind farm

Respondents who would like to know more about the project

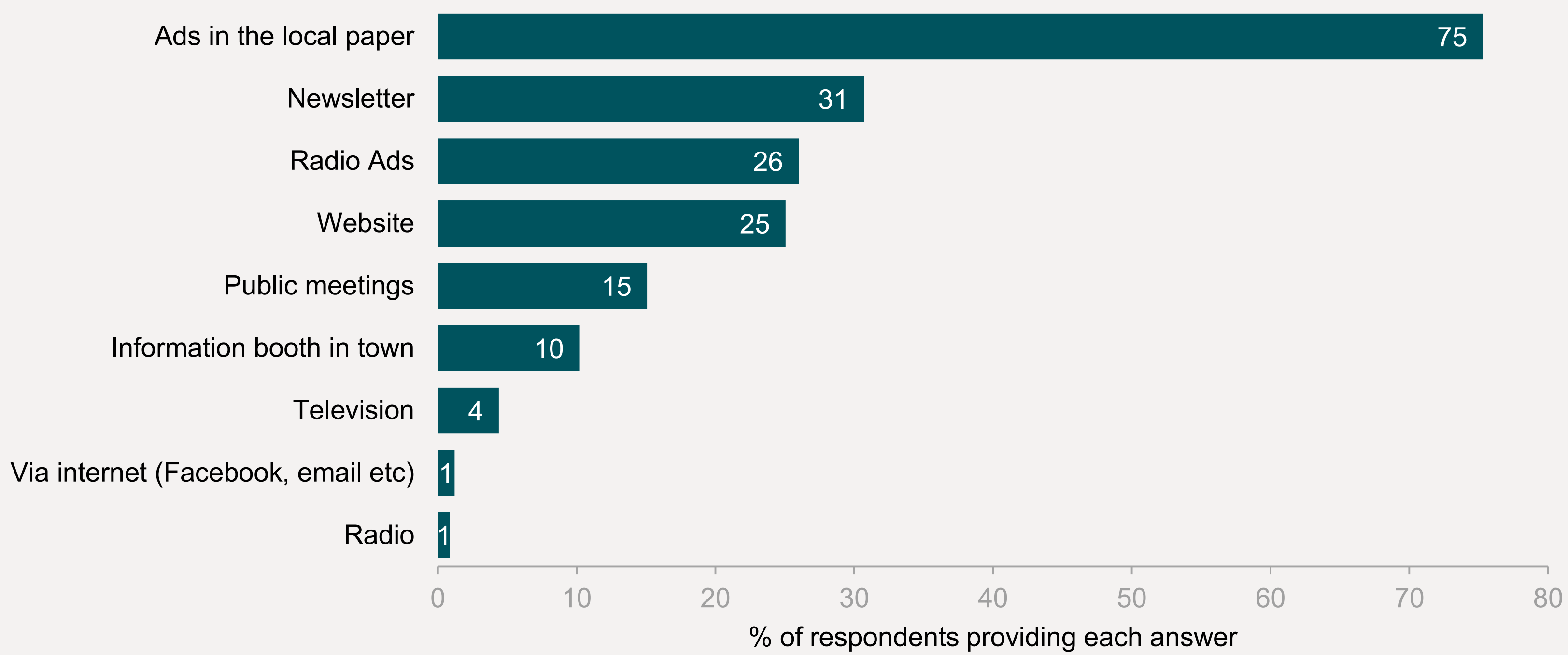


There is also a desire to know about wider issues such as who will benefit, risks to wildlife, and impacts on health of residents.

Q. What sort of information about the Mount Emerald Wind Farm project would you like?

Most think that local newspaper ads are the best way to keep them informed about the progress of the wind farm

All respondents



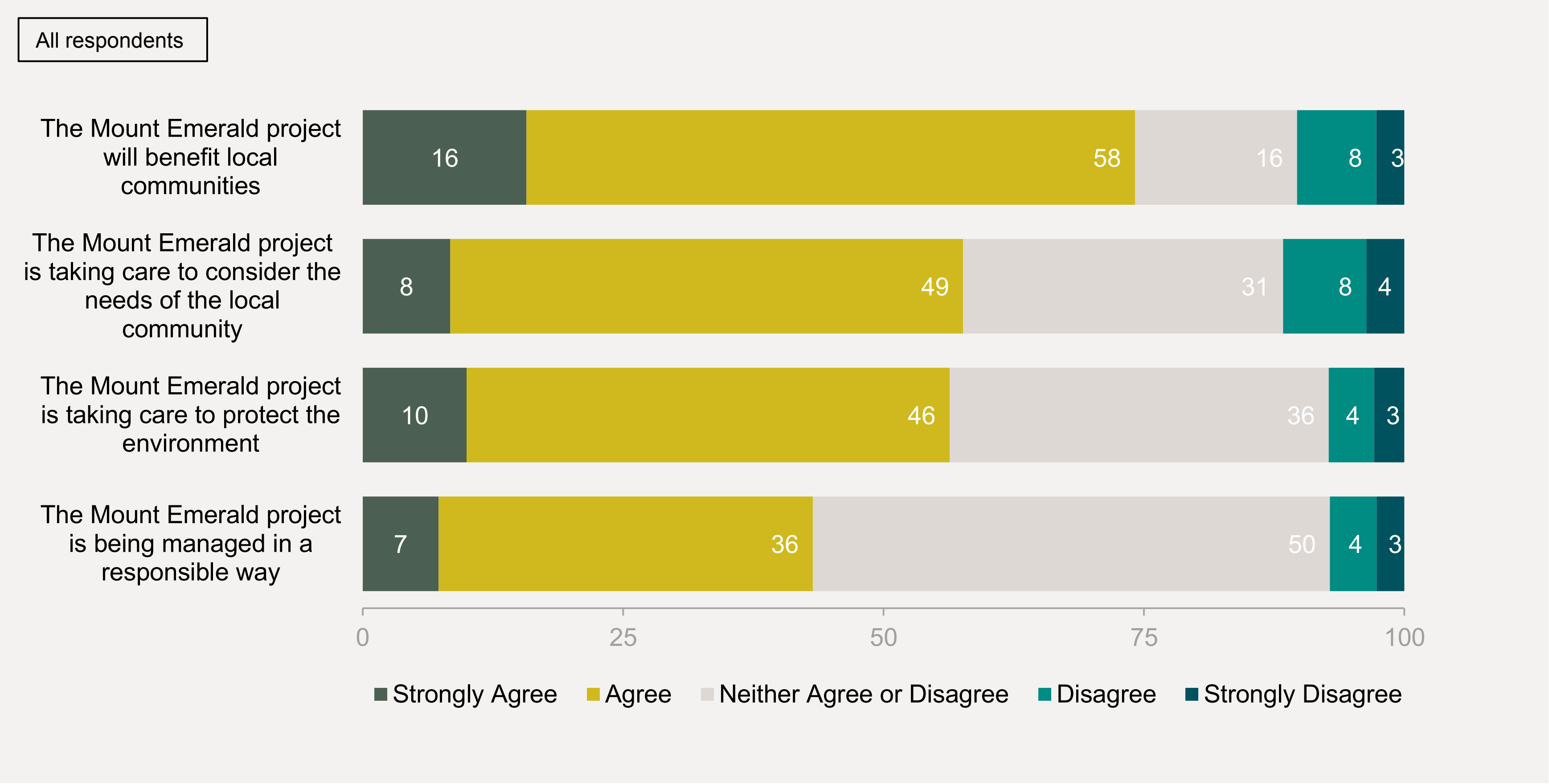
Three quarters of respondents identify local papers as their preferred information route.

31% say they would like to see a newsletter.

Q14. Which of the following would be the best way to keep you informed about the progress of the wind farm?

Attitudes to Project Management

Respondents feel that the project will benefit local communities and is taking care to meet the needs of the environment and the local community.



Only a small proportion of respondents disagree that the project will benefit the community or the environment.

However, 50% of respondents are unsure if the project is being managed in a responsible way – a potential area for improvement.

Q: Do you strongly agree, agree, neither agree nor disagree, disagree or strongly disagree with each statement

Demographics

Sample Characteristics

Gender, Age and Nearest Town

Sample sub-segment	% of sample (unweighted)	# in sample
Male	51	206
Female	49	194
18 to 29	13	53
30 to 49	41	165
50 to 64	30	121
65 +	15	61
Atherton	36	143
Mareeba	46	183
Tolga	9	36
Dimbulah	4	15
Walkamin	3	10
Other	3	11

Total sample = 400 Please note that percentages have been rounded, and may not equal 100%.

Where they live

Sample sub-segment	% of sample (unweighted)	# in sample
In-town	61	246
Out of Town	39	154
Live in area full-time	96	385
Live in area part-time	4	15
Less than 1km from farm site	1	2
1km to 5km from farm site	4	17
5km to 10kn from farm site	14	56
10 to 15km from farm site	23	91
15 to 20km from farm site	28	110
More than 20km from farm site	31	124

Total sample = 400 Please note that percentages have been rounded, and may not equal 100%.

Employment and Living Arrangements

Sample sub-segment	% of sample (unweighted)	# in sample
Working full-time	53	210
Working part-time	17	69
Unemployed/not working	4	14
Student	1	2
Retired	18	73
Manage household/ family	8	32

Sample sub-segment	% of sample (unweighted)	# in sample
Single with dependent children living at home	5	21
Married/defacto with dependent children living at home	37	146
Single without dependent children living at home	19	77
Married/defacto without dependent children living at home	36	143
Other	4	13

Total sample = 400 Please note that percentages have been rounded, and may not equal 100%.

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Appendix 10

Cultural Heritage Assessment

Prepared by Converge

Terry Johannesen
Project Development Manager
RATCH Australia Corporation Limited
Level 4, 231 George Street, Brisbane QLD 4000

6 November 2013

Sent by email: terry.johannesen@ratchaustralia.com

Dear Terry

This letter reports on a site inspection of the RATCH's proposed Mt Emerald wind farm development at Lot 7 on Crown Plan SP235244, Arriga in the Springmount area, near Mareeba on the Tablelands (the Project Area). The inspection was carried out on 31 May 2010, by myself, to assess the cultural heritage values of the project area. An updated search results of the Cultural Heritage Coordination Unit's register held by the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA) was provided on 23 October 2013.

Legislation relevant to this inspection is the *Aboriginal Cultural Heritage Act 2003* (the Act). The aim of this inspection was to determine which of the five categories provided by Queensland's Cultural Heritage Duty of Care Guidelines best describe the conditions of your Project Area and the nature of proposed works.

Approach

The Cultural Heritage Duty of Care Guidelines provide five categories (listed below), each of which identify reasonable and practicable measures for ensuring activities are managed appropriately.

Category 1 - pertains to activities that involve No Surface Disturbance. It is held that activities that pose no threat to Aboriginal cultural heritage, such as walking or driving along an existing road, comply with the Duty of Care Guidelines as set out in the Act and as such, the activity is able to continue without further cultural heritage assessment.

Category 2 - encompasses activities that will cause No Further Surface Disturbance to an area. The Act maintains that if an activity is causing No Further Surface Disturbance then any Aboriginal cultural heritage that remains will not be disturbed or damaged any further than what has previously occurred. As such, the activity is complying with the Duty of Care Guidelines of the Act and so may continue without further cultural heritage assessment.

Category 3 - provides for activities carried out in a Developed Area. When an activity is carried out under these circumstances, the Act holds that no further cultural heritage assessment is necessary.

Category 4 - pertains to areas that have previously been subject to Significant Ground Disturbance. This category holds that any further activity may not damage or disturb Aboriginal cultural heritage, but makes provision for possible residual Aboriginal cultural heritage significance being in the activity area. This category is predicated by the fundamental principle of the Act, namely the recognition, protection and conservation of

Aboriginal cultural heritage (Section 5); and by the direction of the Duty of Care Guidelines to consultation with Aboriginal Parties.
Category 5 - encompasses any activity that does not fall into any of the preceding categories. This category makes the assumption that there is a high risk of the activity damaging or disturbing Aboriginal cultural heritage. As such, the Act requires that cultural heritage be addressed prior to the commencement of any such activity. This is done through a Cultural Heritage Management Plan (CHMP), Cultural Heritage Study or by Agreement.

Outcomes

The assessment was of a due diligence nature to determine the need for consultation with Aboriginal Parties before your project commences.

The Project Area lies totally within Lot 7 on Crown Plan SP235244. The country within this lot rises steeply to form a high plateau area which extends to the south-west from Walsh Bluff. The plateau generally forms a number of north-south ridges which are intersected by two main creek lines which drain to the eastern side of the plateau. Other ephemeral creeks are also located within the area. To the immediate east of the western ridge lies a shallow gully which falls to a steeper gully leading west, north-west, into the Springmount dump area (ex CEC Springmount property).

The vegetation comprises open forest with grass tree and native grasses understorey and eucalypt upper storey. Granite outcrops feature within this landscape.
Ground disturbance within the area appears to be confined to a track and power line crossing east - west across the southern end of the site and a track pushed to the north along the western ridge.

The proposed wind farm development comprises the turbines which will consist of a tapering 80m steel tower (ground to hub) supporting a three bladed rotor with blade lengths of up to 50m. Tower diameter at the base will be approximately 4.2m tapering to 2 m at the central hub. Access tracks will generally follow the ridge lines. It is proposed that clearing for access track and underground power cabling may be up to 10m wide in vegetated areas. Turbine sites may require up to a 1600m^2 clearing to facilitate construction and maintenance. A network of underground cables will connect the turbines with an onsite substation which will connect to the Powerlink 275 kV concrete tower line.

A number of cultural heritage assessments have been undertaken in the vicinity of the proposed wind farm area. Whilst it was not possible to access all these unpublished reports the results of other assessments are provided in the assessments consulted.

In 1984 Nicky Horsfall undertook an archaeological survey of a proposed transmission line from Kareeya power station to Turkinje substation. This proposed powerline passed to the west of the current study area. One site was located to the north of Hoot Hill (south, south-west of the current study area). It comprised a rockshelter with a chert flake on the east bank of a dry creek just north of Oaky Creek. A rockshelter was also located in the vicinity of Mt Aunt. It was noted that the powerline corridor had not been surveyed in its entirety but a 2km stretch north of Hoot Hill was carried out as was the proposed corridor between Granite Creek and the Turkinje station (to the north of the current study area).

In 1995 an archaeological survey of the then proposed powerline between Chalumbin and Woree was conducted by Northern Archaeology Consultancies. The powerline corridor passed through the south-eastern extent of the current Project Area. No sites were found within the current study area although 2 sites were located near Oaky Creek to the south of Hoot Hill (SW of the current Study area). Both sites comprised low density artefact scatters of milky quartz and silcrete flakes. It is noted in the methodology section of this report that not all the powerline was surveyed due to difficulties of access and because the very steep and often unstable ridge slopes were considered (based on earlier studies) to be of lower archaeological potential. This included 'southwest of Walkamin along the Great Dividing Range'. It therefore seems possible that the area of the powerline which lay within the current Study Area was not able to be surveyed. Nevertheless top of ridge flats were considered to have higher archaeological potential.

An assessment of the cultural heritage issues of the Atherton Tableland water storage facilities was conducted by Grimwade and Sandes in September 1998. The assessment notes the frequent correlation of Aboriginal habitation sites with water courses particularly where there has been little or no activity since colonisation.

A cultural heritage assessment of the CEC Springmount property to the immediate north-west of the study area (west and north-west of Walsh Bluff) was conducted by Gordon Grimwade and Associates in 1998. The survey sampled the different land types within the study area. It identified 9 rockshelters distributed within two complexes which were located near creek bottoms. Two of these rockshelters had evidence of Aboriginal occupation. An isolated artefact was located on the upper flat of a gentle slope and one artefact scatter of moderate density was located on the flat of a narrow top of a small finger ridge on the south side a valley on the south-western side of the Project Area. Artefacts comprised 17 chert flakes and cores and nine quartz flakes and debitage. It was noted that ground surface visibility was higher on the ridge tops and it is unclear if and to what extent this has biased results. The report also notes that Bones Knob is a significant place for the Bar Barrum People as it is a massacre site. Bones Knob lies approximately 10 km south-east of Walsh Bluff. A number of rockshelters with cave art in the Mt Aunt area located during an assessment by Duke are also noted. Mt Aunt lies approximately 6.5km to the north-east of the current study area.

A search of the all relevant heritage databases and registers for the Lot 7 on SP235244 including a 500m buffer extending from the boundaries of the lot identified six sites to be located in close proximity to the Lot.

The location of these sites is identified in Figure 1. No sites are located within Lot 7 on SP235244. However, DATSIMA note that it is not possible to conclusively guarantee the accuracy of these recordings (in particular, the longitude and latitude location description for each site) and extra diligence is required when operating in these locations. Therefore it is possible, given the proximity of these sites to Lot 7 on SP235244, that the identified sites are located within or very close to the project area.

In addition it is probable that the relative absence of recorded Aboriginal cultural heritage places reflects a lack of previous cultural heritage surveys of the area and therefore that the lack of sites on the Registers are not likely to reflect a true picture of the Aboriginal cultural heritage values of the area.

DATSIMA further notes that there is currently no registered Aboriginal Party for this area.
A search of the National Native Title Tribunal's interactive mapping website indicates that the tenure for the lot is freehold and that no Native Title Determination Applications (NTDAs) exist over the Project Area. It is noted that native title is extinguished over freehold.

The area does however fall within and Indigenous Land Use Agreement (ILUA) QI2005/011Bar Barrum Small Mining ILUA.

The North Queensland Aboriginal Land Council Aboriginal Corporation (NQLCAC) is the native title representative body for this area. They have indicated that both Bar Barrum and Muluridji Peoples should be contacted to determine the correct Aboriginal Party for the area.

In light of the above outcomes, and noting that there has been little previous significant ground disturbance (as defined in the Duty of Care guidelines) over the majority of the area and that the proposed activities should be regarded as likely to cause surface ground disturbance, the area can best be described as falling within category 5 of the Duty of Care Guidelines. As such it is likely that certain features of the area may have residual cultural heritage significance and/or that previously unrecorded places of cultural heritage significance may occur within the area. It is important to be informed about any cultural heritage significance that may attach to these features and/or places. This will require consultation with the appropriate Aboriginal Party(ies) if compliance is to be achieved. The appropriate Aboriginal Parties for the area are the Bar Barrum and the Muluridji Peoples.
The potential for Aboriginal cultural heritage being present within the study area is moderate. If Aboriginal cultural heritage was present, reasonable management approaches can usually mitigate the site, and on this basis, it is predicted that no or little project constraint will be an outcome. Only sites that are considered significant Aboriginal areas or objects in the meaning of the Act may require constraints such as retention of open space buffers, and even then, through negotiation with Aboriginal Parties, mutually appropriate management outcomes may be forthcoming.

Converge recommends that a process be adopted whereby consultation with the appropriate Aboriginal Party(ies) for the area be initiated. It is expected that consultation would result in a cultural heritage survey and CHMP or agreement pursuant to section 23(3)(a)(iii) of the Act. As there is no claim, and potential overlapping interests, a CHMP would need to be advertised, and could attract many of responses from Aboriginal Parties, all of whom need to be endorsed. Therefore it is suggested that an agreement pursuant to section 23(3)(a)(iii) of the Act is initiated involving those people advocated by the NQLC as this will reduce the potential for multiple people and thereby potentially simplify the agreement process.

I would welcome the opportunity to assist you in this process and to develop a proposal in this regard for your consideration.

Yours sincerely,

Karen Townrow

Karen Townrow
Cairns

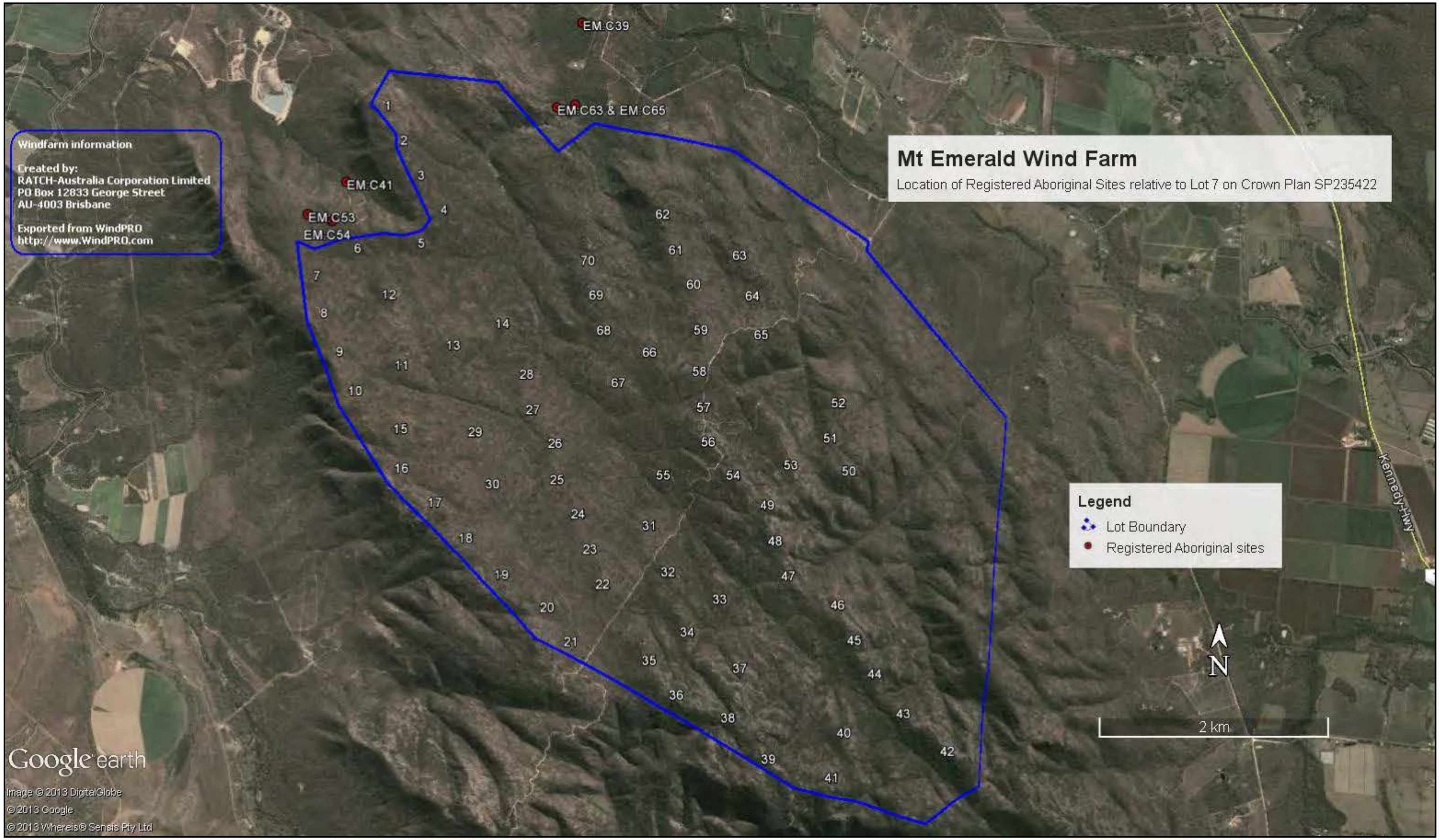

Figure 1: Location of sites identified in DATSIMA's register of Aboriginal Sites

References:

Grimwade, G. & C. Sandes

1998 Atherton Tableland Water Storage Facilities: Cultural Heritage Issues. Unpublished report. Wallin & Grimwade Heritage Services, Brisbane.

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Moore, M. W.

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Northern Archaeology Consultancies

1995 Archaeological and Anthropological investigations for the proposed transmission line route Chalumbin to Woree, North Queensland. Report to Queensland Electricity Commission. Sinclair Knight Merz, Brisbane.

Appendix 11

Geotechnical Investigation (GT12-156-001R REV 1)

Prepared by ETS Geotechnical

RATCH AUSTRALIA CORPORATION

GEOTECHNICAL INVESTIGATION

MOUNT EMERALD WIND FARM

REPORT NUMBER: GT12-156-001R REV 1

JULY 2013

REVISION 1

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Revision No.	***Author***	***Reviewer***	***Reason for Issue***	***Approved for Issue***			
				Name	***Signature***	***Date***	***RPEQ No***
1	C. Ryan	P. Shaw	FINAL	M. Ganza	M. Ganza	02/07/13	4449

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1.0 INTRODUCTION

Engineering Testing Services Pty Ltd (ETS) has conducted a geotechnical investigation for the proposed Mount Emerald Wind Farm on the Atherton Tablelands, Queensland. The proposed site is located approximately 7km west of the township of Walkamin, 21km south of Mareeba and 22km north of Atherton. The investigation was undertaken for RATCH Australia Corporation (RATCH).

It is understood that the proposed wind turbine farm will involves the construction of up to 75 turbines of 2-3MW generation capacity. The turbines will have a rotor diameter of 90m to 100m and these will be mounted on steel tube towers 80m to 90m high. RATCH has envisaged a raft footing system of 15m to 20m in diameter, 1.5m to 2m deep of a rock anchor type.

The scope of the work for the investigation comprised ten (10) boreholes to a depth of 10m or 6m of solid rock coring, followed by laboratory testing, engineering analysis and reporting.

The aim of the investigation was to identify materials, material properties and groundwater conditions to enable a geotechnical assessment and advice to be provided on the following:

- General geological description of the site;
- Provide descriptions of the soil and rock types encountered and comments on the water table depth if encountered;
- Provide engineering design parameters for the soil and rock types encountered;
- Advice on footing design options;
- Advice on bearing capacities;
- Provision of advice on any other geotechnical issues or hazards that come to light during the investigation which may impact on the design or construction.

2.0 FIELD WORK

Fieldwork was conducted by ETS from the 4th February 2013 to the 16th February 2013 and included a visual assessment of the various sites, their surrounds and subsurface investigations. The investigation consisted of drilling 10 boreholes to a maximum depth of 10m, or 6m of rock, which ever came first. The boreholes were drilled close to the locations highlighted by RATCH. Standard Penetration Testing (SPT) was carried out where possible to assist in assessing the consistency and density of the subsurface materials. Where rock was encountered core samples were collected and placed into core trays for rock logging and testing. Soil resistivity testing was carried out at each of the borehole locations to provide soil resistance parameters for the design of electrical earthing devices.

The results of the field work (borehole logs) are presented in Appendix B. The approximate locations at which the field work was conducted are displayed in Figure 1, Appendix A.

3.0 STANDARDS & GUIDELINES

The soil, rock classification descriptions, field and laboratory testing were carried out in general accordance with the following Australian Standards.

AS 1726-1993	Geotechnical Site Investigations
AS 1289	Methods of Testing Soils for Engineering Purposes
AS 4133	Methods for Testing Rocks for Engineering Purposes

4.0 LABORATORY TESTING

The following laboratory testing was conducted at NATA accredited laboratories on samples recovered during fieldwork in order to assist with the assessment of geotechnical design parameters:

- Atterberg Limits
- Particle Size Distribution Analysis
- Point Load Test
- Unconfined Compressive Strength

Results of laboratory testing are presented in Appendix C.

5.0 GEOLOGY

Numerous volcanic sequences have been identified in the Atherton area of which the majority have been subdivided into the Featherbed, Koolmoon, Sundown and Scardons Volcanic Groups. The Mount Emerald/ Walsh's Bluff topographic feature are believed to represent outflow deposits of the Glen Gordon Cauldron and are members of the Koolmoon Volcanic Group. This group comprises of Early Permian densely welded rhyolitic ignimbrite and minor rhyolitic lava. The lava flows are commonly flow banded and autobrecciated. The group has well developed columnar jointing and is up to 600m thick.

6.0 SITE CONDITIONS AND OBSERVATIONS

6.1 Visual Assessment

The proposed wind farm site is located to the north of Mount Emerald and is situated approximately 3.5km to the southwest of Walkamin. The site covers an area of approximately 15km^2 with elevation variations of up 550m throughout the site. Large relatively flat sections exist on the site between hilly peaks to the northeast and southwest of the site. The site was generally covered in medium dense bush consisting of small to large trees, long grass and shrubs. Several small creeks were encountered across the site.

Numerous large rock outcrops were observed throughout Mount Emerald and in the vicinity of all of the drill sites.

Site access was via a dirt track suitable for four wheeled drive vehicles, the track crossed the site from north and south. A second major track was used to gain access to borehole locations BH1-BH4, this track was low-lying and become impassable after periods of rainfall due to boggy ground.

6.2 Subsurface Conditions

The investigation consisted of drilling 10 boreholes to a maximum depth of 10 metres, or 6 metres of rock, whichever came first. A shallow soil profile existed at the borehole locations and was generally found to be less than 1 metre thick. The soil consisted of a Sandy SILT (ML) of low plasticity, with fine to coarse sand and of a stiff consistency. The soil was underlain by members of the Koolmoon Volcanic Group which generally consisted of rhyolitic ignimbrite. The ignimbrite was slightly weathered to fresh with minor moderately and highly weathered zones. Generally the weathering was limited to iron oxide discolouration without any significant affect to the rock strength. A preliminary field assessment of rock strength indicated the rock was generally within the high to very high strength range which was confirmed with laboratory strength testing.

Discontinuities in the core were generally confined to joints dipping at high angles relative to the core axis. Infill was found in some of the joints and consisted as either iron oxide or clay. Infill generally occurred as veneer thickness or less than 5mm. Minor faults were also identified in some of the boreholes and were found to dip between 0° and 26° relative to the core axis. Infill was clay and/or gouge material.

7.0 ENGINEERING ASSESSMENT AND RECOMMENDATIONS

7.1 Design Parameters

Rock strength has been determined using a variety of methods including field strength correlation assessments as outlined in AS1726, Point Load Testing and Unconfined Compressive Strength Testing. Tables 1 and 2 present the findings of those assessments.

TABLE 1. ROCK STRENGTH PARAMETERS- UNCONFINED COMPRESSIVE STRENGTH

Borehole	Depth (m)	Unconfined Compressive Strength	AS1726 Strength Term
BH1	0.67 -0.85	74.6 MPa	Very High
BH2	0.98 - 1.16	164 MPa	Very High
BH4	0.50 - 0.70	40.5 MPa	High
BH7	1.30 - 1.55	221 MPa	Very High
BH9	3.05 - 3.29	56.3 MPa	High
BH10	0.40 - 0.53	37.8 MPa	High

TABLE 2. ROCK STRENGTH PARAMETERS- POINT LOAD TEST

Borehole	Depth (m)	Point Load Test $Is_{(50)}$	AS1726 Strength Term
BH2	1.21 – 1.45	13 MPa	Extremely High
BH4	1.5 – 1.74	7 MPa	Very High
BH5	5.85 – 6.03	1.7 MPa	High
BH8	2.39 – 2.57	2.6 MPa	High
BH9	0.22 – 0.48	6.3 MPa	Very High
BH10	3.93 – 4.18	4.1 MPa	Very High

Laboratory testing was completed to determine modulus parameters required for detailed footing design. A summary of these results is presented in Table 3. The laboratory reports are presented in Appendix C.

TABLE 3. MODULUS PARAMETERS

Borehole	Depth (m)	Tangent Modulus	Poisson Ratio	Secant Modulus	Poisson Ratio
BH1	0.67 -0.85	43 GPa	0.074	42 GPa	0.074
BH2	0.98 - 1.16	58.6 GPa	0.084	55.6 GPa	0.084
BH4	0.50 - 0.70	33.5 GPa	0.118	29 GPa	0.128
BH7	1.30 - 1.55	58.9 GPa	0.088	56.3 GPa	0.088
BH9	3.05 - 3.29	53.6 GPa	0.055	52.5 GPa	0.055
BH10	0.40 - 0.53	40.3 GPa	0.073	43 GPa	0.073

7.2 Footing Recommendations

Based on the information collected during the preliminary subsurface investigation, the subsurface conditions are suitable for support of the turbine foundations on a raft foundation system. Since shallow bedrock was encountered at the borehole locations, other potential alternatives for supporting the proposed turbines include rock anchors and rock socketed piers.

It is understood that the customer would prefer to use a raft or rock anchor system at this site. The brief provided to ETS outlines a proposed raft design founded approximately 1.5m to 2.0m deep and 15m to 20m in diameter.

Shallow foundations will likely require rock excavation or blasting at most locations to achieve the planned foundation depth, or placing the foundations at the bedrock surface and raising the site grade to provide the required soil cover over the foundations for overturning stability. If the bedrock surface slopes significantly, or a combination of soil and rock is encountered at the planned foundation elevation, lean concrete will be required to create a level, uniform bearing surface to support the foundations.

The rippability characteristics of the rock encountered during the investigation are discussed in Section 7.3 of this report. Should blasting be considered at this site a pre-blast survey and blasting plan should be prepared prior to performing any blasting activities.

7.3 Excavation Characteristics and Rippability

The excavatability of rock depends on the geotechnical properties of the material, on the method of excavation and on the type and size of excavating equipment used. In mechanical excavation the cutting parts of the equipment must be forced into discontinuities in the rock mass or into the fabric of weak rock. It is generally accepted that the discontinuity (fracture) spacing and the strength of the rock are particularly important properties and general ripping depths can be significantly increased when the rock is bedded or foliated, or highly fractured. The nature of the rock and inherent planes of weakness therefore play an important part in rock excavation assessment.

A rippability assessment for the rock encountered during the geotechnical investigation has been carried out using Weaver's Rock Classification System for

Rippability. Based on Bieniawki's Geomechanics Classification of Rock Masses, this rippability classification system allocates a weighted value to each input parameter. The total rating is given a rippability assessment. Tables 4 and 5 below, show the ratings obtained after the assessment of each grade of weathered rock encountered on site.

TABLE 4. RIPPABILITY RATING

Parameters	Fresh Rock		Slightly Weathered	
	Assessed Classification	Rating	Assessed Classification	Rating
Est. Seismic Velocity	>2150	26	2150-1850	24
Rock Hardness	Very Hard Rock	5	Hard Rock	3
Rock Weathering	Unweathered	9	Slightly	7
Defect Spacing (mm)	300-50	10	300-50	10
Defect Continuity	Slightly Continuous	5	Slightly Continuous	5
Defect Gouge	Ave. <5mm	3	Ave. <5mm	3
Strike and Dip Orientation	Unfavourable	13	Unfavourable	13
Total Rating		**71**		**65**

TABLE 5. RIPPABILITY ASSESSMENT

Total Rating	Weaver's Classification (modified)		AS2868-1986
	Tractor Selection	Power (kw)	Class
< 25	D7	135	105 C
25 - 50	D7/D8	135 – 200	105 C – 150 C
50 – 70	D8/D9	200 – 290	150 C – 200 C
70 - 90	D11/ Hydraulic Breaking plus D9	290 – 575	200 C – 500 C
90 - 100	Blasting		

Notes:
Weaver J. M. (1975), Geological Factor Significant in the Assessment of Rippability, Die Siviele Ingenieur (South Africa).
AS 2868 – 1986: "Classification of machinery for earthmoving, construction, surface mining and agricultural purposes".

Weaver noted that for values above 75 should be considered unrippable without using pre-blasting or other techniques.

Excavation of the slightly weathered rock can be carried out by bull dozers (D8/D9) in bulk excavations and excavators with ripping tynes in confined excavations. Excavation of the fresh rock will need to be carried out with a large bull dozer (D11) or with a combination of hydraulic fracturing plus ripping with a D9 dozer.

Given the limited investigation and high strength of the rock it is suggested that an allowance should be budgeted for rock breaking works in addition to minor blasting. Consideration could be given to lightly blasting of the rock mass to loosen it and to facilitate excavation.

7.4 Bearing Capacity

Bearing capacity has been assessed on an understanding that the proposed footings will be founded approximately 1.0m below the ground surface into rock and will be a minimum of 15m wide. Based on this and an assessment of the unconfined compressive strength, fracture spacing and allowable defect range, an allowable bearing capacity of 3.0 MPa may be adopted.

The quoted bearing capacity allows for <1% settlement of the minimum footing dimension.

It is recommended that upon completion of a footing design the bearing capacity is reviewed to ensure the design conforms to our assumptions.

As subsoil conditions may vary from location to location, a qualified geotechnical engineer shall inspect the foundation prior to pouring of concrete. The geotechnical engineer should confirm that the allowable bearing pressures have been obtained. The foundation should be cleaned and free of loose caved in material prior to pouring the concrete.

7.5 Sliding Stability

A coefficient of friction value of 0.58 may be used for preliminary foundation design to evaluate sliding stability of the turbine foundations for concrete footings founded on the underlying bedrock.

7.6 Site Classification

Site classification in accordance with AS2870 has may have little relevance if the footings are to be founded on rock. However is provided to assist with footing designs for structures which may be founded on the soil or at shallow depths.

The Atterberg Limits tests indicate the Sandy SILT (ML) is slightly reactive to changes in moisture content with an estimated predicted ground surface movement (y_s) within the **Class S** category (0 to 20mm) for footings designed in accordance with Australian Standard 2870 "Residential Slabs and Footings – Construction". It is recommended that any high level footing and slab systems be designed to accommodate the anticipated ground surface movement and the designers should satisfy themselves that the use of AS2870 is applicable for the proposed design.

The ground surface movement (y_s) estimated in this report does not take into account the effects of future trees planted or removed.

7.7 Excavation Conditions, Batter Angles & Dewatering

It is anticipated that excavations will consist of the following:

- Trenching – Upper level footings and services.

Excavation through the sandy silty soils is expected to be readily undertaken using conventional earthmoving equipment (i.e. backhoe or excavator).

Table 6 presents short and long term recommended maximum batter angles for excavations through the soil profile.

TABLE 6: BATTER ANGLES

Material	Short Term	Long Term
Controlled Fill	1H:1V	2H:1V
Sandy SILT	1.5H:1V	2H:1V

These values apply to dry slopes and batter heights of up to 3.5 metres in soil above the water table. Surcharge loads should not be placed near the crest of batter slopes as they may initiate slope failure. Flatter batter slopes would be required where seepage is encountered and further geotechnical advice should be requested if this occurs. It is essential that batters be suitably protected from erosion and scour by the establishment of ground cover and shrubs, installation of surface drains, etc. Runoff should not be allowed to discharge directly across the batters.

Groundwater was not encountered during the investigations but if required, sump and pump dewatering methods are expected to be suitable only when catering for minor seepage through the less permeable silty clay / clay soils.

7.8 Soil Resistivity

Soil resistivity testing was completed at the borehole locations using a FLUKE 1625 Earth Ground Tester. Testing was carried out to determine the soils resistive properties for use in the design of electrical earthing systems associated with the proposed wind turbines. Testing was carried out in two (2) directions perpendicular to each other in the vicinity of the boreholes. At the time of the investigation the ground was saturated at all of the tested locations. The depth which the earth stakes were placed into the ground was limited due to the shallow soil profile at many of the locations.

Soil resistivity was been calculated using the Wenner Method.

Table 7 presents the results of the field testing.

TABLE 7. SOIL RESISTIVITY RESULTS

Borehole	a Electrode Spacing (m)	R_e Wenner Resistance (Ω)	Strike	P_E Apparent Soil Resistance (Ωm)
BH1	0.8	258.3	East-West	1298
BH1	0.8	244.9	North-South	1231
BH2	0.8	198.1	East-West	995
BH2	0.8	205.5	North-South	1032
BH3	0.8	181.9	East-West	914
BH3	0.8	176.0	North-South	884
BH4	0.8	65	East-West	326
BH4	0.8	63.9	North-South	321
BH5	0.8	187.3	East-West	941
BH5	0.8	163.2	North-South	820
BH6	0.8	168	East-West	844
BH6	0.8	179.9	North-South	904
BH7	0.8	283.3	East-West	1424
BH7	0.8	252	North-South	1266
BH8	0.8	143.8	East-West	722
BH8	0.8	118	North-South	593
BH9	0.8	269	East-West	1355
BH9	0.8	288	North-South	1448
BH10	0.8	304	East-West	1528

BH10	0.8	295	North-South	1485

8.0 RECOMMENDATIONS

The current study presents an initial appraisal of likely conditions across the Mount Emerald wind farm site. Access at this relatively early stage in the project has been limited, to the extent that a fully representative sample of site conditions may not have been obtained. Further subsurface investigation and analysis may be necessary.

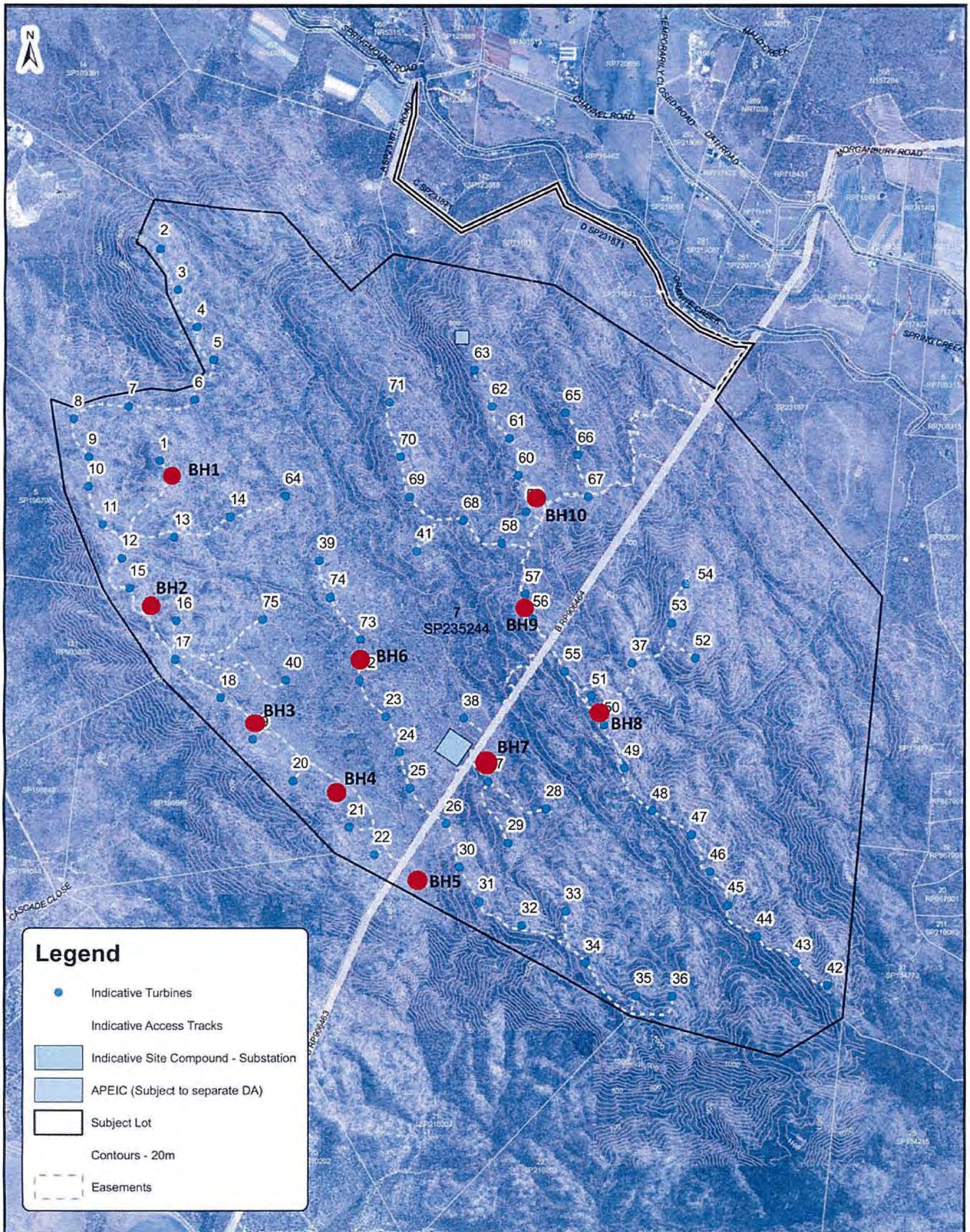
It is recommended that an ETS geotechnical engineer inspect all footing excavations to confirm the subsurface conditions.

9.0 LIMITATIONS

We have prepared this report for the use of **RATCH AUSTRALIA CORPORATION** for design purposes in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **RATCH AUSTRALIA CORPORATION** or their design consultants, i.e. Architect & Civil/Structural Engineers. It may not contain sufficient information for purposes of other parties or for other uses. Your attention is drawn to the document - "Understand the Limitations of Your Geotechnical Report", which is included in Appendix D of this report. This document has been prepared to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by ETS, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

GEOTECHNICAL

APPENDIX A – LOCALITY PLAN



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	Compiled by: RMS		135 Abbott St PO Box 1949 CAIRNS QLD 4870
	Map Projection: MGAz55	Title: Mount Emerald Site Layout	T +61 7 4031 1336 F +61 7 4031 2942 W rpsgroup.com.au
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	File Reference: PR100246-26b.mxd		
	Sheet Number: 1 of 1		Scale (A3): 1:25,000 — Date: 13/7/2011 — Drawing No.: PR100246-26 — Issue: B

APPENDIX B – BOREHOLE LOGS

ETS GEOTECHNICAL

ENGINEERING BOREHOLE LOG

BOREHOLE No BH1
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald
COORDINATES 325444.0 E; 8101359.0 N
JOB No GT12-156
SURFACE R.L. 865.00m
PLUNGE 90 °
DATE STARTED
GRID DATUM MGA94 56
HEIGHT DATUM AHD
BEARING 0 °
DATE COMPLETED
DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( )% / CORE REC %	SAMPLE	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	INTACT STRENGTH (EH VH H M L VL EL)	DEFECT SPACING (mm) (20 60 200 600 2000)	GRAPHIC LOG	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	865.00												
	865.10	(49)		SANDY CLAY: pale grey brown, low plasticity, fine to coarse grained sand		CL							
		86		RHYOLITE IGNIMBRITE: pale brown grey, flow banded, layered, slightly weathered to fresh, very high strength	V		SW				JT 10° Clay; JT 50° Clay; 0.67: UCS=74.6 MPa; JT 55°; JT 65° Clay Infill 5mm thick		
1		(0) / 99			V						JT 30° Clay		
2		(49) / 98			V								
3		(78) / 87			V						JT 65° Clay		
4		(15)			V								
5					V		F				JT 5° Clay		
6	871.10	100			V								
				BH1 TERMINATED AT 6.10 m Target depth									
7													

REMARKS

LOGGED BY CR

ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH2
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald — COORDINATES 325558.0 E; 8100922.0 N
JOB No GT12-156 — SURFACE R.L. 873.00m — PLUNGE 90° — DATE STARTED — GRID DATUM MGA94 56
HEIGHT DATUM AHD — BEARING 0° — DATE COMPLETED — DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( ) % / CORE REC %	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	873.00		SANDY CLAY: pale grey brown, low plasticity, fine to coarse grained sand		CL				
	873.75	(70)	RHYOLITE IGNIMBRITE: pale grey, flow banded, layered, fresh, very high strength	V		F	0.98: UCS=164 MPa Is(50)=13.37 MPa	x	
							Is(50)=13 MPa	x	
							JT 88°		
3		100 (32)					JT 24° Clay Infill 10mm thick		
		100 (52)							
5							JT 25° Clay		
	879.85	100	BH2 TERMINATED AT 6.85 m Target depth						
7 / 7.2									

REMARKS

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH3
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald — COORDINATES 326433.0 E; 8100062.0 N
JOB No GT12-156 — SURFACE R.L. 867.00m — PLUNGE 90° — DATE STARTED — GRID DATUM MGA94 56
HEIGHT DATUM AHD — BEARING 0° — DATE COMPLETED — DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( ) % / CORE REC %	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	INTACT STRENGTH (EH VH H M L VL EL)	DEFECT SPACING (mm) (20 60 200 600 2000)	ADDITIONAL DATA AND TEST RESULTS
0	867.00								
	867.11		SANDY CLAY: pale grey brown, low plasticity, fine to coarse grained sand		CL				
		(28)	RHYOLITE IGNIMBRITE: pale grey brown, flow banded, layered, slightly weathered, very high strength	V		SW			JT 28° Fe; JT 36°
1		89 / (0)		V					JT 10° Fe
		75 / (92)		V					JT 55° Clay Infill 8mm thick
2–6				V					JT 55° Clay Infill 55mm thick; JT 40° Clay
	873.35	96		V					
7			BH3 TERMINATED AT 6.35 m Target depth						

REMARKS

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH4
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald — COORDINATES 326906.0 E; 8099841.0 N
JOB No GT12-156 — SURFACE R.L. 839.00m — PLUNGE 90 ° — DATE STARTED — GRID DATUM MGA94 56
HEIGHT DATUM AHD — BEARING 0 ° — DATE COMPLETED — DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( ) % / CORE REC %	MATERIAL DESCRIPTION	USC	WEATHERING	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	839.00		SANDY CLAY: pale grey brown, low plasticity, fine to coarse grained sand	CL				
	839.20	(75)	RHYOLITE IGNIMBRITE: grey brown, flow banded, layered, highly weathered to slightly weathered, high to very high strength		MW	0.50: UCS=40.5 MPa		
		100 / (75)				JT 30°		
						Is(50)=7.09 MPa	x	
						JT 70° Fe		
						JT 20° Fe; JT 25° Fe		
		100 / (45)			SW	JT 5° Clay		
						JT 25° Fe Vuggy Iron Infill 5mm thick; JT 80° Fe		
		100 / (88)				JT 57°		
		100 / (52)			HW	JT 85° Clay Weathered Gouge Infill 10mm thick		
						JT 45°		
						JT 5° Clay Infill thickness 40mm		
	845.35	100						
			BH4 TERMINATED AT 6.35 m Target depth					

REMARKS

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH5
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald — COORDINATES 327273.0 E; 8098688.0 N
JOB No GT12-156 — SURFACE R.L. 916.00m — PLUNGE 90 ° — DATE STARTED — GRID DATUM MGA94 56
HEIGHT DATUM AHD — BEARING 0 ° — DATE COMPLETED — DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( )% / CORE REC %	MATERIAL DESCRIPTION	USC	WEATHERING	ADDITIONAL DATA AND TEST RESULTS	SAMPLES / TESTS
0	916.00		SANDY CLAY: pale grey brown, low plasticity, fine to coarse grained sand	CL			
	916.70	(63) 100	RHYOLITE IGNIMBRITE: pale grey brown with yellow orange, flow banded, layered, highly weathered to slightly weathered, high to very high strength		SW	JT 10°	
		(77) 100				JT 30° Clay; JT 80°; JT 20° Clay; JT 65°	
		(65) 100				JT 55° Fe	
		(79) 100			HW	Is(50)=1.72 MPa; JT 22° Clay Clay gouge Infill 70mm thick	x
		(40) 100			SW	JT 15° Clay	
7	923.01		BH5 TERMINATED AT 7.01 m Target depth				

REMARKS

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH6
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald
COORDINATES 326905.0 E; 8099836.0 N
JOB No GT12-156
SURFACE R.L. 854.00m
PLUNGE 90 °
DATE STARTED
GRID DATUM MGA94 56
HEIGHT DATUM AHD
BEARING 0 °
DATE COMPLETED
DRILLER Saxon

DEPTH (m)	R.L. (m)		RQD ( ) % / CORE REC %	SAMPLE	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	INTACT STRENGTH (EH VH H M L VL EL)	DEFECT SPACING (mm) (20 60 200 600 2000)	GRAPHIC LOG	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	854.00				SANDY CLAY: grey, low plasticity, fine to coarse grained sand		CL							
	854.70		(17) 100		RHYOLITE IGNIMBRITE: grey, flow banded, layered, moderately weathered to fresh, high to very high strength	V		MW						
1			(0) 100			V						JT 5° Fe; JT 60°; JT 5° Fe; JT 60°		
2			(32) 100			V						JT 18° Fe; JT 68°		
3			(61) 100			V		F				JT 10° KT		
4			(7) 100			V						JT 85°		
5	859.25					V								
					BH6 TERMINATED AT 5.25 m Target depth									
6														
7														

REMARKS

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ETS GEOTECHNICAL

ENGINEERING BOREHOLE LOG

BOREHOLE No BH7
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald
COORDINATES 328138.0 E; 8099992.0 N
JOB No GT12-156
SURFACE R.L. 821.00m
PLUNGE 90 °
DATE STARTED
GRID DATUM MGA94 56
HEIGHT DATUM AHD
BEARING 0 °
DATE COMPLETED
DRILLER Saxon

DEPTH (m)	R.L. (m)		RQD ( )% / CORE REC %	SAMPLE	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	INTACT STRENGTH (EH VH H M L VL EL)	DEFECT SPACING (mm) (20 60 200 600 2000)	GRAPHIC LOG	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	821.00													
	821.18				CLAY: pale grey brown, low plasticity		CL							
			(88) 100 (90)		RHYOLITE IGNIMBRITE: pale grey, flow banded, layered, slightly weathered to fresh, very high strength	V		SW						
1						V						1.30: UCS=221 MPa		
2						V						JT 9° Fe		
3						V		F				JT 80°		
4			90 (80)			V								
5						V						JT 55° Fe		
6	827.10		100			V						JT 28° Fe		
					BH7 TERMINATED AT 6.20 m Target depth									
7														

REMARKS

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No: BH8
SHEET: 1 of 1
REFERENCE No:

PROJECT: RATCH Wind Farm
LOCATION: Mount Emerald
COORDINATES: 328921.0 E; 8100190.0 N
JOB No: GT12-156
SURFACE R.L.: 935.00m
PLUNGE: 90 °
DATE STARTED:
GRID DATUM: MGA94 56
HEIGHT DATUM: AHD
BEARING: 0 °
DATE COMPLETED:
DRILLER: Saxon

DEPTH (m)	R.L. (m)		RQD ( ) % / CORE REC %	SAMPLE	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	INTACT STRENGTH (EH VH H M L VL EL)	DEFECT SPACING (mm) (20 60 200 600 2000)	GRAPHIC LOG	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	935.00				CLAY: pale grey brown, low plasticity		CL							
	935.58		(56)		RHYOLITE IGNIMBRITE: pale white grey pale brown, slightly weathered, high strength	V		SW						
												Is(50)=2.66 MPa		x
												JT 55° Fe Clay		
4			97 (80)											
	941.33		97											
					BH8 TERMINATED AT 6.33 m Target depth									

REMARKS:

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH9
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald COORDINATES 328560.0 E; 8100982.0 N
JOB No GT12-156 SURFACE R.L. 842.00m PLUNGE 90 ° DATE STARTED GRID DATUM MGA94 56
HEIGHT DATUM AHD BEARING 0 ° DATE COMPLETED DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( ) % / CORE REC %	MATERIAL DESCRIPTION	LITHOLOGY	USC	WEATHERING	ADDITIONAL DATA AND TEST RESULTS	SAMPLES	TESTS
0	842.00	(38)	RHYOLITE IGNIMBRITE: pale brown grey with yellow orange, flow banded, layered, moderately weathered to slightly weathered, high strength	V		MW	Is(50)=6.34 MPa; JT 33°; JT 42°		x
		100 / (16)		V			JT 15° Fe		
		100 / (55)		V		SW	JT 22° Fe; JT 75° Clay Infill thickness 5mm; 3.05: UCS=56.3 MPa		
		100 / (87)		V			JT 5° Fe; JT 55°		
6	848.05	100		V					
			BH9 TERMINATED AT 6.20 m Target depth						

INTACT STRENGTH: EH VH H M L VL EL
DEFECT SPACING (mm): 20 60 200 600 2000

REMARKS

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ENGINEERING BOREHOLE LOG

ETS GEOTECHNICAL

BOREHOLE No BH10
SHEET 1 of 1
REFERENCE No

PROJECT RATCH Wind Farm
LOCATION Mount Emerald — COORDINATES 328506.0 E; 8101596.0 N
JOB No GT12-156 — SURFACE R.L. 840.00m — PLUNGE 90° — DATE STARTED — GRID DATUM MGA94 56
HEIGHT DATUM AHD — BEARING 0° — DATE COMPLETED — DRILLER Saxon

DEPTH (m)	R.L. (m)	RQD ( )% / CORE REC %	MATERIAL DESCRIPTION	LITHOLOGY	USC / WEATHERING	ADDITIONAL DATA AND TEST RESULTS	SAMPLES / TESTS
0	840.00		SANDY CLAY: grey, low plasticity, fine to coarse grained sand		CL		
0.30	840.30	(71)	RHYOLITE IGNIMBRITE: pale brown grey with pale red, flow banded, layered, moderately weathered to slightly weathered, high to very high strength	V	SW	0.40: UCS=37.8 MPa	
				V		JT 20° Clay	
				V		JT 70° Fe	
				V		JT 85° Fe	
3		100 / (29)		V	MW	JT 77° Clay Infill thickness 10mm	
		100 / (81)		V	SW	JT 80° Fe	
4				V		Is(50)=4.16 MPa	x
				V		JT 80° Fe	
				V		JT 80° Fe	
6				V		JT 20° Clay	
6.30	846.30	100	BH10 TERMINATED AT 6.30 m Target depth				
7							

REMARKS

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APPENDIX C – LABORATORY RESULTS

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

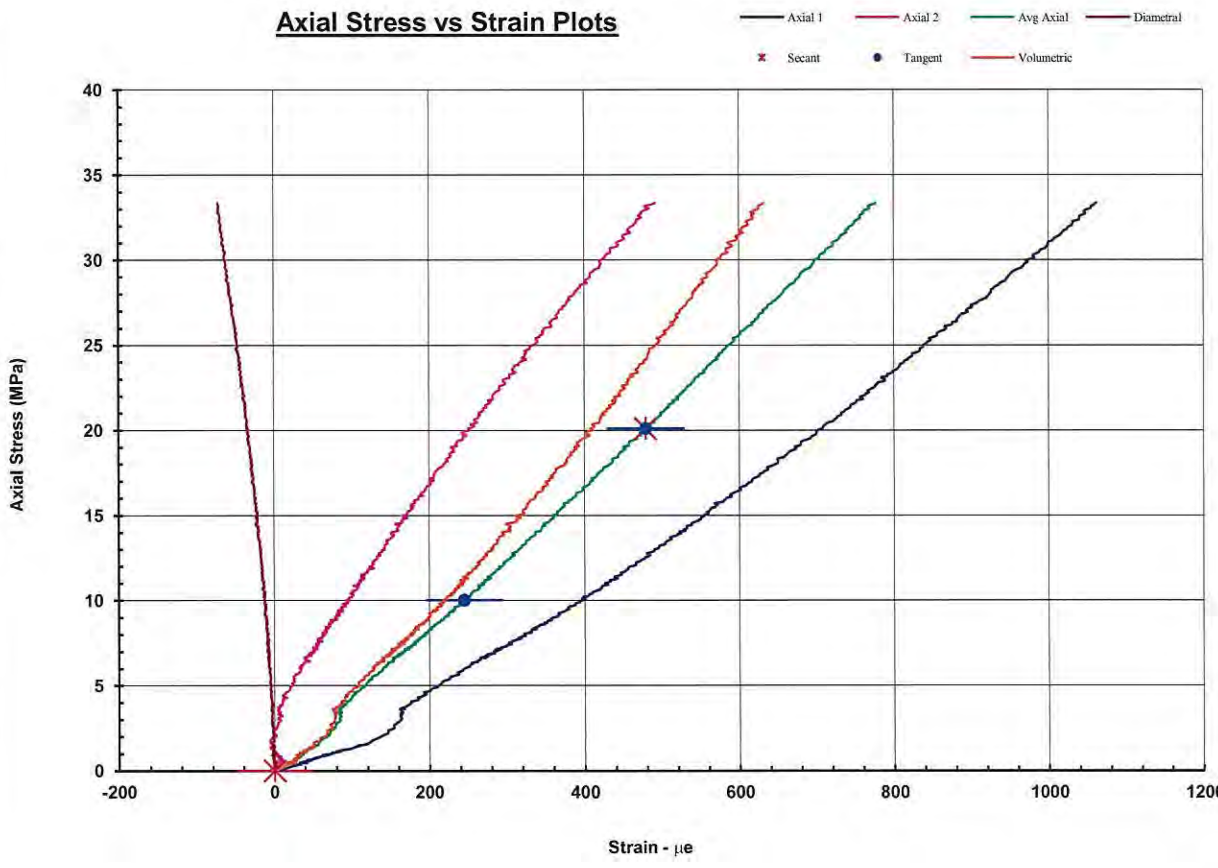
Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040025-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH01	**Depth (m)**	0.67-0.85
Description	-	**Sample Type**	Single Individual Rock Core Specimen

Uniaxial Compressive Strength 74.6 MPa

	Young's Modulus	**Poisson Ratio**	
Tangent	43.0 GPa	0.074	from 13 % to 27 % of Max UCS
Secant	42.0 GPa	0.074	from 0 % to 27 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks: Tested as received.

Sample/s supplied by client

Graph not to scale

Authorised Signatory

J. Russell

Trilab
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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040025-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH01	**Depth (m)**	0.67-0.85
Description	-		

Uniaxial Compressive Strength 74.6 MPa

Average Sample Diameter (mm)	51.9	Moisture Content (%)	0.5
Sample Height (mm)	142.5	Wet Density (t/m^3)	2.57
Duration of Test (min)	8.90	Dry Density (t/m^3)	2.55
Rate of Loading (MPa/min)	8.38	Bedding (°)	Nil
Mode of Failure	Conical	Test Apparatus	Kelba 1000kN Load Cell

Notes/Remarks:

Photo not to scale

Accredited for compliance with ISO/IES 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
J. Russell

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Laboratory No. 9926

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040026-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH02	**Depth (m)**	0.98-1.16
Description	-	**Sample Type**	Single Individual Rock Core Specimen

Uniaxial Compressive Strength 164 MPa

	Young's Modulus	**Poisson Ratio**	
Tangent	58.6 GPa	0.084	from 3 % to 12 % of Max UCS
Secant	55.6 GPa	0.084	from 0 % to 12 % of Max UCS

Axial Stress vs Strain Plots

Notes/Remarks: Tested as received.

Sample/s supplied by client

Graph not to scale

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040026-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH02	**Depth (m)**	0.98-1.16
Description	-		

Uniaxial Compressive Strength 164 MPa

Average Sample Diameter (mm)	51.8	Moisture Content (%)	0.7
Sample Height (mm)	140.5	Wet Density (t/m^3)	2.58
Duration of Test (min)	9.17	Dry Density (t/m^3)	2.56
Rate of Loading (MPa/min)	17.91	Bedding (°)	Nil
Mode of Failure	Disintegration	Test Apparatus	Kelba 1000kN Load Cell

Notes/Remarks:

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

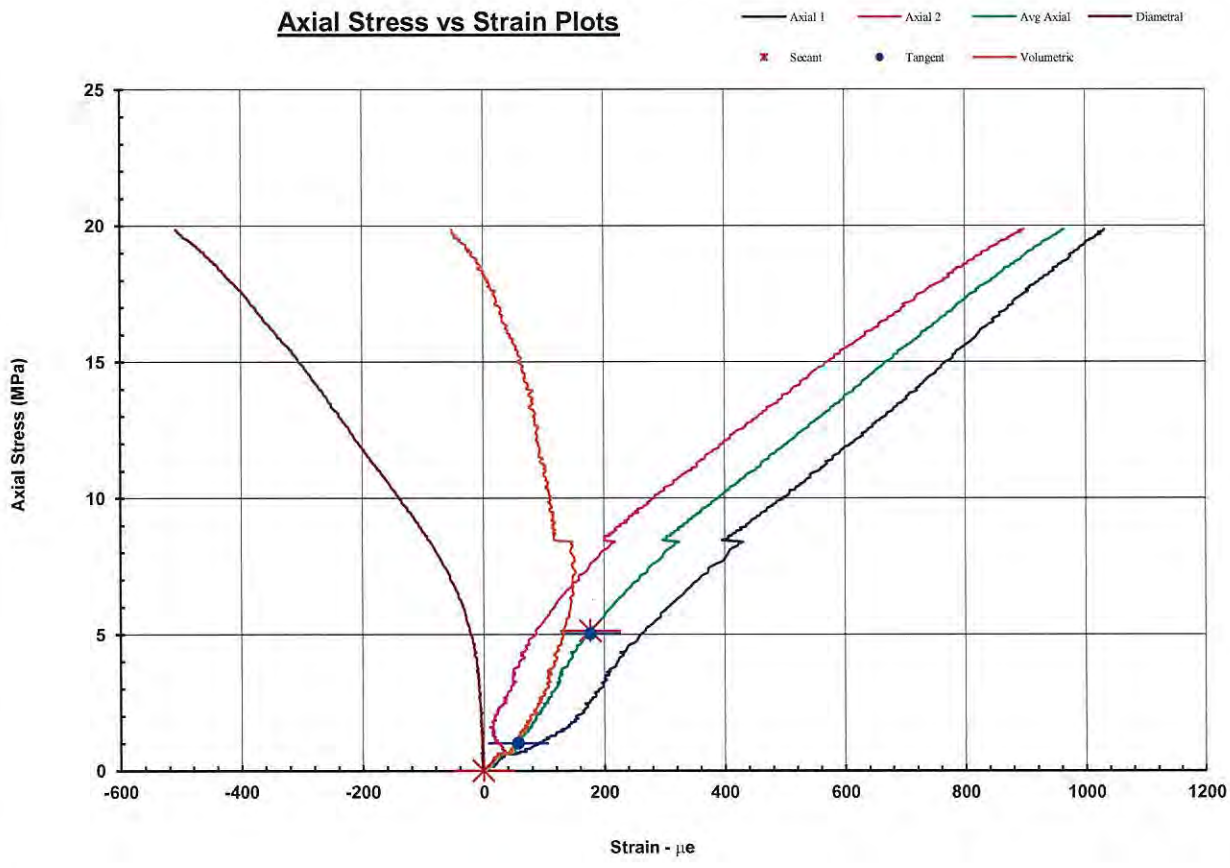
Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040027-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH04	**Depth (m)**	0.50-0.70
Description	-	**Sample Type**	Single Individual Rock Core Specimen

Uniaxial Compressive Strength 40.5 MPa

	Young's Modulus	**Poisson Ratio**	
Tangent	33.5 GPa	0.118	from 2 % to 12 % of Max UCS
Secant	29.0 GPa	0.128	from 0 % to 12 % of Max UCS

Axial Stress vs Strain Plots



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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040027-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH04	**Depth (m)**	0.50-0.70
Description	-		

Uniaxial Compressive Strength 40.5 MPa

Average Sample Diameter (mm)	52.0	Moisture Content (%)	0.8
Sample Height (mm)	142.1	Wet Density (t/m^3)	2.53
Duration of Test (min)	6.75	Dry Density (t/m^3)	2.51
Rate of Loading (MPa/min)	6.00	Bedding (°)	0-25
Mode of Failure	Shear	Test Apparatus	Kelba 1000kN Load Cell

Notes/Remarks:

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

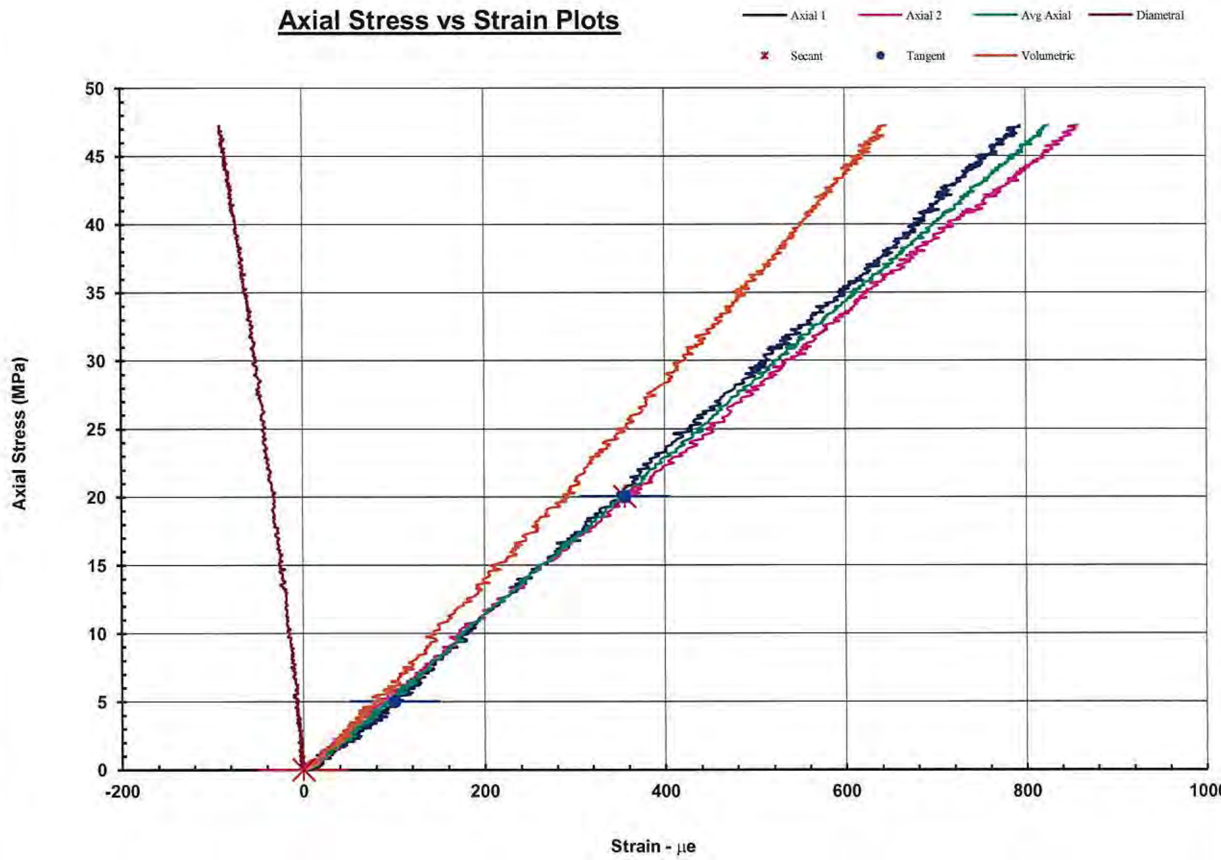
Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040028-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH07	**Depth (m)**	1.30-1.55
Description	-	**Sample Type**	Single Individual Rock Core Specimen

Uniaxial Compressive Strength 221 MPa

	Young's Modulus	**Poisson Ratio**	
Tangent	58.9 GPa	0.088	from 2 % to 9 % of Max UCS
Secant	56.3 GPa	0.088	from 0 % to 9 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks: Tested as received.

Sample/s supplied by client

Graph not to scale

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040028-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH07	**Depth (m)**	1.30-1.55
Description	-		

Uniaxial Compressive Strength 221 MPa

Average Sample Diameter (mm)	51.9	Moisture Content (%)	0.9
Sample Height (mm)	142.4	Wet Density (t/m^3)	2.60
Duration of Test (min)	10.20	Dry Density (t/m^3)	2.58
Rate of Loading (MPa/min)	21.67	Bedding (°)	Nil
Mode of Failure	Conical	Test Apparatus	Kelba 1000kN Load Cell

Notes/Remarks:

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Tested at Trilab Brisbane Laboratory.

Authorised Signatory
J. Russell

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UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

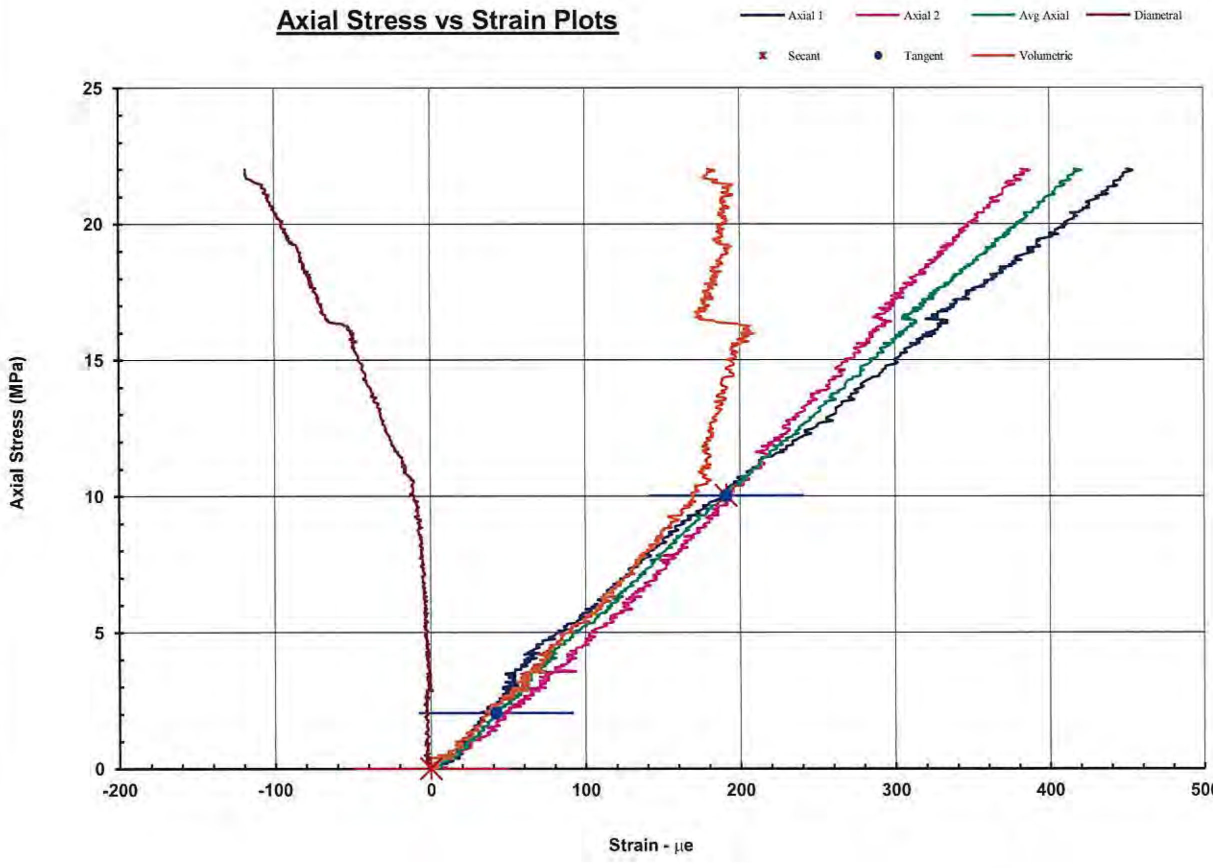
Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040029-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH09	**Depth (m)**	3.05-3.29
Description	-	**Sample Type**	Single Individual Rock Core Specimen

Uniaxial Compressive Strength 56.3 MPa

	Young's Modulus	**Poisson Ratio**	
Tangent	53.6 GPa	0.055	from 4 % to 18 % of Max UCS
Secant	52.5 GPa	0.055	from 0 % to 18 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks: Tested as received.

Sample/s supplied by client

Graph not to scale

Accredited for compliance with ISO/IES 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
J. Russell

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040029-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH09	**Depth (m)**	3.05-3.29
Description	-		

Uniaxial Compressive Strength 56.3 MPa

Average Sample Diameter (mm)	51.9	Moisture Content (%)	0.7
Sample Height (mm)	141.8	Wet Density (t/m^3)	2.55
Duration of Test (min)	11.10	Dry Density (t/m^3)	2.54
Rate of Loading (MPa/min)	5.07	Bedding (°)	Nil
Mode of Failure	Disintegration	Test Apparatus	Kelba 1000kN Load Cell

Notes/Remarks:

Photo not to scale

Trilab
Soil Rock Calibration

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Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

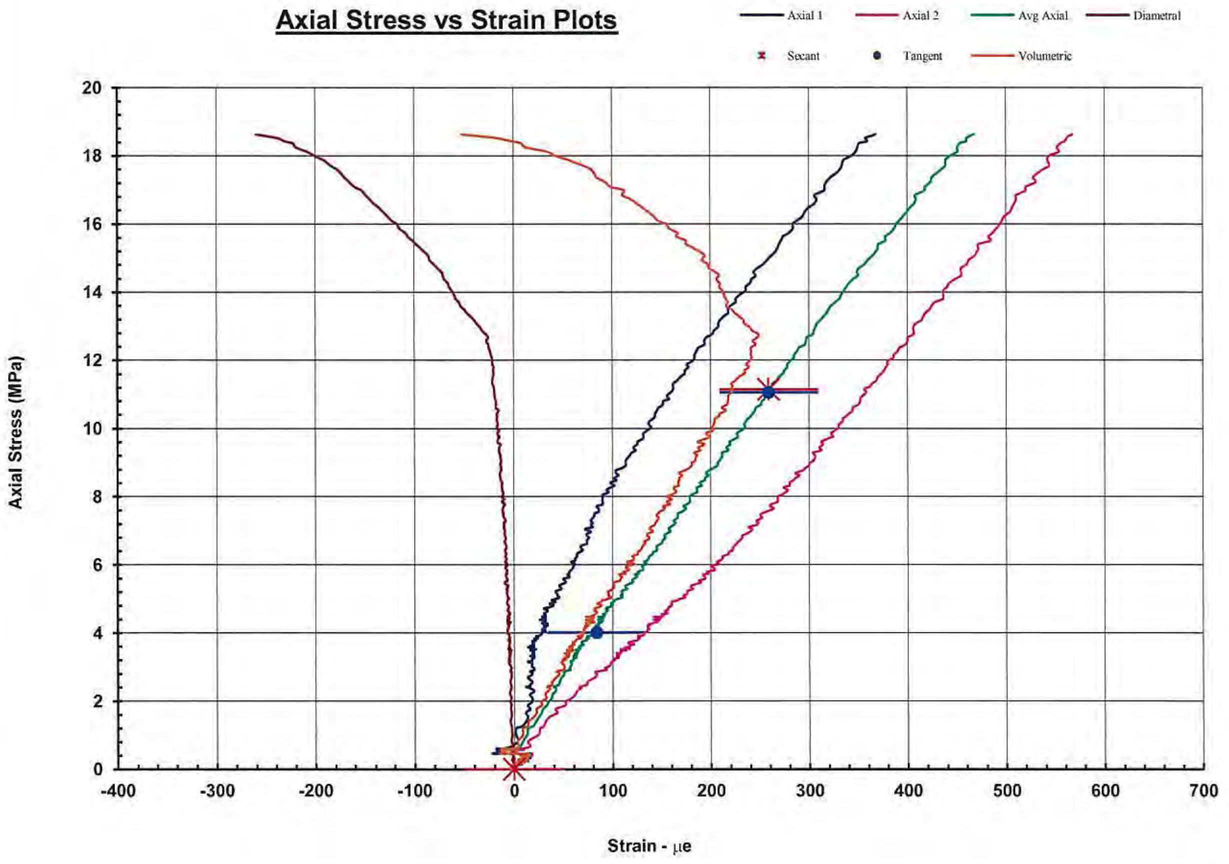
Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040030-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH10	**Depth (m)**	0.40-0.53
Description	-	**Sample Type**	Single Individual Rock Core Specimen

Uniaxial Compressive Strength 37.8 MPa

	Young's Modulus	**Poisson Ratio**	
Tangent	40.3 GPa	0.073	from 11 % to 29 % of Max UCS
Secant	43.0 GPa	0.073	from 0 % to 29 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks: Tested as received.

Sample/s supplied by client — Graph not to scale

Trilab
Soil Rock Calibration

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346A Bilsen Road,
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2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

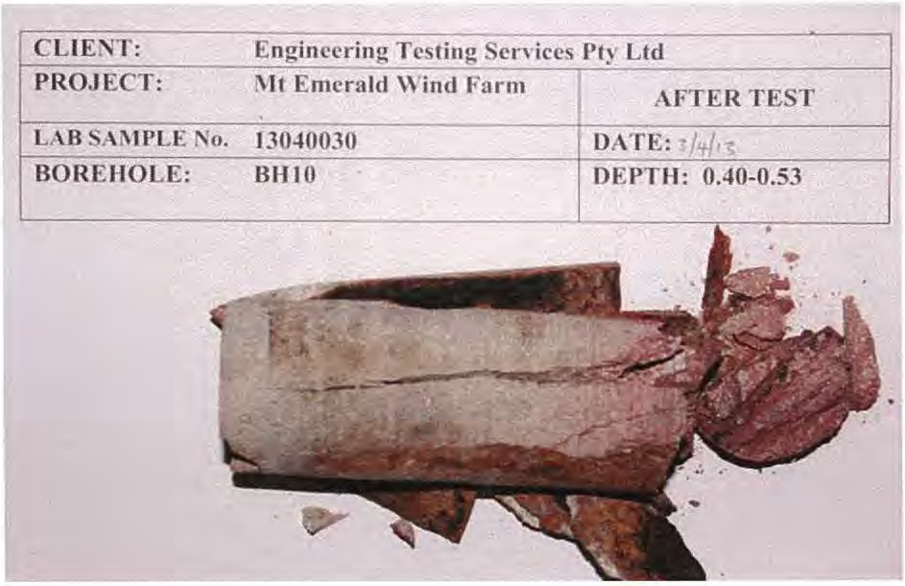
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Engineering Testing Services Pty Ltd	**Report No.**	13040030-MOD
Project	Mt Emerald Wind Farm	**Test Date**	3/04/2013
		Report Date	4/04/2013
Client ID	BH10	**Depth (m)**	0.40-0.53
Description	-		

Uniaxial Compressive Strength 37.8 MPa

Average Sample Diameter (mm)	51.9	Moisture Content (%)	0.8
Sample Height (mm)	140.9	Wet Density (t/m^3)	2.52
Duration of Test (min)	8.05	Dry Density (t/m^3)	2.50
Rate of Loading (MPa/min)	4.69	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	Kelba 1000kN Load Cell



Notes/Remarks:

Photo not to scale

Accredited for compliance with ISO/IES 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
J. Russell

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

GEOTECHNICAL

Engineering Testing Services Pty Ltd
Phone: 07 4047 8600 - Fax: 07 4047 8699
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PO Box 252 BUNGALOW Qld 4870
info@engineeringtesting.com.au
www.engineeringtesting.com.au
ABN: 71 882 809 386
NATA Accreditation No. 1833

POINT LOAD TEST REPORT

Customer :	**RATCH Australia Corporation**	Report Number:	**GT12-156 PLT**
Address:	**Building A4 SW1 52 Merivale St. Sth. Brisbane QLD 4101**	Report Date:	**2/04/2013**
Job Number :	**GT12-156**	Order Number	**-**
Project :	**Mount Emerald Windfarm**	Test Method:	**AS 4133.4.1**
Location :	**Mount Emerald, Walkamin**		

Sample No :	1	2	3	4
ID No :	BH10	BH4	BH8	BH5
Date Sampled :	8/04/2013	8/04/2013	8/04/2013	8/04/2013
Sampled By:	ETS	ETS	ETS	ETS
Sampling Test Method :	AS1289.1.2.1 6.5.3	AS1289.1.2.1 6.5.3	AS1289.1.2.1 6.5.3	AS1289.1.2.1 6.5.3
Date Tested :	8/04/2013	8/04/2013	8/04/2013	8/04/2013
Time Tested :	14:00	14:05	14:10	14:15
Lithological Description :	Rhyolitic Ignimbrite	Rhyolitic Ignimbrite	Rhyolitic Ignimbrite	Rhyolitic Ignimbrite
Sample Condition :	Slightly Weathered	Slightly Weathered	Slightly Weathered	Slightly Weathered
Storage History :	-	-	-	-
Sample Location :	3.93 - 4.18	1.5 - 1.74	2.39 - 2.57	5.85 - 6.03
Platen Separation (mm)	39.0	39.5	41.5	37.0
Sample Length (mm)	74.0	74.5	76.5	72.0
Orientation to weakness planes	Parallel	Parallel	Parallel	Parallel
Max gauge reading (kN)	7.08	12.30	4.97	2.70
Load Direction :	Diametral	Diametral	Diametral	Diametral
I_s (Mpa) :	4.65	7.88	2.88	1.97
$I_{s(50)}$ (Mpa) :	4.16	7.08	2.65	1.72
Anisotrophy Index $I_{a(50)}$ (Mpa) :	-	-	-	-
Remarks :				

Signature:

Approved by: Cameron Ryan

Position: Senior Engineering Geologist

Date: 8/04/2013

FORM NUMBER

PLT-1

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www.engineeringtesting.com.au
ABN: 71 882 809 386
NATA Accreditation No: 1833

POINT LOAD TEST REPORT

Customer :	RATCH Australia Corporation	Report Number:	GT12-156 PLT
Address:	Building A4 SW1 52 Merivale St. Sth. Brisbane QLD 4101	Report Date:	2/04/2013
Job Number :	GT12-156	Order Number	-
Project :	Mount Emerald Windfarm	Test Method:	AS 4133.4.1
Location :	Mount Emerald, Walkamin		

Sample No :	5	6		
ID No :	BH2	BH9		
Date Sampled :	8/04/2013	8/04/2013		
Sampled By:	ETS	ETS		
Sampling Test Method :	AS1289.1.2.1 6.5.3	AS1289.1.2.1 6.5.3		
Date Tested :	8/04/2013	8/04/2013		
Time Tested :	14:20	14:25		
Lithological Description :	Rhyolitic Ignimbrite	Rhyolitic Ignimbrite		
Sample Condition :	Slightly Weathered	Slightly Weathered		
Storage History :	-	-		
Sample Location :	1.21 - 1.45	0.22 - 0.48		
Platen Separation (mm)	37.0	38.0		
Sample Length (mm)	0.24	0.26		
Orientation to weakness planes	Parallel	Parallel		
Max gauge reading (kN)	20.96	10.35		
Load Direction :	Diametral	Diametral		
I_s (Mpa) :	15.31	7.16		
$I_{s(50)}$ (Mpa) :	13.37	6.33		
Anisotrophy Index $I_{a(50)}$ (Mpa) :	-	-		

Remarks :

Signature:

Approved by: Cameron Ryan

Position: Senior Engineering Geologist

Date: 8/04/2013

FORM NUMBER

PLT-1

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NATA Accreditation No: 1833

Atterberg Limits Report

Client:	**RATCH Australia Corporation**	Report Number:	**CL13-035-001**
Client Address:	**Building A4 SW1 52 Merivale St. Sth. Brisbane QLD 4101**		
Job Number:	**GT12-156**	Report Date:	**5/04/2013**
Project:	**Mount Emerald Wind Farm**	Order Number:	-
Location	**Mount Emerald QLD 4872**		
Lab No:	**CS8850**	Sample Location:	
Date Sampled:	**4/03/2013**		**BH1**
Date Tested:	**4/04/2013**		**0.2m**
Sampled By:	**DK**		
Sample Method:	**AS1289.1.2.1 6.4(b)**		
Material Source:	**Insitu Material**	Spec Description:	-
For Use As:	**Material Investigation**	Lot Number:	-
Remarks:	**Sandy SILT (ML)**	Spec Number:	-

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289 3.1.2**	-	**31**	-
Plastic Limit (%)	**AS1289 3.2.1**	-	**26**	-
Plasticity Index	**AS1289 3.3.1**	-	**5**	-
Linear Shrinkage (%)	**AS1289 3.4.1**	-	**2.0**	-

APPROVED SIGNATORY

Darren Koch

NATA Accreditation No. 1833

FORM NUMBER

REP ASATT-1

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ABN: 71 882 809 386
NATA Accreditation No: 1833

Quality of Materials Report

Client:	**RATCH Australia Corporation**	Report Number:	**CL13-035-002**
Client Address:	**Building A4 SW1 52 Merivale St. Sth. Brisbane QLD 4101**		
Job Number:	**GT12-156**	Report Date:	**5/04/2013**
Project:	**Mount Emerald Wind Farm**	Order Number:	**-**
Location	**Mount Emerald QLD 4872**		
Lab No:	**CS8851**	Sample Location:	**BH2 0.2m**
Date Sampled:	**4/03/2013**		
Date Tested:	**4/04/2013**		
Sampled By:	**DK**		
Sample Method:	**AS1289.1.2.1 6.4(b)**		
Material Source:	**Insitu Material**	Spec Description:	-
For Use As:	**Material Investigation**	Lot Number:	**-**
Remarks:	**Sandy SILT (ML)**	Spec Number:	**-**

Particle Size Distribution

Test Method AS1289 3.6.1

A.S. Sieve Size	Specification	Result % Passing
75mm	-	**100**
53mm	-	**100**
37.5mm	-	**100**
19.0mm	-	**100**
9.5mm	-	**95**
4.75mm	-	**80**
2.36mm	-	**75**
0.425mm	-	**70**
0.075mm	-	**55**

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	**AS1289 3.1.2**	**-**	**20**	**-**
Plastic Limit (%)	**AS1289 3.2.1**	**-**	**14**	**-**
Plasticity Index	**AS1289 3.3.1**	**-**	**6**	**-**
Linear Shrinkage (%)	**AS1289 3.4.1**	**-**	**2.5**	**-**
PI x % passing 0.425mm (WPI)			**420**	
LS x % passing 0.425mm			**175**	
Ratio of % passing (0.075 / 0.425)			**0.78**	

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APPENDIX D - UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT

GEOTECHNICAL & MATERIALS TESTING

UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT

This report has been based on project details as provided to us at the time of the commission. It therefore applies only to the site investigated and to a specific set of project requirements as understood by Engineering Testing Services.

If there are changes to the project, you need to advise us in order that the effect of the changes on the report recommendations can be adequately assessed. Engineering Testing Services cannot take responsibility for problems that may occur due to project changes if they are not consulted.

It is important to remember that the subsurface conditions described in the report represent the state of the site at the time of investigation. Natural processes and the activities of man can result in changes to site conditions. For example, ground water levels can change or fill can be placed on a site after the investigation is completed. If there is a possibility that conditions may have changed with time, Engineering Testing Services should be consulted to assess the impact on the recommendations of the report.

The site investigation only identifies the actual subsurface conditions at the location and time when the samples were taken. Geologists and engineers then extrapolate between the investigation points to provide an assumed three-dimensional picture of the site conditions. The report is based on the assumption that the site conditions as identified at the investigation locations are representative of the actual conditions throughout an area. This may not be the case and actual conditions may differ from those inferred to exist. This will not be known until construction has commenced. Your geotechnical report and the recommendations contained within it can therefore only be regarded as preliminary.

In the event that conditions encountered during construction are different to those described in the report, Engineering Testing Services should be consulted immediately. Nothing can be done to change the actual site conditions which exist but steps can be taken to reduce the impact of unexpected conditions. For this reason, the services of Engineering Testing Services should be retained through the development stage of a project.

Problems can occur when other design professionals misinterpret a report. To help avoid this, Engineering Testing Services should be retained for work with other design professionals to explain the implications of the report.

This report should be retained as a complete document and should not be copied in part, divided or altered in any way.

It is recommended that Engineering Testing Services is retained during the construction phase to confirm that conditions encountered are consistent with design assumptions. For example, this may involve assessment of bearing capacity for footings, stability of natural slopes or excavations or advice on temporary construction conditions.

This document has been produced to help all parties involve recognise their individual responsibilities.

Appendix 12

EPBC Act Protected Matters Report and Wildlife Online

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

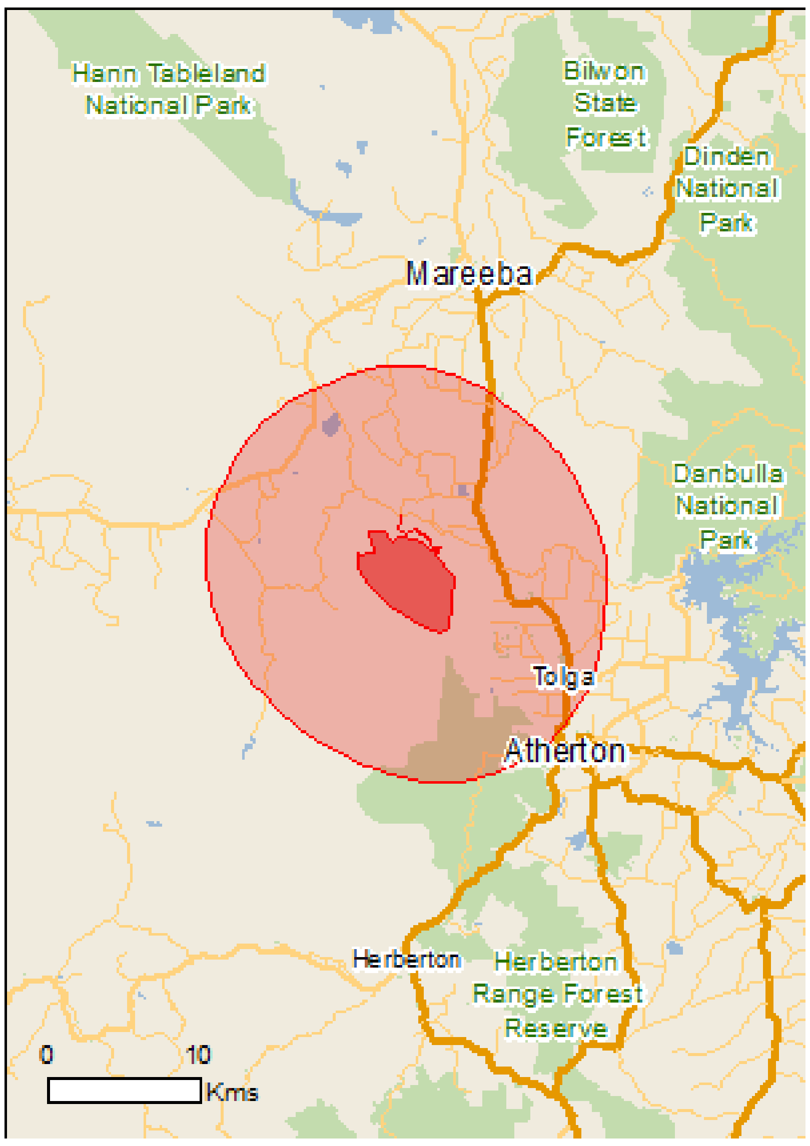
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

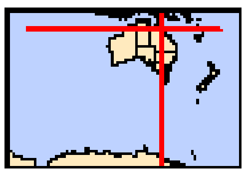
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 26/09/13 12:19:15



Coordinates
Buffer: 10.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	47
Listed Migratory Species:	16

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	1
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	34
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Broad leaf tea-tree (Melaleuca viridiflora) woodlands in high rainfall coastal north Queensland	Endangered	Community may occur within area
Mabi Forest (Complex Notophyll Vine Forest 5b)	Critically Endangered	Community known to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Casuarius casuarius johnsonii Southern Cassowary (Australian), Southern Cassowary [25986]	Endangered	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Poephila cincta cincta Black-throated Finch (southern) [64447]	Endangered	Species or species habitat known to occur

Name	Status	Type of Presence
		within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Fish		
Melanotaenia eachamensis Lake Eacham Rainbowfish [26185]	Endangered	Species or species habitat known to occur within area
Frogs		
Litoria nannotis Waterfall Frog, Torrent Tree Frog [1817]	Endangered	Species or species habitat may occur within area
Litoria nyakalensis Mountain Mistfrog [1820]	Critically Endangered	Species or species habitat known to occur within area
Litoria rheocola Common Mistfrog [1802]	Endangered	Species or species habitat likely to occur within area
Nyctimystes dayi Lace-eyed Tree Frog, Australian Lacelid [1813]	Endangered	Species or species habitat likely to occur within area
Pseudophryne covacevichae Magnificent Brood Frog [64385]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Bettongia tropica Northern Bettong [214]	Endangered	Species or species habitat likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat known to occur within area
Dasyurus maculatus gracilis Spotted-tailed Quoll or Yarri (North Queensland subspecies) [64475]	Endangered	Species or species habitat likely to occur within area
Hipposideros semoni Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat [180]	Endangered	Species or species habitat may occur within area
Petaurus australis unnamed subsp. Yellow-bellied Glider (Wet Tropics), Fluffy Glider [66668]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Pteropus conspicillatus Spectacled Flying-fox [185]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Species or species habitat may occur within area

Name	Status	Type of Presence
Rhinolophus philippinensis (large form)		
Greater Large-eared Horseshoe Bat [66890]	Endangered	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus		
Bare-rumped Sheathtail Bat [66889]	Critically Endangered	Species or species habitat likely to occur within area
Other		
Cycas platyphylla		
a cycad [55796]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia purpureopetala		
[61156]	Vulnerable	Species or species habitat may occur within area
Alloxylon flammeum		
Red Silky Oak, Queensland Waratah, Tree Waratah [56400]	Vulnerable	Species or species habitat likely to occur within area
Arthraxon hispidus		
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area
Cajanus mareebensis		
[8635]	Endangered	Species or species habitat known to occur within area
Chamaesyce carissoides		
[67187]	Vulnerable	Species or species habitat likely to occur within area
Dendrobium bigibbum		
Cooktown Orchid [10306]	Vulnerable	Species or species habitat may occur within area
Dendrobium johannis		
[13585]	Vulnerable	Species or species habitat may occur within area
Grevillea glossadenia		
[7979]	Vulnerable	Species or species habitat likely to occur within area
Homoranthus porteri		
[55196]	Vulnerable	Species or species habitat likely to occur within area
Huperzia filiformis		
Rat's Tail Tassel-fern [24163]	Endangered	Species or species habitat likely to occur within area
Huperzia marsupiiformis		
Water Tassel-fern [56632]	Vulnerable	Species or species habitat likely to occur within area
Phaius australis		
Lesser Swamp-orchid [5872]	Endangered	Species or species habitat known to occur within area
Phaius tancarvilleae		
Swamp Lily, Greater Swamp-orchid [2104]	Endangered	Species or species habitat known to occur within area
Prostanthera clotteniana		
[76165]	Critically Endangered	Species or species habitat known to occur within area
Sauropus macranthus		
[13189]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Streblus pendulinus Siah's Backbone, Sia's Backbone, Isaac Wood [21618]	Endangered	Species or species habitat known to occur within area
Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid [10771]	Vulnerable	Species or species habitat likely to occur within area
Tropilis callitrophilis Thin Feather Orchid [82771]	Vulnerable	Species or species habitat may occur within area
Tylophora rupicola [55237]	Endangered	Species or species habitat likely to occur within area
Sharks		
Pristis microdon Freshwater Sawfish [66182]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Marine Species		
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Grus antigone		
Sarus Crane [904]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Defence - ATHERTON RIFLE RANGE

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat likely to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat likely to occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Monarcha trivirgatus		
Spectacled Monarch [610]		Species or species habitat known to occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Reptiles		
Crocodylus johnstoni		
Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus		
Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Brydes Granite Gorge Beetle Site	QLD	Indicative Place

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Lonchura punctulata Nutmeg Mannikin [399]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Bufo marinus Cane Toad [1772]		Species or species habitat likely to occur within area
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Annona glabra Pond Apple, Pond-apple Tree, Alligator Apple,		Species or species

Name	Status	Type of Presence
Bullock's Heart, Cherimoya, Monkey Apple, Bobwood, Corkwood [6311]		habitat likely to occur within area
Anredera cordifolia		
Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus plumosus		
Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Cabomba caroliniana		
Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Cryptostegia grandiflora		
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Dolichandra unguis-cati		
Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes		
Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis		
Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Parthenium hysterophorus		
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Protasparagus plumosus		
Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lepidodactylus lugubris		
Mourning Gecko [1712]		Species or species habitat likely to occur within area

Coordinates

-17.15222 145.36528,-17.15306 145.36472,-17.15361 145.36333,-17.15333 145.36167,
-17.15444 145.35611,-17.15417 145.35472,-17.16028 145.35556,-17.16678 145.35806,
-17.17222 145.36167,-17.18444 145.37417,-17.19528 145.39444,-17.19806 145.40472,
-17.19556 145.40917,-17.1675 145.41222,-17.15444 145.40056,-17.15056 145.40333,
-17.15056 145.40222,-17.14972 145.39972,-17.14778 145.3975,-17.14583 145.39694,
-17.14361 145.39528,-17.14139 145.39056,-17.14 145.39,-17.14278 145.38306,-17.13944
145.37889,-17.13528 145.38,-17.13306 145.38028,-17.13417 145.37972,-17.13528 145.37972,
-17.13972 145.37861,-17.14333 145.38306,-17.14028 145.38972,-17.14139 145.39028,
-17.14389 145.39528,-17.14583 145.39667,-17.14806 145.3975,-17.14972 145.39944,
-17.15083 145.40194,-17.15083 145.40278,-17.15389 145.40083,-17.14667 145.38972,
-17.14444 145.37833,-17.14694 145.37556,-17.14167 145.37083,-17.14083 145.36194,
-17.14361 145.36056,-17.14389 145.36111,-17.14583 145.36278,-17.14694 145.36278,
-17.15222 145.36528

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: 17.1667
Longitude: 145.387
Distance: 10
Email: naomi.watts@rpsgroup.com.au
Date submitted: Thursday 26 Sep 2013 12:44:36
Date extracted: Thursday 26 Sep 2013 12:50:04

The number of records retrieved = 742

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			1
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		1
animals	amphibians	Hylidae	*Litoria bicolor*	northern sedgefrog		C		1
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		1
animals	amphibians	Hylidae	*Litoria fallax*	eastern sedgefrog		C		2
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		1
animals	amphibians	Myobatrachidae	*Uperoleia altissima*	tableland gungan		C		1
animals	birds	Acanthizidae	*Gerygone mouki*	brown gerygone		C		2
animals	birds	Acanthizidae	*Sericornis citreogularis*	yellow-throated scrubwren		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		2
animals	birds	Acanthizidae	*Sericornis magnirostra*	large-billed scrubwren		C		2
animals	birds	Acanthizidae	*Oreoscopus gutturalis*	fernwren		C		1
animals	birds	Acanthizidae	*Sericornis frontalis*	white-browed scrubwren		C		1
animals	birds	Acanthizidae	*Gerygone albogularis*	white-throated gerygone		C		4
animals	birds	Acanthizidae	*Sericornis keri*	Atherton scrubwren		C		1
animals	birds	Accipitridae	*Lophoictinia isura*	square-tailed kite		NT		2
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		3
animals	birds	Accipitridae	*Circus approximans*	swamp harrier		C		1
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		6
animals	birds	Accipitridae	*Circus assimilis*	spotted harrier		C		2
animals	birds	Accipitridae	*Elanus scriptus*	letter-winged kite		C		1
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		11
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle		C		4
animals	birds	Accipitridae	*Erythrotriorchis radiatus*	red goshawk		E	V	1
animals	birds	Accipitridae	*Accipiter novaehollandiae*	grey goshawk		NT		1
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		C		1
animals	birds	Anatidae	*Dendrocygna arcuata*	wandering whistling-duck		C		1
animals	birds	Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		C		1
animals	birds	Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose		NT		1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		5
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		6
animals	birds	Anatidae	*Nettapus pulchellus*	green pygmy-goose		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		3
animals	birds	Anseranatidae	*Anseranas semipalmata*	magpie goose		C		1
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		2
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		3
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		4
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		1
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		2
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		4
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		3
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		7
animals	birds	Campephagidae	*Lalage leucomela*	varied triller		C		2
animals	birds	Campephagidae	*Lalage sueurii*	white-winged triller		C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		8
animals	birds	Campephagidae	*Coracina tenuirostris*	cicadabird		C		1
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		7
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		4
animals	birds	Cisticolidae	*Cisticola exilis*	golden-headed cisticola		C		2
animals	birds	Climacteridae	*Cormobates leucophaea minor*	white-throated treecreeper (northern)		C		2
animals	birds	Columbidae	*Macropygia amboinensis*	brown cuckoo-dove		C		1
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		2
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		9
animals	birds	Columbidae	*Columba livia*	rock dove	Y			1
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		1
animals	birds	Columbidae	*Streptopelia chinensis*	spotted dove	Y			4
animals	birds	Columbidae	*Geophaps scripta peninsulae*	squatter pigeon (northern subspecies)		C		2/ 1
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		3/ 1
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		5
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		2
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		6/ 1
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		1
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		1
animals	birds	Dicruridae	*Dicrurus bracteatus*	spangled drongo		C		7
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		3
animals	birds	Estrildidae	*Lonchura castaneothorax*	chestnut-breasted mannikin		C		2
animals	birds	Estrildidae	*Neochmia temporalis*	red-browed finch		C		4
animals	birds	Estrildidae	*Erythrura gouldiae*	Gouldian finch		E	E	3
animals	birds	Estrildidae	*Lonchura punctulata*	nutmeg mannikin	Y			1
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		1
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		2
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		1
animals	birds	Gruidae	*Grus antigone*	sarus crane		C		1
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		1
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		1
animals	birds	Halcyonidae	*Todiramphus macleayii*	forest kingfisher		C		1
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		11
animals	birds	Hirundinidae	*Cheramoeca leucosterna*	white-backed swallow		C		2
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		5
animals	birds	Jacanidae	*Irediparra gallinacea*	comb-crested jacana		C		2
animals	birds	Laridae	*Gygis alba*	white tern		C		1
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		2
animals	birds	Megapodiidae	*Megapodius reinwardt*	orange-footed scrubfowl		C		1
animals	birds	Megapodiidae	*Alectura lathami*	Australian brush-turkey		C		6
animals	birds	Meliphagidae	*Philemon buceroides*	helmeted friarbird		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		9
animals	birds	Meliphagidae	*Melithreptus lunatus*	white-naped honeyeater		C		1
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		2
animals	birds	Meliphagidae	*Ramsayornis fasciatus*	bar-breasted honeyeater		C		1
animals	birds	Meliphagidae	*Myzomela sanguinolenta*	scarlet honeyeater		C		4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		5
animals	birds	Meliphagidae	*Acanthorhynchus tenuirostris*	eastern spinebill		C		1
animals	birds	Meliphagidae	*Stomiopera flavus*	yellow honeyeater		C		5
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		6
animals	birds	Meliphagidae	*Myzomela obscura*	dusky honeyeater		C		1
animals	birds	Meliphagidae	*Meliphaga notata*	yellow-spotted honeyeater		C		1
animals	birds	Meliphagidae	*Bolemoreus frenatus*	bridled honeyeater		C		1
animals	birds	Meliphagidae	*Caligavis chrysops*	yellow-faced honeyeater		C		2
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		2
animals	birds	Meliphagidae	*Phylidonyris niger*	white-cheeked honeyeater		C		3
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		6
animals	birds	Monarchidae	*Symposiarchus trivirgatus*	spectacled monarch		C		2
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		2
animals	birds	Monarchidae	*Myiagra cyanoleuca*	satin flycatcher		C		1
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		24
animals	birds	Monarchidae	*Monarcha melanopsis*	black-faced monarch		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		4
animals	birds	Nectariniidae	*Nectarinia jugularis*	olive-backed sunbird		C		1
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		1
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		3
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		2
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		2
animals	birds	Pachycephalidae	*Pachycephala pectoralis*	golden whistler		C		1
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		5
animals	birds	Pachycephalidae	*Colluricincla megarhyncha*	little shrike-thrush		C		1
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		2
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		4
animals	birds	Pardalotidae	*Pardalotus rubricatus*	red-browed pardalote		C		1
animals	birds	Passeridae	*Passer domesticus*	house sparrow	Y			2
animals	birds	Petroicidae	*Eopsaltria australis*	eastern yellow robin		C		2
animals	birds	Petroicidae	*Heteromyias cinereifrons*	grey-headed robin		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		2
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		4
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		3
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		1
animals	birds	Podicipedidae	*Podiceps cristatus*	great crested grebe		C		1
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		5
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		2
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		9
animals	birds	Psittacidae	*Cyclopsitta diophthalma macleayana*	Macleay's fig-parrot		V		1
animals	birds	Psittacidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet		C		5
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		3
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		1
animals	birds	Psophodidae	*Psophodes olivaceus*	eastern whipbird		C		1
animals	birds	Ptilonorhynchidae	*Scenopoeetes dentirostris*	tooth-billed bowerbird		C		2
animals	birds	Ptilonorhynchidae	*Ailuroedus melanotis*	spotted catbird		C		6/2

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animals	birds	Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	great bowerbird		C		1
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		3
animals	birds	Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet		C		1
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		8
animals	birds	Rhipiduridae	*Rhipidura rufifrons*	rufous fantail		C		1
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		5
animals	birds	Strigidae	*Ninox connivens*	barking owl		C		1
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		1
animals	birds	Sturnidae	*Sturnus tristis*	common myna	Y			19
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	birds	Timaliidae	*Zosterops lateralis*	silvereye		C		6
animals	birds	Turdidae	*Zoothera heinei*	russet-tailed thrush		C		1
animals	birds	Turnicidae	*Turnix maculosus*	red-backed button-quail		C		1
animals	birds	Tytonidae	*Tyto javanica*	eastern barn owl		C		1/1
animals	birds	Tytonidae	*Tyto longimembris*	eastern grass owl		C		3
animals	birds	Tytonidae	*Tyto tenebricosa multipunctata*	lesser sooty owl		C		1
animals	malacostracans	Parastacidae	*Cherax quadricarinatus*	redclaw				4
animals	mammals	Dasyuridae	*Dasyurus hallucatus*	northern quoll		C	E	7/1
animals	mammals	Dasyuridae	*Planigale maculata*	common planigale		C		3/2
animals	mammals	Felidae	*Felis catus*	cat	Y			1
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			3
animals	mammals	Macropodidae	*Thylogale stigmatica*	red-legged pademelon		C		2
animals	mammals	Macropodidae	*Macropus parryi*	whiptail wallaby		C		1
animals	mammals	Macropodidae	*Macropus robustus*	common wallaroo		C		1
animals	mammals	Macropodidae	*Macropus agilis*	agile wallaby		C		10
animals	mammals	Macropodidae	*Petrogale mareeba*	Mareeba rock-wallaby		NT		3/2
animals	mammals	Muridae	*Rattus sordidus*	canefield rat		C		1/1
animals	mammals	Muridae	*Rattus rattus*	black rat	Y			1/1
animals	mammals	Muridae	*Uromys caudimaculatus*	giant white-tailed rat		C		1
animals	mammals	Peramelidae	*Isoodon sp.*					1
animals	mammals	Peramelidae	*Perameles nasuta*	long-nosed bandicoot		C		3/1
animals	mammals	Petauridae	*Dactylopsila trivirgata*	striped possum		C		1
animals	mammals	Petauridae	*Petaurus norfolcensis*	squirrel glider		C		1
animals	mammals	Petauridae	*Petaurus breviceps*	sugar glider		C		2/2
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		8/1
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		2
animals	mammals	Pseudocheiridae	*Petauroides volans*	greater glider		C		1
animals	mammals	Pseudocheiridae	*Pseudochirops archeri*	green ringtail possum		NT		2/2
animals	mammals	Pseudocheiridae	*Pseudocheirus peregrinus*	common ringtail possum		C		1/1
animals	mammals	Pteropodidae	*Pteropus conspicillatus*	spectacled flying-fox		C	V	9/2
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		1
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		C		4/2
animals	ray-finned fishes	Apogonidae	*Glossamia aprion*	mouth almighty				81
animals	ray-finned fishes	Atherinidae	*Craterocephalus stercusmuscarum*	flyspecked hardyhead				54
animals	ray-finned fishes	Belonidae	*Strongylura krefftii*	freshwater longtom				1
animals	ray-finned fishes	Cichlidae	*Tilapia mariae*	spotted tilapia	Y			9

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animals	ray-finned fishes	Clupeidae	*Nematolosa erebi*	bony bream				82
animals	ray-finned fishes	Eleotridae	*Hypseleotris compressa*	empire gudgeon				21
animals	ray-finned fishes	Eleotridae	*Oxyeleotris lineolata*	sleepy cod				10
animals	ray-finned fishes	Eleotridae	*Oxyeleotris selheimi*	blackbanded gudgeon				1
animals	ray-finned fishes	Eleotridae	*Hypseleotris galii*	firetail gudgeon				1
animals	ray-finned fishes	Eleotridae	*Mogurnda adspersa*	southern purplespotted gudgeon				1
animals	ray-finned fishes	Eleotridae	*Mogurnda mogurnda*	northern purplespotted gudgeon				8
animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia splendida inornata*	checkered rainbowfish				25
animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia eachamensis*	Lake Eacham rainbowfish			E	1/1
animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia splendida splendida*	eastern rainbowfish				75
animals	ray-finned fishes	Plotosidae	*Tandanus tandanus*	freshwater catfish				21
animals	ray-finned fishes	Plotosidae	*Neosilurus ater*	black catfish				7
animals	ray-finned fishes	Plotosidae	*Porochilus rendahli*	Rendahl's catfish				21
animals	ray-finned fishes	Plotosidae	*Neosilurus hyrtlii*	Hyrtl's catfish				7
animals	ray-finned fishes	Poeciliidae	*Poecilia reticulata*	guppy	Y			12
animals	ray-finned fishes	Terapontidae	*Leiopotherapon unicolor*	spangled perch				11
animals	ray-finned fishes	Terapontidae	*Hephaestus fuliginosus*	sooty grunter				8
animals	ray-finned fishes	Terapontidae	*Hephaestus carbo*	coal grunter				5
animals	ray-finned fishes	Terapontidae	*Amniataba percoides*	barred grunter				54
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		2
animals	reptiles	Boidae	*Morelia spilota*	carpet python		C		4
animals	reptiles	Boidae	*Morelia kinghorni*	amethystine python (Australian form)		C		1
animals	reptiles	Colubridae	*Tropidonophis mairii*	freshwater snake		C		1/1
animals	reptiles	Diplodactylidae	*Amalosia rhombifer*	zig-zag gecko		C		1
animals	reptiles	Elapidae	*Cryptophis nigrescens*	eastern small-eyed snake		C		1/1
animals	reptiles	Elapidae	*Pseudonaja textilis*	eastern brown snake		C		1/1
animals	reptiles	Elapidae	*Cacophis churchilli*			C		1/1
animals	reptiles	Elapidae	*Acanthophis antarcticus*	common death adder		NT		1/1
animals	reptiles	Scincidae	*Cryptoblepharus metallicus*	metallic snake-eyed skink		C		1
animals	reptiles	Scincidae	*Carlia storri*			C		1/1
animals	reptiles	Scincidae	*Eulamprus tenuis*			C		1/1
animals	reptiles	Typhlopidae	*Ramphotyphlops sp.*					1/1
fungi	club fungi	Basidiomycota	*Lepista*			C		1/1
fungi	club fungi	Basidiomycota	*Macrolepiota clelandii*			C		1/1
fungi	club fungi	Basidiomycota	*Pisolithus albus*			C		1/1
fungi	club fungi	Basidiomycota	*Scleroderma*			C		1/1
fungi	club fungi	Basidiomycota	*Cortinarius*			C		1/1
fungi	club fungi	Basidiomycota	*Polyporus*			C		1/1
fungi	club fungi	Basidiomycota	*Amanita*			C		1/1
fungi	club fungi	Basidiomycota	*Boletus*			C		1/1
fungi	club fungi	Basidiomycota	*Microporellus obovatus*			C		1/1
fungi	club fungi	Basidiomycota	*Agaricus*			C		2/2
fungi	club fungi	Basidiomycota	*Calvatia*			C		1/1
fungi	club fungi	Basidiomycota	*Inonotus*			C		1/1
fungi	sac fungi	Acarosporaceae	*Acarospora*			C		1/1
fungi	sac fungi	Pertusariaceae	*Pertusaria subventosa var. subventosa*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
fungi	sac fungi	Pertusariaceae	*Ochrolechia*			C		1/1
fungi	sac fungi	Physciaceae	*Pyxine plumea*			C		1/1
fungi	sac fungi	Physciaceae	*Buellia*			C		1/1
fungi	sac fungi	Teloschistaceae	*Caloplaca*			C		1/1
plants	conifers	Araucariaceae	*Agathis atropurpurea*	blue kauri pine		C		1/1
plants	conifers	Cupressaceae	*Callitris intratropica*	coast cypress pine		C		1/1
plants	conifers	Podocarpaceae	*Sundacarpus amarus*			C		1/1
plants	cycads	Cycadaceae	*Cycas media subsp. banksii*			C		1/1
plants	cycads	Cycadaceae	*Cycas media - C.platyphylla*			C		1/1
plants	ferns	Adiantaceae	*Cheilanthes nitida*			C		1/1
plants	ferns	Adiantaceae	*Cheilanthes brownii*			C		1/1
plants	ferns	Adiantaceae	*Adiantum philippense*			C		2/2
plants	ferns	Adiantaceae	*Doryopteris concolor*			C		1/1
plants	ferns	Adiantaceae	*Paraceterach muelleri*			C		1/1
plants	ferns	Adiantaceae	*Cheilanthes sieberi subsp. sieberi*			C		1/1
plants	ferns	Adiantaceae	*Cheilanthes tenuifolia*	rock fern		C		1/1
plants	ferns	Aspleniaceae	*Asplenium paleaceum*	scaly asplenium		C		1/1
plants	ferns	Athyriaceae	*Callipteris prolifera*			C		2/2
plants	ferns	Azollaceae	*Azolla pinnata*	ferny azolla		C		1/1
plants	ferns	Azollaceae	*Azolla*					1
plants	ferns	Dryopteridaceae	*Lastreopsis microsora subsp. microsora*			C		1/1
plants	ferns	Hymenophyllaceae	*Hymenophyllum walleri*			C		1/1
plants	ferns	Hymenophyllaceae	*Hymenophyllum samoense*			C		1/1
plants	ferns	Lindsaeaceae	*Lindsaea microphylla*	lacy wedge fern		C		1/1
plants	ferns	Nephrolepidaceae	*Arthropteris tenella*	climbing fern		C		1/1
plants	ferns	Ophioglossaceae	*Ophioglossum gramineum*			C		1/1
plants	ferns	Polypodiaceae	*Pyrrosia confluens var. dielsii*			C		1/1
plants	ferns	Polypodiaceae	*Colysis sayeri*			C		1/1
plants	ferns	Pteridaceae	*Acrostichum aureum*	golden mangrove fern		C		1/1
plants	ferns	Pteridaceae	*Pteris tripartita*	lacy bracken		C		1/1
plants	ferns	Thelypteridaceae	*Sphaerostephanos unitus var. unitus*			C		2/2
plants	ferns	Thelypteridaceae	*Cyclosorus interruptus*			C		1/1
plants	ferns	Vittariaceae	*Monogramma acrocarpa*			C		1/1
plants	higher dicots	Acanthaceae	*Asystasia sp. (Newcastle Bay L.J.Brass 18671)*			C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens subsp. glaucoviolacea*			C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens var. hispida*			C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens*			C		1/1
plants	higher dicots	Acanthaceae	*Thunbergia fragrans*		Y			1/1
plants	higher dicots	Acanthaceae	*Brunoniella australis*	blue trumpet		C		1/1
plants	higher dicots	Acanthaceae	*Hypoestes phyllostachya*		Y			1/1
plants	higher dicots	Acanthaceae	*Harnieria hygrophiloides*	white karambal		C		1/1
plants	higher dicots	Amaranthaceae	*Celosia argentea*		Y			1/1
plants	higher dicots	Amaranthaceae	*Amaranthus spinosus*	needle burr	Y			1/1
plants	higher dicots	Amaranthaceae	*Deeringia amaranthoides*	redberry		C		1/1
plants	higher dicots	Apiaceae	*Actinotus gibbonsii*	dwarf flannel flower		C		2/2
plants	higher dicots	Apocynaceae	*Gomphocarpus physocarpus*	balloon cottonbush	Y			1/1

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plants	higher dicots	Apocynaceae	*Marsdenia suborbicularis*			C		1/1
plants	higher dicots	Apocynaceae	*Marsdenia longipedicellata*			C		1/1
plants	higher dicots	Apocynaceae	*Wrightia saligna*			C		1/1
plants	higher dicots	Apocynaceae	*Neisosperma poweri*			C		1/1
plants	higher dicots	Apocynaceae	*Phyllanthera grayi*			V		7/7
plants	higher dicots	Apocynaceae	*Tylophora colorata*			C		1/1
plants	higher dicots	Apocynaceae	*Alstonia muelleriana*	hard milkwood		C		1/1
plants	higher dicots	Apocynaceae	*Asclepias curassavica*	red-head cottonbush	Y			1/1
plants	higher dicots	Araliaceae	*Astrotricha pterocarpa*			C		1/1
plants	higher dicots	Araliaceae	*Trachymene montana*			C		2/2
plants	higher dicots	Araliaceae	*Hydrocotyle*			C		1/1
plants	higher dicots	Asteraceae	*Acmella grandiflora var. brachyglossa*			C		6/6
plants	higher dicots	Asteraceae	*Picris angustifolia subsp. carolorum-henricorum*			C		1/1
plants	higher dicots	Asteraceae	*Phacellothrix cladochaeta*			C		2/2
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			1/1
plants	higher dicots	Asteraceae	*Coronidium lanuginosum*			C		2/2
plants	higher dicots	Asteraceae	*Centratherum punctatum*		Y			1/1
plants	higher dicots	Asteraceae	*Senecio prenanthoides*			C		1/1
plants	higher dicots	Asteraceae	*Glossocardia refracta*			C		1/1
plants	higher dicots	Asteraceae	*Cyanthillium cinereum*			C		1/1
plants	higher dicots	Asteraceae	*Calyptocarpus vialis*	creeping cinderella weed	Y			1/1
plants	higher dicots	Asteraceae	*Praxelis clematidea*		Y			3/3
plants	higher dicots	Asteraceae	*Peripleura diffusa*			C		1/1
plants	higher dicots	Asteraceae	*Camptacra gracilis*			C		2/2
plants	higher dicots	Asteraceae	*Peripleura scabra*			NT		1/1
plants	higher dicots	Asteraceae	*Ageratina riparia*	mistflower	Y			1/1
plants	higher dicots	Asteraceae	*Cosmos caudatus*		Y			2/2
plants	higher dicots	Asteraceae	*Cirsium vulgare*	spear thistle	Y			1/1
plants	higher dicots	Balanopaceae	*Balanops australiana*			C		1/1
plants	higher dicots	Bignoniaceae	*Dolichandra unguis-cati*		Y			2/2
plants	higher dicots	Boraginaceae	*Heliotropium peninsulare*			C		1/1
plants	higher dicots	Boraginaceae	*Heliotropium tabuliplagae*			C		2/2
plants	higher dicots	Brassicaceae	*Lepidium virginicum*	Virginian peppercress	Y			1/1
plants	higher dicots	Byttneriaceae	*Keraudrenia lanceolata*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Erythrophleum chlorostachys*			C		2/2
plants	higher dicots	Caesalpiniaceae	*Chamaecrista mimosoides*	dwarf cassia		C		1/1
plants	higher dicots	Caesalpiniaceae	*Chamaecrista exigua var. exigua*			C		1/1
plants	higher dicots	Campanulaceae	*Wahlenbergia caryophylloides*			C		1/1
plants	higher dicots	Campanulaceae	*Lobelia gibbosa var. gibbosa*			C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea corymbosa var. corymbosa*			C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea spirostylis subsp. spirostylis*			C		1/1
plants	higher dicots	Casuarinaceae	*Allocasuarina torulosa*			C		1/1
plants	higher dicots	Celastraceae	*Euonymus australiana*			C		1/1
plants	higher dicots	Celastraceae	*Celastrus subspicata*	large-leaved staffvine		C		1/1
plants	higher dicots	Celastraceae	*Denhamia disperma*			C		3/3
plants	higher dicots	Celastraceae	*Elaeodendron melanocarpum*			C		1/1

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plants	higher dicots	Convolvulaceae	*Ipomoea gracilis*			C		1/1
plants	higher dicots	Convolvulaceae	*Turbina corymbosa*		Y			1/1
plants	higher dicots	Convolvulaceae	*Ipomoea polymorpha*			C		1/1
plants	higher dicots	Convolvulaceae	*Xenostegia tridentata*			C		1/1
plants	higher dicots	Convolvulaceae	*Ipomoea polpha subsp. polpha*			C		7/7
plants	higher dicots	Cucurbitaceae	*Neoalsomitra clavigera*			C		1/1
plants	higher dicots	Dichapetalaceae	*Dichapetalum papuanum*			C		1/1
plants	higher dicots	Dilleniaceae	*Hibbertia*			C		2/2
plants	higher dicots	Dilleniaceae	*Hibbertia aspera subsp. pilosifolia*			C		1/1
plants	higher dicots	Ebenaceae	*Diospyros australis*	black plum		C		1/1
plants	higher dicots	Elaeocarpaceae	*Elaeocarpus coorangooloo*	brown quandong		NT		10/10
plants	higher dicots	Ericaceae	*Monotoca scoparia*	prickly broom heath		C		1/1
plants	higher dicots	Ericaceae	*Leucopogon*			C		3/3
plants	higher dicots	Ericaceae	*Astroloma sp. (Baal Gammon B.P.Hyland 10341)*			C		1/1
plants	higher dicots	Ericaceae	*Melichrus urceolatus*	honey gorse		C		1/1
plants	higher dicots	Ericaceae	*Acrothamnus spathaceus*			C		1/1
plants	higher dicots	Ericaceae	*Leucopogon ruscifolius*			C		1/1
plants	higher dicots	Euphorbiaceae	*Alchornea ilicifolia*	native holly		C		1/1
plants	higher dicots	Fabaceae	*Gompholobium nitidum*			C		1/1
plants	higher dicots	Fabaceae	*Cajanus scarabaeoides var. scarabaeoides*			C		2/2
plants	higher dicots	Fabaceae	*Crotalaria medicaginea var. medicaginea*			C		1/1
plants	higher dicots	Fabaceae	*Vigna*			C		1/1
plants	higher dicots	Fabaceae	*Galactia*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia*			C		1/1
plants	higher dicots	Fabaceae	*Hovea nana*			C		4/4
plants	higher dicots	Fabaceae	*Uraria picta*			C		2/2
plants	higher dicots	Fabaceae	*Cajanus cajan*	pigeon pea	Y			1/1
plants	higher dicots	Fabaceae	*Mirbelia pungens*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia juncea*			C		2/2
plants	higher dicots	Fabaceae	*Crotalaria brevis*			C		2/2
plants	higher dicots	Fabaceae	*Tephrosia varians*			C		1/1
plants	higher dicots	Fabaceae	*Zornia stirlingii*			C		1/1
plants	higher dicots	Fabaceae	*Desmodium pullenii*			C		1/1
plants	higher dicots	Fabaceae	*Glycine tomentella*	woolly glycine		C		2/2
plants	higher dicots	Fabaceae	*Indigofera colutea*	sticky indigo		C		1/1
plants	higher dicots	Fabaceae	*Indigofera linnaei*	Birdsville indigo		C		1/1
plants	higher dicots	Fabaceae	*Kennedia rubicunda*	red Kennedy pea		C		1/1
plants	higher dicots	Fabaceae	*Lotononis bainesii*	lotononis	Y			1/1
plants	higher dicots	Fabaceae	*Zornia macdonaldii*			C		1/1
plants	higher dicots	Fabaceae	*Crotalaria calycina*			C		3/3
plants	higher dicots	Fabaceae	*Crotalaria goreensis*	gambia pea	Y			2/2
plants	higher dicots	Fabaceae	*Erythrina vespertilio subsp. vespertilio*			C		2/2
plants	higher dicots	Fabaceae	*Indigofera linifolia*			C		2/2
plants	higher dicots	Fabaceae	*Stylosanthes humilis*	Townsville stylo	Y			1/1
plants	higher dicots	Fabaceae	*Tephrosia leptoclada*			C		1/1
plants	higher dicots	Fabaceae	*Uraria lagopodioides*			C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Fabaceae	*Indigofera bancroftii*			C		1/1
plants	higher dicots	Fabaceae	*Aeschynomene micranthos*			C		1/1
plants	higher dicots	Fabaceae	*Aeschynomene paniculata*		Y			1/1
plants	higher dicots	Fabaceae	*Lamprolobium fruticosum*			C		3/3
plants	higher dicots	Fabaceae	*Desmodium rhytidophyllum*			C		2/2
plants	higher dicots	Fabaceae	*Aphyllodium biarticulatum*			C		1/1
plants	higher dicots	Fabaceae	*Austrodolichos errabundus*			C		1/1
plants	higher dicots	Fabaceae	*Rhynchosia acuminatissima*			C		1/1
plants	higher dicots	Fabaceae	*Rhynchosia minima var. minima*			C		2/2
plants	higher dicots	Fabaceae	*Neonotonia wightii var. wightii*		Y			2/2
plants	higher dicots	Fabaceae	*Pultenaea millarii var. millarii*			C		2/2
plants	higher dicots	Fabaceae	*Tephrosia filipes subsp. filipes*			C		1/1
plants	higher dicots	Fabaceae	*Galactia tenuiflora forma sericea*			C		2/2
plants	higher dicots	Fabaceae	*Macrotyloma axillare var. axillare*		Y			2/2
plants	higher dicots	Fabaceae	*Mirbelia speciosa subsp. ringrosei*			C		1/1
plants	higher dicots	Fabaceae	*Cajanus reticulatus var. reticulatus*			C		2/2
plants	higher dicots	Fabaceae	*Crotalaria montana var. angustifolia*			C		1/1
plants	higher dicots	Flacourtiaceae	*Homalium brachybotrys*			C		1/1
plants	higher dicots	Flacourtiaceae	*Scolopia braunii*	flintwood		C		1/1
plants	higher dicots	Flacourtiaceae	*Casearia grayi*			C		1/1
plants	higher dicots	Gentianaceae	*Fagraea fagraeacea*			C		2/2
plants	higher dicots	Goodeniaceae	*Goodenia stirlingii*			V		1/1
plants	higher dicots	Goodeniaceae	*Goodenia rosulata*			C		1/1
plants	higher dicots	Haloragaceae	*Haloragis heterophylla*	rough raspweed		C		1/1
plants	higher dicots	Lamiaceae	*Prostanthera*			C		3/3
plants	higher dicots	Lamiaceae	*Plectranthus parviflorus*			C		1/1
plants	higher dicots	Lamiaceae	*Mesosphaerum suaveolens*		Y			1/1
plants	higher dicots	Lamiaceae	*Plectranthus diversus*			C		1/1
plants	higher dicots	Lamiaceae	*Platostoma longicorne*			C		1/1
plants	higher dicots	Lamiaceae	*Anisomeles malabarica*			C		1/1
plants	higher dicots	Lamiaceae	*Pogostemon stellatus*			C		1/1
plants	higher dicots	Lamiaceae	*Plectranthus amoenus*			V		1/1
plants	higher dicots	Lamiaceae	*Salvia misella*		Y			2/2
plants	higher dicots	Lamiaceae	*Prostanthera sp. (Dinden P.I.Forster+ PIF17342)*			E		1/1
plants	higher dicots	Lentibulariaceae	*Utricularia*			C		1
plants	higher dicots	Lentibulariaceae	*Utricularia bifida*			C		1/1
plants	higher dicots	Lentibulariaceae	*Utricularia caerulea*	blue bladderwort		C		1/1
plants	higher dicots	Loganiaceae	*Mitrasacme pygmaea*			C		1/1
plants	higher dicots	Loranthaceae	*Lysiana filifolia*			NT		1/1
plants	higher dicots	Loranthaceae	*Amyema miquelii*			C		1/1
plants	higher dicots	Loranthaceae	*Decaisnina brittenii subsp. brittenii*			C		1/1
plants	higher dicots	Loranthaceae	*Amylotheca dictyophleba*			C		1/1
plants	higher dicots	Lythraceae	*Rotala tripartita*			C		1/1
plants	higher dicots	Melastomataceae	*Melastoma malabathricum subsp. malabathricum*			C		1/1
plants	higher dicots	Menyanthaceae	*Nymphoides indica*	water snowflake		C		2/2
plants	higher dicots	Menyanthaceae	*Nymphoides*			C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Mimosaceae	*Acacia humifusa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia leptoloba*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia flavescens*	toothed wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia disparrima subsp. calidestris*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia leptocarpa*	north coast wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia aulacocarpa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia crassicarpa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia melanoxylon*	blackwood		C		1/1
plants	higher dicots	Mimosaceae	*Acacia multisiliqua*			C		2/2
plants	higher dicots	Mimosaceae	*Vachellia bidwillii*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia purpureopetala*			V	V	1/1
plants	higher dicots	Mimosaceae	*Acaciella angustissima*		Y			1/1
plants	higher dicots	Mimosaceae	*Acacia burrana*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia whitei*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia simsii*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia hemignosta*			C		2/2
plants	higher dicots	Moraceae	*Ficus obliqua*			C		3/3
plants	higher dicots	Moraceae	*Ficus leptoclada*			C		1/1
plants	higher dicots	Myrsinaceae	*Tapeinosperma pallidum*			C		1/1
plants	higher dicots	Myrsinaceae	*Myrsine variabilis*			C		2/2
plants	higher dicots	Myrtaceae	*Gossia bidwillii*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca uxorum*			E		5/5
plants	higher dicots	Myrtaceae	*Melaleuca nervosa*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca recurva*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca sylvana*			E		2/2
plants	higher dicots	Myrtaceae	*Sannantha angusta*			C		2/2
plants	higher dicots	Myrtaceae	*Syzygium australe*	scrub cherry		C		1/1
plants	higher dicots	Myrtaceae	*Uromyrtus tenella*			C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca borealis*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca monantha*			C		3/3
plants	higher dicots	Myrtaceae	*Corymbia intermedia*	pink bloodwood		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus cullenii*	Cullen's ironbark		C		4/4
plants	higher dicots	Myrtaceae	*Homoranthus porteri*			V	V	5/5
plants	higher dicots	Myrtaceae	*Melaleuca citrolens*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca viminalis*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia ellipsoidea*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus cloeziana*	Gympie messmate		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus granitica*	granite ironbark		C		2/2
plants	higher dicots	Myrtaceae	*Corymbia clarksoniana*			C		6/6
plants	higher dicots	Myrtaceae	*Corymbia leichhardtii*	rustyjacket		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus leptophleba*	Molloy red box		C		6/6
plants	higher dicots	Myrtaceae	*Melaleuca stenostachya*			C		4/4
plants	higher dicots	Myrtaceae	*Eucalyptus tereticornis*			C		1
plants	higher dicots	Myrtaceae	*Leptospermum amboinense*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Myrtaceae	*Melaleuca trichostachya*			C		2/2
plants	higher dicots	Myrtaceae	*Lophostemon grandiflorus*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus lockyeri subsp. exuta*			C		2/2
plants	higher dicots	Myrtaceae	*Corymbia citriodora subsp. citriodora*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca viridiflora var. viridiflora*			C		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus pachycalyx subsp. pachycalyx*			C		1/1
plants	higher dicots	Myrtaceae	*Lophostemon grandiflorus subsp. riparius*			C		2/2
plants	higher dicots	Myrtaceae	*Gossia hillii*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca*			C		2/1
plants	higher dicots	Myrtaceae	*Lophostemon*			C		1
plants	higher dicots	Nyctaginaceae	*Pisonia aculeata*	thorny Pisonia		C		1/1
plants	higher dicots	Nyctaginaceae	*Mirabilis jalapa*	four o'clock	Y			1/1
plants	higher dicots	Oleaceae	*Olea paniculata*			C		1/1
plants	higher dicots	Oleaceae	*Ligustrum australianum*			C		1/1
plants	higher dicots	Oleaceae	*Notelaea*			C		1/1
plants	higher dicots	Oleaceae	*Notelaea sp. (Barakula A.R.Bean 7553)*			C		1/1
plants	higher dicots	Oleaceae	*Jasminum dallachii*	soft jasmine		C		2/2
plants	higher dicots	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		2
plants	higher dicots	Opiliaceae	*Opilia amentacea*			C		1/1
plants	higher dicots	Passifloraceae	*Passiflora herbertiana subsp. herbertiana*	native passionfruit		C		1/1
plants	higher dicots	Phyllanthaceae	*Glochidion harveyanum*			C		1/1
plants	higher dicots	Phyllanthaceae	*Antidesma parvifolium*			C		2/2
plants	higher dicots	Phyllanthaceae	*Margaritaria dubium-traceyi*			C		2/2
plants	higher dicots	Phyllanthaceae	*Sauropus macranthus*			V	V	6/6
plants	higher dicots	Phyllanthaceae	*Antidesma bunius*	currantwood		C		1/1
plants	higher dicots	Phyllanthaceae	*Glochidion harveyanum var. harveyanum*			C		1/1
plants	higher dicots	Phyllanthaceae	*Sauropus aphyllus*			C		1/1
plants	higher dicots	Phytolaccaceae	*Phytolacca octandra*	inkweed	Y			1/1
plants	higher dicots	Picrodendraceae	*Pseudanthus ligulatus subsp. ligulatus*			C		2/2
plants	higher dicots	Picrodendraceae	*Petalostigma banksii*			C		2/2
plants	higher dicots	Pittosporaceae	*Bursaria incana*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala persicariifolia*			C		2/2
plants	higher dicots	Polygalaceae	*Polygala paniculata*		Y			1/1
plants	higher dicots	Polygalaceae	*Comesperma*			C		3/3
plants	higher dicots	Polygalaceae	*Salomonia ciliata*			C		1/1
plants	higher dicots	Polygonaceae	*Persicaria barbata*			C		1/1
plants	higher dicots	Polygonaceae	*Persicaria decipiens*	slender knotweed		C		3/3
plants	higher dicots	Polygonaceae	*Muehlenbeckia zippelii*			C		2/2
plants	higher dicots	Polygonaceae	*Persicaria*			C		1
plants	higher dicots	Proteaceae	*Grevillea glauca*	bushy's clothes peg		C		2/2
plants	higher dicots	Proteaceae	*Grevillea dryandri subsp. dryandri*			C		1/1
plants	higher dicots	Proteaceae	*Hakea persiehana*			C		1/1
plants	higher dicots	Proteaceae	*Alloxylon flammeum*			V	V	4/4
plants	higher dicots	Proteaceae	*Grevillea coriacea*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea parallela*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea glossadenia*			V	V	4/4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	higher dicots	Proteaceae	*Grevillea pteridifolia*	golden parrot tree		C		1/1
plants	higher dicots	Proteaceae	*Stenocarpus angustifolius*			C		2/2
plants	higher dicots	Putranjivaceae	*Drypetes deplanchei*	grey boxwood		C		2/2
plants	higher dicots	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		1/1
plants	higher dicots	Rhamnaceae	*Alphitonia pomaderroides*			C		3/3
plants	higher dicots	Rhamnaceae	*Rhamnus nipalensis*			C		1/1
plants	higher dicots	Rhamnaceae	*Cryptandra debilis*			C		3/3
plants	higher dicots	Rubiaceae	*Hedyotis auricularia var. melanesica*			C		1/1
plants	higher dicots	Rubiaceae	*Psychotria sp. (Danbulla S.T.Blake 15262)*			C		1/1
plants	higher dicots	Rubiaceae	*Atractocarpus fitzalanii subsp. fitzalanii*			C		1/1
plants	higher dicots	Rubiaceae	*Coffea arabica*	Arabian coffee	Y			1/1
plants	higher dicots	Rubiaceae	*Ixora oreogena*			C		1/1
plants	higher dicots	Rubiaceae	*Richardia scabra*		Y			1/1
plants	higher dicots	Rubiaceae	*Psydrax attenuata*			C		2/2
plants	higher dicots	Rubiaceae	*Randia tuberculosa*			C		1/1
plants	higher dicots	Rubiaceae	*Coelospermum reticulatum*			C		1/1
plants	higher dicots	Rubiaceae	*Hodgkinsonia frutescens*			C		4/4
plants	higher dicots	Rubiaceae	*Larsenaikia ochreata*			C		1/1
plants	higher dicots	Rubiaceae	*Opercularia diphylla*			C		1/1
plants	higher dicots	Rubiaceae	*Gynochthodes umbellata*			C		1/1
plants	higher dicots	Rutaceae	*Zieria minutiflora subsp. trichocarpa*			C		1/1
plants	higher dicots	Rutaceae	*Zieria whitei*			C		3/3
plants	higher dicots	Rutaceae	*Melicope jonesii*			C		1/1
plants	higher dicots	Rutaceae	*Acronychia laevis*	glossy acronychia		C		2/2
plants	higher dicots	Rutaceae	*Boronia bipinnata*	rock boronia		C		2/2
plants	higher dicots	Rutaceae	*Zieria cytisoides*	downy Zieria		C		2/2
plants	higher dicots	Rutaceae	*Acronychia vestita*			C		1/1
plants	higher dicots	Rutaceae	*Boronia occidentalis*			C		1/1
plants	higher dicots	Rutaceae	*Flindersia schottiana*	bumpy ash		C		1/1
plants	higher dicots	Rutaceae	*Zanthoxylum veneficum*			C		2/2
plants	higher dicots	Rutaceae	*Melicope broadbentiana*			C		1/1
plants	higher dicots	Rutaceae	*Acronychia crassipetala*			C		1/1
plants	higher dicots	Rutaceae	*Zanthoxylum ovalifolium*			C		1/1
plants	higher dicots	Santalaceae	*Exocarpos latifolius*			C		1/1
plants	higher dicots	Santalaceae	*Santalum lanceolatum*			C		1/1
plants	higher dicots	Santalaceae	*Exocarpos cupressiformis*	native cherry		C		1/1
plants	higher dicots	Sapindaceae	*Castanospora alphandii*	brown tamarind		C		1/1
plants	higher dicots	Sapindaceae	*Diploglottis bernieana*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea lanceolata var. subsessilifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Guioa acutifolia*	northern guioa		C		1/1
plants	higher dicots	Sapindaceae	*Alectryon tomentosus*			C		4/4
plants	higher dicots	Sapindaceae	*Arytera divaricata*	coogera		C		3/3
plants	higher dicots	Sapindaceae	*Atalaya variifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea tenuifolia*			C		1/1
plants	higher dicots	Sapotaceae	*Sersalisia sericea*			C		1/1
plants	higher dicots	Scrophulariaceae	*Limnophila aromatica*			C		1/1

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plants	higher dicots	Scrophulariaceae	*Limnophila fragrans*			C		1/1
plants	higher dicots	Scrophulariaceae	*Striga parviflora*			C		2/2
plants	higher dicots	Scrophulariaceae	*Rhamphicarpa australiensis*			NT		1/1
plants	higher dicots	Solanaceae	*Nicandra physalodes*	apple of Peru	Y			1/1
plants	higher dicots	Solanaceae	*Solanum seaforthianum*	Brazilian nightshade	Y			1/1
plants	higher dicots	Solanaceae	*Physalis peruviana*		Y			1/1
plants	higher dicots	Solanaceae	*Nicotiana tabacum*		Y			3/3
plants	higher dicots	Solanaceae	*Solanum torvum*	devil's fig	Y			1/1
plants	higher dicots	Solanaceae	*Cestrum nocturnum*		Y			3/3
plants	higher dicots	Sparrmanniaceae	*Grewia retusifolia*			C		2/2
plants	higher dicots	Sterculiaceae	*Argyrodendron trifoliolatum*	booyong		C		1/1
plants	higher dicots	Sterculiaceae	*Brachychiton diversifolius subsp. orientalis*			C		1/1
plants	higher dicots	Stylidiaceae	*Stylidium cordifolium*			C		2/2
plants	higher dicots	Stylidiaceae	*Stylidium eriorhizum*			C		1/1
plants	higher dicots	Stylidiaceae	*Stylidium capillare*			C		1/1
plants	higher dicots	Surianaceae	*Guilfoylia monostylis*	guilfoylia		C		2/2
plants	higher dicots	Thymelaeaceae	*Phaleria clerodendron*	scented daphne		C		1/1
plants	higher dicots	Thymelaeaceae	*Phaleria chermsideana*	scrub daphne		C		2/2
plants	higher dicots	Thymelaeaceae	*Thecanthes cornucopiae*			C		1/1
plants	higher dicots	Thymelaeaceae	*Pimelea sericostachya subsp. sericostachya*			C		1/1
plants	higher dicots	Urticaceae	*Urtica incisa*	stinging nettle		C		1/1
plants	higher dicots	Violaceae	*Hybanthus monopetalus*			C		1/1
plants	higher dicots	Viscaceae	*Notothixos subaureus*	golden mistletoe		C		1/1
plants	higher dicots	Viscaceae	*Viscum articulatum*	flat mistletoe		C		1/1
plants	higher dicots	Vitaceae	*Cissus cardiophylla*			C		1/1
plants	higher dicots	Vitaceae	*Cayratia trifolia*			C		1/1
plants	higher dicots	Vitaceae	*Tetrastigma petraeum*			C		3/3
plants	higher dicots	Vitaceae	*Clematicissus opaca*			C		3/3
plants	higher dicots	Zygophyllaceae	*Tribulus terrestris*	caltrop		C		1/1
plants	lower dicots	Annonaceae	*Polyalthia nitidissima*	polyalthia		C		1/1
plants	lower dicots	Cabombaceae	*Brasenia schreberi*			NT		1/1
plants	lower dicots	Ceratophyllaceae	*Ceratophyllum demersum*	hornwort		C		1/1
plants	lower dicots	Himantandraceae	*Galbulimima baccata*			C		1/1
plants	lower dicots	Lauraceae	*Endiandra dielsiana*			C		1/1
plants	lower dicots	Lauraceae	*Endiandra bessaphila*			C		4/4
plants	lower dicots	Lauraceae	*Beilschmiedia recurva*			C		1/1
plants	lower dicots	Lauraceae	*Cryptocarya cocosoides*			C		6/6
plants	lower dicots	Lauraceae	*Cryptocarya densiflora*			C		1/1
plants	lower dicots	Lauraceae	*Cinnamomum laubatii*			C		1/1
plants	lower dicots	Lauraceae	*Cinnamomum camphora*	camphor laurel	Y			1/1
plants	lower dicots	Lauraceae	*Cassytha filiformis*	dodder laurel		C		1/1
plants	lower dicots	Lauraceae	*Neolitsea brassii*			C		3/3
plants	lower dicots	Lauraceae	*Neolitsea dealbata*	white bolly gum		C		2/2
plants	lower dicots	Menispermaceae	*Pachygone ovata*			C		1/1
plants	lower dicots	Menispermaceae	*Hypserpa smilacifolia*			NT		1/1
plants	lower dicots	Nymphaeaceae	*Nymphaea*			C		1

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plants	lower dicots	Nymphaeaceae	*Nymphaea immutabilis*			C		1/ 1
plants	lower dicots	Ranunculaceae	*Clematis pickeringii*			C		2/ 2
plants	monocots	Alismataceae	*Caldesia reniformis*			C		1/ 1
plants	monocots	Araceae	*Spirodela oligorrhiza*			C		2/ 2
plants	monocots	Asparagaceae	*Asparagus racemosus*	native asparagus		C		1/ 1
plants	monocots	Boryaceae	*Borya septentrionalis*			C		1/ 1
plants	monocots	Colchicaceae	*Iphigenia indica*			C		1/ 1
plants	monocots	Commelinaceae	*Cartonema spicatum*			C		1/ 1
plants	monocots	Commelinaceae	*Murdannia vaginata*		Y			1/ 1
plants	monocots	Cyperaceae	*Fuirena umbellata*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus polystachyos var. polystachyos*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus haspan subsp. haspan*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus conicus var. conicus*			C		1/ 1
plants	monocots	Cyperaceae	*Fimbristylis cinnamometorum*			C		1/ 1
plants	monocots	Cyperaceae	*Rhynchospora subtenuifolia*			C		1/ 1
plants	monocots	Cyperaceae	*Schoenoplectus mucronatus*			C		5/ 3
plants	monocots	Cyperaceae	*Cyperus*			C		1
plants	monocots	Cyperaceae	*Eleocharis*			C		2
plants	monocots	Cyperaceae	*Cyperus mirus*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus fulvus*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus distans*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus triceps*			C		1/ 1
plants	monocots	Cyperaceae	*Scleria brownii*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus flavidus*			C		1/ 1
plants	monocots	Cyperaceae	*Bulbostylis densa*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus aquatilis*			C		2/ 2
plants	monocots	Cyperaceae	*Cyperus trinervis*			C		1/ 1
plants	monocots	Cyperaceae	*Eleocharis dulcis*			C		1/ 1
plants	monocots	Cyperaceae	*Eleocharis minuta*		Y			1/ 1
plants	monocots	Cyperaceae	*Schoenus falcatus*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus unioloides*			C		1/ 1
plants	monocots	Cyperaceae	*Bulbostylis barbata*			C		1/ 1
plants	monocots	Cyperaceae	*Fimbristylis cymosa*			C		1/ 1
plants	monocots	Cyperaceae	*Fimbristylis nutans*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus holoschoenus*			C		1/ 1
plants	monocots	Cyperaceae	*Cyperus involucratus*		Y			1/ 1
plants	monocots	Cyperaceae	*Cyperus polystachyos*			C		2/ 2
plants	monocots	Cyperaceae	*Lipocarpha chinensis*			C		2/ 2
plants	monocots	Cyperaceae	*Eleocharis equisetina*			C		1/ 1
plants	monocots	Cyperaceae	*Eleocharis geniculata*			C		1/ 1
plants	monocots	Cyperaceae	*Schoenoplectus laevis*			C		1/ 1
plants	monocots	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		2/ 2
plants	monocots	Cyperaceae	*Fimbristylis macrantha*			C		1/ 1
plants	monocots	Cyperaceae	*Eleocharis atropurpurea*			C		2/ 2
plants	monocots	Eriocaulaceae	*Eriocaulon scariosum*			C		1/ 1
plants	monocots	Eriocaulaceae	*Eriocaulon nanum*			C		1/ 1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Hydrocharitaceae	*Ottelia alismoides*			C		1/1
plants	monocots	Hypoxidaceae	*Curculigo ensifolia var. ensifolia*			C		1/1
plants	monocots	Laxmanniaceae	*Lomandra*			C		2/2
plants	monocots	Laxmanniaceae	*Lomandra multiflora subsp. multiflora*			C		1/1
plants	monocots	Laxmanniaceae	*Lomandra filiformis*			C		1/1
plants	monocots	Orchidaceae	*Diuris oporina*	northern white donkeys tails		NT		2/2
plants	monocots	Orchidaceae	*Zeuxine oblonga*	hairy jewel orchid		C		1/1
plants	monocots	Orchidaceae	*Phaius australis*			E	E	1/1
plants	monocots	Orchidaceae	*Corybas cerasinus*			NT		1/1
plants	monocots	Orchidaceae	*Empusa habenarina*			C		1/1
plants	monocots	Orchidaceae	*Acianthus borealis*			C		1/1
plants	monocots	Orchidaceae	*Cheirostylis ovata*	caterpillar orchid		C		1/1
plants	monocots	Orchidaceae	*Dipodium ensifolium*	leafy hyacinth orchid		C		1/1
plants	monocots	Orchidaceae	*Pterostylis stricta*			C		1/1
plants	monocots	Orchidaceae	*Peristylus banfieldii*			NT		1/1
plants	monocots	Orchidaceae	*Dendrobium monophyllum*			C		1/1
plants	monocots	Orchidaceae	*Spathoglottis paulinae*			NT		1/1
plants	monocots	Orchidaceae	*Arthrochilus oreophilus*			C		1/1
plants	monocots	Orchidaceae	*Dockrillia calamiformis*			C		1/1
plants	monocots	Orchidaceae	*Thelymitra angustifolia*			C		1/1
plants	monocots	Orchidaceae	*Dendrobium speciosum subsp. pedunculatum*			C		1/1
plants	monocots	Pandanaceae	*Pandanus cookii*			C		1/1
plants	monocots	Poaceae	*Dactyloctenium aegyptium*	coast button grass	Y			2/2
plants	monocots	Poaceae	*Capillipedium parviflorum*	scented top		C		2/2
plants	monocots	Poaceae	*Mnesithea rottboellioides*			C		1/1
plants	monocots	Poaceae	*Schizachyrium pseudeulalia*			C		1/1
plants	monocots	Poaceae	*Aristida utilis var. utilis*			C		2/2
plants	monocots	Poaceae	*Hyparrhenia rufa subsp. rufa*		Y			1/1
plants	monocots	Poaceae	*Setaria pumila subsp. pumila*		Y			1/1
plants	monocots	Poaceae	*Aristida calycina var. calycina*			C		1/1
plants	monocots	Poaceae	*Sorghum nitidum forma aristatum*			C		1/1
plants	monocots	Poaceae	*Ischaemum australe var. australe*			C		1/1
plants	monocots	Poaceae	*Chloris divaricata var. divaricata*	slender chloris		C		1/1
plants	monocots	Poaceae	*Hymenachne amplexicaulis cv. Olive*		Y			1/1
plants	monocots	Poaceae	*Panicum seminudum var. cairnsianum*			C		2/2
plants	monocots	Poaceae	*Bothriochloa bladhii subsp. bladhii*			C		1/1
plants	monocots	Poaceae	*Urochloa holosericea subsp. holosericea*			C		1/1
plants	monocots	Poaceae	*Hyparrhenia*			C		1/1
plants	monocots	Poaceae	*Eriachne rara*			C		2/2
plants	monocots	Poaceae	*Panicum simile*			C		1/1
plants	monocots	Poaceae	*Sarga plumosum*			C		2/2
plants	monocots	Poaceae	*Chloris virgata*	feathertop rhodes grass	Y			1/1
plants	monocots	Poaceae	*Eleusine indica*	crowsfoot grass	Y			1/1
plants	monocots	Poaceae	*Eriachne obtusa*			C		2/2
plants	monocots	Poaceae	*Panicum effusum*			C		1/1
plants	monocots	Poaceae	*Sehima nervosum*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Setaria surgens*			C		1/1
plants	monocots	Poaceae	*Urochloa mutica*		Y			2
plants	monocots	Poaceae	*Eriachne armitii*			C		1/1
plants	monocots	Poaceae	*Leersia hexandra*	swamp rice grass		C		3/1
plants	monocots	Poaceae	*Panicum incomtum*			C		1/1
plants	monocots	Poaceae	*Themeda triandra*	kangaroo grass		C		1/1
plants	monocots	Poaceae	*Mnesithea formosa*			C		1/1
plants	monocots	Poaceae	*Urochloa pubigera*			C		1/1
plants	monocots	Poaceae	*Andropogon gayanus*	gamba grass	Y			2/2
plants	monocots	Poaceae	*Aristida warburgii*			C		2/2
plants	monocots	Poaceae	*Arundinella setosa*			C		3/3
plants	monocots	Poaceae	*Digitaria bicornis*			C		2/2
plants	monocots	Poaceae	*Oplismenus aemulus*	creeping shade grass		C		1/1
plants	monocots	Poaceae	*Oryza meridionalis*			C		1/1
plants	monocots	Poaceae	*Panicum antidotale*	giant panic	Y			1/1
plants	monocots	Poaceae	*Urochloa brizantha*		Y			1/1
plants	monocots	Poaceae	*Urochloa decumbens*		Y			1/1
plants	monocots	Poaceae	*Aristida perniciosa*			C		1/1
plants	monocots	Poaceae	*Cymbopogon ambiguus*	lemon grass		C		1/1
plants	monocots	Poaceae	*Cymbopogon obtectus*			C		1/1
plants	monocots	Poaceae	*Eragrostis cumingii*			C		1/1
plants	monocots	Poaceae	*Megathyrsus maximus*		Y			1/1
plants	monocots	Poaceae	*Melinis minutiflora*	molasses grass	Y			1/1
plants	monocots	Poaceae	*Sporobolus fertilis*	giant Parramatta grass	Y			1/1
plants	monocots	Poaceae	*Urochloa polyphylla*			C		1/1
plants	monocots	Poaceae	*Cenchrus caliculatus*	hillside burrgrass		C		1/1
plants	monocots	Poaceae	*Cymbopogon refractus*	barbed-wire grass		C		1/1
plants	monocots	Poaceae	*Echinochloa inundata*	marsh millet		C		1/1
plants	monocots	Poaceae	*Ectrosia agrostoides*			C		1/1
plants	monocots	Poaceae	*Eragrostis pubescens*			C		1/1
plants	monocots	Poaceae	*Eragrostis schultzii*			C		1/1
plants	monocots	Poaceae	*Themeda quadrivalvis*	grader grass	Y			2/2
plants	monocots	Poaceae	*Whiteochloa airoides*			C		2/2
plants	monocots	Poaceae	*Aristida superpendens*			C		1/1
plants	monocots	Poaceae	*Cenchrus polystachios*		Y			1/1
plants	monocots	Poaceae	*Cymbopogon bombycinus*	silky oilgrass		C		1/1
plants	monocots	Poaceae	*Heteropogon contortus*	black speargrass		C		2/2
plants	monocots	Poaceae	*Heteropogon triticeus*	giant speargrass		C		2/2
plants	monocots	Poaceae	*Schizachyrium fragile*	firegrass		C		3/3
plants	monocots	Poaceae	*Enneapogon lindleyanus*			C		1/1
plants	monocots	Poaceae	*Sporobolus pyramidalis*		Y			1/1
plants	monocots	Poaceae	*Digitaria nematostachya*			C		1/1
plants	monocots	Poaceae	*Sporobolus jacquemontii*		Y			2/2
plants	monocots	Pontederiaceae	*Monochoria cyanea*			C		1/1
plants	monocots	Potamogetonaceae	*Potamogeton*			C		1/1
plants	monocots	Typhaceae	*Typha*			C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Typhaceae	*Typha domingensis*			C		1/1
plants	monocots	Xyridaceae	*Xyris complanata*	yellow-eye		C		1/1
plants	mosses	Meteoriaceae	*Aerobryopsis longissima*			C		1/1
plants	mosses	Sematophyllaceae	*Sematophyllum subpinnatum*			C		1/1
plants	uncertain	Indet.	*Indet.*			C		2
plants	whisk ferns	Psilotaceae	*Psilotum nudum*	skeleton fork fern		C		2/2

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix 13

Fauna Survey Summary and Ecological Assessment Report (R67966)

Prepared by RPS

RPS

Ecological Assessment Report

Springmount Wind Farm, Arriga

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Report No: PR100246/R67966
Version/Date: Draft /July 2010

Important Note

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In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Quality Assurance Statement				
			Approved for Issue	
Revision No.	Author	Reviewer	Signature	Date
A	Simon Gleed Lyndall Harvey	David Finney		

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1 Introduction

RPS (Cairns) Australia East Pty Ltd (RPS) was engaged to undertake ecological studies for the proposed Springmount Wind farm to support regulatory approvals for the proposed project.

This report outlines the principal environmental characteristics of a number of sites on which a wind farm comprising 74 wind turbines is proposed to be established at Arriga, west of the township of Walkamin in north Queensland. The study area in which these sites are bounded is shown in **Appendix A**.

The report considers a range of environmental matters, primarily fauna, vegetation and flora, and species of conservation significance listed under State and Commonwealth environmental legislation. All the turbines are proposed to be located in remnant vegetation, as defined under the *Vegetation Management Act 1999*[1].

1.1 Scope of Work

The following scope of work was identified and forms the purpose of the field assessment and the broad content of this report.

Flora Assessment

- Identification of the common flora species that are representative at a range of sites within the study area;
- Classification of conservation significant species as identified under the *Nature Conservation Act 1992* (NC Act) and the *Environmental Protection and Biodiversity Act 1999* (EPBC Act);
- Preliminary significance assessment of the impact of the project on any endangered, vulnerable or rare flora species listed under the NC Act and EPBC Act which occur within the study area; and identification of mitigation measures;
- Review of regional ecosystem mapping and remnant vegetation classification for the project area, and its relevance in terms of the *Vegetation Management Act 1999:* and
- Presence and identification of any declared or environmental weeds within the study area.

Fauna Assessment

- Identification of the actual presence of the fauna species within the study area;
- Identification of fauna species likely to inhabit the study area;
- Classification of the species identified under the NC Act and the EPBC Act; and
- A preliminary significance assessment of the impact to any actual or potential fauna species that may occur within the study area; and identification of mitigation measures.

[1] Remnant vegetation refers to the definition for such as cited under Queensland's *Vegetation Management Act 1999*, which broadly describes plant communities in relation to their height, percentage canopy cover and underlying geology or soil formation.

1.2 Project Area Location and Description

Seventy-four wind turbines are proposed to be located in the rural area of Arriga, which is located in the northern portion of the Atherton Tablelands in north Queensland. A substation is proposed at the base of the eastern flank of the ranges, into which power generated by the wind farm will feed into the main electricity grid. The location (the study area) of the wind farm and the proposed position of wind turbines is shown in **Appendix A**.

The project area sits atop a series of dissected granitic and rhyolite ridges, rising 750 to 950 metres in elevation, culminating in Walsh's Bluff at the northern end of the site. The entire area where the wind farm is proposed to be established supports several types of remnant vegetation, with the greatest diversity in the southern end of the project area, where the Einasleigh Uplands and the Wet Tropics bioregions join. These vegetation types and the broader project area are considered to have high natural integrity with evidence of gross disturbance and modification.

Surrounding land outside of the project area and at lower elevations is characterised by intensive agricultural uses, including sugar cane production, grazing and a range of cropping enterprises. Turbines are not proposed to be located on any of these land use types.

The 74 wind turbine sites that have been identified on a preliminary basis will occupy small footprints of land connected by a network of underground cabling, the disturbance footprint of which will also serve as access tracks for construction and future maintenance.

Preliminary designs are for wind turbines with a total height (including the rotor) of 100 metres. Each turbine is estimated to occupy a cleared footprint of land of 20 x 40 metres where clearing is constrained and requires being limited in extent (i.e. adjacent to sensitive environments); or 30 x 40 metres where space allows (i.e. in less sensitive environments).

The preliminary road and underground cabling layout which connects each turbine and allows for access between sites will require a cleared width of approximately 10 metres for the construction stage, with an expected decrease in width through natural vegetation succession after construction is completed to 5 metres. These tracks will be required to be left clear of vegetation to allow for future maintenance of the project. The preliminary road and cabling network is shown in **Appendix A**.

Existing built infrastructure in the study area comprises a high voltage electrical transmission corridor that passes through the project area in an approximate southwest direction towards Oaky Creek. This corridor is maintained free of vegetation and forms the primary access route into the site.

2 Methods

The methods adopted for completing the study are detailed below and consist of two primary aspects, a desktop review of published environmental information, and a physical ground investigation of the environmental characteristics of the study area.

2.1 Desktop Review

A review of databases and information relating primarily to rare and threatened species of flora and fauna was undertaken as a preliminary exercise to determine the probability of particular species occurring at or in the vicinity of the study sites. The results of these searches and reviews of information assisted with planning targeted field surveys for conservation significant species, as well as gaining a better understanding of the ecology of certain species. Concurrent with this review was an examination of vegetation mapping for the region.

The following databases and sources of information were reviewed:

- *Regional Ecosystem mapping.* The most recent version of the Department of Environment and Resource Management's (DERM) regional ecosystem (RE) vegetation mapping (version 6.0, November 2009) was used to provide an indication of the status and position of remnant vegetation in relation to landforms of the project site. This mapping was overlaid on a digital colour aerial photograph base sourced from Google Earth™;
- *Essential Habitat mapping*. In association with the RE mapping for the study area, essential habitat mapping has been prepared by DERM for conservation significant species. A review of this mapping in relation to the vegetation types and respective habitats was made to establish its relevance;
- *Wildlife Online* database of flora and fauna. This database holds records of plants and animals that have either been sighted or collected within a given radius of the site (a search parameter was prescribed limiting the search area to a 10 km radius around an approximate central point of the study area). The records held in this database are jointly maintained by Queensland's Environmental Protection Agency and the Queensland Parks and Wildlife Service - now incorporated into DERM;
- *Protected Matters* database of Matters of National Environmental Significance (NES). This database applies a range of bio-models to predict the presence of species of flora and fauna and other matters of NES within a given radius of the site (a search parameter was prescribed limiting the search area to a 10km radius around an approximate central point of the study area), as cited under the Commonwealth's *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *HERBRECS* database of plant records. This database provides confirmed records of plant collections made within a specified area, of which voucher specimens are held by the Environmental Protection Agency's (EPA) Queensland Herbarium. Data from this source provides useful information on the known location of rare and threatened species and expedites targeted surveys for such plants in the field;
- *Queensland Museum Biodiversity database.* This database provides confirmed records of fauna species recorded within a specified area. Data from this source provides additional information on the known location of rare and threatened fauna species;
- *Regional Vegetation Management Code – Coastal Bioregions*. The 'Performance Requirements' of this code (as issued under the *Vegetation Management Act 1999*) were addressed and interpreted for their relevance to the project; and
- Other databases containing relevant species information, including Birdata (web version of Birds Australia's New Atlas of Australian Birds) and the International Union for the Conservation of Nature (IUCN) Red List

- Literature review. A range of scientific papers and other literature were reviewed for a number of related matters.

The pre-survey desktop study also allowed for a preliminary assessment of potential impacts on significant flora species and vertebrate fauna populations and habitats within the area, and the determination of appropriate survey sites based on available mapping, habitat types and other relevant information, which were later refined in the field.

A list of vertebrate fauna species previously recorded within the site, and those predicted to occur within the area, was also collated prior to the commencement of field work.

2.2 Field Survey

2.2.1 Survey Timing

The ecological assessment of the Springmount Wind farm (herein referred to as the survey) was undertaken over a five day period, including four night's nocturnal survey for fauna, and Anabat survey (bats), between 10th and 14th of May 2010, representing a late wet season survey. It should be noted that at the time of survey, most of the ephemeral and seasonal water courses were dry, with the exception of a small ephemeral creek located at the camp site (Granite Creek), which was found to contain some water at the time of the survey. Therefore, Granite Creek was considered an important survey site and habitat representation, signifying the only natural source of freshwater within the study area.

It should also be noted that this ecological assessment was carried out during only one season, and in one year. Complete ecological surveys often require multiple surveys, at different times of year, and over a period of a number of years, to enable full survey of all species present. However, the field survey has been complemented with information from other sources, as described in Section 2.1, and the area would not be expected to exhibit major variability from year to year.

2.2.2 Survey Methodology

The field assessment was undertaken by two ecologists to record the ecological character of the study area, and to search for conservation significant species (flora and fauna). Elements of this survey included:

- Establishing the relevance of the regional ecosystem (RE) mapping of 'remnant' vegetation communities, the associated description of these communities, and their positional accuracy in relation to the mapping and their context in the landscape;
- The compilation of a provisional floristic checklist of vascular plants occurring within the study area, with specific emphasis placed on the floristic composition of representative vegetation communities affected by the 'footprint' of the wind turbines;
- Trapping survey and random meander foot traverses to detect the presence of fauna through recording vocalisations, visual sightings, and interpretation of fauna signs such as scats, tracks and other presence indicators; and
- An appraisal of the habitat qualities for fauna as well as habitat suited to supporting plants. Emphasis was placed on specific habitat niches for conservation significant flora and fauna, focusing on microchiropteran bats and birds. The appraisal also extended to an intuitive and qualitative assessment of structural and ecological qualities of vegetation and other landscape features.

2.2.3 Fauna Survey Methods

Fauna searches were conducted at 24 sites through the range of habitat types occurring in the study area, targeting signs of fauna species including visual observations, tracks, scats, nest sites, diggings, fur, feathers and remains (**Figure 1**). Terrestrial trapping stations were established at six sites, including pitfall traps, Elliott traps and hair tubes, targeting terrestrial fauna species potentially occurring in the area.

Across the site, a variety of survey techniques were used to provide as comprehensive a coverage of species as possible within the scope and timeframe of the project. The trapping and fauna detection methods used were based on the standard biological survey methodology developed by the NSW Department of Primary Industries and Animal Research Review Panel, and approved by the Queensland Department of Environment and Resource Management (DERM) and the Queensland Department of Employment, Economic Development and Innovation (DEEDI) Animal Ethics Committee. Specifically the survey methodology was developed and undertaken in accordance with the following guidelines:

- Wildlife Survey Guidelines, NSW Department of Agriculture and NSW National Parks and Wildlife Service (recognised and recommended wildlife survey guidelines for Queensland use) including:
  - Guideline 3 – General ethical considerations and wildlife surveys;
  - Guideline 4 – Surveys of terrestrial and arboreal mammals;
  - Guideline 5 - Surveys of bats;
  - Guideline 7 – Surveys of birds;
  - Guideline 8 – Surveys of reptiles and amphibians;
- ANZCCART Guidelines for the Euthanasia of Animals Used for Scientific Purposes; and
- Hygiene protocol for the control of disease in frogs (NSW National Parks and Wildlife Service).

Field surveys included:

- *Pitfall Trapping*

  - Pitfall traps were established predominantly to sample for reptiles, amphibians and small mammals. Each pitfall trap line comprised one PVC bucket (200 mm diameter, 400 mm depth) set into the ground with the lip flush with the ground surface, and drift fencing, also dug into the ground (400 mm high).
  Two pitfall traps were established at three sites, set approximately 20 m apart, depending on the habitat, terrain and conditions at each site, with drift fencing positioned at right angles to each other. A total of six pitfall traps were established across three sites in the study area. Traps were checked twice daily in the early morning and late afternoon.

  All pitfall traps were opened for four consecutive days and three consecutive nights.

- *Elliott Trapping*:

  - Elliott box traps (size A and B) were deployed at six survey sites. Trap-lines consisted of five traps, with the exception of the Granite Creek site which comprised 10 Elliott traps, spaced at approximately 10m apart. These lines were installed approximately 20m from and parallel to the pitfall traps. A small bait of peanut butter, rolled oats and honey was placed in Elliott traps as bait at some of the sites targeting small mammals, such as rodents. Pilchards were used to bait the remaining Elliott traps, targeting carnivorous mammals such as dasyurids.

  All Elliott traps were left open during the day and night, and checked twice per day. All Elliott traps were opened for three (3) consecutive days/nights, with the exception of Site 67. Elliott traps at this site were open for two (2) consecutive nights.

- *Funnel Trapping*:

  - One line comprising eight funnel traps was established along a small, first order drainage line close to the centre of the site. Funnel traps were used to target larger reptiles, specifically snakes. These traps were set along potential movement pathways, such as alongside fallen timber and piles of debris and through obvious animal runs in stream bank vegetation.

- *Harp Trapping*:

  - One harp trap was deployed for four consecutive nights across a potential flyway over the creek at the Granite Creek site. The trap was strategically placed to trap bats foraging over the water body or to capture bats coming down to drink along the creek.
  The harp trap was checked at approximately 1900 hours and 2230 hours each night, and 0545 hours each morning.

- *Microbat Call Recognition*:

  - Microbat calls were sampled using Anabat SD1 electronic bat detectors (Titley Electronics, Ballina, NSW). Passive monitoring was undertaken for four consecutive nights in the vicinity of the Granite Creek site, and an additional four consecutive nights of passive monitoring was undertaken on the ridge tops at both the southern and northern extents of the site, where some significant rock fissures could be observed during helicopter reconnaissance flights. Monitoring commenced at dusk (approximately 1830 hours) and continued until dawn (approximately 0545 hours).
  No caves were observed within the survey area; however, a number of significant hollows were identified, providing potential roost sites for microbats. As such, the Anabat was used for general recording throughout the survey area.

  Anabat recordings were analysed using Anabat software (CFCread and Analook) by Anabat Echolocation Call Analysis Specialist, Greg Ford of Balance Environmental in Toowoomba. Identifications were made by categorising call shape and frequency, with a species match given in consideration to region, known bat distributions, and habitats present.

  The focus of the bat surveys was to assess the presence of bat species found within the allotment, and to assess the potential for rare and threatened species to occur.

- *Walk-through Transect Diurnal Bird Surveys:*

  - Walk-through diurnal bird surveys were conducted at 20 of the 24 sites. While it is recommended that bird surveys commence within 30 minutes of dawn, site accessibility, overall size of the property and logistical considerations necessitated an alternative bird survey method, comprising walk-through transect surveys at varying times during the day. All sites were surveyed for a minimum of 45 minutes, and any incidental records were also collected at all other times when on the property.
  Surveys were undertaken by walking slowly through each accessible turbine site. Birds were identified by sight with the aid of binoculars or by their characteristic calls.

- *Spotlighting:*

  - Spotlighting both on foot (using head torches and variable intensity spotlights) and by slow-moving vehicle (0-5 km/hr), was undertaken targeting reptiles, amphibians, bats, terrestrial and arboreal mammals and nocturnal birds.
  Spotlighting surveys on foot were conducted along transects moving through accessible proposed turbine sites, and along the creek at the Granite Creek site, which represented the only accessible, semi-permanent source of fresh water within the study area. Several hundred metres were surveyed in a set time frame. Each foot survey was conducted in the first two hours after sunset, while spotlighting from a slow-moving vehicle generally occurred between 2000 hours and 2200 hours. One experienced observer conducted each survey. All sightings were recorded.

- Habitat Searches:

  - Habitat searches were undertaken at 18 of the 24 sites, targeting reptiles and amphibians within the study area. This involved hand searches of suitable microhabitats, such as under bark, under and in fallen logs and timber, under rocks, in leaf litter, in and around termite mounds and in rock fissures and crevices. A minimum of 45 minutes of habitat searches were conducted at each site. It is noted that weather conditions for herpetofauna surveys was not optimal given the extended period of dry weather and cooler conditions preceding the survey, and the results are indicative of this climatic condition and do not account for seasonal variation of habitat qualities.

- *Opportunistic Records*:

  - Non-systematic sampling was conducted across all sites and throughout the remainder of the accessible survey area. The presence of all vertebrate species was recorded wherever and whenever possible. Opportunistic sampling included the following:

  » Incidental sightings

  The presence of all vertebrate species encountered while working and travelling within the study area during the day and night, and during trap line establishment was recorded as an incidental sighting.

  When moving to, from or between survey sites at night, roads were traversed in a vehicle at very low speed with any fauna detected within headlights recorded. Unconfirmed or suspected observations were also noted.

  » Secondary evidence

  The presence of evidence or activity, including tracks, scats, pellets, scratches, diggings, burrows, dens and nests were recorded wherever and whenever possible. Photographic records were taken where possible.

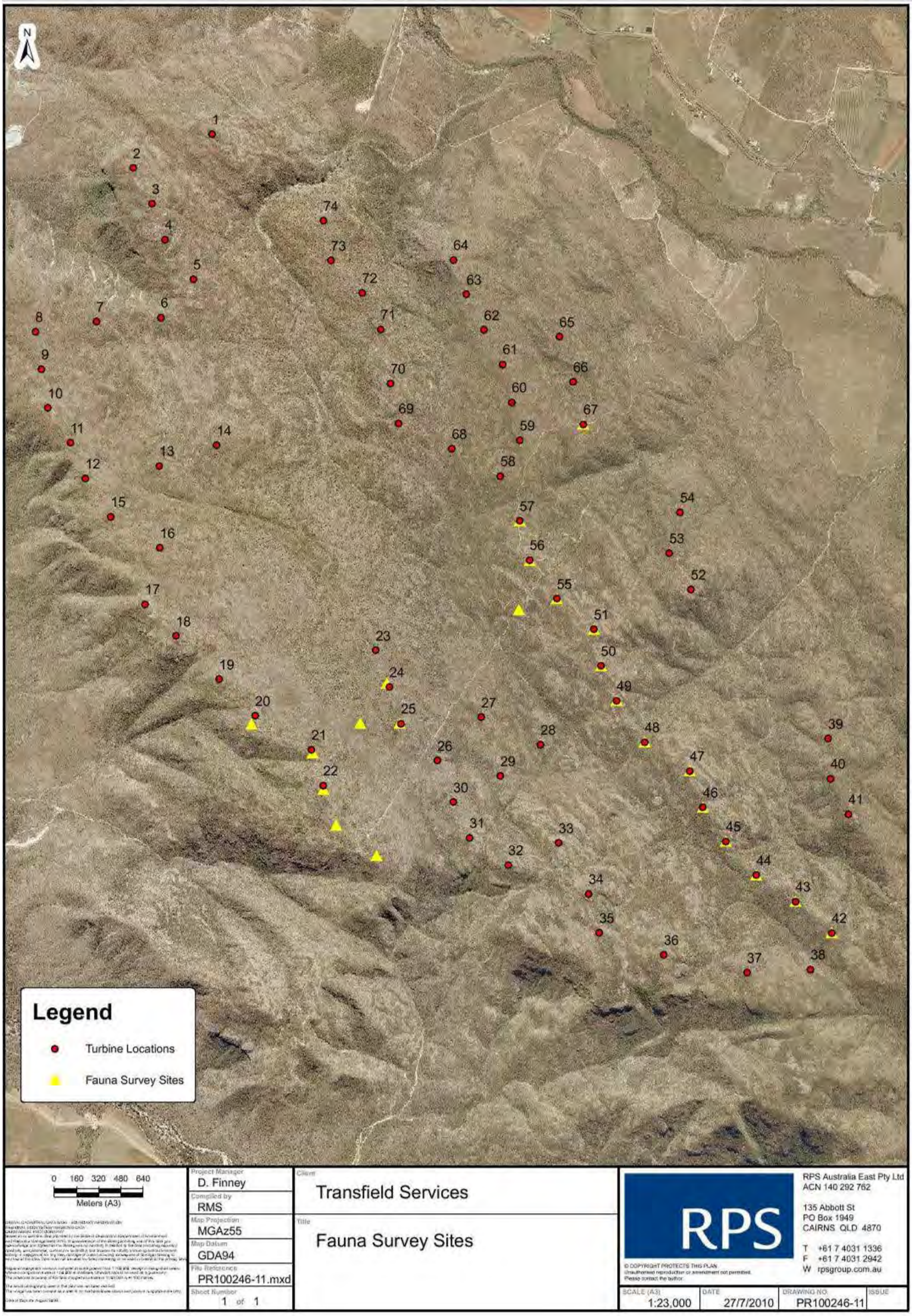

Figure 1 - Location of Fauna Survey Sites

2.2.4 Flora and Vegetation Survey Methods

Representative sites were selected across the project area in order to sample the broadest vegetation types likely to be impacted by the establishment of the wind farm, and to understand the diversity of vegetation types and probable locations of particular flora species restricted to certain habitats or limited by environmental conditions (**Figure 2**).

Methods adopted for the survey are in keeping with protocols outlined and issued by DERM (Wannan, 2009). We note however, that it was unnecessary to determine whether a particular vegetation type is considered remnant or non-remnant as defined under the *Vegetation Management Act 1999*, as all the turbines are considered to occur in areas mapped as remnant vegetation. The remnant status of these sites has been accepted and thus detailed transects to determine percentage foliage intercept were not undertaken. Structural formations were ascribed according to Specht et al (1974).

A minimum 500 m^2 plot area was surveyed at each vegetation survey site. Plots were orientated so that the longest side was parallel to the prevailing land contour. Within each survey plot the structural layers of the vegetation were characterised according to five strata: the dominant tree layer (tallest layer), the sub canopy or secondary tree layer, the dominant shrub layer, a secondary shrub layer (if present), and the ground layer. Emergent trees above the dominant tree canopy layer were noted, but not recorded as a layer. A centreline of 50 m along the longest axis was used to visually estimate the structural class of the vegetation. The mean height of the vegetation was recorded.

Only vascular plant species were recorded including trees, shrubs, grasses, forbs and graminoids. A complete inventory of all species occurring within each plot was compiled. For species that could not be identified in the field, a voucher specimen was collected and used for later identification. A number of specimens are currently being prepared for lodgement with the Queensland Herbarium (BRI) for formal identification.

Using the Queensland Herbarium's HERBRECS data as a basis for identifying relevant species, thorough ground searches were made for plants of conservation interest. Where possible, these searches extended beyond the bounds of the 500 m^2 vegetation survey plot, and often included the section of land between turbines (i.e. along ridges).

Access constraints and the limited time of the ground survey precluded the opportunity to survey all 74 proposed wind turbine sites. This is relevant particularly for the southern end of the project area, where plant diversity is expected to be highest, given the juncture of the Einasleigh Uplands and Wet Tropics bioregions. Also, Mount Emerald, an area regarded for its concentration of plants with narrow or limited distribution occurs in this location, and its geographical influence is considered important.

The habitat qualities of these sites in respect to supporting rare and threatened plants was also assessed based on a range of characteristics such as the maturity of the vegetation, the complexity of structural layers and an interpretation of plant functional groups and how they relate to ecological processes. Consideration was also made of landscape connectivity, refugial areas, and fireproof niches.

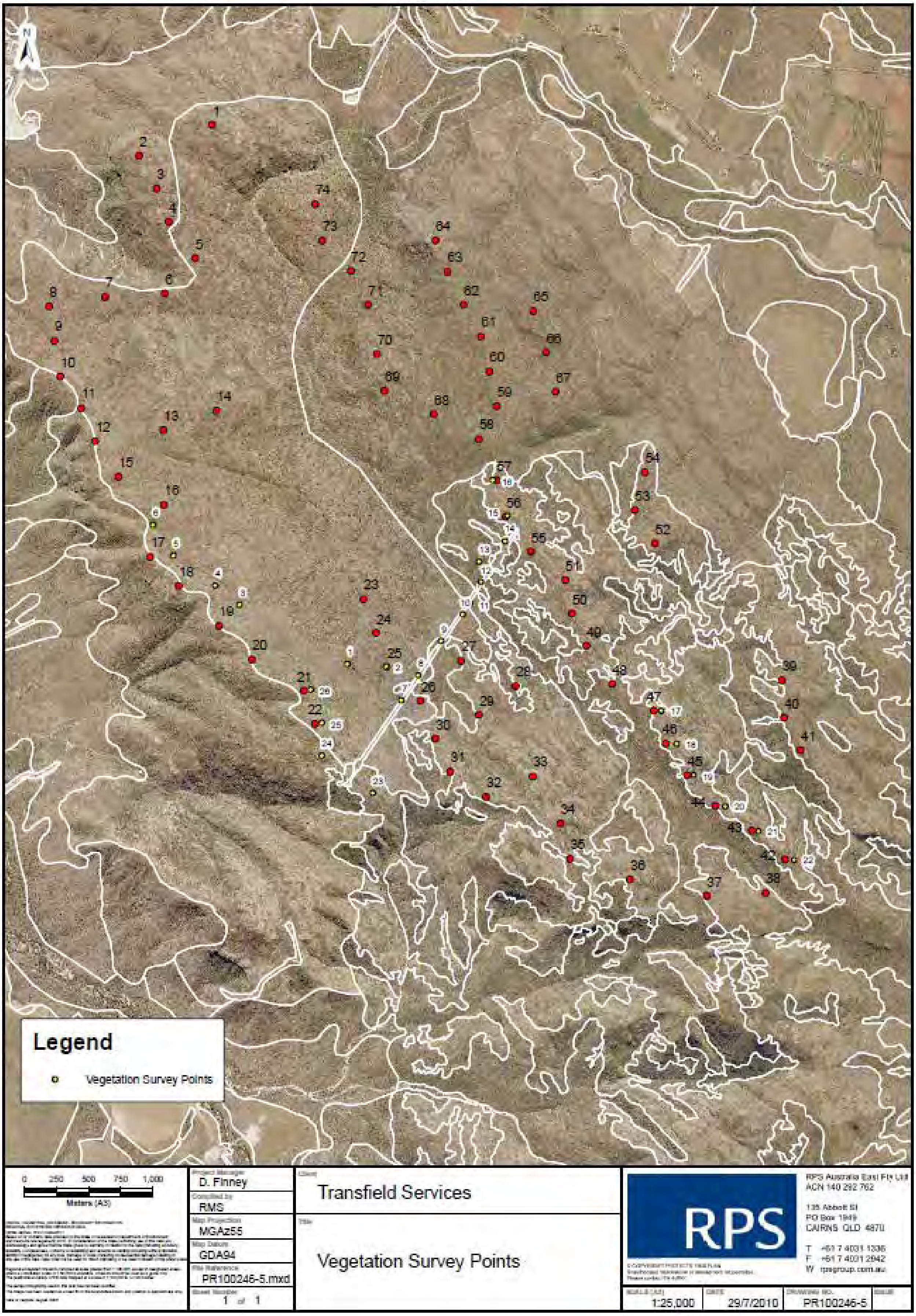

Figure 2 Location of Vegetation Survey Sites

2.2.5 Target Species

A search of the EPBC Protected Matters Search Tool predicted the potential occurrence of 15 threatened flora species and 22 vertebrate fauna species, listed as threatened under the EPBC Act. In addition, a search of the Wildlife Online database identified nine species of threatened or near threatened fauna and 24 threatened or near threatened flora species that have previously been recorded within 10 km of the site (Section 4).

These threatened species were considered during survey planning and design, and methods were employed to target these species in the field. An assessment of the likelihood of occurrence of each species was prepared following the field investigations, based on habitat type, availability and quality throughout the site, and the known distribution and ecological requirements of each species.

2.3 Taxonomy and Nomenclature

Nomenclature and taxonomy of vertebrate species generally follows that of the Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA), and Queensland Museum.

Field identification was generally based on the following field guides:

- General
  - Tracks, Scats and Other Traces, Triggs (2006).
- Nomenclature for flora follows Bostock, and Holland (2007).
- Regional Ecosystem descriptions follow those given in the Regional Ecosystem Description Database (November 2007).
- Mammals
  - The Mammals of Australia, Strahan (2008).
  - A Field Guide to Mammals of Australia, Menkhorst and Knight (2001).
  - Australian Bats, Churchill (1998).
- Birds
  - Reader's Digest Photographic Field Guide to Birds of Australia, Flegg and Madge (1995).
  - Reader's Digest Complete Book of Australian Birds (1997).
  - The Slater Field Guide to Australian Birds, Slater (2003).
  - Field Guide to Australian Birds, Morcombe (2003).
- Amphibians and Reptiles
  - A Field Guide to Australian Frogs, Barker, Grigg and Tyler (1995).
  - A Photographic Guide to Snakes and Other Reptiles of Australia, Swan (1996).
  - A Field Guide to Reptiles of Queensland, Wilson (2005).
  - Complete Guide to the Reptiles of Australia, Wilson and Swan (2003).

2.4 Survey Limitations

The limitations associated with this Ecological Assessment Report are presented herewith. The limitations have been taken into account specifically in relation to threatened species assessments, results and conclusions.

In instances where surveys were not able to reliably detect a particular species or guild, a precautionary approach has been adopted. As such 'assumed presence' of known and expected threatened species, populations and ecological communities has been made where relevant and scientifically justified to ensure a holistic assessment.

2.4.1 Site Access

The project area is located on elevated land of rugged, dissected topography. A number of wind turbines are proposed to be positioned along narrow ridgelines, of which the only access to some of these sites is by helicopter drop-in or by foot traverse. Consequently, several sites could not be ground surveyed because of access limitations. Descriptions of environmental conditions for these remote sites have therefore been extrapolated from surrogate sites where access could be made.

The ability to access all trapping sites in a reasonable timeframe to satisfy all animal ethics requirements also influenced the location of trapping survey sites. Areas with limited or restricted access were therefore investigated using alternative survey methods, such as walk-through transect surveys during which bird surveys, habitat searches and habitat assessments were undertaken. In addition, a number of incidental observations were recorded during the walk through transect surveys.

2.4.2 Survey Timing

As the presence and abundance of fauna within a particular area may be seasonal in response to the availability and quality of resources, or vary with environmental conditions, the timing of the survey can greatly influence the species which are recorded. Flowering and fruiting plant species, which attract local and some nomadic or migratory species, may fruit or flower during specific seasons or in response to environmental conditions, or in cycles spanning a number of years. Furthermore, these resources might only be accessed in some areas during years when resources otherwise more accessible to threatened species fail. As a consequence threatened species may be absent from some areas even where potential habitat exists for extended periods.

Nevertheless, it is considered that the survey effort undertaken to date within the locality provides a baseline picture of the habitat values occurring within the site.

2.4.3 Significant Species

The presence and abundance of flora and fauna within a particular area is not static over time and may be seasonal in response to the availability of resources and climatic conditions. However, the field investigations provided an overview of habitat types and values occurring within the subject site, and this habitat assessment, combined with knowledge of each species ecological requirements, has been used to predict the likelihood of occurrence of threatened fauna species within the site (Section 4).

2.4.4 Fire

Despite the timing of the survey coinciding with the end of the wet season, severe bushfires had passed over the project area during the previous year (2009). The effects of these fires were pronounced along ridge topography of the eastern portion of the project area, rendering the identification of much of the ground flora and shrub layers difficult. Nevertheless, a representative account of the conspicuous flora is given in this report. Fires however, may have had bearing on the presence of fauna and their use of certain ecological niches, given that a number of habitats were modified.

2.4.5 Data Availability and Accuracy

The collated threatened fauna species records provided by the DERM Wildlife Online Database (2010) for the area are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to DERM for collation. During the review of threatened species records sourced from the Wildlife Online Database, consideration has been given to the accuracy of each threatened species record in addition to an assessment of habitat suitability within the site (Section 4.3). Similarly the EPBC Protected Matters Search Tool is a predictive model, which identifies all species that have previously been recorded, or for which suitable habitat exists or could potentially occur within the area. This database is subject to the same inherent inaccuracy issues as the Wildlife Online database.

In order to address these limitations in respect to data accuracy, threatened species records have been used to provide a guide only to the types of species which occur within the locality of the site. As a consequence habitat assessment and the results of surveys conducted within the site have been used to assess the likelihood of occurrence of threatened species within the site (Section 4).

3 Results of Desktop Review

Published scientific journal papers and other literature, as well as a range of databases provide a historical and scientific context from which ecological considerations can be made in relation to flora and fauna, particularly rare and threatened species, and the landscape importance of environmental features. The findings of this exercise are discussed in the following section.

3.1 Regional Ecosystem Mapping

Remnant vegetation communities in Queensland are classified as Regional Ecosystems (REs) for the purposes and administration of the *Vegetation Management Act* 1999 (VMA). Vegetation mapping of these communities in the wet tropics bioregion was revised and updated in September 2009 and released as version 6.0. The scale of this mapping is 1:50,000. DERM (2009) describe regional ecosystems as:

> *"Regional ecosystems are communities of vegetation that are consistently associated with a particular combination of geology, land form and soil in a bioregion. Each regional ecosystem has been assigned a conservation status which is based on its current remnant extent (how much of it remains) in a bioregion"*.

The Regional Ecosystem (RE) mapping for the study area encompasses two bioregions: the Wet Tropics (1:50,000) and the Einasleigh Uplands (1:100,000). The map production scale for each bioregion renders the resolution of the mapping significantly different. For example, heterogeneous polygons are applied for many areas in the Einasleigh Uplands due to the scale of the mapping and the possible presence of small patches of vegetation associations that cannot be differentiated at a scale of 1:100,000; whereas, the percentage of heterogeneous polygons shown in the wet tropics bioregion is much lower due to the finer resolution of the mapping at 1:50,000.

Regional ecosystem mapping shows the remnant vegetation communities found within the broader study area occur primarily on a single land zone type - 12, described as: Mesozoic to Proterozoic igneous rocks, forming ranges, hills and lowlands. Predominantly granitic rocks and intermediate to acid volcanics such as granites, granodiorites, andesites and rhyolites, as well as minor areas of associated interbedded sediments and basic intrusive rock types such as gabbros and dolerites. Excludes serpentinites (land zone 11) and younger igneous rocks (land zone 8). Soils are mainly Tenosols and Rudosols on steeper slopes with Chromosols and Sodosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.

The REs intersected by turbines and the road and cabling network are summarised in **Table 1**. Descriptions of these REs are given in **Table 2** with their respective conservation status as listed under the VMA. Effectively this interpretation reflects what types of remnant vegetation will be potentially affected by clearing and disturbance during the construction phase.

Mapping showing the landscape position of remnant communities (REs) in relation to the study area and each turbine site is given in **Appendix B**. Descriptions of remnant vegetation are reproduced from the information and data held in the latest version of REDD updated in November 2007. Complete descriptions of REs are given in **Appendix C** (some information from the REDD description of less ecological relevance has been omitted for brevity).

Table 1 - Regional ecosystems intersected by wind turbines within the study area.

No. of turbines	Turbines numbers	Mapped RE	VMA status[1]
23 turbines	1, 5-16, 19-26, 73-74	9.12.4c / 9.12.2	LC / LC
20 turbines	2-4, 17-18, 58-72	9.12.30a / 9.12.20 / 9.12.4c	LC / LC / LC
5 turbines	27 - 28	7.12.34	LC
26 turbines	29 - 57	7.12.57	OC

[1] Conservation status under the *Vegetation Management Act 1999*: LC – Least Concern; OC – Of Concern

Table 2 - Description of regional ecosystems intersected within the project footprint.

RE	Description	Status[1]
7.12.34	*Eucalyptus portuensis* (white mahogany) and/or *E. drepanophylla* (ironbark), +/- *C. intermedia* (pink bloodwood) +/- *C. citriodora* (lemon-scented gum), +/- *E. granitica* (granite ironbark) open-woodland to open-forest. Uplands on granite, of the dry rainfall zone.	LC
7.12.57	Shrubland and low woodland mosaic with *Syncarpia glomulifera* (turpentine), *Corymbia abergiana* (range bloodwood), *Eucalyptus portuensis* (white mahogany), *Allocasuarina littoralis* (black sheoak) and *Xanthorrhoea johnsonii* (grasstree). Uplands and highlands on granite and rhyolite, of the moist and dry rainfall zones.	OC
9.12.2	Mixed open forest to occasionally low open woodland including combinations of the species *Eucalyptus portuensis* (white mahogany), *Corymbia citriodora* (lemon-scented gum), *E. granitica* (granite ironbark) or *E. crebra* (narrow-leaved ironbark), *C. intermedia* (pink bloodwood) or *C. clarksoniana* (Clarkson's bloodwood) +/- *E. cloeziana* (Gympie messmate) +/- *Corymbia* spp. There is often an open to mid-dense sub-canopy containing canopy species +/- *Melaleuca viridiflora* (broad-leaved paperbark) +/- *Lophostemon suaveolens* (swamp mahogany) +/- *C. leichhardtii* (yellowjacket) . The shrub layer varies from scattered shrubs to mid-dense and includes juvenile canopy species, *Acacia flavescens* (yellow wattle), *Callitris intratropica* (cypress pine), *L. suaveolens*, *Xanthorrhoea johnsonii* (grasstree) and *Petalostigma pubescens* (quinine). The dense grassy ground layer is generally dominated by *Themeda triandra* (kangaroo grass) +/- *Heteropogon triticeus* (giant speargrass) +/- *Mnesithea rottboellioides* (northern canegrass). In some areas, patches dominated by *E. moluccana* (gum-topped box) or *E. cloeziana* may occur. Occurs on rises, hill and ranges.	LC
9.12.4c	Low woodland to low open woodland of *Callitris intratropica* (cypress pine) and *Eucalyptus shirleyi* (silver-leaved ironbark) and/or *E. melanophloia* (silver-leaved ironbark) +/- *Corymbia leichhardtii* (yellowjacket). The sparse mid layer can include juvenile canopy species, *Melaleuca monantha* (teatree), *Dolichandrone heterophylla* (lemonwood), *Alphitonia obtusifolia*, *Petalostigma pubescens* (quinine), *Acacia bidwillii* (corkwood wattle) and *Grevillea* spp. The dominants in the grassy ground can include *Schizachyrium fragile* (firegrass), *Heteropogon contortus* (black speargrass) or *Themeda triandra* (kangaroo grass). Occurs predominantly on sandy shallow soils derived from granite on rolling low hills to hills.	LC
9.12.20	Woodland to low woodland of *Eucalyptus pachycalyx* (pumpkin gum) +/- *E. cloeziana* (Gympie messmate) +/- *Corymbia leichhardtii* (yellowjacket) +/- *Callitris intratropica* (cypress pine) +/- *E. portuensis* (white mahogany) +/- *E. cullenii* (Cullen's ironbark) or *E. atrata*. The mid-dense shrub layer includes juvenile canopy species, *Grevillea glauca* (bushman's clothepeg), *Persoonia falcata* and *Xanthorrhoea johnsonii* (grass-tree). The medium to dense grassy ground layer is mostly dominated by *Themeda triandra* (kangaroo grass). Occurs on steep rugged hills on acid volcanics.	LC
9.12.30a	Woodland to open forest of *Corymbia leichhardtii* (yellowjacket) and *Eucalyptus cloeziana* (Gympie messmate) +/- *E. portuensis* (white mahogany) +/- *C. citriodora* (lemon-scented gum) +/- *E. cullenii* (Cullen's ironbark) +/- *Callitris intratropica* (cypress pine). Some canopy species can occur as emergents. The sparse to mid-dense shrub layer is dominated by juvenile canopy species, *Persoonia falcata*, *Grevillea glauca* (bushman's clothepeg) and *Allocasuarina inophloia* (stringybark sheoak) and a lower shrub with *Jacksonia thesioides* and *Xanthorrhoea johnsonii* (grass-tree) can occur. The sparse to mid-dense ground layer is dominated by *Themeda triandra* (kangaroo grass). Rocky rhyolite hills to steep hills.	LC

[1] Conservation status as listed under the *Vegetation Management Act 1999*: LC – Least Concern, OC – Of Concern.

The position of turbines as shown on the mapping should be viewed as indicative and used as a guide because of the potential mapping error of ± 50 m (Wet Tropics bioregion) and ± 100 m (Einasleigh Uplands bioregion). For these situations, recommendations have been made to consider refining the position (micro-site location) of turbines if they intersect with an 'of concern' RE as it occurs on the ground, and possibly relocate them to a position in 'least concern' remnant vegetation. It is noted however, that this may not be possible for some turbines given the surrounding vegetation and its attendant conservation status (i.e. a least concern remnant community may not occur adjacent to the position of the proposed turbine).

Opportunities exist to undertake more detailed ground-truth work to delineate the boundaries between 'of concern' and 'least concern' communities in order to fine tune the position of each turbine to offset impacts to remnant vegetation listed as 'of concern' under the VMA. We note however, that due to the limitations of scale with RE mapping, that inconspicuous communities that occupy niches of land are not described under the RE classification, and hence difficulties are likely to be encountered in attributing a conservation status to a community that is not described in the Regional Ecosystem Description Database.

This is notably relevant for many proposed turbine sites, where 26 turbines are shown on mapping to occur within RE 7.12.57 – an 'of concern' remnant community. The reality of this situation is that the on-ground floristic account and the mapping description rarely match. For example, rock pavements are a common feature of the ridge country, and also coincide with the placement of a turbine. These features are poorly represented by woody vegetation, and even less so by trees; yet they exist as narrow, linear mosaics within broader areas of mappable vegetation characterised by trees. They are too small and narrow in area to be incorporated as separate units (polygons) in the mapping.

3.2 Essential Habitat

A review of regional ecosystem and the associated essential habitat mapping was made to determine what areas of vegetation constitute this important type of habitat for conservation significant species of flora and fauna. A circular area associated with the south-western corner of the study area is shown to be essential habitat for the species listed in **Table 3**. Proposed turbines 26 and 28-35 occur within the mapped essential habitat zone. Turbines 22 and 27 are shown to be just outside of this area.

Table 3 - Species shown to have essential habitat in the study area.

Scientific Name	Common Name	NCA[1]	EPBC[2]
Fauna			
Casuarius casuarius johnsonii	Southern cassowary (southern population)	E	E
Flora			
Acacia purpureopetala	A wattle (prostrate)	V	V
Grevillea glossadenia	A shrub	V	V
Homoranthus porteri	A shrub	V	V
Plectranthus amoenus	A herb	V	-

[1] Conservation status as listed under the *Nature Conservation Act 1992*:
E – Endangered, V – Vulnerable, LC – Least Concern

[2] Conservation status as listed under the *Environment Protection and Biodiversity Conservation Act 1999*:
E – Endangered, V - Vulnerable

The presence of the southern cassowary in habitat in deeply dissected and elevated rocky terrain is considered to be most unlikely. There is a remote possibility that this species may traverse more favourable habitat around the Oaky Creek area to the west of the wind farm, but again this is improbable given the separation of this region from favoured forested habitats (vine forest) located a considerable distance away. Land here is flatter and supports the necessary resources for the cassowary. The project footprint of the wind farm does not support any resources for the cassowary.

The four species of plants listed as having essential habitat in the south-western corner of the study area is more realistic than the likelihood of the cassowary being present. A small population of *Grevillea glossadenia* growing in association with *Homoranthus porteri* was found in precisely the area shown on the essential habitat mapping. Despite concerted ground searches though, the prostrate wattle *Acacia purpureopetala* was not found in this area. However, this does not discount its presence in similar habitat at this location, and the steeply dissected country of the south-western corner of the study area is likely to harbour this inconspicuous species. Similarly, *Plectranthus amoenus* was not found during ground searches; however, this species is relatively conspicuous and should be able to be identified if present. As such, it is recommended that detailed ground searches are undertaken at precise locations of the turbines in this area, at a time when more focussed investigation can be practicably undertaken.

We note that ground surveys of the proposed locations of the turbines shown to be in the essential habitat zone were unable to be undertaken during this survey. No plant species of conservation interest were recorded from turbine 22, which occurs just outside the essential habitat area. The REs which correspond with the essential habitat mapping and associated species are listed in **Table 4**.

Table 4 - Regional ecosystems corresponding with essential habitat (not all RE shown here are present in study area).

Scientific Name	RE - Habitat
Fauna	
Casuarius casuarius johnsonii[1]	7.1.3, 7.2.1, 7.2.3, 7.2.4, 7.2.5, 7.2.6, 7.2.11, 7.3.1, 7.3.3, 7.3.4, 7.3.5, 7.3.6, 7.3.7, 7.3.8, 7.3.10, 7.3.12, 7.3.17, 7.3.23, 7.3.25, 7.3.36, 7.3.37, 7.3.38, 7.8.1, 7.8.2, 7.8.3, 7.8.4, 7.8.7, 7.8.8, 7.8.14, 7.11.1, 7.11.2, 7.11.5, 7.11.6, 7.11.7, 7.11.10, 7.11.12, 7.11.13, 7.11.14, 7.11.18, 7.11.23, 7.11.24, 7.11.25, 7.11.28, 7.11.29, 7.11.30, 7.11.34, 7.12.1, 7.12.2, 7.12.4, 7.12.5, 7.12.7, 7.12.9, 7.12.13, 7.12.16, 7.12.17, 7.12.19, 7.12.20, 7.12.39, 7.12.40, 7.12.44, 7.12.47, 7.12.50, 7.12.68
Flora	
Acacia purpureopetala	None listed, but mapping shows: 7.12.34, 7.12.57, 9.12.4c/9.12.2, 7.12.65k.
Grevillea glossadenia	None listed, but mapping shows: 7.12.34, 7.12.57, 9.12.4c/9.12.2, 7.12.65k.
Homoranthus porteri	None listed, but mapping shows: 7.12.34, 7.12.57, 9.12.4c/9.12.2, 7.12.65k.
Plectranthus amoenus	7.12.7; 7.12.27; 7.12.30; 7.12.34; 7.12.52; 7.12.57; 7.12.65; 9.12.4; 9.12.17; 9.12.20

[1] The REs shown here for essential habitat for *Casuarius casuarius johnsonii* do not all occur within the study area.

3.3 Wildlife Online Database Search

3.3.1 Flora and Vegetation

A total of 95 records of flora were returned in a search of the Wildlife Online database. This search was based on a four kilometre search radius established around the approximate centre of the study area (centred on coordinates latitude 17.1676° and longitude 145.3814°). Given the wind farms relatively isolated position in the landscape – separated from different land forms by steeply dissected rocky terrain, this search area was considered sufficient to capture representative data from the range of vegetation and habitat types likely to be found.

Of these records, seven species are listed as conservation significant and are shown in **Table 5**. It is noted that these records from the Wildlife Online database are either confirmed through visual sightings or by voucher specimens held in the Queensland Herbarium. The complete Wildlife Online search results are given in **Appendix D**.

Table 5 - Conservation significant flora as listed in the Wildlife Online database (search centred on coordinates: latitude 17.1676°, longitude 145.3814° within a four kilometre radius search around the site).

Scientific Name	Common Name	NCA[1]	EPBC[2]
Acacia purpureopetala	-	V	V
Goodenia stirlingii	-	V	-
Grevillea glossadenia	-	V	V
Homoranthus porteri	-	V	V
Melaleuca uxorum	-	E	-
Peripleura scabra	-	NT	-
Plectranthus amoenus	-	V	-

[1] Conservation status as listed under the *Nature Conservation Act 1992*:
E – Endangered, V – Vulnerable, NT – Near Threatened

[2] Conservation status as listed under the *Environment Protection and Biodiversity Conservation Act 1999*:
E – Endangered, V - Vulnerable

3.3.2 Fauna

Given that the presence and abundance of fauna within a particular area is not static over time, a search of the Wildlife Online database was expanded for the fauna assessment to include a search radius of 10 km from the study area. Within 10 km of the site, twelve threatened or near threatened fauna species listed under the NC Act have previously been recorded (**Table 6**).

Table 6 **Conservation significant fauna as listed in the Wildlife Online database (search centred on coordinates: latitude 17.1676°, longitude 145.3814°).**

Species	Common Name	Conservation Status		Previously recorded within 10km	Previously recorded within 5km	Likelihood of Occurrence
		NCA[1]	EPBC[2]			
Erythrotriorchis radiatus	Red Goshawk	E	V	Yes (1)	Yes (1)	**Possible** - occurs across northern Australia and south through to eastern Queensland and far north eastern NSW. Reported to be rare in NSW, with most records in NSW from around the Clarence River Catchment (DECC, 2008). Within its range, the Red Goshawk occurs sparsely in a wide range of open forests and woodlands, especially near rivers, wetlands and rainforest fringes (Pizzey and Knight, 1997). No potential nests or other evidence was observed during the survey.
Accipiter novaehollandiae	Grey Goshawk	NT	-	Yes (2)	No	**Possible** - this species has been recorded in rainforests, forests, forest gullies and valleys, taller woodlands and timbered water courses (Pizzey and Knight 2003). Widespread in the Greater Brisbane region in South-east Queensland, but less common in dense urban settings. No Grey Goshawks or their nesting sites were observed during the survey.
Lophoictinia isura	Square-tailed Kite	NT	-	Yes (2)	No	**Possible** - however, no nests or evidence of this species were observed. Square-tailed Kites occur in open eucalypt forest, woodlands and sand plains of coastal and sub-coastal mainland Australia. This species is sparsely distributed through even preferred habitat and breeding pairs are known to occupy very large home ranges of at least 100 km2 (Schodde and Tidemann, 1993; NPWS, 2000). Nests are a pile of sticks approximately 0.6 – 1 m in diameter, and are usually located in tall or emergent living trees that are near watercourses (NPWS, 2000; Schodde and Tidemann, 1993).
Erythrura gouldiae	Gouldian Finch	E	E	Yes (3)	Yes (1)	**Possible** - however, unlikely to breed within the site as there are no permanent sources of fresh water. The critical components of suitable core habitat for the Gouldian Finch appear to be the presence of favoured annual and perennial grasses (especially Sorghum), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing Eucalyptus trees (especially E. tintinnans, E. brevifolia and E. leucophloia). Its breeding habitat is usually confined to ridges and rocky foothills, but the tendency to nest in these upland areas is probably due to the presence of Sorghum grasses rather than to the actual topography of the landscape.
Cyclopsitta diophthalma macleayana	Macleay's Fig-parrot	-	V	Yes (1)	No	**Unlikely** - due to a lack of appropriate habitat within the site. This species prefers lowland rainforests, adjacent eucalypt woodlands, coastal scrub and timbered watercourses where it feeds on figs, loquats and other fruit trees.
Nettapus coromandelianus	Australian Cotton Pygmy-goose	NT	-	Yes (1)	No	**Unlikely** to occur - due to a lack of essential habitat characteristics required by this species. The Australian Cotton Pygmy-goose prefers deeper freshwater swamps, lagoons, dams and water impoundments with waterlilies and other semi-emergent plants (Pizzey and Knight 2007). This species congregates in flocks on permanent water bodies during the dry season.
Dasyurus hallucatus	Northern Quoll	-	E	Yes (1)	No	**Possible** - this species commonly occur where rocky escarpments occur within or adjoining eucalypt forest and woodland, around human settlements and in rainforest patches or on beaches. Northern Quolls are scansorial, using a variety of den sites including rock crevices, tree hollows, logs, termite mounds, roofs of houses and

Species	Common Name	Conservation Status		Previously recorded within 10km	Previously recorded within 5km	Likelihood of Occurrence
		NCA[1]	EPBC[2]			
						goanna burrows (Van Dyke & Strahan, 2008). No evidence of northern quoll was recorded during the survey
Petrogale mareeba	Mareeba Rock-wallaby	NT	-	Yes (3)	No	**Probable** - this species is quite restricted in distribution, being found only in the Mareeba area, just west of Cairns, north to Mt. Carbine and south to Mt. Garnet. They are found in rocky habitats, which tend to be granite boulders found in tropical open woodland, consistent with the habitat of the site. This species has been recorded within 10km of the study site, and evidence of rock-wallaby habitation was prolific throughout the site, with scats observed and collected from most rocky ridge tops.
Pseudochirops archeri	Green Ringtail possum	NT	-	Yes (2)	No	**Unlikely** to occur - this species tends to favour rainforests habitats with tangled thornless vines. This habitat is lacking within the study site.
Pteropus conspicillatus	Spectacled Flying-fox	-	V	Yes (11)	No	**Unlikely** to occur - this species is chiefly found in rainforest areas where it feeds on blossoms and fruit, but also visits eucalypts for nectar and pollen. They prefer to roost in the middle and upper canopies of rainforest in the full sun. Colonies of the Spectacled Flying-fox can also be found in mangroves, paperbark and eucalypt forests. No colony is known to be found more than 7 km from a rainforest (WIKI). No flying fox roosts were identified during the survey.
Acanthophis antarcticus	Common Death Adder	NT	-	Yes (1)	No	**Possible** - this species is found in a wide variety of habitats amongst leaf litter and debris often at the bases of shrubs or small trees (Cogger 2000).
Melanotaenia eachamensis	Lake Eacham Rainbowfish	-	E	Yes (1)	Yes (1)	**Unlikely** to occur - as no permanent water courses occur within the site. This species occurs in slow to moderately-flowing streams, especially smaller tributaries. It is also found around the vegetated margins of lakes and reservoirs. The species prefers sunlit margins of streams with abundant cover such as log snags and aquatic plants and also forms schools near the surface of rocky pools.

[1] Conservation Status as listed under the *Nature Conservation Act 1992*: E – Endangered; V – Vulnerable; NT: Near Threatened

[2] Conservation Status as listed under the *Environmental Protection and Biodiversity Conservation Act 1999*: CE - Critically Endangered; E – Endangered; V - Vulnerable

3.4 Protected Matters Database Search

3.4.1 Flora and Vegetation

A polygon search was made of the EPBC Act's Protected Matters database for 'matters of national environmental significance' that could occur within the study area. This database returns records of conservation significant species as listed under the EPBC Act, and are based on a range of parameters and predictions using a range of bio-models and data. The search resulted in eight records of flora that could possibly occur within the study area in suitable habitats. Records for plants of conservation interest are shown in **Table 7**. The complete Protected Matters report is given in **Appendix E**.

Information contained in Table 6 under the column *Presence in Study Area* is derived from a range of sources and intuitive field knowledge of particular species. The landscape context of the wind farm proposal is important to consider when predicting whether a certain species is likely to occur; for example, epiphytic ferns such as *Huperzia marsupiiformis* are most unlikely to occur on ridge topography where turbines are proposed to be constructed, due simply to a complete absence of suitable, closed forest habitat. It is noted that the search of the Protected Matters database did not return results for plants of conservation interest (and listed under the EPBC Act) that obviously occur within the search area, and have been validated by voucher specimens held in the Queensland Herbarium. Two species that are relevant in this context are *Grevillea glossadenia* and *Homoranthus porteri* – both of which were found during the current survey in the south-west portion of the study area.

Table 7 - Conservation significant flora as listed in the EPBC Act's Protected Matters database.

Scientific Name	Common Name	Status[1]	Presence in Study Area
Acacia guymeri	-	V	Possible
Acacia ramiflora	-	V	Possible
Chamaesyce carissoides	-	V	Possible
Dendrobium superbiens	Curly Pinks	V	Unlikely – sub-optimal habitat.
Huperzia marsupiiformis	Water Tassel-fern	V	Unlikely due to absence of well-developed vine forest habitat.
Phalaenopsis rosenstromii	An orchid	E	Unlikely due to altitude above sea level. Generally occurs at lower elevation in well-developed rainforest.
Taeniophyllum muelleri	Minute Orchid, Ribbon-root Orchid	V	Unlikely due to sub-optimal habitat.
Tropilis callitrophilis	Thin Feather Orchid	V	Possible, but not sighted in range of habitats.

[1] Conservation status as listed under the *Environment protection and Biodiversity Conservation Act 1999*9:
CE – Critically Endangered, E – Endangered, V – Vulnerable, X – Extinct.

3.4.2 Fauna

Given that the presence and abundance of fauna within a particular area is not static over time, a search of the EPBC Act's Protected Matters database for 'matters of national environmental significance' was also expanded to include a search radius of 10km from the study area.

Twenty-two threatened fauna species were identified as having the potential to occur within this search area (**Table 8**). Seventeen migratory species were also identified through this search as having the potential to occur (**Table 9**). An assessment of the likelihood of occurrence of these species was prepared following the field investigations, based on habitat type, availability and quality throughout the site, and the known distribution and ecological requirements of each species. Some species are considered more likely to occur on the site than others. In addition, an assessment of the likelihood of occurrence of listed migratory species was also undertaken.

Table 8 - Conservation significant fauna as listed in the EPBC Act's Protected Matters database.

Species	Common Name	Conservation Status		Previously recorded within 10km	Likelihood of Occurrence
		EPBC	NCA		
Casuarius casuarius johnsonii	Southern Cassowary	E	E	No	**Unlikely** to occur - based on the available habitat within the study area. Cassowaries require a high diversity of fruiting trees to provide a year-round supply of fleshy fruits. Although occurring primarily in rainforest, they also use woodlands, melaleuca swamps, mangroves and even beaches, both as intermittent food sources and as connecting habitat between more suitable sites.
Erythrotriorchis radiatus	Red Goshawk	V	E	Yes	**Possible** - occurs across northern Australia and south through to eastern Queensland and far north eastern NSW. Reported to be rare in NSW, with most records in NSW from around the Clarence River Catchment (DECC, 2008). Within its range, the Red Goshawk occurs sparsely in a wide range of open forests and woodlands, especially near rivers, wetlands and rainforest fringes (Pizzey and Knight, 1997). No potential nests or other evidence was observed during the survey.
Accipiter novaehollandiae	Grey Goshawk	-	NT	Yes	**Possible** - this species has been recorded in rainforests, forests, forest gullies and valleys, taller woodlands and timbered water courses (Pizzey and Knight 2003). Widespread in the Greater Brisbane region in South-east Queensland, but less common in dense urban settings. No Grey Goshawks or their nesting sites were observed during the survey.
Lophoictinia isura	Square-tailed Kite	-	NT	Yes	**Possible** - however, no nests or evidence of this species were observed. Square-tailed Kites occur in open eucalypt forest, woodlands and sand plains of coastal and sub-coastal mainland Australia. This species is sparsely distributed through even preferred habitat and breeding pairs are known to occupy very large home ranges of at least 100 km2 (Schodde and Tidemann, 1993; NPWS, 2000). Nests are a pile of sticks approximately 0.6 – 1 m in diameter, and are usually located in tall or emergent living trees that are near watercourses (NPWS, 2000; Schodde and Tidemann, 1993).
Erythrura gouldiae	Gouldian Finch	E	E	Yes	**Possible** occurrence - however, unlikely to breed within the site as there are no permanent sources of fresh water within the site. The Gouldian Finch inhabits open woodlands that are dominated by Eucalyptus trees and support a ground cover of Sorghum and other grasses. It has also been recorded in undescribed thickets of vegetation along streams and gorges, and at the margins of stands of mangroves. The Gouldian Finch drinks regularly and thus is often seen at watering points and associated habitat such as beds of grass and grass-covered banks around shallow waterholes, watercourses, soaks and springs. The critical components of suitable core habitat for the Gouldian Finch appear to be the presence of favoured annual and perennial grasses (especially Sorghum), a nearby source of surface water and, in the breeding season, unburnt hollow-bearing Eucalyptus trees (especially *E. tintinnans*, *E. brevifolia* and *E. leucophloia*). Its breeding habitat is usually confined to ridges and rocky foothills, but the tendency to nest in these upland areas is probably due to the presence of Sorghum grasses rather than to the actual topography of the landscape.
Neochmia ruficauda ruficauda	Star Finch (eastern), Star Finch (southern)	E	E	No	**Unlikely** to occur - due to the lack of essential habitat characteristics required by this species. The Star Finch favours swamp vegetation, open grassland with sparse vegetation and cultivated land close to a permanent source of freshwater, and is believed to have a distribution extending north to Bowen, several hundred kilometres south of the survey site.
Cyclopsitta diophthalma macleayana	Macleay's Fig-parrot	-	V	Yes	**Unlikely** - due to a lack of appropriate habitat within the site. This species prefers lowland rainforests, adjacent eucalypt woodlands, coastal scrub and timbered watercourses where it feeds on figs, loquats and other fruit trees.
Nettapus coromandelianus	Australian Cotton Pygmy-goose	-	NT	Yes	**Unlikely** to occur - due to a lack of essential habitat characteristics required by this species. The Australian Cotton Pygmy-goose prefers deeper freshwater swamps, lagoons, dams and water impoundments with waterlilies and other semi-emergent plants (Pizzey and Knight 2007). This species congregates in flocks on permanent water bodies during the dry season.

Species	Common Name	Conservation Status		Previously recorded within 10km	Likelihood of Occurrence
		EPBC	NCA		
Rostratula australis	Australian Painted Snipe	V	V	No	**Unlikely** to occur - due to a lack of essential habitat characteristics required by this species. The Australian painted Snipe prefers well vegetated shallows and margins of wetlands, dams, sewage ponds; wet pastures, marshy areas, irrigation systems, lignum, tea-tree scrub, open timber (Prizzey and Knight 2007)
Litoria nannotis	Waterfall Frog, Torrent Tree Frog	E	E	No	**Unlikely** - due to a lack of essential habitat characteristics available within the site. This species is a rainforest specialist. It has been recorded in rainforests and wet sclerophyll forests near waterfalls and cascades. They are commonly seen on boulders beside or behind waterfalls.
Litoria nyakalensis	Mountain Mistfrog	CE	E	No	**Unlikely** - due to a lack of essential habitat characteristics available within the site. This species is a rainforest specialist, closely associated with streams in rainforest and wet sclerophyll forest. Frogs have been found on emergent rocks and boulders (Barker et al. 1995).
Litoria rheocola	Common Mistfrog	E	E	No	**Unlikely** - due to a lack of essential habitat characteristics available within the site. This species is a rainforest specialist that lives in rainforests and wet sclerophyll forests. It is often found near fast flowing mountain streams and waterfalls.
Nyctimystes dayi	Lace-eyed Tree Frog, Australian Lacelid	E	E	No	**Unlikely** - due to a lack of essential habitat characteristics available within the site. This species lives in montane areas often near fast flowing rocky streams. They are often seen on rocks and plants at the side of these streams.
Pseudophryne covacevichae	Magnificent Brood Frog	V	V	No	Unlikely to occur - this species appears to be restricted to specific habitats with all records being from a small area near Ravenshoe, within the rhyolites of the Glen Gorden Volcanics.
Taudactylus acutirostris	Sharp-snouted Day Frog, Sharp-snouted Torrent Frog	EX	E	No	**Highly unlikely** - this species is believed to be extinct in the wild. It was known to inhabit montane forests in north-east Queensland, where it was found amongst rocks and plants beside small mountain streams. This habitat is lacking from the study site.
Dasyurus hallucatus	Northern Quoll	E	-	Yes	**Possible** - this species commonly occurs where rocky escarpments occur within or adjoining eucalypt forest and woodland, around human settlements and in rainforest patches or on beaches. Northern Quolls are scansorial, using a variety of den sites including rock crevices, tree hollows, logs, termite mounds, roofs of houses and goanna burrows (Van Dyke & Strahan, 2008). No evidence of northern quoll was recorded during the survey.
Dasyurus maculatus gracilis	Spotted-tailed Quoll or Yarri (North Queensland subspecies)	E	E	No	**Possible** - this species occurs along the east coast of Australia from south east Queensland to South Australia and Tasmania. It has been recorded in a wide range of habitat types including dry and moist sclerophyll forests and woodlands, rainforest, coastal heathland, and riparian forest. This species been occasionally sighted in treeless areas, rocky outcrops and grazing lands (NPWS, 1999; NPWS, 2000; Strahan, 1998). The Spotted-tailed Quoll shelters and dens in small caves, fallen logs with large hollows and tree hollows and may utilise numerous dens within its home range which has been estimated to be between 800 ha to 20 km2 (NPWS, 2000; NPWS in prep, 1999). No evidence of the Spotted-tailed Quoll was observed during the survey.
Petrogale mareeba	Mareeba Rock-wallaby	-	NT	Yes	**Probable** - this species is quite restricted in distribution, being found only in the Mareeba area, just west of Cairns, north to Mt. Carbine and south to Mt. Garnet. They are found in rocky habitats, which tend to be granite boulders found in tropical open woodland, consistent with the habitat of the site. This species has been recorded within 10km of the study site, and evidence of rock-wallaby habitation was prolific throughout the site, with scats observed and collected from most rocky ridge tops.
Pseudochirops archeri	Green Ringtail possum	-	NT	Yes	**Unlikely** to occur - this species tends to favour rainforests habitats with tangled thornless vines. This habitat is lacking within the study site.
Hipposideros semoni	Semon's Leaf-nosed Bat, Greater Wart-nosed	E	E	No	**Unlikely** to occur - this species favours rainforest, forest, open woodland, vine thickets for foraging. However, it roosts alone in small limestone and sandstone caves which are absent from the study site and surrounding area.

Species	Common Name	Conservation Status		Previously recorded within 10km	Likelihood of Occurrence
		EPBC	NCA		
	Horseshoe-bat				
Petaurus australis unnamed subsp.	Fluffy Glider, Yellow-bellied Glider (Wet Tropics)	V	V	No	**Unlikely** to occur - this species inhabits tall open forest on the western fringe of the Wet Tropics Heritage Area. Floristics of the forest may vary from one location to another but the presence of two eucalypt species, *Eucalyptus resinifera* and *Eucalyptus grandis*, is essential. The first is used for sap-feeding (Quin et al. 1996; Russell 1984) and the second as a den tree (Bradford & Harrington 1999; Russell 1984). Both of these essential species are absent from the study site.
Pteropus conspicillatus	Spectacled Flying-fox	V	-	Yes	**Unlikely** to occur - this species is chiefly found in rainforest areas where it feeds on blossoms and fruit, but also visits eucalypts for nectar and pollen. They prefer to roost in the middle and upper canopies of rainforest in the full sun. Colonies of the Spectacled Flying-fox can also be found in mangroves, paperbark and eucalypt forests. No colony is known to be found more than 7 km from a rainforest (WIKI). No flying fox roosts were identified during the survey.
Pteropus poliocephalus	Grey-headed Flying-fox	V	-	No	**Unlikely** to occur - the Grey-headed Flying-fox occurs in a range of habitats including subtropical and temperate rainforests, dry and wet sclerophyll forests, Banksia woodland, heaths and Melaleuca swamps (Duncan et al, 1999; NPWS, 2001). No flying fox roosts were observed during the survey.
Rhinolophus philippinensis (large form)	Greater Large-eared Horseshoe Bat	E	E	No	**Unlikely** to occur - this species is believed to be an obligate cave dweller, although other man-made structures such as abandoned mines, tunnels, houses and culverts have also been recorded. Maternity sites have not been documented but are thought to be limited to caves and abandoned mines where micro-climatic factors are suitable. Forage in the surrounding environments at night and employ a range of foraging strategies (DEWHA, 2008)
Saccolaimus saccolaimus nudicluniatus	Bare-rumped Sheathtail Bat	CE	E	No	**Unlikely** to occur - there are two distinct populations of this species, one in the Top End of the Northern Territory, and the other in north-eastern Queensland, in coastal areas form Bowen to Cape York Peninsula. They occur in tropical woodland and tall open forests, usually within 40km of the coast. They are most commonly found in poplar gum woodland (Churchill 1998).
Egernia rugosa	Yakka Skink	V	V	No	**Possible** - this species usually takes refuge under dense vegetation, hollow logs, in cavities in soil-bound root systems of fallen trees and beneath rocks in open dry sclerophyll forest or woodland throughout its range.
Acanthophis antarcticus	Common Death Adder	-	NT	Yes	Possible - this species is found in a wide variety of habitats amongst leaf litter and debris often at the bases of shrubs or small trees (Cogger 2000).
Melanotaenia eachamensis	Lake Eacham Rainbowfish	E	E	Yes	**Unlikely** to occur - as no permanent water courses occur within the site. This species occurs in slow to moderately-flowing streams, especially smaller tributaries. It is also found around the vegetated margins of lakes and reservoirs. The species prefers sunlit margins of streams with abundant cover such as log snags and aquatic plants and also forms schools near the surface of rocky pools. Larger, more permanent pools in the lower reaches of Granite Creek (outside of the project footprint) may provide more favourable habitat.
Pristis microdon	Freshwater Sawfish	V	-	No	**Very unlikely** to occur - due to a lack of appropriate habitat. Juveniles and sub-adult Freshwater Sawfish predominantly occur in rivers and estuaries, while large mature animals tend to occur more often in coastal and offshore waters up to 25m depth.

[1] Conservation status as listed under the *Nature Conservation Act 1992*: E – Endangered; V – Vulnerable; NT – Near Threatened

[2] Conservation status as listed under the *Environmental Protection and Biodiversity Conservation Act 1999*: CE – Critically Endangered; E – Endangered; V - Vulnerable

Table 9 - Migratory fauna species as listed in the EPBC Act's Protected Matters database

Group	Species	Common Name	Likelihood of Occurrence	Previously recorded within 10km
Migratory Terrestrial Species	*Erythrura gouldiae*	Gouldian Finch	**Possible** - however, unlikely to breed within the site as there are no permanent sources of fresh water within the site.	Yes
	Haliaeetus leucogaster	White-bellied Sea-Eagle	Possible - while it prefers coastal habitats and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands, this species is widespread and occupies a variety of habitat types.	Yes
	Hirundapus caudacutus	White-throated Needletail	**Possible** - this species occupies airspace over forests, woodlands, farmlands, plains, lakes, coasts and towns, frequently foraging over hilltops and timbered areas (Pizzey and Knight 2007).	No
	Hirundo rustica	Barn Swallow	**Possible** - however, this species is usually found near water.	No
	Merops ornatus	Rainbow Bee-eater	**Occurs** - recorded during the survey.	Yes
	Monarcha melanopsis	Black-faced Monarch	**Possible** - however, this species prefers rainforests, eucalypt woodlands, coastal scrub, damp gullies, occupying more open forests when migrating (Pizzey and Knight 2007).	Yes
	Monarcha trivirgatus	Spectacled Monarch	**Unlikely** to occur - due to a lack of suitable habitat within the site. This species prefers understorey of mountain / lowland rainforest, thickly wooded gullies and waterside vegetation including mangroves, usually occurring well below the canopy (Pizzey and Knight 2007).	Yes
	Myiagra cyanoleuca	Satin Flycatcher	**Possible** - however, this species prefers heavily vegetated gullies in rainforest and taller woodlands, usually above the shrub layer. During migration, they are found in coastal forests, woodlands, mangroves and trees in open country and gardens (Pizzey and Knight 2007).	Yes
	Rhipidura rufifrons	Rufous Fantail	**Likely** to occur - this species has previously been recorded within 10km of the site, and suitable habitat exists within the study area to support this species.	Yes
Migratory Wetland Birds	*Ardea alba*	Great Egret, White Egret	**Unlikely** to occur - due to a lack of suitable habitat within the study site. This species occurs along the shallows of rivers, estuaries, tidal mudflats, freshwater wetlands, irrigation areas and larger dams (Pizzey and Knight 2007).	No
	Ardea ibis	Cattle Egret	**Unlikely** to occur - based on a lack of suitable habitat within the study site. This species occurs in stock paddocks, croplands, pastures, garbage tips, wetlands, tidal mudflats and drains (Pizzey and Knight 2007).	No
	Gallinago hardwickii	Latham's Snipe, Japanese Snipe	**Unlikely** to occur - based on a lack of suitable habitat within the site. This species prefers soft, wet ground or shallow water with tussocks or other green or dead growth, samphire on saltmarshes and mangrove fringes. It also favours wet parts of paddocks, seepage below dams, irrigated areas, scrub or open woodland from sea level to alpine bogs over 2000m (Pizzey and Knight 2007).	No
	Grus antigone	Sarus Crane	**Unlikely** to occur - based on a lack of suitable habitat within the site. This species prefers well-vegetated, shallow wetlands and swamps, habitat which is absent from the site.	Yes
	Nettapus coromandelianus albipennis	Australian Cotton Pygmy-goose	**Unlikely** to occur - based on a lack of suitable habitat within the study site. This species prefers deeper freshwater swamps, lagoons, dams with water lilies and other semi-emergent water plants (Pizzey and Knight 2007).	Yes
	Rostratula benghalensis s. lat.	Painted Snipe	**Unlikely** to occur - based on a lack of suitable habitat within the site. The Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent	No

Group	Species	Common Name	Likelihood of Occurrence	Previously recorded within 10km
			lakes, swamps and claypans. They also utilise inundated or waterlogged grassland or saltmarsh, dams, sewage ponds and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (DEWHA 2010b).	
Migratory Marine Birds	*Apus pacificus*	Fork-tailed Swift	**Possible** - the Fork-tailed Swift Breeds in the north-east and mid-east Asia and winters in Australia and southern New Guinea. It is generally found in flocks, hawking insects in low to very high airspace over varied habitat, from rainforest to semi-desert (Logan City Council 2010).	No
Migratory Marine Reptiles	*Crocodylus porosus*	Salt-water Crocodile, Estuarine Crocodile	**Highly unlikely** to occur - based on a lack of suitable habitat within the site. This species requires coastal rivers and swamps though often seen in open sea. Also extends well inland via major drainage systems and the billabongs in the river floodplains (Cogger, 2000).	No

3.5 HERBRECS – Queensland Herbarium Records

HERBRECS is the Queensland Herbarium's specimen records database and lists voucher specimen label data for plants that have been collected from a given region. A request was made to the Herbarium to supply the records data for the project area.

From the HERBRECS data, 1048 species of plants have been recorded from a grid that encompasses the project area. This grid incorporates a wide zone extending well beyond the project's footprint, and consequently takes in a range of habitats that are not present in the study area. To retrieve a more representative account of the flora presence in the study area, the HERBRECS data was reviewed and redundant taxa excluded. For example, rainforest-obligate species collected from east of the Kennedy Highway were pruned from the dataset.

The pruned dataset identifies that 12 specimens comprising nine species of conservation significant plants have been collected within or adjacent to the project area. A summary of significant species extracted from the HERBRECS data is given in **Table 10**. The location of these species in relation to the study area is shown in **Appendix F**.

Several taxa shown in the HERBRECS data may not be encountered within the project area. It is noted also, that the conservation status under the NCA has recently been revised, and many

Table 10 - Summary of HERBRECS data for conservation significant flora.

Name	NCA[1]	EPBC[1]	No. Collections	Comments
Acacia longipedunculata	NT	-	3	Outside project area. Stannary Hills.
Acacia purpureopetala	V	V	2	Specimens collected from south of turbine 31. Also from Stannary Hills.
Agathis microstachya	NT	-	4	Significantly outside project area. Associated with poor rainforest.
Alloxylon flammeum	V	V	1	Outside project area. Rocky Creek.
Archidendropsis xanthoxylon	NT	-	1	Outside project area. Atherton district.
Brasenia schreberi	NT	-	1	Outside project area. Nardello's lagoon.
Cajanus mareebensis	E	E	2	Outside project area. Near Dimbulah, and Gorge Creek west of Mareeba.
Chamaesyce carissoides	V	V	1	Outside project area. Stannary Hills.
Elaeocarpus coorangooloo	NT	-	2	Outside project area. Atherton district and Tolga.
Glossocardia orthochaeta	E	-	1	Outside project area. Stannary Hills.
Grevillea glossadenia	V	V	3	Specimens collected from south of turbine 31 and just SW of 51. Confirmed sightings during this survey 500 m SE of turbine 22.
Homoranthus porteri	V	V	3	Specimens collected from south of turbine 31. Confirmed sightings during this survey 500 m SE of turbine 22.
Lysiana filifolia	NT	-	1	Significantly outside project area. Stannary Hills.
Melaleuca uxorum	E	-	2	Specimen collected from rocky country just south of turbine 36.
Peripleura scabra	NT	-	2	Outside project area. Stannary Hills.
Peripleura sericea	NT	-	2	Outside project area. Stannary Hills.
Plectranthus amoenus	V	-	5	Specimens collected from near turbine 66. Other specimens collected outside of study area south of turbine 31.

Name	NCA[1]	EPBC[1]	No. Collections	Comments
Prostanthera sp. (Dinden P.I.Forster+ PIF17342)	E	-	1	South of project area near Oaky Creek.
Rhamphicarpa australiensis	NT	-	1	Outside project area. Nardello's Lagoon.
Tephrosia savannicola	R	-	1	Outside project area. Stannary Hills. Note, this species is no longer listed under the NCA.
Thaleropia queenslandica	NT	-	3	Significantly outside project area. In rainforest.
Zieria obovata	V	V	1	Outside project area. Stannary Hills.

[1] The conservation status codes under the *Nature Conservation Act 1992* and the *Environment Protection and Biodiversity Conservation Act 1999* as follows: E – Endangered, V – Vulnerable, R – Rare (former status), NT – Near Threatened.

Given the proximity of the project area to Mt Emerald and the Stannary Hills region, where several species of conservation interest have been collected, there is reasonable probability that a number of taxa shown in **Table 4** could occur in the project area.

3.6 Queensland Museum Biodiversity Database

No threatened or near threatened fauna species were identified through a search of the Queensland Museum Biodiversity database in the immediate vicinity of the study area.

3.7 Regional Vegetation Management Codes

A review was made of the Regional Vegetation Management Codes as issued under the *Vegetation Management Act 1999*. The two codes are relevant given that the project area encompasses two bioregions: the Einasleigh Uplands (Western Bioregions Code, and the Wet Tropics (Coastal Bioregions code). Both code versions were released in November 2009.

A provisional address to the performance requirements of the codes is given in **Appendix G**. We note that a total of 26 turbines (29 – 57) are proposed to be located in remnant vegetation communities listed as 'of concern' under the *Vegetation Management Act 1999*.

3.8 Watercourses

Watercourses occurring in the study area were mapped using the Department of Environment and Resource Management's (DERM) Regrowth Watercourses data (version 1.0, 2010). These features are shown on the mapping given in **Appendix H**. The mapping shows that a number of lower order watercourses will be crossed (mostly first order stream features). All these features flow intermittently during the wet season, and their integrity is expected to remain in near natural condition with expected limited levels of disturbance.

A comprehensive survey of watercourses was not undertaken in the field, although detailed floristic investigations were undertaken of a reach of Granite Creek more or less situated in the centre of the study area. This section of watercourse is in sound ecological condition. Vegetation lining this feature is limited to a narrow band of *Lophostemon grandiflorus* trees, which form the only differentiation between stream bank dependent vegetation and the surrounding woodland. This limited floristic diversity is a good indicator of seasonal flows and relatively dry bank conditions.

4 Results of Field Investigation

A five-day field survey of the study area was undertaken in early May 2010 to investigate the vegetation, floristic composition, and range of habitats present in the study area. Weather conditions experienced during the survey period were generally fine. Days were hot, dry and excessively windy, with the greatest wind speeds experienced between mid morning and early evening, and also over night. Mornings were generally fine, with some cloud developing later in the day. Some very light rain fell across the site on Wednesday 12th May and a localised, light shower occurred on the afternoon of Thursday 13th May. A summary of weather conditions during the survey has been provided in **Appendix I.**

An opportunity was also taken during the field investigation to make an assessment of the probable level of impact that the proposed project might have on the immediate environmental character of the study area, with reference to vegetation communities and flora of conservation interest.

The survey aimed at investigating a number of sites where wind turbines are proposed to be located. These sites were determined through consultation with representatives of the project's proponent, and through interpretation of aerial photography of the study area showing the remnant vegetation overlay and the provisional position of each wind turbine. A degree of lateral investigation was allowed for in order to accommodate for site-specific changes if required (e.g. in the event that a provisional position of a turbine occurred in an environmentally sensitive area).

Tertiary level vegetation surveys focussed on determining the accuracy of RE mapping and making assessments of the conspicuous floristic composition of mapped vegetation communities. This level of survey is consistent with the methods outlined by Neldner et al (2005) and records the landform characteristics, and the floristic composition of all structural layers (canopy, subcanopy, shrub and ground layers). Wherever possible, flora surveys were inclusive of an area approximating the expected cleared footprint for a turbine, plus a buffer distance around the proposed site.

Some turbine locations could not be investigated due to their remoteness and the difficulty in reaching these sites within the timeframe allocated for the investigation. Although a number of sites were adopted as surrogates for those that could not be reached and investigated, the detailed floristic accounts, particularly for the ground flora could not be compiled.

The findings of the field investigations of vegetation, fauna and habitats are presented in the following sections.

4.1 Flora and Vegetation Assessment

4.1.1 Flowering and Fruiting Phenology

No trees were observed to be flowering or fruiting at the time of the survey. The vestiges of capsules of *Corymbia abergiana* (rarely), *C. leichhardtii*, *Eucalyptus cloeziana*, *E. lockyeri* and *E. shirleyi* aided their identification in the early stages of the survey. Scorched flower buds of *E. reducta* were also observed.

Shrubs, notably *Homoranthus porteri* and *Grevillea glossadenia* were flowering along with a range of subshrubs and woody legumes. Wattles (*Acacia* spp.) do not feature prominently as floristic elements other than the relatively common presence of *Acacia umbellata* on flat surfaces and *A. aulacocarpa* along fire-affected ridges. The latter species was sterile at the time of the survey, and regenerating from basal coppice shoots. The scorched remnants of *A. umbellata* fruits were evident in many places. This species is the commonest wattle across the study area and clearly favours open woodland communities and landforms that are sparsely populated by trees. A number of shrubs were observed to be sterile, rendering their identification difficult. Most of these shrubs occurred on rocky substrates with a particular preference to exposed rocky knolls and outcropping rhyolite and granite.

The ground layer was observed to be relatively productive in terms of flowering and fruiting. Herbaceous legumes are relatively uncommon in the study area, and only two taxa were encountered in sterile form. All species of grass were seen in fertile form, as were non-leguminous forbs and subshrubs. Two species of *Lomandra* were found to be sterile. Two ferns: a hirsute *Cheilanthes* species and an indeterminate species were sterile.

4.1.2 Effects of Fire

Extensive fires had passed over the eastern ridge sections of the study area. These fires are estimated to have occurred in approximately October 2009 and possibly progressed across the landscape in a north-westerly direction and carried by the prevailing winds. From visual assessments of the extent of scorching on trees, the fires are presumed to have been relatively hot and ferocious – extending completely into the crowns of trees in the canopy of vegetation to 10 metres high. Emergence of epicormic shoots and young branchlet formation provide evidence that the fires severely affected sections of ridgeline vegetation (particularly smaller trees such as Corymbia abergiana). Dense, monospecific stands of low wattle regrowth (believed to be *Acacia aulacocarpa*) have developed as the dominant shrub layer in areas where fire appears to have had the severest impact. Little other ground layer vegetation is present in these situations except for clumps of tussock grasses (an *Aristida* sp.).

The fires described above have not affected the whole project area. For example, the flat-bottomed valley in the interior and the western ridgeline, although burnt during prior years, have remained relatively intact and show fewer signs of severe fire events. In this sense, it is believed that fire passes through the project area on a period basis – enough to limit the development of excessive fuel loads. For example, sections of woodland or open forest where the pronounced effect of recent fires was not evident, did not support a conspicuously ‘heavy’ fuel load in the ground layer, and in fact, were relatively easy to traverse. In these circumstances, grasses such as *Themeda triandra* and *Heteropogon triticeus* are invariably present and favour the under-canopy environment afforded by the structural formation of woodland to open forest, rather than sparser open woodland. Generally, it was found that ironbarks (*Eucalyptus crebra* and *E. granitica*) are poorly represented in these vegetation communities.

4.1.3 Vegetation Description

The condition of the vegetation within the study area is considered to be in sound ecological condition with commensurately high levels of floristic integrity. Disturbance and landscape modification are limited to the edges of the unsealed access track that enters the study area from its northern end, east of the base of Walsh Bluff; and the cleared corridor necessary for the maintenance of the existing power line that passes through the site. Aside from the vegetation that was cleared for the access track and the power line corridor, and disjunct patches of the introduced grader grass (*Themeda quadrivalvis*) adjacent to these clearings, no other salient detractors from the level of naturalness are apparent.

The mapping and description of each vegetation community and classification as defined under Queensland’s regional ecosystem concept (original work published as Sattler and Williams, 1999, with mapping and description amendments presented in version 6 RE data) is provided in **Appendix B** and **C** respectively.

Remnant vegetation communities (REs) which are mapped within and immediately around the study area and those communities in which wind turbines are proposed to be sited are listed earlier in this report in **Tables 1** and **2**.

Regional ecosystem mapping was found to have varying levels of accuracy, particularly in regard to the floristic composition when compared to the RE descriptions. Polygon accuracy is difficult to detect on the ground, but such accuracy is assumed to be greater in the wet tropics bioregion portion of the project site, where mapping has been prepared at a scale of 1:50,000. Mapping accuracy is markedly different for the remainder of the study area (mostly the northern section) where this area is included in the Einasleigh

Upland bioregion. Mapping for this region was prepared at a scale of 1:100,000 and the application of heterogeneous polygons are more frequent.

The project area is in good ecological condition, which is evidenced by very low levels of disturbance and the broad coverage of remnant vegetation. Consequently, vegetation integrity is high, with areas of physical disturbance limited to the existing power line easement and access roads that link the tower infrastructure for this power line. Small populations of grader grass (*Themeda quadrivalvis*) are the only weed of significance observed in the project area. Outside of the disturbance footprint of the power line infrastructure, vegetation integrity is at its highest, with no signs of physical modification, and only marginal incursions of weeds, of which Praxelis (*Praxelis clematidea*) is the only noteworthy species. This herbaceous plant is invariably found as widely dispersed individuals in intact woodland communities, and its presence is a consequence of its wind dispersed seeds, or possibly carried in the fur of mammals. There appears to be no particular preference for Praxelis to inhabit a certain niche (unlike grader grass for example, which has the propensity to occupy the verges of roads).

Several vegetation communities are present in the project area. Many of these have limited patterns of distribution and occupy relatively small niches associated with the rocky and dissected terrain. The commonest and most widespread community is the woodland association comprising *Callitris intratropica*, *Corymbia leichhardtii* and *Eucalyptus shirleyi* on flatter land in the centre of the project area. This landform is characterised by less surface rocks; whereas a majority of the other communities are established on land such as ridge tops or in the limited growing environment afforded by accumulated organic material amongst rock fissures.

A woodland community typified by *Eucalyptus cloeziana* occurs as patches mostly across western facing slopes. This woodland merges with other woodland types and may include other co-dominant trees such as *Corymbia citriodora* and *Eucalyptus portuensis*.

Ridges are characterised by the ironbark *Eucalyptus granitica* (primarily along northern ridges), *Eucalyptus reducta*, *Eucalyptus portuensis* and *Corymbia abergiana* (mostly along southern ridges). The tree diversity in this situation is relatively simple, where greater plant diversity is found in the ground and lower shrub layers.

Stream dependent vegetation is confined to a very narrow band of a single, interrupted line of trees along Granite Creek that flows through the valley and exits the survey area through the ravine just east of Walsh's Bluff. Detailed surveys of vegetation in this ravine were not undertaken as this area is considered to be outside of the proposed zone of impact.

A population of plants of conservation interest was found at the former proposed turbine 24 (we note that since the time of the field survey this turbine has been repositioned). Two species are common here: *Grevillea glossadenia* and *Homoranthus porteri*. The latter forms thickets and is well-represented by numerous individuals. *G. glossadenia* is less prevalent, although it is still common – both grow in association. There is also an association with the wattle *Acacia leptostachya* at this site. It was expected that the conservation significant prostrate wattle *A. purpureopetala* would be found at this location; however, it was not detected, but we cannot discount its possible presence at a range of sites south of the existing power line, and to a lesser extent, at sites on rocky and dissected country to the north of the power line – possibly around Walsh's Bluff.

4.1.4 Description of Vegetation Survey Sites

A ground survey was undertaken to sample as widely as possible, a range of vegetation communities within the five-day timeframe of the fieldwork. Emphasis on the field investigation was made to sample representative vegetation communities in which turbines are proposed to be established. Given the scale of the project (74 wind turbines) it was not possible to sample all the vegetation units likely to be impacted. In this respect, it is recommended that further vegetation studies are undertaken closer to the final layout of the project, with reference to ground searches for plants of conservation interest.

Emphasis was placed on surveying sites for flora where a wind turbine is proposed to be located. Given the rugged terrain and difficulty in accessing some of the proposed sites (notably in the southern half of the study area), plus the limited timeframe in which the field surveys were to be completed, a number of sites were unable to be surveyed. Surveys were undertaken by establishing sample plots with a minimum area of 50 x 50 m or greater if the location allowed for such. Note that some ridge lines are less than 50 m wide, and therefore, the vegetation sampling area was reconfigured accordingly. Plots were systematically surveyed for all vascular plants in all structural layers. To gauge floristic variation and discrete vegetation patterns, random meander surveys were also performed outside of the plot and through vegetation that links one turbine to the next where a string of turbines are proposed to be situated on narrow ridges.

The survey recorded native species (deemed to occur naturally in the region), and naturalised species (i.e. not native to Australia and often expressed as weeds). A checklist list of the flora species identified during this survey is provided in **Appendix J**. It is noted that at the time of the ground survey, the ridges along the eastern boundary of the survey area had been affected by severe fires during 2009, and many plants in the shrub and ground layers had not fully recuperated, rendering their identification difficult or impossible. Similarly, given the relatively low structure of the vegetation on these ridges, many of the principal canopy tree species had responded to the fires by developing dense epicormic growth with atypical leaf forms.

Many plants in the ground layer along ridges are expected to be ephemeral or annual species, and are quite likely to regenerate once suitable conditions prevail. The survey for flora must therefore be viewed as provisional, being more indicative of the woody, perennial component rather than the ephemeral or annual component, which is expected to comprise grasses, legumes and a number of forbs and sub-shrubs.

Descriptions of the vegetation survey points are given in the following sub-sections. The location of these sites is shown in **Appendix K**. The vegetation integrity rating was derived from Wannan (2009).

4.1.5 Vegetation Survey Point 1 (Land surrounding Granite Creek)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Open woodland to woodland 8-15 m of *Callitris intratropica* and *Corymbia leichhardtii* interspersed with ± bare rock pavements.

T1 (8-10 m): <u>*Callitris intratropica*</u>, <u>*Corymbia leichhardtii*</u>, (*Eucalyptus lockyeri*), *Corymbia citriodora*, (*E. crebra*).

T2 (4-6 m): *C. intratropica*, *Corymbia leichhardtii*, *E. shirleyi*, (*Melaleuca nervosa*), *M. viridiflora*, (*E. crebra*).

S1 (3 m): *Acacia umbellata*, *Breynia oblongifolia*, (*Grevillea glauca*, *G. parallela*), *C. leichhardtii*, *Persoonia falcata*, *Xanthorrhoea johnsonii*, (*Asparagus* sp.), (*Petalostigma pubescens*), (*Dendrobium canaliculatum*), *Erythroxylon ellipticum*, (*Dolichandrone heterophylla*), (*Clerodendrum floribundum*).

S2 (1.5 m): *Acacia umbellata* in small patches, otherwise S2 is absent.

G (1 m): *Xanthorrhoea johnsonii*, *Eragrostis schultzii*, (*Aristida* sp.), <u>*Dichanthium sericeum*</u>, <u>Poaceae sp</u>. (erect, tufted 1m), *Glossocardia bidens*, *Aeschynomene* sp., *Rhynchospora corymbosa*, (*Praxelis clematidea*), *Melinis repens*, *Tacca leontopetaloides*, *Panicum effusum*, *Panicum seminudum* var. *cairnsianum*, *Vernonia cinerea*, *Lomandra* sp., (*Haemodorum coccineum*), *Cheilanthes tenuifolia*, (*Themeda triandra*), (*Persoonia falcata*), *Hibbertia stirlingii*, *Acacia humifusa*, *Cymbopogon bombycinus*, *Eriachne ciliata*, *Eriachne* sp. (short grass to 10 cm), *Polycarpaea spirostylis*, *Setaria surgens*, *Schizachyrium pseudeulalia*, *Cartonema spicatum*, *Crotalaria brevis*, *Scleria* sp., *Eragrostis* sp., (*Heteropogon triticeus*), (*Euphorbia mitchellii*).

Habitat Features: Exfoliating flakes on rock pavements (geckos). Limited, but longer term availability of water in rock pools in Granite Creek. Significant tree hollows not observed. Numerous dead standing trees - *Callitris intratropica* (stags).

Notes: A fairly uniform landscape with little topographical differentiation and relief. Includes the flatter parts of the project area, and excludes ridges, mid and upper slopes. Ground becomes increasingly rockier as it gently ascends towards Walsh Bluff in the north. Country south of the existing power line is more dissected, where *Eucalyptus shirleyi* and *E. leichhardtii* become co-dominant and form a lower woodland community (~ 5-8 m). A vegetation integrity rating of 2 has been applied to this survey area, with the only disturbance limited to the infrequently used vehicle track that passes through the area. Weeds are virtually absent, and comprise widely dispersed individuals of herbaceous species (*P. clematidea* and *M. repens*).

4.1.6 Vegetation Survey Point 2 (Wind Turbine Site 25)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland to open woodland 8-12 m of *Eucalyptus shirleyi* and *Callitris intratropica* with *E. cloeziana* on rolling hills.

T1 (8-12 m): *Eucalyptus shirleyi*, *Callitris intratropica*, *E. cloeziana* (tallest trees in disjunct groups).

T2 (5-7 m): *C. intratropica*, *E. shirleyi*, *E. crebra*.

S1 (1.5 m): *C. intratropica*, (*Petalostigma pubescens*), *E. shirleyi*, (*Corymbia leichhardtii*), *Dolichandrone heterophylla*, *Breynia oblongifolia*, *Alphitonia excelsa*, *Alyxia spicata*, *Melaleuca* sp. (multi-stemmed, hirsute branchlets), *Grevillea dryandri*.

S2: Absent.

G (0.6 m): *Xanthorrhoea johnsonii*, *Cymbopogon bombycinus*, *Cheilanthes* sp., *Themeda triandra*, *Rhynchospora corymbosa*, *Grevillea dryandra*, *Asparagus racemosus*, *Haemodorum coccineum*, *Panicum effusum*, *Schizachyrium pseudeulalia*, (*Praxelis clematidea*), *Aristida utilis*, *Eriachne ciliata*, *Glossocardia bidens*, *Eragrostis* sp., Poaceae sp. (superficially similar to *Sarga plumosum*).

Habitat Features: Limited features, although small rock pavement provides habitat for skinks. Possible development of good tree hollows in larger specimens of *E. cloeziana* trees. Canopy of nearby *E. cloeziana* trees provides cover for sheltering birds. Small zones of vegetated rock pavement provide habitat for skinks and geckos (fissures and cracks).

Notes: Site occurs on edge of roll over of hill where *E. cloeziana* trees are present. Top of roll-over characterised by more open and widespread vegetation dominated by *E. shirleyi*, with greater exposure and lower growing plant forms. Indeterminate *Melaleuca* sp. collected. No conservation significant species recorded. Weeds limited to isolated specimens of *Praxelis clematidea*. Vegetation integrity rating of 1: given absence of significant weeds, separation from tracks and power line easement.

4.1.7 Vegetation Survey Point 3 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland of *Eucalyptus crebra* and *Corymbia citriodora* to 10 – 12 m on relatively uniform surface.

T1 (10 -12 m): *Eucalyptus crebra*, *Corymbia citriodora*.

T2 (6 – 8 m): *Callitris intratropica*, *E. crebra*, *Corymbia citriodora*.

S1 (1.2 – 1.8 m): *Eucalyptus crebra*, *Persoonia falcata*.

S2: Absent.

G (0.9): *Heteropogon triticeus*, *Themeda triandra*, *Dichanthium sericeum*, *Xanthorrhoea johnsonii*, *Schizachyrium pseudeulalia*, Poaceae sp. (superficially similar to *Sarga plumosum*).

Habitat Features: Relatively low given the patchy distribution of larger trees. Some small tree hollows in older specimens of *Corymbia citriodora*. The ground and shrub layers are floristically simple.

Notes: The vegetation integrity rating is 2 due to the proximity to an infrequently used vehicle track.

4.1.8 Vegetation Survey Point 4 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Low woodland to open woodland of *Eucalyptus shirleyi* to 4 – 5 m on stony rises.

T1 (4 – 5 m): *Eucalyptus shirleyi*.

T2 (3.5 m): *Melaleuca monantha.*

S1 (1.2 m): *Grewia retusifolia*, *Eucalyptus shirleyi*, *Persoonia falcata*.

S2: Absent.

G (0.5 m): *Heteropogon triticeus*, *Cymbopogon bombycinus*, *Themeda triandra*, *Breynia oblongifolia*, *Xanthorrhoea johnsonii*, *Melinis repens*, Poaceae sp. (superficially similar to *Sarga plumosum*), *Hibbertia stirlingii*, *Schizachyrium pseudeulalia*, *Hibiscus meraukensis*.

Habitat Features: Limited to niche availability for reptiles (geckos and skinks) in outcropping rock jumbles.

Notes: This type is representative of what appears to be the most depauperate ground conditions in the study areas, and is also represented in other areas north and just south of the power line. The vegetation integrity rating is 2 due its proximity to an infrequently used vehicle track.

4.1.9 Vegetation Survey Point 5 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland of *Eucalyptus crebra* to 8 – 10 m on rocky surfaces of brow of hill.

T1 (8 – 10 m): *Eucalyptus crebra*, *Corymbia citriodora*.

T2 (6 m): (*Melaleuca nervosa*), (*Corymbia leichhardtii*).

S1 (2 – 3 m): *Eucalyptus crebra*.

S2: Absent.

G (0.6 m): *Xanthorrhoea johnsonii*, *Themeda triandra*, *Dichanthium sericeum*, *Heteropogon triticeus*, Poaceae sp. (superficially similar to *Sarga plumosum*).

Habitat Features: Potential tree hollows in old specimens of *Corymbia citriodora*. A structurally simple vegetation type with limited floristic diversity.

Notes: The vegetation integrity rating is 2 due its proximity to an infrequently used vehicle track.

4.1.10 Vegetation Survey Point 6 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland of *Eucalyptus cloeziana* and *Corymbia citriodora* to 8 – 10 m on uneven ground with rocky soils.

T1 (8 – 10 m): *Eucalyptus cloeziana*, *Corymbia citriodora*, (*Eucalyptus portuensis*).

T2 (5 – 7 m): *Corymbia citriodora*.

S1 (1.2 – 3 m): *Corymbia citriodora*, *Acacia disparrima*, *Grevillea parallela*, *Erythroxylon ellipticum*, *Jacksonia thesioides*, *Capparis canescens*, *Pogonolobus reticulatus*, *Persoonia falcata*, *Bursaria spinosa*.

S2: Absent.

G (0.3 – 0.9 m): *Grevillea dryandri*, *Indigofera pratensis*, *Vernonia cinerea*, *Heteropogon triticeus*, *Xanthorrhoea johnsonii*, *Tephrosia juncea*, *Schizachyrium pseudeulalia*, *Themeda triandra*, *Hibbertia stirlingii*, *Crotalaria brevis*, *Panicum effusum*, *Dichanthium sericeum*, *Breynia oblongifolia*, *Lomandra* sp. (glaucous leaves), *Heteropogon triticeus*, *Grewia retusifolia*, *Aeschynomene micranthos*, Poaceae sp. (superficially similar to *Sarga plumosum*).

4.1.11 Vegetation Survey Point 7 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Low woodland of *Eucalyptus lockyeri* to 5 m on rocky, uneven surfaces.

T1 (4 – 5 m): <u>*Eucalyptus lockyeri*</u>.

T2 (3 m): (*Melaleuca viridiflora*).

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Sparsely vegetated with limited important habitat opportunities, except perhaps rocky ground surface (geckos and skinks).

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement.

4.1.12 Vegetation Survey Point 8 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland of *Callitris intratropica* to 8 m on stony and rocky soils.

T1 (8 m): <u>*Callitris intratropica*</u>, (*Eucalyptus lockyeri*).

T2 (4 – 5 m): *Corymbia leichhardtii*.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Limited due to absence of complexity is vegetated layers. Although not recorded, the ground and shrub layers are simple with limited floristic diversity.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement.

4.1.13 Vegetation Survey Point 9 (no wind turbine)

Mapped RE: 7.12.34 (Least Concern under VMA)

Field Description: Woodland of *Corymbia leichhardtii* and *Eucalyptus lockyeri* to 10 m on very rocky surfaces.

T1 (10 m): *Corymbia leichhardtii*, *Eucalyptus lockyeri*, (*Eucalyptus cloeziana*).

T2 (6 – 8 m): *Corymbia leichhardtii*, *Eucalyptus lockyeri*.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Limited due to absence of complexity is vegetated layers. Although not recorded, the ground and shrub layers are simple with limited floristic diversity.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared track immediately below the power line; otherwise, vegetation is relatively intact.

4.1.14 Vegetation Survey Point 10 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland of *Eucalyptus shirleyi* to 5 m on rocky surfaces.

T1 (10 m): *Eucalyptus shirleyi*, (*Callitris intratropica* emergent to 8 m).

T2: Absent.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Tree hollows not observed. As with other areas where *Callitris intratropica* is present, this tree provides useful perching opportunities, but rarely exhibits hollows due to its resilience to decay. Minimal structural layering in vegetation, and paucity of diversity in ground and shrub layers.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared track immediately below the power line; otherwise, vegetation is relatively intact.

4.1.15 Vegetation Survey Point 11 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Woodland of *Eucalyptus crebra* to 12 m on sloping ground.

T1 (12 m): *Eucalyptus crebra*, (*Corymbia leichhardtii*).

T2: Not recorded.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Not recorded in detail; although tree hollows possibly present. Greater structural diversity and layering than sites to south-west (supporting *Eucalyptus shirleyi*). Potential edge zone of refugial areas leading into watercourse.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared track immediately below the power line; otherwise, vegetation is relatively intact.

4.1.16 Vegetation Survey Point 12 (no wind turbine)

Mapped RE: 7.12.34 (Least Concern under VMA)

Field Description: Woodland of *Corymbia leichhardtii* and *Eucalyptus granitica* to 10 – 12 m on sloping ground with rocky surfaces.

T1 (10 – 12 m): *Corymbia leichhardtii*, *Eucalyptus granitica*, (*Corymbia citriodora*).

T2: Not recorded.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Not recorded in detail; although tree hollows possibly present. Has greater structural diversity and layering than sites to south-west (supporting *Eucalyptus shirleyi*). Has potential edge zone of refugial areas leading into watercourse.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared track immediately below the power line; otherwise, vegetation is relatively intact.

4.1.17 Vegetation Survey Point 13 (no wind turbine)

Mapped RE: 7.12.34 (Least Concern under VMA)

Field Description: Woodland to open forest of *Eucalyptus cloeziana* and *Corymbia citriodora* to 15 m on side of rocky hill.

T1 (12 – 15 m): *Eucalyptus cloeziana*, *Corymbia citriodora*.

T2: Not recorded.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Not recorded in detail; although tree hollows possibly present in old *Corymbia citriodora* trees. Has greater structural diversity and layering than sites to south-west (supporting *Eucalyptus shirleyi*). Has potential edge zone of refugial areas leading into watercourse.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared track immediately below the power line; otherwise, vegetation is relatively intact.

4.1.18 Vegetation Survey Point 14 (no wind turbine)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Woodland of *Eucalyptus portuensis* to 8 m on rocky hill slope approaching ridge.

T1 (8 m): *Eucalyptus portuensis*.

T2 (5 -6 m): *Eucalyptus lockyeri*.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Reduction in structural layering floristic diversity, which is likely to correspond with lesser habitat resources and fewer niche opportunities. Greater exposure to drying elements than VP12. Tree hollows not observed.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared track immediately below the power line; otherwise, vegetation is relatively intact.

4.1.19 Vegetation Survey Point 15 (Wind Turbine 56)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Mixed woodland of *Corymbia abergiana*, *Eucalyptus lockyeri*, *Corymbia citriodora* and *Eucalyptus shirleyi* on ridge with pale soils and scattered surface rocks (with small areas of rock pavement).

T1 (6 – 8 m): *Eucalyptus lockyeri*, *Corymbia citriodora*, (*C. abergiana*).

T2 (4 – 5 m): *Eucalyptus shirleyi*.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: No tree hollows observed. Probable niche opportunities for reptiles (geckos and skinks) in fissures and flakes associated with scattered rock pavements. Vegetation structural layering is simple. Although recorded in detail, ground and shrub layer diversity is relatively low.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared vehicle track; otherwise, vegetation is relatively intact.

4.1.20 Vegetation Survey Point 16 (Wind Turbine 57)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Woodland of *Eucalyptus cloeziana* and *E. portuensis* with *Callitris intratropica* to 8 m on ridge with pale, rocky soils.

T1 (8 m): *Eucalyptus cloeziana*, *E. portuensis*, *Callitris intratropica*, *Corymbia citriodora*.

T2: Not recorded.

S1: Not recorded.

S2: Not recorded.

G: Not recorded.

Habitat Features: Potential for tree hollows in older specimens of *Eucalyptus cloeziana* and *Corymbia citriodora trees*, but not observed. Structural layering and floristic diversity is expected to be higher than turbine site 56 (VP 15), as this trait has been observed at other sites where *E. cloeziana* occurs.

Notes: Observational survey from vehicle. The vegetation integrity rating is 2 due to close proximity of site to power line and cleared easement. Significant disturbance is restricted to the cleared vehicle track; otherwise, vegetation is relatively intact.

4.1.21 Vegetation Survey Point 17 (Wind Turbine 47)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Low open woodland to woodland of *Eucalyptus portuensis* and *Allocasuarina littoralis* to 4 m.

T1 (4 m): *Eucalyptus portuensis*.

T2 (3 m): *Allocasuarina littoralis*.

S1 (1 – 1.5 m): *Xylomelum scottianum*, *Eucalyptus portuensis*, *Jacksonia thesioides*, *Persoonia falcata*.

S2: Absent.

G (0.5 m): *Aristida* sp. (*utilis*?), *Themeda triandra*, *Helichrysum newcastlianum*, *Tephrosia juncea*, *Grevillea dryandri*, *Evolvulus alsinoides*, Epacridaceae sp., *Jacksonia thesioides*, *Hibbertia stirlingii*, *Crotalaria brevis*, *Panicum effusum*, *Schizachyrium pseudeulalia*, *Tricoryne anceps*, *Vernonia cinerea*, *Xanthorrhoea johnsonii*, *Crassocephalum crepidioides*, *Praxelis clematidea*, *Breynia oblongifolia*, *Lindernia* sp.

Habitat Features: Potential habitat for skinks and geckos in angular rocks that characterise the ground surface.

Notes: Small area of perched rocks. The vegetation integrity rating is 1. This site was unaffected by the previous season's fires.

4.1.22 Vegetation Survey Point 18 (Wind Turbine 46)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Low woodland of *Corymbia abergiana* and *Eucalyptus portuensis* to 5 – 6 m on broad ridge with pale, sandy soil.

T1 (5 – 6 m): *Corymbia abergiana*, *Eucalyptus portuensis*.

T2: Absent.

S1 (1.2 m): *Acacia aulacocarpa*.

S2 (0.6 m): <u>*Acacia aulacocarpa*</u> – formed by mass regrowth of basal coppice shoots after fire event.

G (0.6 m): *Alloteropsis semialata*, *Mnesithea formosa*, *Lomandra* sp., *Helichrysum newcastlianum*, *Grevillea dryandri*, *Phyllanthus* sp., *Crassocephalum crepidioides*, *Cheilanthes* sp., *Xanthorrhoea johnsonii*, *Jacksonia thesioides*, Epacridaceae sp., *Aeschynomene micranthos*.

Habitat Features: Limited due to development of thick *Acacia* thickets (i.e. absence of structural complexity). No tree hollows observed. Ground layer flora is simple.

Notes: Comparatively 'thicker' soil development than other sites on same ridge. Site affected severely by previous season's fires (~October 2009). The vegetation integrity rating is 1, given its separation from disturbance influences such as tracks and power lines.

4.1.23 Vegetation Survey Point 19 (Wind Turbine 45)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Low woodland of *Corymbia abergiana* and *Eucalyptus portuensis* to 4 – 5 m on broad ridge.

T1 (4 – 5 m): <u>*Corymbia abergiana*</u>, *E. portuensis*, (*Callitris intratropica*).

T2: Absent.

S1 (~1.2 m): *Persoonia falcata*, (*Callitris intratropica*), *Acacia aulacocarpa*, (*Eucalyptus shirleyi*), *Xanthorrhoea johnsonii*.

S2: Absent.

G (0.4 – 0.7 m): *Cymbopogon bombycinus*, *Grevillea dryandri*, *Aristida* sp., *Haemodorum coccineum*, *Vernonia cinerea*, *Helichrysum newcastlianum*, (*Eucalyptus shirleyi*), *Themeda triandra*, *Tricoryne anceps*, *Schizachyrium pseudeulalia*, *Jacksonia thesioides*, *Hibbertia stirlingii*.

Habitat Features: Relatively limited compared to other sites along the same ridge. The ridge topography is wider with greater development of the soil profile, but does not feature large class trees. The ground and shrub layers are structurally and floristically simple.

Notes: Affected severely by the previous season's fires (~October 2009), with scorch height extending through the canopies of trees. The vegetation integrity rating is 1, despite the site's unremarkable composition. Northwards from this site, other sites along the ridge show similar traits of relatively simple floristic and structural composition.

4.1.24 Vegetation Survey Point 20 (Wind Turbine 44)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Open forest of *Callitris intratropica* to 8 – 10 m on ridge.

T1 (8 – 10 m): <u>*Callitris intratropica*</u>, *Eucalyptus cloeziana* (emergent to 16 m).

T2 (8 m): *Corymbia citriodora*, *Callitris intratropica*.

S1 (1.5 – 2.0 m): *Corymbia abergiana*, *Acacia aulacocarpa*, *Jacksonia thesioides*, *Larsenaikia ochreata*.

S2: Absent.

G (0.4 m): *Glossocardia bidens*, *Praxelis clematidea*, *Euphorbia mitchellii*, *Cymbopogon bombycinus*, *Cheilanthes* sp. (glabrous), *Cheilanthes* sp. (hirsute, grey), *Helichrysum newcastlianum*, *Xanthorrhoea johnsonii*, *Themeda triandra*, Poaceae sp. (5 cm, tufted, very narrow leaves), Apiaceae sp. (forb), *Rhynchospora corymbosa*, *Haemodorum coccineum*, Epacridaceae sp., *Schizachyrium pseudeulalia*, *Buchnera* sp., *Hibbertia stirlingii*, *Phyllanthus* sp., *Crotalaria brevis*, *Aeschynomene micranthos*, *Panicum effusum*.

Habitat Features: Site characterised by its rocky substrate and revealed areas of rock pavement. This occurs on edge of steep drop-away, and above rock shelves. Has potential edge zone of refugial habitat for plants. Tree hollows not observed, but possible in larger specimens adjacent to site in surrounding woodland.

Notes: At the time of the inspection, this site was not windy – unlike other sites along the same ridge. The vegetation integrity rating is 1.

4.1.25 Vegetation Survey Point 21 (Wind Turbine 43)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Woodland to open forest to 14 m of *Eucalyptus reducta* and *Corymbia citriodora* on flat top ridge.

T1 (14 m): <u>*Eucalyptus reducta*</u>, *Corymbia citriodora*.

T2 (7 – 9 m): *Corymbia abergiana*, *Eucalyptus portuensis*.

S1 (1.6 m): *Persoonia falcata*, *Jacksonia thesioides*, *Acacia aulacocarpa*.

S2 (0.6 m): Formed as a response to fire, with uniform development of *Acacia aulacocarpa*.

G (0.4 m): *Themeda triandra*, *Leucopogon* sp., *Hovea nana*, *Grevillea dryandri*, Epacridaceae sp., *Panicum trichoides*, *Hibbertia stirlingii*, *Vernonia cinerea*, *Lomandra* sp., *Schizachyrium* sp., *Thysanotus tuberosus*, *Tricoryne anceps*, *Xanthorrhoea johnsonii*.

Habitat Features: Site occurs on edge of eastern fall of steep ridge, where large rocks form crevices and broad cracks: potential for geckos and other dependent reptiles. Has potential habitat for rare and threatened plant species on rock ledges below site. No tree hollows observed, but possible in older specimens.

Notes: Small patches of rock pavement. Site exhibits no evidence of disturbance, and hence the vegetation integrity rating is 1.

4.1.26 Vegetation Survey Point 22 (Wind Turbine 42)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Rock pavement at terminus of ridge with sparse vegetation cover limited to scattered trees of *Corymbia citriodora* and *Eucalyptus leptophleba* to 4 m.

T1: Absent (two stunted trees present: *C. citriodora* and *E. leptophleba* to 4 m).

T2: Absent.

S1 (1.2 m): *Persoonia falcata*, *Acacia disparrima*.

S2: Absent.

G (0.6 m): *Xanthorrhoea johnsonii*, *Dianella* sp. (*nervosa?*), *Themeda triandra*, *Cheilanthes* sp., *Dichanthium sericeum*, Poaceae sp. (5 cm, tufted, very fine leaves), *Grevillea dryandri*, *Phyllanthus* sp., *Praxelis clematidea*, *Hibbertia stirlingii*, *Thelymitra* sp. (*fragrans*?), *Ageratum conyzoides*, *Evolvulus alsinoides*, *Schizachyrium* sp., *Breynia oblongifolia*, *Tricoryne anceps*, *Panicum* sp.

Habitat Features: Very limited: absence of exfoliating rocks and vegetated layering. Possible tree hollows in older trees of surrounding area.

Notes: Very simple vegetation structure, where plants persist on a thin veneer of soil in patches (i.e. many bare areas of exposed rock). The vegetation integrity rating is 1 – 2, and the natural erosive effects of wind stripping appear to be the conspicuous modifier.

4.1.27 Vegetation Survey Point 23 (no wind turbine)

Mapped RE: 7.12.57 (Of Concern under VMA)

Field Description: Shrubland to low woodland 4-8 m of *Acacia leptostachya* (thickets), *Eucalyptus portuensis* and *E. cloeziana* on western edge of ridge.

T1 (4-8 m): <u>*Acacia leptostachya*</u>, *Eucalyptus portuensis*, *E. cloeziana*.

T2 (4 m): *Acacia leptostachya*, (*E. shirleyi*), (*Callitris intratropica*), *Alphitonia obtusifolia*, (*E. pachycalyx*), *E. lockyeri*.

S1 (0.6-3 m): <u>*Acacia leptostachya*</u>, *Grevillea glossadenia*, *Homoranthus porteri* (common), *Xanthorrhoea johnsonii*, *Capparis canescens*, *Persoonia falcata*.

S2: Absent.

G (0.6 m): *Haemodorum coccineum*, *Phyllanthus* sp., *Dodonaea* sp., *Lomandra* sp., *Xanthorrhoea johnsonii*, *Grevillea glossadenia*, *Homoranthus porteri*, *Praxelis clematidea*, *Chloris virgata*, *Themeda triandra*, *Thysanotus tuberosus*, *Panicum trichoides*, *Vernonia cinerea*, *Dichanthium sericeum*.

Habitat Features: Habitat for two species of rare and threatened plants: *Homoranthus porteri* and *Grevillea glossadenia*. Expected habitat for *Acacia purpureopetala*, but not sighted in ground survey. Numerous habitat opportunities for fauna making transition from ranges to land to the west in the vicinity of Oaky Creek. Tree hollows in older tree specimens (*Eucalyptus pachycalyx*).

Notes: Site is located to south-east of power line where land and ridges drop away dramatically to the west. Vegetation integrity rating is 2, with evidence of minor disturbance and presence of weeds in low abundance. *Acacia leptostachya* forms dense thickets on rocky substrates and is clearly associated with *Homoranthus porteri*, but less so for *G. glossadenia*, which grows amongst rhyolite rocks in fissures with poor soil development.

4.1.28 Vegetation Survey Point 24 (no wind turbine)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Open woodland to 8 m of *Eucalyptus portuensis* with *Allocasuarina inophloia* on colluvial slope.

T1: (8 m): *Eucalyptus portuensis*, <u>*Allocasuarina inophloia*</u>, (*E. cloeziana*), (*Corymbia leichhardtii*).

T2: (4-6 m): *Allocasuarina inophloia*.

S1 (1.2 – 2.0 m): *Allocasuarina inophloia*, *Melaleuca viridiflora*, *Melaleuca* sp. (multi-stemmed, hirsute branchlets), *Acacia leptostachya*, *Jacksonia thesioides*, (*Eucalyptus shirleyi*), *Persoonia falcata*.

S2: Absent.

G (0.6 m): *Breynia oblongifolia*, *Rhynchospora corymbosa*, (*Crassocephalum crepidioides*), *Haemodorum coccineum*, *Schizachyrium pseudeulalia*, *Phyllanthus* sp., *Dichanthium sericeum*, *Xanthorrhoea johnsonii*, *Eriachne* sp., *Themeda triandra*.

Habitat Features: Limited, simple ground and shrub layer flora. Surface rocks absent – soil is sandy. Tree hollows not observed, large class trees not present.

Notes: A relatively simple vegetation type with little structural development. The vegetation integrity rating is 2, and is affected by the proximity of the power line to the south of the survey site (presence of the Asteraceae weed *Crassocephalum crepidioides* is a part-indicator of nearby land disturbance). Fires had affected the ground and shrub layer significantly, many woody species regenerating from basal coppice shoots.

4.1.29 Vegetation Survey Point 25 (Wind Turbine Site 22)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Small rock pavement surrounded by low woodland of *Eucalyptus portuensis* to 6 m.

T1 (6 m): Absent on rock pavement, but formed by *Eucalyptus portuensis* (6 m), *Corymbia citriodora* in surrounding woodland.

T2: Absent on rock pavement.

S1 (1.5 - 3 m): *E. portuensis*, *E. shirleyi*, *Clerodendrum floribundum*, *Dodonaea lanceolata*, *Callitris intratropica*, *Breynia oblongifolia*, *Grevillea parallela*, *Xanthorrhoea johnsonii*, *Tephrosia* sp., *Acacia humifusa*, *A. leptostachya*, *Persoonia falcata*, *Erythroxylon ellipticum*, *Capparis canescens*, *Jacksonia thesioides*, *Melaleuca* sp. (multi-stemmed, hirsute branchlets).

S2: Absent.

G (0.3 – 0.7 m): *Crotalaria brevis*, *Helichrysum newcastlianum*, *Heteropogon contortus*, *Praxelis clematidea*, *Commelina ensifolia*, *Themeda triandra*, *Panicum trichoides*, *Euphorbia mitchellii*, *Cymbopogon bombycinus*, *Vernonia cinerea*, *Polycarpaea spirostylis*, *Pterocaulon sphacelatum*, *Lomandra* sp. (grey short leaves, apex obtuse), *Eustrephus latifolia*, *Schizachyrium pseudeulalia*, indeterminate fern species.

Habitat Features: Niches for geckos, skinks amongst rocks, but site lacking exfoliating faces. Tree hollows possibly present in larger trees adjacent to survey area. Sheltered aspect to west of site, where land drops away steeply.

Notes: Narrow site will require significant levelling. Access tracks proposed along very narrow sections of ridge. The vegetation integrity rating is 1 given the absence of disturbance and very low abundance of introduced plant species (scattered individuals of *Praxelis clematidea*).

4.1.30 Vegetation Survey Point 26 (Wind Turbine Site 21)

Mapped RE: 9.12.4c/9.12.2 (both Least Concern under VMA)

Field Description: Rock pavement surrounded by shrubland of *Acacia leptostachya* to 4-5 m.

T1: Absent on rock pavement, but formed by *Eucalyptus portuensis* and *E. lockyeri* in surrounding woodland.

T2: Absent on rock pavement, but *Callitris intratropica* in surrounding woodland.

S1: *Acacia leptostachya*, *Callitris intratropica* – peripheral zones of rock pavement. Otherwise: *Jacksonia thesioides*, *Dodonaea lanceolata*, *Eucalyptus shirleyi*, *Persoonia falcata*, *Alphitonia excelsa, Petalostigma pubescens*, *Larsenaikia ochreata*.

S2: Absent.

G: *Eriachne ciliata*, *Breynia oblongifolia*, *Borya septentrionalis*, *Lomandra filiformis*, *Drynaria rigidula*, *Xanthorrhoea johnsonii*, *Cheilanthes* sp., *Rhynchospora corymbosa*, Apiaceae sp., *Aristida utilis*, *Sida* sp., Poaceae sp. (5 cm, very fine leaves), *Polycarpaea spirostylis*, *Schizachyrium pseudeulalia*, *Evolvulus alsinoides*, (*Praxelis clematidea*), *Helichrysum newcastlianum*.

Habitat Features: Long-term availability is limited to the cover given by large rock flakes (Cogger's Gecko). Short-term availability of water is surface scoops on pavement. No tree hollows observed.

Notes: The site of the turbine supports very little vegetation. Surrounding woodland has higher diversity. The vegetation integrity of the site and immediate surrounds is one due to the absence of weeds and other detractors.

4.2 Fauna of the Study Area

Fauna survey sites corresponded with the vegetation survey sites to provide an assessment of fauna habitat and likely occurrence of species throughout all representative habitat types within the study area. A summary of survey methods employed at each site is included in **Appendix L**.

A total of 57 terrestrial fauna species were recorded during the survey. Of these, 54 species were confirmed and three unconfirmed records were also noted. With the exception of *Hipposideros diadema* (Diadem Leaf-nosed Bat), listed as near threatened under Queensland legislation, no threatened fauna species were recorded. One migratory species, *Merops ornatus* (Rainbow Bee-eater) described as common and widespread (Birds in Backyards 2010b) was recorded within the survey area. A full species inventory of fauna recorded during the survey has been included in **Appendix M**.

4.2.1 Birds

A total of 25 birds, including 24 confirmed species and one unconfirmed record, were recorded during walk-through transect surveys or through incidental sightings collected within the site during the survey period. With the exception of *Merops ornatus*, listed as a migratory terrestrial species under the EPBC Act, no other species of conservation significance were recorded during the survey.

The most commonly observed birds included *Pardalotus striatus* (Striated Pardalote) and *Lichmera indistincta* (Brown Honeyeater) both recorded at 13 sites, *Platycercus adscitus* (Pale-headed Rosella), recorded at 10 sites and *Strepera graculina* (Pied Currawong), and recorded at nine of the 24 sites surveyed.

Raptors were scarce during the survey period, and no nocturnal birds of prey were recorded, potentially indicating a low abundance of suitable prey species such as small mammals, which was supported by the results of trapping and spotlighting activities, with no small mammals or evidence of small mammal activity detected during the survey.

4.2.2 Herpetofauna

Twelve reptile species were detected within the site during the survey period. This included three gecko species (**Plate 1**), six skinks (**Plate 2**), one dragon species and two snakes, one of which was identified by a sloughed skin, while the second species was captured in a pitfall trap. While the two snake species were detected only once, with the exception of *Gehyra nana* (Spotted Gecko) all other reptiles were recorded on at least three separate occasions.

In addition, seven species of amphibian were recorded during the survey, including one introduced species, *Chaunus marinus* (Cane Toad), which was observed at seven of the survey sites, and most abundant along the Granite Creek site. The most commonly encountered species was *Litoria inermis* (Bumpy Rocketfrog), which was prolific along the banks of the creek at the Granite Creek site. Multiple individuals were observed baking in full sun throughout the day on the rocky creek banks, dispersing into the water when disturbed.

No species of conservation significance were recorded during the survey, However, an interesting observation of *Litoria latopalmata* (Broad-palmed Frog) was made at proposed turbine site 42, at approximately 850 – 900m elevation (**Plate 3**). Habitat within this site was not considered consistent with the preferred habitat of this species.

4.2.3 Mammals

Two confirmed terrestrial mammal species were recorded during the survey period, including *Tachyglossus aculeatus* (Short-beaked Echidna) and *Equus caballus* (Horse). Evidence of *T. aculeatus* in the form of scratching around termite mounds and the base of tree trunks, was observed at many locations within the site, and the remains of one individual were identified on the access track near Proposed Turbine Site 67 (**Plate 4**). Extensive evidence of rock-wallaby presence was also observed throughout the site, with an abundance of scats observed and collected from rocky outcrops along the ridge tops at a number of the proposed Turbine Sites (**Plate 5**). While this species was not visually observed and is yet to be confirmed, it is considered likely to be *Petrogale mareeba* (mareeba Rock-wallaby), based on the current known distribution of rock-wallaby species throughout North Queensland. *P. mareeba* is listed as near threatened pursuant to the Nature Conservation (Wildlife) Regulation (NCWR) 2006 of the Nature Conservation Act 1992.

Nine microchiropteran species (bats) were positively identified through call recording and analysis (**Appendix N**), of which one species, *Hipposideros diadema* (Diadem leaf-nosed Bat) is listed as near threatened under the NCWR 2006.

Plate 1 - ***Oedura coggeri*** **(Northern Spotted Velvet Gecko), recorded at three sites during the survey.**

Plate 2 - ***Carlia jarnoldae*** **(breeding male) observed at Site 21**

Plate 3 - ***Litoria latopalmata*** **(Broad-palmed Frog) observed on the rocky ridge top at Site 42**

Plate 4 - Remains of *Tachyglossus aculeatus* (Short-beaked Echidna) found near Site 67

Plate 5 - Rock-wallaby scats (possibly of *Petrogale mareeba* (Mareeba Rock-wallaby)) listed as near threatened under the NCA 1992.

4.3 Important Vegetation Types and Habitat

Specialist habitats for plants were recognised in the project area across a range of landscape situations. The study area is broadly characterised by the perched basin located centrally and surrounded by undulated landforms which are terminated at the periphery by dissected, rocky ridge lines. These ridges are the preferred locations for a majority of the wind turbines.

The intermittently flowing Granite Creek passes more or less through the centre of the study area - flowing from south to north. This watercourse culminates in a series of pools and waterfalls before its outfall through the gorge at the northeast of the study area (just east of Walsh's Bluff). Given the presence of this water in a mostly dry landscape, it is expected that small nodes of plant habitats could occur in the gorge in sheltered positions, although these will not be affected by the wind farm proposal. The gorge could be considered partially fireproof, and therefore constitutes an important refugial area for fauna as well as discrete vegetation types.

Despite Granite Creek not being directly affected by the wind farm proposal, this watercourse has important ecological values. Although not directly impacted by the need to clear vegetation for the establishment of turbines, access tracks that may have to cross this feature should take into consideration its ecological relevance in that it forms the primary artery for ecological 'flows' through the project area. Watercourses act as conduits for wildlife through the landscape, where even poorly treed features afford some cover and resources, and can link important habitats within a broad region.

The ridge country, particularly south of the existing power line, features niche habitats in highly restricted situations for a unique range of species not found elsewhere in the study area. Soil genesis at these sites is minimal and tends to be accumulated deposits from weathered rhyolite settling between rocks and in fissures. These soils are however, enriched with organic matter rendering their texture somewhat peat-like, with greater water holding capacity than less organic soils on broader landforms. These niches are almost exclusively occupied by low growing heath-type plants, mostly with microphyll or reduced needle-like leaves. Where trees have established, these are stunted, wind-sheared forms with coarse, often tessellated bark. Nearly all the ridge sites inspected had been affected by fire – presumed to have occurred in the latter half of 2009 (probably around October). Clearing of these ridgelines could result in the loss or reduction of specialist plant communities reliant on the unusually characterised substrate and extreme exposure. There is also some probability that species of conservation interest could occupy these niches given their relatively small area and inaccessible locations, which renders them less prone to disturbance from anthropogenic sources. Species that are known to occur in this type of landform include *Homoranthus porteri*, *Grevillea glossadenia*, *Acacia purpureopetala*, and the poorly known *Melaleuca uxorum* amongst others. Detailed ground searches would be required at each proposed turbine location to determine whether such species occur.

It was observed that the ridges to the north of the power line and dominated by trees of *Eucalyptus granitica* and *E. portuensis* did not support the same diversity of plant species described above, and have a simpler ground flora with lower abundance of heath-like plants.

4.3.1 Summary of Habitat Types

The rugged, discontinuous terrain of the study area creates several habitat types for flora and fauna. These habitats include:

- Dissected and rocky ridgelines of granite and rhyolite geology, including knolls of outcropping rock. The vegetation structure in these exposed situations rarely develops beyond woodland and is primarily sparse, open woodland. Around wind turbine site 44, the vegetation structure is open forest, probably due to the marginally higher shelter aspect and less exposure to constant wind.
- Undulating hills of less rugged terrain supporting woodland to open forest (occasionally). Trees on this landform are taller, have wider girths and present a number of tree hollows greater than 10 cm diameter. Kangaroo grass (*Themeda triandra*) and giant spear grass (*Heteropogon triticeus*) dominate the grass layer. The primary species of trees in this situation are *Corymbia citriodora*, *Eucalyptus cloeziana*, and *E. portuensis*.
- Low bank environments adjacent to watercourses with temporary flow (steeper bank systems occur where land falls away from the ‘plateau’ to lower-lying areas to the east of the project area). This habitat type is characterised by exposed root systems of *Lophostemon grandiflorus* and sometimes *Callitris intratropica* trees, which along with large, angular rocks and boulders create deep crevices and capture points for organic matter with higher moisture content an localised humidity than the surrounding woodland.
- Rock pavements, generally in elevated situations, are exposed and support wind-sheared, heath-like plants. Trees when present, are sparsely represented, and are invariably stunted with gnarled forms. Wattles (usually *Acacia leptostachya*) sometimes create dense, impenetrable thickets around bare rock surfaces where some semblance of soil development has occurred. The resurrection plant *Borya septentrionalis* finds a foothold in hollowed scoops on these rock pavements. These small surface hollows also afford short-lived watering points for fauna on an otherwise desiccated landform.
- Sheltered valleys and broad gullies supporting higher densities of trees (bloodwoods). Some of these areas should be considered as partially fire-resistant niches, and are therefore important as refugial zones for fauna and nodes of more mesophytic vegetation than surrounding sclerophyll vegetation. These zones also support a longer-term soil-water status and promote a higher percentage foliage cover; where the vegetation structure merges to open forest communities where the moisture gradient is highest and more persistent.

- Micro-gilgai and semi-aquatic environments (algae encrusted depressions on flat, clay plains and country with no or slight surface relief). These are temporary features and dependent solely on rainfall, and thus evaporate relatively quickly. Algal crusts are occasionally present where grasses have not been able to establish. These are potential micro-habitats for semi-aquatic plants such as *Rhamphicarpa australiensis*. Although this conservation significant species was not observed, it has been collected from north of the project area around Nardello's Lagoon.

4.4 Conservation Values of the Study area

4.4.1 Significant Flora

A number of conservation significant plants were identified in the desktop review of literature and databases (HERBRECS, Wildlife Online, EPBC Act's Protected Matters search tool) as potentially (or confirmed) occurring in the project area. These searches provide a useful background from which to determine where targeted ground investigations are best directed. Field surveys were then made of the range of habitats for conservation significant flora considered to be representative of the project area that will be potentially affected (impacted) by the proposed wind farm. It is noted however, that these surveys focussed on targeted sites identified as a proposed location for a wind turbine.

Ground searches detected two species of plants noted as being of conservation interest under both Queensland and Commonwealth legislation. These were the shrubs *Homoranthus porteri* and *Grevillea glossadenia*: both of which were found at one location growing in association on the ridge above the western fall of the range just south of the existing powerline.

No other rare or threatened flora species were recorded during the surveys; however, this does not imply that such species do not occur, and it is important to recognise that the probability of emergence of the ground flora is imminent following rainfall, and therefore a range of forbs, grasses and subshrubs may become apparent from March onwards (it is recognised that April and May are considered to be appropriate months for gaining a representative account of the ground layer vegetation in north Queensland). In this respect, it is recommended that detailed flora surveys of the groundlayer at potentially affected sites should be undertaken when conditions are more conducive to active growth and flowering of this important vegetation stratum.

4.4.2 Significant Fauna

Thirty-four threatened fauna species, listed under Commonwealth and / or Queensland legislation and 17 migratory species have been identified or have been predicted to occur within the study area. However, during the field investigations, only one species listed as near threatened under the NC Act was confirmed. *Hipposideros diadema* (Diadem's Leafnosed Bat) was recorded on one occasion at the Granite Creek site on the night of 12th May 2010. In addition, it is considered likely that the rock-wallaby species inhabiting the ridge tops is the near threatened *Petrogale mareeba*, also listed under Queensland legislation.

5 Potential Ecological Impacts

5.1 General Impacts on Flora and Fauna

The potential impacts of the project are difficult to categorise and quantify at this stage of the investigation as the preliminary layout may change: i.e. mapping inaccuracies with vegetation community boundaries; noise; rotor blade strike; alienation of wildlife; visual amenity. Nevertheless, it is expected that linear and patch clearing of vegetation will be required for the construction pad of each turbine (approximately 20m x 40m), construction of access tracks and where underground cabling is required to connect each turbine and finally connect to the main electricity grid. Such clearing has the potential to reduce connectivity of vegetation and modify important wildlife habitats in some areas. This is particularly relevant for the narrow ridges that characterise a majority of the sites chosen for turbine placement. These impacts can however, be mitigated or substantially reduced with considered placement of each wind turbine and the incorporation into the construction phase of a range of specially developed impact mitigation strategies.

Direct impacts are expected to occur during the construction phase of the project. Hard stand construction pads, access tracks and trenching for underground cabling that links each turbine and eventually feeds into the electricity grid will require vegetation clearing. In non-remnant areas (i.e. the existing cleared corridor of the power line easement), these impacts are considered of less significance from an environmental perspective. Nevertheless, the immediate effects of linear clearing within woodland remnants introduces a range of impacts, most of which could be managed and offset through the provision of stringent work practices determined through the compilation of detailed Environmental Work Plans (EMPs).

In the short term, linear clearing within remnant vegetation has the potential to create intermittent breaks in connectivity for ground fauna, but will have a lesser effect for flying and terrestrial fauna. Impacts in this sense are likely to be restricted to direct bird and bat strikes with turbine impellors. Conservation significant fauna could also be affected by the removal or major modification to key habitat resources, such as feed and den or roost trees. In addition, short term disturbance during the construction phase may result in the temporary relocation of local wildlife species and populations.

The ingress of weeds into otherwise weed-free sites is also a possibility, with confirmed evidence that the grass weed *Themeda quadrivalvis* (grader grass) has already established in linear strips and patches associated with the existing powerline through the project area. This species tends to establish in thick, banded swards and can quickly out-compete native grasses and other native plants. The dry bulk (dead foliage and seed heads) of grader grass has the capacity to exacerbate fires by developing abnormal fuel loads.

Given that the project area is relatively unaffected by serious weed incursion, the ecological integrity of vegetation has the potential to be compromised, and in the worst case scenario, irreversibly altered by the ingress of noxious plants.

Human visitation and machinery movement (during construction and infrequently during maintenance activities) is likely to have a temporary impact assuming that such activities are undertaken and offset with consideration to Weed Management Plans, EMPs and other specifically prepared management strategies.

The stripping and loss of ground vegetation has the potential to exacerbate soil erosion unless checked by appropriate erosion and sediment control measures and a recovering of bare soil surfaces with plant matter. It is recommended that a useful suite of plants that could be selected for site rehabilitation is researched.

Loss of vegetation for access tracks and the turbine construction pads could result in impacts to vegetation considered to be habitat for plants of conservation interest in the south of the project area. Here, plant diversity is influenced by the proximity to Mount Emerald, as this area is known for its concentration of species of conservation interest, where shrubs such as *Grevillea glossadenia*, *Homoranthus porteri* and *Acacia purpureopetala* have been collected. It is noted that these species are not entirely restricted to this portion of the project area, and their presence, and possibly other species could occur on Walsh Bluff and in similar habitats along ridges of the western portion of the project area. Dedicated threatened and near threatened plant surveys should be undertaken prior to the construction stage and when the final configuration of the wind farm is determined.

Direct impacts to vegetation communities will be most prevalent at each turbine site and along the road and cabling network that is proposed to connect each turbine and eventually to the main electricity grid. These impacts will result from vegetation clearing and ground surface levelling expected to be in the order of 20 or 30 metres wide for turbine construction pads, and road-cabling access tracks expected to be approximately 10 metres wide.

Removal of vegetation along narrow ridges at a number of turbine sites could result in a very thin band of trees remaining either side of the clearing. Clearing of vegetation in these width-restricted situations could result in loss of discrete vegetation communities – many of which are too narrow or small in area to accurately show on mapping. For example, short sections of the ridgeline between turbines 42 and 50 support a band of *Eucalyptus abergiana* (range bloodwood) trees. Sometimes this community is expressed as an area no wider than 20 m, where the ridge falls away abruptly and almost vertically to the northeast and more gradually to the southwest. Loss of the canopy in these situations could result in a different suite of species developing in the ground layer at the edge of the clearing.

Ridges also support heath-type vegetation comprising low shrubs and plants which occupy small niches. These indiscrete plant communities could be irreversibly altered given the scale of clearing required to accommodate a wind turbine. It is not known how these communities will respond to disturbance of this nature, or what successional traits will occur. For example, whether the communities will be replaced by a similar floristic composition of whether a different suite of colonising plants will eventuate.

Vegetation clearing will also remove and modify the groundcover, whether this comprises grasses and herbaceous plants, or rocky cover. On rocky country, plants are woody subshrubs with stunted and contorted forms – an adaptation to persistent wind shearing, cooler temperatures, lengthy periods of dry and rapidly drained substrates. Whether these plant communities are able to recuperate after significant alteration is unknown. A possible result is a change in floristic composition to more herbaceous species, or replacement by colonisers such as wattles (*Acacia* spp.).

The creation or widening of access tracks could in some situations, result in the ground surface being, at least temporarily, destabilised by machinery beyond its normal 'settled' condition. Possible impacts in this sense could include the transport of sediment, the development of rill and gully erosion, as well as possible sheet erosion after heavy rainfall events. Given the gravelly-clay nature of the substrate over most of the study area, the movement of clay particles can be expected. It was observed during the survey that the vehicle track entering the site to higher elevations had recently been resurfaced by a bulldozer, and within five days of traversing this track, the surface had been reduced in many sections to fine dust. This effect could be heightened along ridges where the zone of erosion is not contained due to the ridge dropping off either side. In this situation, surface erosion of narrow ridges could 'spill' over, carrying sediment to downhill settlement areas.

A discernible characteristic of the study area is its rugged and markedly dissected ridge topography. This landscape situation becomes increasingly more pronounced at the study area's southern end, and sections of the western edge. The provision of wind turbines on these ridges (many of which are narrow with very steep to near-vertical sides) will require the establishment of a series of access tracks and construction pads and the need to clear undisturbed vegetation. Clearing of these ridgeline communities could result in fragmentation of the vegetation's current contiguous condition. It is noted however, that the original cleared width of 10 m will be allowed to regenerate under natural circumstances to 5 m width: at which stage vegetation connectivity will be in an improved state.

5.2 Rotor Strike

The primary concern for fauna arising from wind farm developments is the probability of mortality of bird and bat species from collision with turbine rotors (DEWHA 2008). DEWHA further identify that groups of fauna considered being at most risk, and the situations in which they are most affected include the following:

- water birds that are listed threatened species, listed migratory species, and/or part of the ecological character of a Ramsar wetland;
- seabirds that are listed threatened species, listed migratory species and/or part of the ecological character of a Ramsar wetland—in the case of coastal and offshore wind farms;
- listed migratory species and listed threatened species that migrate within Australia where wind farms are situated on migration routes, and
- species that are at risk of extinction, that is, species that are listed as endangered or critically endangered, in particular, certain species of bats and birds, where wind farms are situated on a site they frequent.

It should be noted that some species are more prone to collide with turbine rotors than others (DEWHA 2008). For example, large soaring raptors tend to fly at turbine rotor height and are not agile fliers. Therefore, these species are more likely to collide with rotors than agile species, or those which fly higher or lower than rotor height. Such species are also likely to use the site topography differently and may frequent areas such as cliff edges and other updraft slopes more often (DEWHA 2008).

Some bat species are also known to fly at the height of the turbine rotors. Species that travel in flocks are also at relatively high risk of collision, particularly those that travel at night. Hence, listed threatened species that are nocturnal and also large soaring species are at greater risk of mortality from collision with rotors than are listed threatened species that tend to stay below the sweep area of the rotor blades. Similarly, listed threatened species of birds and bats that prefer open airspace tend to be more at risk than those that stay close to vegetation (DEWHA 2008).

Preliminary investigations undertaken in May 2010 indicate a relatively low diversity of bat and bird species occurring within the site. In addition, only one migratory species, *Merops ornatus* (Rainbow Bee-eater), recognised as a common and widespread species (Birds in Backyards 2010), was observed within the site. The project area is not recognised specifically as a migration route for this species, as northern populations are present year round (Birds in Backyards 2010b). The Rainbow Bee-eater generally flies below the height of the turbine rotor blades, foraging for insects, and as such, the impacts of rotor strike on this migratory species are predicted to be low.

Four small raptor species were recorded during the survey, all of which were sighted on one occasion only. One large raptor, *Aquila audax* (Wedge-tailed Eagle), was also recorded at four sites during the survey. No raptor nests were identified, although suitable foraging habitat for these birds occurs within and surrounding the site.

Seabirds and waterbirds, including threatened species, or not considered at risk from the proposed development, as no seabirds or waterbirds were recorded, and no suitable habitat exists within the site or in the close vicinity to support such species or populations.

No threatened bird or bat species were recorded during the survey. However, one near threatened bat species, *Hipposideros diadema* (Diadem leaf-nosed Bat), was recorded at the Granite Creek site. This species is a low flier in gallery forests, over water pools and is also found in disturbed forests (Aul and Vijaykumar 2003). As such, the proposed wind farm should not have a significant impact on this near threatened species through rotor blade strikes.

Appropriate mitigation measures, such as well planned site location, design and construction of wind farms should be included to ensure that native vegetation and habitats are largely preserved, and the risk of direct rotor blade strikes on bird and bat species is minimised to the greatest extent possible. A range of factors may be considered to reduce the likelihood of direct impellor collision, including:

- Wind farm technology, such as:
  - the type of wind turbine;
  - lighting of wind turbines; and
  - the layout of the wind farm;
- site characteristics, including:
  - the ecosystems on the wind farm site;
  - proximity to bird concentrations; and
  - the numbers of birds moving across the wind farm site;
- the risk behaviours of birds (e.g. soaring at rotor swept area (RSA) height); and
- prevailing weather conditions and other local environmental factors.

In addition, a six-year study assessing the impacts of offshore wind farms on bird species determined that up to 86% of birds travelling towards wind farms avoided going through them (Fox et al. 2006).

It is recognised however, that such incidences are very difficult to quantify at preliminary stages of investigation, and further surveys should be undertaken prior to the construction of the wind farm, to determine the extent of potential risk associated with rotor blade strikes to bird and bat species. Nevertheless, given that no bat roosts or conservation significant fauna species were identified in the study area, the level of impact is postulated to be low. It is also recommended that periodic monitoring of fauna strikes is undertaken and records of these events maintained and disseminated to relevant authorities to further the knowledge of such events. This could be performed as part of the wind farm maintenance schedule.

The disturbance of vegetation and other associated impacts of the wind farm, including noise and shadow effects, may also result in habitat avoidance or alienation from important sites, on or off the wind farm.

In summary, detailed site positioning of wind turbines has the benefit of locating a position of least ecological impact. With careful turbine placement and consideration given to the routing of the road and cabling network, the impacts of the wind farm are expected to be of relatively low intensity and recoverable.

6 Recommendations and Mitigation for Habitat Management

It is recommended that the following mitigation measures should be adhered to or implemented to minimise and monitor any likely and potential ecological impacts of the project:

- An Adaptive Management Program should be implemented, including a bird and bat monitoring program;
- All vegetation removal should be restricted to the actual development footprint. Careful micro-site locating of roads and cabling should be undertaken to minimise potential impacts;
- Turbine locations should be 'micro-sited' to take advantage of areas of least ecological significance to further protect native vegetation and habitats;
- Access roads and cabling should be aligned along existing tracks wherever possible to minimise vegetation removal and loss of hollow-bearing trees, the number of easements, and the spread of weeds;
- Weed management is strongly recommended given that invasive species such as *Themeda quadrivalvis* (Grader Grass) are known to have a detrimental effect on the function of woodland and open forest plant communities in north Queensland and elsewhere in Australia. A Weed Management Plan could be developed that addresses the strategies and impact mitigation for deleterious species;
- Power line (cabling) between turbines should be constructed underground and along road infrastructure to minimise the number of easements through the property and reduce further incidents of potential avian and bat collisions (including the creation of perching locations in the vicinity of turbines). After initial clearing and construction, the cabling and road network should be allowed to regenerate under natural conditions to 5 m cleared width;
- A wildlife 'spotter-catcher' should be engaged to oversee construction work at each site where clearing of vegetation, particularly mature trees with hollows, is required. In the event that fauna are found in hollows or other nests, these individuals should be relocated to an appropriate site and the Queensland Parks and Wildlife Service should be contacted with the details of the find. Stranded or injured fauna should be cared for by a qualified and licensed wildlife carer.
- Where possible, dead standing timber and living, hollow-bearing trees should be retained. This is particularly important as hollows were generally limited throughout the study area. These hollow-bearing trees have reached mature age and senesced as a natural consequence, and old trees such as these provide a range of important and established habitat niches for nesting, as well as perches (particularly for birds of prey and owls). In sheltered locations these trees assume greater significance due to their proximity to diverse foraging areas.
- Where construction requires felling of vegetation, logs and coarse woody debris should be retained on the site and as close to where it was felled as possible without increasing fire hazards in the immediate vicinity of turbine sites. Retention of this woody matter increases the diversity of the groundlayer habitat. Stockpiling of felled timber should be avoided in order that fuel loads and the potential for severe bushfires is offset to most practical level. Scattering felled vegetation around the cleared site is less likely to concentrate fuel loads in one place.
- A post-construction bird and bat monitoring program, such as that described by NWCC (1999) and AusWEA (2005) should be established to determine the impacts of the project on bird / bat populations. Such data may prove invaluable for assessing the impacts of future wind farms within Queensland;
- Constructional and operational phases of the development should be in line with the Best Practice Guidelines for Wind Energy Projects (AusWEA 2002), including the implementation of an Environmental Management Plan (EMP) and a Construction Management Plan (CMP);

- The CMP should include appropriate weed control measures such as washing machinery after entering affected areas and spraying road ways to ensure the spread of weeds is restricted during construction and throughout the ongoing operation of the wind farm; and
- Pre-clearing surveys should be undertaken by experienced ecologists at turbine and infrastructure locations to identify hollow-bearing trees and threatened flora species prior to the commencement of any construction and should include:
  - Marking of hollow bearing or significant habitat trees and threatened flora species (where appropriate);
  - Areas of vegetation to be retained should be clearly marked, and
  - Careful micro-site locating of infrastructure and turbines to minimise the removal of hollow-bearing trees and/or threatened flora should be undertaken. Where removal of hollow-bearing trees cannot be avoided, an ecologist (spotter-catcher) should be present during felling to minimise harm to fauna species.
- A Threatened Plant Species Management Plan should be developed that identifies species of conservation interest, which are known to occur in the project area. The plan should include the range of strategies and impact mitigation measures that are be implemented to ensure that respective conservation outcomes are achieved in accordance with Queensland and Commonwealth legislation (*Environment Protection and Biodiversity Conservation Act 1999* and the *Nature Conservation Act 1992* respectively).

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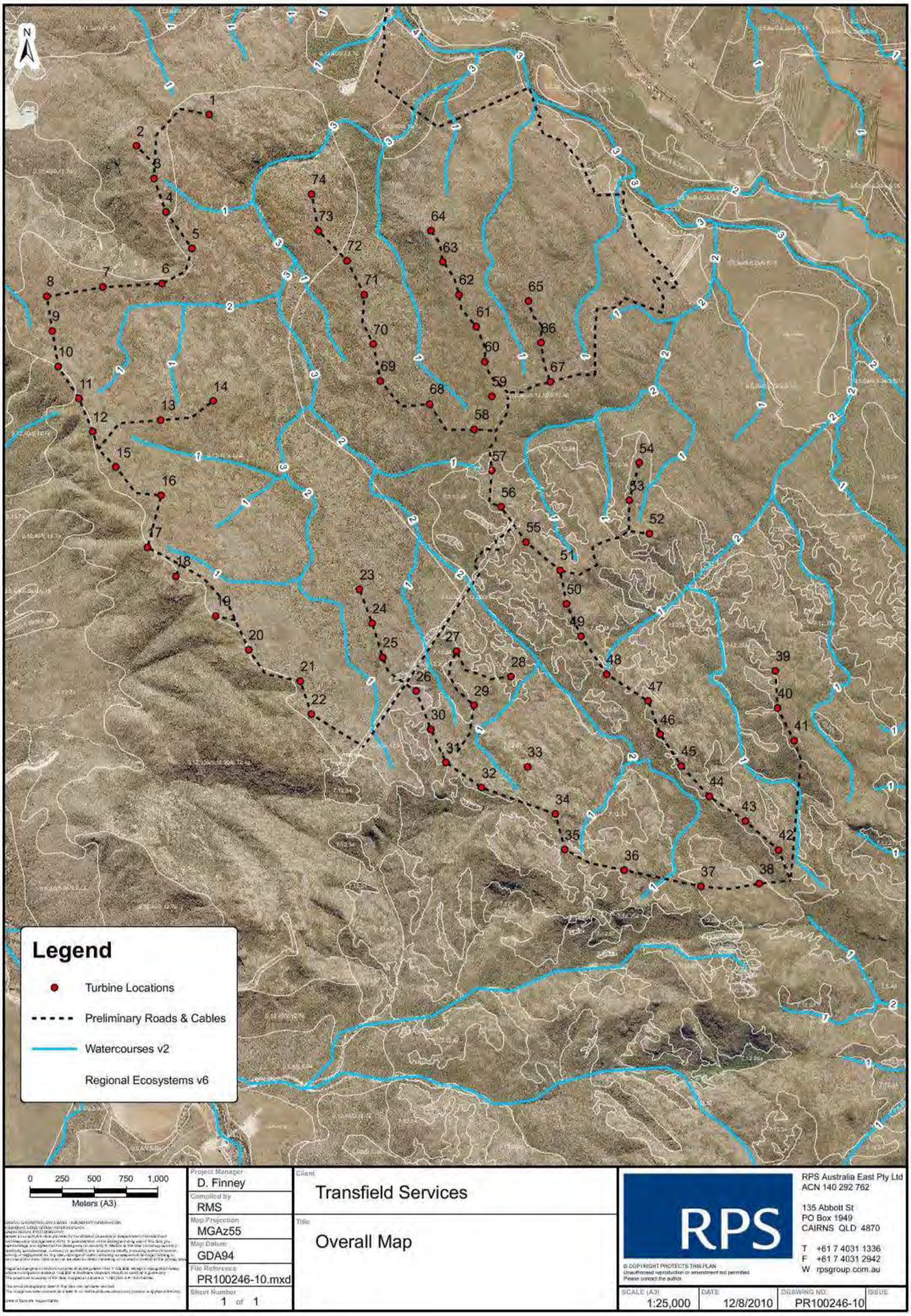
Appendix A

Proposed Turbine Positions, and Road & Cabling Network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Turbine Locations
Preliminary Roads & Cables
Watercourses v2
Regional Ecosystems v6
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Meters (A3)
Project Manager
D. Finney
Compiled by
RMS
Map Projection
MGAz55
Map Datum
GDA94
File Reference
PR100246-10.mxd
Sheet Number
1 of 1
Client
Transfield Services
Title
Overall Map
RPS
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1:25,000
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12/8/2010
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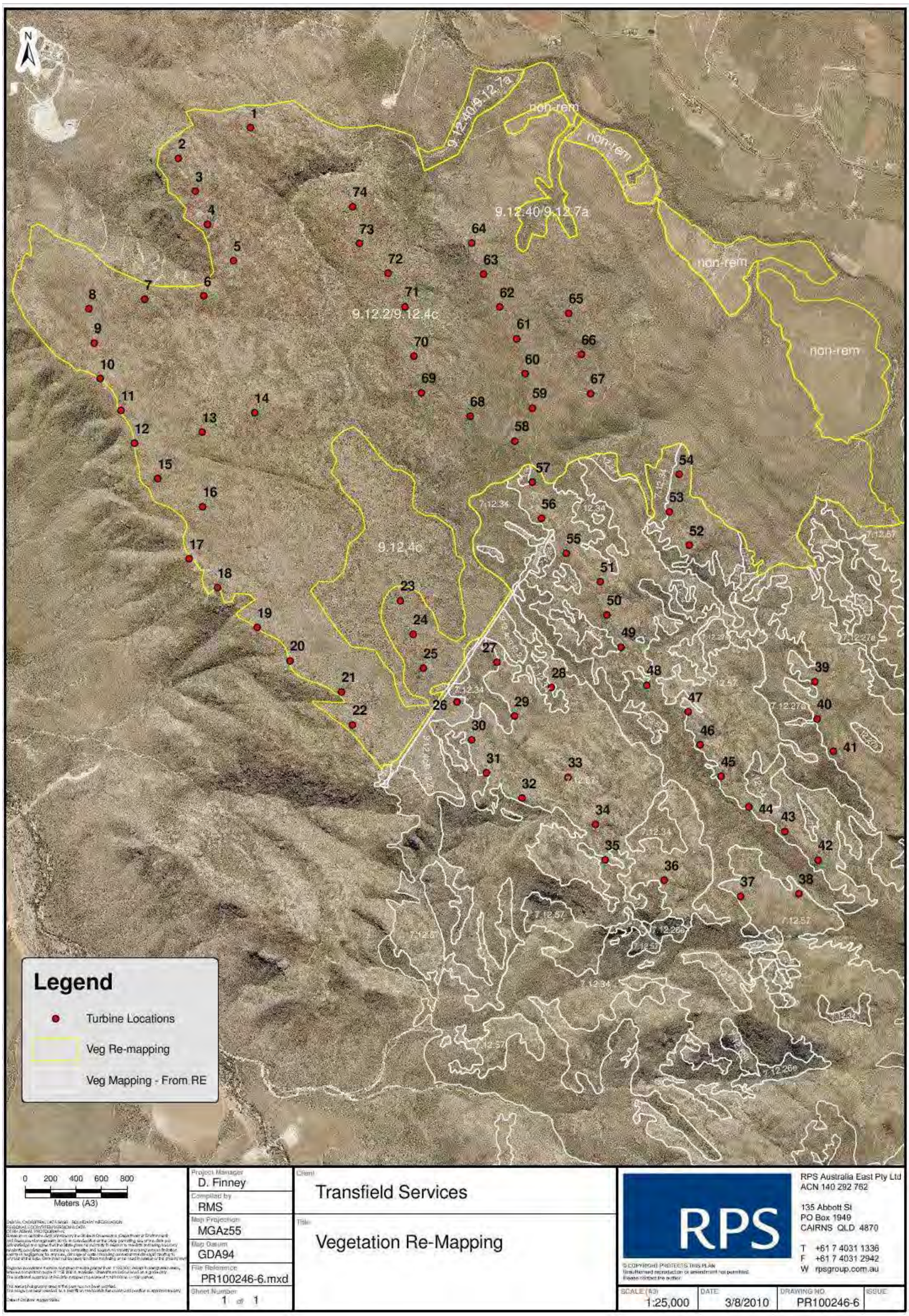
Appendix B

Regional Ecosystem Mapping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Turbine Locations
Veg Re-mapping
Veg Mapping - From RE
9.12.2/9.12.4c
9.12.4c
9.12.40/9.12.7a
non-rem
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Project Manager
D. Finney
Compiled by
RMS
Map Projection
MGAz55
Map Datum
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File Reference
PR100246-6.mxd
Sheet Number
1 of 1
Client
Transfield Services
Title
Vegetation Re-Mapping
RPS
RPS Australia East Pty Ltd
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Appendix C

Regional Ecosystem Descriptions

Appendix D

Wildlife Online Database Search Results

Queensland Government

Environmental Protection Agency

Queensland Parks and Wildlife Service

Wildlife Online Extract

Search Criteria: Species List for a Specified Point

Species: All

Type: All

Status: All

Records: All

Date: All

Latitude: 17.1696

Longitude: 145.3898

Distance: 10

Email: lyndall.harvey@rpsgroup.com.au

Date submitted: Tuesday 04 May 2010 10:45:18

Date extracted: Tuesday 04 May 2010 10:46:21

The number of records retrieved = 800

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			2
animals	amphibians	Hylidae	*Litoria fallax*	eastern sedgefrog		C		2
animals	amphibians	Hylidae	*Litoria rothii*	northern laughing treefrog		C		1
animals	amphibians	Hylidae	*Litoria bicolor*	northern sedgefrog		C		1
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		1
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		1
animals	amphibians	Myobatrachidae	*Uperoleia altissima*	tableland gungan		C		1
animals	birds	Acanthizidae	*Gerygone albogularis*	white-throated gerygone		C		4
animals	birds	Acanthizidae	*Sericornis frontalis*	white-browed scrubwren		C		1
animals	birds	Acanthizidae	*Sericornis keri*	Atherton scrubwren		C		1
animals	birds	Acanthizidae	*Gerygone mouki*	brown gerygone		C		2
animals	birds	Acanthizidae	*Sericornis citreogularis*	yellow-throated scrubwren		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		2
animals	birds	Acanthizidae	*Sericornis magnirostra*	large-billed scrubwren		C		2
animals	birds	Acanthizidae	*Oreoscopus gutturalis*	fernwren		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Accipitridae	*Elanus scriptus*	letter-winged kite		C		1
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		11
animals	birds	Accipitridae	*Circus assimilis*	spotted harrier		C		2
animals	birds	Accipitridae	*Erythrotriorchis radiatus*	red goshawk		E	V	1
animals	birds	Accipitridae	*Accipiter novaehollandiae*	grey goshawk		R		2/1
animals	birds	Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle		C		4
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		3
animals	birds	Accipitridae	*Accipiter fasciatus*	brown goshawk		C		2
animals	birds	Accipitridae	*Lophoictinia isura*	square-tailed kite		R		2
animals	birds	Accipitridae	*Circus approximans*	swamp harrier		C		1
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		6
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		C		1
animals	birds	Anatidae	*Cygnus atratus*	black swan		C		4
animals	birds	Anatidae	*Malacorhynchus membranaceus*	pink-eared duck		C		1
animals	birds	Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose		R		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		5
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		2
animals	birds	Anseranatidae	*Anseranas semipalmata*	magpie goose		C		1
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		2
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		4
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		3
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		2
animals	birds	Artamidae	*Artamus leucorynchus*	white-breasted woodswallow		C		2
animals	birds	Burhinidae	*Burhinus grallarius*	bush stone-curlew		C		4
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		7
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		3
animals	birds	Campephagidae	*Lalage sueurii*	white-winged triller		C		2
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		7
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		7
animals	birds	Campephagidae	*Coracina tenuirostris*	cicadabird		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Campephagidae	*Lalage leucomela*	varied triller		C		2
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		4
animals	birds	Cisticolidae	*Cisticola exilis*	golden-headed cisticola		C		2
animals	birds	Climacteridae	*Cormobates leucophaea minor*	white-throated treecreeper (northern)		C		1
animals	birds	Columbidae	*Columba livia*	rock dove	Y			1
animals	birds	Columbidae	*Geopelia humeralis*	bar-shouldered dove		C		1
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		2
animals	birds	Columbidae	*Geophaps scripta*	squatter pigeon		C		2/1
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		8
animals	birds	Columbidae	*Macropygia amboinensis*	brown cuckoo-dove		C		1
animals	birds	Columbidae	*Streptopelia chinensis*	spotted dove	Y			4
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		2
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		5
animals	birds	Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo		C		1
animals	birds	Cuculidae	*Chalcites minutillus minutillus*	little bronze-cuckoo		C		1
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		2
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		1
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		5/1
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		1
animals	birds	Dicruridae	*Dicrurus bracteatus*	spangled drongo		C		7
animals	birds	Estrildidae	*Erythrura gouldiae*	Gouldian finch		E	E	3
animals	birds	Estrildidae	*Neochmia temporalis*	red-browed finch		C		3
animals	birds	Estrildidae	*Lonchura castaneothorax*	chestnut-breasted mannikin		C		2
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		2
animals	birds	Estrildidae	*Lonchura punctulata*	nutmeg mannikin	Y			1
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		1
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		2
animals	birds	Gruidae	*Grus antigone*	sarus crane		C		1
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		1
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		1
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		11
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		1
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		5
animals	birds	Hirundinidae	*Cheramoeca leucosterna*	white-backed swallow		C		2
animals	birds	Jacanidae	*Irediparra gallinacea*	comb-crested jacana		C		2
animals	birds	Laridae	*Gygis alba*	white tern		C		1
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		3
animals	birds	Megapodiidae	*Alectura lathami*	Australian brush-turkey		C		6
animals	birds	Megapodiidae	*Megapodius reinwardt*	orange-footed scrubfowl		C		1
animals	birds	Meliphagidae	*Meliphaga notata*	yellow-spotted honeyeater		C		1
animals	birds	Meliphagidae	*Myzomela obscura*	dusky honeyeater		C		1
animals	birds	Meliphagidae	*Ramsayornis fasciatus*	bar-breasted honeyeater		C		1
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		2
animals	birds	Meliphagidae	*Melithreptus lunatus*	white-naped honeyeater		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		8
animals	birds	Meliphagidae	*Lichenostomus flavus*	yellow honeyeater		C		4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Meliphagidae	*Philemon buceroides*	helmeted friarbird		C		1
animals	birds	Meliphagidae	*Phylidonyris niger*	white-cheeked honeyeater		C		3
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		3/1
animals	birds	Meliphagidae	*Meliphaga lewinii*	Lewin's honeyeater		C		6
animals	birds	Meliphagidae	*Acanthorhynchus tenuirostris*	eastern spinebill		C		1
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		4
animals	birds	Meliphagidae	*Myzomela sanguinolenta*	scarlet honeyeater		C		4
animals	birds	Meliphagidae	*Lichenostomus frenatus*	bridled honeyeater		C		1
animals	birds	Meliphagidae	*Lichenostomus chrysops*	yellow-faced honeyeater		C		2
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		6
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		2
animals	birds	Monarchidae	*Monarcha melanopsis*	black-faced monarch		C		1
animals	birds	Monarchidae	*Symposiarchus trivirgatus*	spectacled monarch		C		2
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		25
animals	birds	Monarchidae	*Myiagra cyanoleuca*	satin flycatcher		C		1
animals	birds	Nectariniidae	*Nectarinia jugularis*	olive-backed sunbird		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		4
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		1
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		1
animals	birds	Oriolidae	*Sphecotheres vieilloti*	Australasian figbird		C		3
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		1
animals	birds	Pachycephalidae	*Colluricincla boweri*	Bower's shrike-thrush		C		1
animals	birds	Pachycephalidae	*Colluricincla megarhyncha*	little shrike-thrush		C		1
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		5
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		2
animals	birds	Pachycephalidae	*Pachycephala pectoralis*	golden whistler		C		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		3
animals	birds	Pardalotidae	*Pardalotus rubricatus*	red-browed pardalote		C		1
animals	birds	Passeridae	*Passer domesticus*	house sparrow	Y			2
animals	birds	Petroicidae	*Eopsaltria australis*	eastern yellow robin		C		2
animals	birds	Petroicidae	*Heteromyias cinereifrons*	grey-headed robin		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		3
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		3
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		2
animals	birds	Phasianidae	*Coturnix ypsilophora*	brown quail		C		1
animals	birds	Podicipedidae	*Podiceps cristatus*	great crested grebe		C		1
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		4
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		2
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		3
animals	birds	Psittacidae	*Trichoglossus chlorolepidotus*	scaly-breasted lorikeet		C		5
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		10/1
animals	birds	Psittacidae	*Cyclopsitta diophthalma macleayana*	Macleay's fig-parrot		V		1
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		1
animals	birds	Psophodidae	*Psophodes olivaceus*	eastern whipbird		C		1
animals	birds	Ptilonorhynchidae	*Ailuroedus melanotis*	spotted catbird		C		6/2
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	great bowerbird		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Ptilonorhynchidae	*Scenopoeetes dentirostris*	tooth-billed bowerbird		C		2
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		3
animals	birds	Recurvirostridae	*Recurvirostra novaehollandiae*	red-necked avocet		C		1
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		5
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		9
animals	birds	Rhipiduridae	*Rhipidura rufifrons*	rufous fantail		C		1
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		1
animals	birds	Strigidae	*Ninox connivens*	barking owl		C		1
animals	birds	Sturnidae	*Sturnus tristis*	common myna	Y			21
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	birds	Timaliidae	*Zosterops lateralis*	silvereye		C		7
animals	birds	Turdidae	*Zoothera heinei*	russet-tailed thrush		C		1
animals	birds	Turdidae	*Zoothera lunulata cuneata*	bassian thrush (north-east Queensland)		C		1/1
animals	birds	Turnicidae	*Turnix maculosus*	red-backed button-quail		C		2/1
animals	birds	Turnicidae	*Turnix pyrrhothorax*	red-chested button-quail		C		1/1
animals	birds	Tytonidae	*Tyto javanica*	eastern barn owl		C		1/1
animals	birds	Tytonidae	*Tyto longimembris*	eastern grass owl		C		3
animals	birds	Tytonidae	*Tyto tenebricosa multipunctata*	lesser sooty owl		C		1
animals	bony fish	Belonidae	*Strongylura krefftii*	freshwater longtom				1
animals	bony fish	Clupeidae	*Nematalosa erebi*	bony bream				1
animals	bony fish	Eleotridae	*Hypseleotris galii*	firetail gudgeon				1
animals	bony fish	Melanotaeniidae	*Melanotaenia eachamensis*	Lake Eacham rainbowfish			E	1/1
animals	bony fish	Melanotaeniidae	*Melanotaenia splendida splendida*	eastern rainbowfish				2
animals	bony fish	Melanotaeniidae	*Melanotaenia splendida inornata*	checkered rainbowfish				1
animals	bony fish	Terapontidae	*Leiopotherapon unicolor*	spangled perch				1
animals	mammals	Dasyuridae	*Planigale maculata*	common planigale		C		3/2
animals	mammals	Dasyuridae	*Dasyurus hallucatus*	northern quoll		C	E	1/1
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			1
animals	mammals	Macropodidae	*Macropus agilis*	agile wallaby		C		1
animals	mammals	Macropodidae	*Macropus parryi*	whiptail wallaby		C		1
animals	mammals	Macropodidae	*Petrogale mareeba*	Mareeba rock-wallaby		R		3/2
animals	mammals	Macropodidae	*Macropus robustus*	common wallaroo		C		1
animals	mammals	Macropodidae	*Thylogale stigmatica*	red-legged pademelon		C		1
animals	mammals	Muridae	*Rattus rattus*	black rat	Y			1/1
animals	mammals	Muridae	*Mesembriomys gouldii*	black-footed tree-rat		C		1/1
animals	mammals	Muridae	*Rattus sordidus*	canefield rat		C		1/1
animals	mammals	Ornithorhynchidae	*Ornithorhynchus anatinus*	platypus		C		1
animals	mammals	Peramelidae	*Perameles nasuta*	long-nosed bandicoot		C		1/1
animals	mammals	Petauridae	*Dactylopsila trivirgata*	striped possum		C		1
animals	mammals	Petauridae	*Petaurus breviceps*	sugar glider		C		2/2
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		2/1
animals	mammals	Potoroidae	*Aepyprymnus rufescens*	rufous bettong		C		1
animals	mammals	Pseudocheiridae	*Pseudochirops archeri*	green ringtail possum		R		2/2
animals	mammals	Pseudocheiridae	*Pseudocheirus peregrinus*	common ringtail possum		C		1/1
animals	mammals	Pteropodidae	*Pteropus scapulatus*	little red flying-fox		C		29

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	mammals	Pteropodidae	*Pteropus conspicillatus*	spectacled flying-fox		C	V	11/3
animals	mammals	Tachyglossidae	*Tachyglossus aculeatus*	short-beaked echidna		C		2/2
animals	reptiles	Boidae	*Morelia spilota*	carpet python		C		5
animals	reptiles	Boidae	*Morelia kinghorni*	amethystine python (Australian form)		C		1
animals	reptiles	Boidae	*Aspidites melanocephalus*	black-headed python		C		2
animals	reptiles	Colubridae	*Tropidonophis mairii*	freshwater snake		C		1/1
animals	reptiles	Elapidae	*Cacophis churchilli*			C		1/1
animals	reptiles	Elapidae	*Pseudonaja textilis*	eastern brown snake		C		1/1
animals	reptiles	Elapidae	*Acanthophis antarcticus*	common death adder		R		1/1
animals	reptiles	Elapidae	*Rhinoplocephalus nigrescens*	eastern small-eyed snake		C		1/1
animals	reptiles	Gekkonidae	*Oedura rhombifer*	zig-zag gecko		C		1
animals	reptiles	Scincidae	*Carlia storri*			C		1/1
animals	reptiles	Scincidae	*Eulamprus tenuis*			C		1/1
animals	reptiles	Scincidae	*Cryptoblepharus metallicus*	metallic snake-eyed skink		C		1
fungi	club fungi	Basidiomycota	*Amanita*			C		1/1
fungi	club fungi	Basidiomycota	*Agaricus*			C		1/1
fungi	club fungi	Basidiomycota	*Polyporus*			C		1/1
fungi	club fungi	Basidiomycota	*Scleroderma*			C		1/1
fungi	club fungi	Basidiomycota	*Trametes lactinea*			C		1/1
fungi	club fungi	Basidiomycota	*Coriolus cingulatus*			C		1/1
fungi	club fungi	Basidiomycota	*Armillaria luteobubalina*			C		1/1
fungi	club fungi	Basidiomycota	*Ganoderma williamsianum*			C		1/1
fungi	club fungi	Basidiomycota	*Microporellus obovatus*			C		1/1
fungi	club fungi	Basidiomycota	*Macrolepiota clelandii*			C		1/1
fungi	club fungi	Basidiomycota	*Coriolus elongatus*			C		1/1
fungi	club fungi	Basidiomycota	*Stereum ostrea*			C		1/1
fungi	club fungi	Basidiomycota	*Pisolithus*			C		1/1
fungi	club fungi	Basidiomycota	*Inonotus*			C		1/1
fungi	club fungi	Basidiomycota	*Lepista*			C		1/1
fungi	club fungi	Basidiomycota	*Boletus*			C		1/1
fungi	sac fungi	Acarosporaceae	*Acarospora*			C		1/1
fungi	sac fungi	Pertusariaceae	*Pertusaria subventosa var. subventosa*			C		1/1
fungi	sac fungi	Physciaceae	*Buellia*			C		1/1
fungi	sac fungi	Physciaceae	*Pyxine plumea*			C		1/1
fungi	uncertain	Ascomycota	*Rosellinia arcuata*			C		1/1
plants	club mosses	Lycopodiaceae	*Huperzia phlegmaria*	coarse tassel fern		R		1/1
plants	conifers	Araucariaceae	*Agathis robusta*	kauri pine		C		1/1
plants	conifers	Araucariaceae	*Agathis microstachya*	bull kauri		R		2/2
plants	conifers	Cupressaceae	*Callitris intratropica*	coast cypress pine		C		3/1
plants	conifers	Podocarpaceae	*Sundacarpus amarus*			C		1/1
plants	cycads	Cycadaceae	*Cycas media subsp. banksii x C.platyphylla*			C		1/1
plants	ferns	Adiantaceae	*Cheilanthes*			C		4
plants	ferns	Adiantaceae	*Adiantum philippense*			C		1/1
plants	ferns	Adiantaceae	*Cheilanthes tenuifolia*	rock fern		C		1/1
plants	ferns	Adiantaceae	*Adiantum hispidulum var. minus*			C		1/1
plants	ferns	Adiantaceae	*Doryopteris concolor*			C		1/1

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plants	ferns	Adiantaceae	*Adiantum silvaticum*			C		1/1
plants	ferns	Aspleniaceae	*Asplenium paleaceum*	scaly asplenium		C		1/1
plants	ferns	Aspleniaceae	*Asplenium australasicum*			C		1/1
plants	ferns	Athyriaceae	*Diplazium dilatatum*			C		2/2
plants	ferns	Athyriaceae	*Callipteris prolifera*			C		2/2
plants	ferns	Azollaceae	*Azolla pinnata*	ferny azolla		C		1/1
plants	ferns	Blechnaceae	*Blechnum wurunuran*			C		1/1
plants	ferns	Blechnaceae	*Pteridoblechnum neglectum*			C		1/1
plants	ferns	Cyatheaceae	*Cyathea celebica*			R		2/2
plants	ferns	Cyatheaceae	*Cyathea baileyana*	wig tree fern		R		1/1
plants	ferns	Davalliaceae	*Davallia pyxidata*			C		1/1
plants	ferns	Dicksoniaceae	*Dicksonia herbertii*			C		2/2
plants	ferns	Dryopteridaceae	*Lastreopsis rufescens*			C		1/1
plants	ferns	Dryopteridaceae	*Lastreopsis microsora subsp. microsora*			C		2/2
plants	ferns	Gleicheniaceae	*Sticherus flabellatus var. flabellatus*			C		1/1
plants	ferns	Hymenophyllaceae	*Hymenophyllum samoense*			C		1/1
plants	ferns	Marattiaceae	*Marattia oreades*	potato fern		C		1/1
plants	ferns	Nephrolepidaceae	*Arthropteris tenella*	climbing fern		C		1/1
plants	ferns	Ophioglossaceae	*Ophioglossum gramineum*			C		1/1
plants	ferns	Polypodiaceae	*Colysis sayeri*			C		1/1
plants	ferns	Polypodiaceae	*Pyrrosia confluens var. dielsii*			C		1/1
plants	ferns	Pteridaceae	*Pteris tripartita*	lacy bracken		C		1/1
plants	ferns	Pteridaceae	*Acrostichum aureum*	golden mangrove fern		C		1/1
plants	ferns	Thelypteridaceae	*Cyclosorus interruptus*			C		1/1
plants	ferns	Thelypteridaceae	*Sphaerostephanos unitus var. unitus*			C		2/2
plants	ferns	Vittariaceae	*Monogramma acrocarpa*			C		1/1
plants	higher dicots	Acanthaceae	*Brunoniella acaulis*			C		1
plants	higher dicots	Acanthaceae	*Asystasia sp. (Newcastle Bay L.J.Brass 18671)*			C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens var. hispida*			C		1/1
plants	higher dicots	Acanthaceae	*Brunoniella australis*	blue trumpet		C		1/1
plants	higher dicots	Acanthaceae	*Harnieria hygrophiloides*	white karambal		C		1/1
plants	higher dicots	Acanthaceae	*Hypoestes phyllostachya*		Y			2/2
plants	higher dicots	Amaranthaceae	*Amaranthus spinosus*	needle burr	Y			1/1
plants	higher dicots	Amaranthaceae	*Deeringia amaranthoides*	redberry		C		1/1
plants	higher dicots	Apiaceae	*Actinotus gibbonsii*	dwarf flannel flower		C		2/2
plants	higher dicots	Apiaceae	*Mackinlaya macrosciadea*	mackinlaya		C		1/1
plants	higher dicots	Apocynaceae	*Alyxia spicata*			C		1/1
plants	higher dicots	Apocynaceae	*Wrightia saligna*			C		1/1
plants	higher dicots	Apocynaceae	*Phyllanthera grayi*			V		7/7
plants	higher dicots	Apocynaceae	*Tylophora benthamii*	coast tylophora		C		1/1
plants	higher dicots	Apocynaceae	*Catharanthus roseus*	pink periwinkle	Y			1/1
plants	higher dicots	Apocynaceae	*Tylophora colorata*			C		1/1
plants	higher dicots	Apocynaceae	*Neisosperma poweri*			C		1/1
plants	higher dicots	Apocynaceae	*Alstonia muelleriana*	hard milkwood		C		1/1
plants	higher dicots	Apocynaceae	*Marsdenia longipedicellata*			C		1/1
plants	higher dicots	Apocynaceae	*Marsdenia suborbicularis*			C		1/1

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plants	higher dicots	Apocynaceae	*Gomphocarpus physocarpus*	balloon cottonbush	Y			2/2
plants	higher dicots	Apocynaceae	*Asclepias curassavica*	red-head cottonbush	Y			1/1
plants	higher dicots	Araliaceae	*Hydrocotyle*			C		1/1
plants	higher dicots	Araliaceae	*Astrotricha pterocarpa*			C		1/1
plants	higher dicots	Asteraceae	*Bidens pilosa*		Y			1
plants	higher dicots	Asteraceae	*Cirsium vulgare*	spear thistle	Y			2/2
plants	higher dicots	Asteraceae	*Cyanthillium cinereum*			C		4
plants	higher dicots	Asteraceae	*Pterocaulon redolens*			C		5
plants	higher dicots	Asteraceae	*Praxelis clematidea*		Y			2/2
plants	higher dicots	Asteraceae	*Ageratum conyzoides*	billygoat weed	Y			1
plants	higher dicots	Asteraceae	*Camptacra gracilis*			C		1/1
plants	higher dicots	Asteraceae	*Eclipta prostrata*	white eclipta		C		1
plants	higher dicots	Asteraceae	*Ageratina riparia*	mistflower	Y			1/1
plants	higher dicots	Asteraceae	*Senecio tamoides*		Y			1/1
plants	higher dicots	Asteraceae	*Cosmos caudatus*		Y			2/2
plants	higher dicots	Asteraceae	*Centratherum punctatum subsp. punctatum*		Y			1/1
plants	higher dicots	Asteraceae	*Acmella grandiflora var. brachyglossa*			C		5/5
plants	higher dicots	Asteraceae	*Phacellothrix cladochaeta*			C		1/1
plants	higher dicots	Asteraceae	*Parthenium hysterophorus*	parthenium weed	Y			1/1
plants	higher dicots	Asteraceae	*Coronidium newcastlianum*			C		1
plants	higher dicots	Asteraceae	*Ozothamnus cassinioides*			C		1/1
plants	higher dicots	Asteraceae	*Tithonia diversifolia*	Japanese sunflower	Y			1/1
plants	higher dicots	Asteraceae	*Montanoa hibiscifolia*		Y			1/1
plants	higher dicots	Balanopaceae	*Balanops australiana*			C		1/1
plants	higher dicots	Bignoniaceae	*Macfadyena unguis-cati*	cat's claw creeper	Y			1/1
plants	higher dicots	Bignoniaceae	*Spathodea campanulata subsp. nilotica*		Y			1/1
plants	higher dicots	Bignoniaceae	*Dolichandrone heterophylla*			C		2
plants	higher dicots	Boraginaceae	*Trichodesma zeylanicum*			C		1
plants	higher dicots	Boraginaceae	*Heliotropium tabuliplagae*			C		1/1
plants	higher dicots	Brassicaceae	*Lepidium virginicum*	Virginian peppercress	Y			1/1
plants	higher dicots	Burseraceae	*Canarium australasicum*	mango bark		C		1
plants	higher dicots	Byttneriaceae	*Keraudrenia lanceolata*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Cassia*			C		2
plants	higher dicots	Caesalpiniaceae	*Senna septemtrionalis*		Y			1/1
plants	higher dicots	Caesalpiniaceae	*Chamaecrista mimosoides*	dwarf cassia		C		1/1
plants	higher dicots	Caesalpiniaceae	*Erythrophleum chlorostachys*			C		3/2
plants	higher dicots	Campanulaceae	*Lobelia*			C		1
plants	higher dicots	Campanulaceae	*Lobelia gibbosa var. gibbosa*			C		1/1
plants	higher dicots	Campanulaceae	*Wahlenbergia*			C		1
plants	higher dicots	Caryophyllaceae	*Polycarpaea corymbosa*			C		1
plants	higher dicots	Caryophyllaceae	*Polycarpaea spirostylis subsp. spirostylis*			C		1/1
plants	higher dicots	Casuarinaceae	*Allocasuarina torulosa*			C		1/1
plants	higher dicots	Casuarinaceae	*Allocasuarina littoralis*			C		2/1
plants	higher dicots	Celastraceae	*Celastraceae*			C		1
plants	higher dicots	Celastraceae	*Euonymus australiana*			C		2/2
plants	higher dicots	Celastraceae	*Elaeodendron melanocarpum*			C		1/1

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plants	higher dicots	Celastraceae	*Maytenus cunninghamii*	yellow berry bush		C		6
plants	higher dicots	Celastraceae	*Maytenus disperma*	orange boxwood		C		3/3
plants	higher dicots	Convolvulaceae	*Xenostegia tridentata*			C		1/1
plants	higher dicots	Convolvulaceae	*Ipomoea polpha subsp. polpha*			C		6/6
plants	higher dicots	Cucurbitaceae	*Neoalsomitra clavigera*			C		1/1
plants	higher dicots	Cunoniaceae	*Pullea stutzeri*	hard alder		C		1/1
plants	higher dicots	Dilleniaceae	*Hibbertia*			C		2/1
plants	higher dicots	Dilleniaceae	*Hibbertia longifolia*			C		2
plants	higher dicots	Ebenaceae	*Diospyros australis*	black plum		C		1/1
plants	higher dicots	Elaeocarpaceae	*Elaeocarpus eumundi*	Eumundi quandong		C		1/1
plants	higher dicots	Elaeocarpaceae	*Elaeocarpus coorangooloo*			R		12/12
plants	higher dicots	Ericaceae	*Monotoca scoparia*	prickly broom heath		C		1/1
plants	higher dicots	Ericaceae	*Acrotriche aggregata*	red cluster heath		C		1/1
plants	higher dicots	Ericaceae	*Melichrus urceolatus*	honey gorse		C		1/1
plants	higher dicots	Ericaceae	*Leucopogon ruscifolius*			C		1/1
plants	higher dicots	Ericaceae	*Astroloma sp. (Baal Gammon B.P.Hyland 10341)*			C		1/1
plants	higher dicots	Ericaceae	*Acrothamnus spathaceus*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia*			C		1
plants	higher dicots	Euphorbiaceae	*Croton insularis*	Queensland cascarilla		C		2/2
plants	higher dicots	Euphorbiaceae	*Bertya polystigma*			C		1/1
plants	higher dicots	Euphorbiaceae	*Alchornea ilicifolia*	native holly		C		2/2
plants	higher dicots	Euphorbiaceae	*Mallotus philippensis*	red kamala		C		1
plants	higher dicots	Euphorbiaceae	*Aleurites rockinghamensis*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia pulcherrima*		Y			1/1
plants	higher dicots	Euphorbiaceae	*Baloghia parviflora*			C		2/2
plants	higher dicots	Fabaceae	*Vigna*			C		1/1
plants	higher dicots	Fabaceae	*Zornia*			C		1/1
plants	higher dicots	Fabaceae	*Desmodium*			C		1
plants	higher dicots	Fabaceae	*Hovea nana*			C		2/2
plants	higher dicots	Fabaceae	*Uraria picta*			C		1/1
plants	higher dicots	Fabaceae	*Derris sp. (Claudie River L.J.Webb+ 8348)*			C		1/1
plants	higher dicots	Fabaceae	*Cajanus scarabaeoides var. scarabaeoides*			C		3/3
plants	higher dicots	Fabaceae	*Crotalaria montana var. angustifolia*			C		1/1
plants	higher dicots	Fabaceae	*Cajanus reticulatus var. reticulatus*			C		2/2
plants	higher dicots	Fabaceae	*Austrosteenisia blackii var. blackii*			C		1/1
plants	higher dicots	Fabaceae	*Mirbelia speciosa subsp. ringrosei*			C		1/1
plants	higher dicots	Fabaceae	*Macrotyloma axillare var. axillare*		Y			2/2
plants	higher dicots	Fabaceae	*Galactia tenuiflora forma sericea*			C		2/2
plants	higher dicots	Fabaceae	*Pultenaea millarii var. millarii*			C		5/5
plants	higher dicots	Fabaceae	*Neonotonia wightii var. wightii*		Y			2/2
plants	higher dicots	Fabaceae	*Glycine tomentella*	woolly glycine		C		3/2
plants	higher dicots	Fabaceae	*Crotalaria montana*			C		2
plants	higher dicots	Fabaceae	*Galactia muelleri*			C		1
plants	higher dicots	Fabaceae	*Crotalaria brevis*			C		1/1
plants	higher dicots	Fabaceae	*Clitoria ternatea*	butterfly pea	Y			1/1
plants	higher dicots	Fabaceae	*Tephrosia juncea*			C		1/1

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plants	higher dicots	Fabaceae	*Mirbelia pungens*			C		1/1
plants	higher dicots	Fabaceae	*Hovea longipes*	brush hovea		C		1/1
plants	higher dicots	Fabaceae	*Cajanus cajan*	pigeon pea	Y			1/1
plants	higher dicots	Fabaceae	*Indigofera pratensis*			C		6
plants	higher dicots	Fabaceae	*Indigofera linifolia*			C		2/1
plants	higher dicots	Fabaceae	*Gompholobium nitidum*			C		1/1
plants	higher dicots	Fabaceae	*Flemingia parviflora*	flemingia		C		4
plants	higher dicots	Fabaceae	*Crotalaria goreensis*	gambia pea	Y			3/2
plants	higher dicots	Fabaceae	*Centrosema pascuorum*		Y			1/1
plants	higher dicots	Fabaceae	*Crotalaria calycina*			C		2/2
plants	higher dicots	Fabaceae	*Lotononis bainesii*	lotononis	Y			1/1
plants	higher dicots	Fabaceae	*Kennedia rubicunda*	red Kennedy pea		C		1/1
plants	higher dicots	Fabaceae	*Rhynchosia minima var. minima*			C		1/1
plants	higher dicots	Fabaceae	*Macroptilium atropurpureum*	siratro	Y			1/1
plants	higher dicots	Fabaceae	*Austrodolichos errabundus*			C		1/1
plants	higher dicots	Fabaceae	*Aphyllodium biarticulatum*			C		1/1
plants	higher dicots	Fabaceae	*Macroptilium lathyroides*		Y			1/1
plants	higher dicots	Fabaceae	*Desmodium rhytidophyllum*			C		2/1
plants	higher dicots	Fabaceae	*Stylosanthes guianensis*		Y			3/1
plants	higher dicots	Fabaceae	*Lamprolobium fruticosum*			C		4/3
plants	higher dicots	Fabaceae	*Indigofera suffruticosa*		Y			1/1
plants	higher dicots	Fabaceae	*Castanospermum australe*	black bean		C		1/1
plants	higher dicots	Fabaceae	*Aeschynomene paniculata*		Y			1/1
plants	higher dicots	Fabaceae	*Indigofera bancroftii*			C		1/1
plants	higher dicots	Fabaceae	*Erythrina vespertilio*			C		2/2
plants	higher dicots	Fabaceae	*Uraria lagopodioides*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia leptoclada*			C		1/1
plants	higher dicots	Fabaceae	*Stylosanthes humilis*	Townsville stylo	Y			1/1
plants	higher dicots	Fabaceae	*Jacksonia thesioides*			C		1
plants	higher dicots	Fabaceae	*Stylosanthes*			C		4
plants	higher dicots	Fabaceae	*Tephrosia*			C		1/1
plants	higher dicots	Fabaceae	*Cajanus*			C		1
plants	higher dicots	Flacourtiaceae	*Homalium brachybotrys*			C		2/2
plants	higher dicots	Gentianaceae	*Fagraea fagraeacea*			C		3/3
plants	higher dicots	Goodeniaceae	*Goodenia rosulata*			C		1/1
plants	higher dicots	Haloragaceae	*Haloragis heterophylla*	rough raspweed		C		1/1
plants	higher dicots	Lamiaceae	*Prostanthera*			C		2/2
plants	higher dicots	Lamiaceae	*Salvia misella*		Y			2/2
plants	higher dicots	Lamiaceae	*Plectranthus amoenus*			V		5/5
plants	higher dicots	Lamiaceae	*Platostoma longicorne*			C		1/1
plants	higher dicots	Lamiaceae	*Prostanthera sp. (Dinden P.I.Forster+ PIF17342)*			E		1/1
plants	higher dicots	Lamiaceae	*Plectranthus graveolens*	flea bush		C		1/1
plants	higher dicots	Lamiaceae	*Plectranthus diversus*			C		1/1
plants	higher dicots	Lamiaceae	*Pogostemon stellatus*			C		1/1
plants	higher dicots	Lamiaceae	*Hyptis suaveolens*	hyptis	Y			1/1
plants	higher dicots	Lecythidaceae	*Planchonia careya*	cockatoo apple		C		6

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plants	higher dicots	Lentibulariaceae	*Utricularia bifida*			C		1/1
plants	higher dicots	Loranthaceae	*Amyema miquelii*			C		1/1
plants	higher dicots	Loranthaceae	*Decaisnina brittenii subsp. brittenii*			C		1/1
plants	higher dicots	Loranthaceae	*Lysiana filifolia*			R		1/1
plants	higher dicots	Lythraceae	*Rotala tripartita*			C		1/1
plants	higher dicots	Malvaceae	*Sida*			C		1
plants	higher dicots	Malvaceae	*Hibiscus meraukensis*	Merauke hibiscus		C		1
plants	higher dicots	Melastomataceae	*Melastoma malabathricum subsp. malabathricum*			C		1/1
plants	higher dicots	Menyanthaceae	*Nymphoides*			C		1
plants	higher dicots	Menyanthaceae	*Nymphoides indica*	water snowflake		C		2/2
plants	higher dicots	Mimosaceae	*Acacia*			C		1
plants	higher dicots	Mimosaceae	*Acacia burrana*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia humifusa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia galioides*			C		1
plants	higher dicots	Mimosaceae	*Acacia purpureopetala*			V	V	1/1
plants	higher dicots	Mimosaceae	*Acacia multisiliqua*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia melanoxylon*	blackwood		C		1/1
plants	higher dicots	Mimosaceae	*Acacia crassicarpa*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia aulacocarpa*			C		3/1
plants	higher dicots	Mimosaceae	*Acacia leptocarpa*	north coast wattle		C		3/1
plants	higher dicots	Mimosaceae	*Acacia hemignosta*			C		3/2
plants	higher dicots	Mimosaceae	*Acacia flavescens*	toothed wattle		C		1/1
plants	higher dicots	Mimosaceae	*Acacia nesophila*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia disparrima subsp. calidestris*			C		2/2
plants	higher dicots	Mimosaceae	*Acaciella angustissima*		Y			1/1
plants	higher dicots	Mimosaceae	*Acacia bidwillii*			C		5/1
plants	higher dicots	Mimosaceae	*Acacia guymeri*			V	V	1
plants	higher dicots	Mimosaceae	*Acacia whitei*			C		3/2
plants	higher dicots	Mimosaceae	*Acacia simsii*			C		1/1
plants	higher dicots	Moraceae	*Ficus obliqua*			C		3/3
plants	higher dicots	Moraceae	*Ficus mollior var. mollior*			C		2/2
plants	higher dicots	Moraceae	*Trophis scandens subsp. scandens*			C		2/2
plants	higher dicots	Moraceae	*Ficus superba var. henneana*			C		1/1
plants	higher dicots	Moraceae	*Streblus brunonianus*	whalebone tree		C		1/1
plants	higher dicots	Moraceae	*Ficus leptoclada*			C		1/1
plants	higher dicots	Myrsinaceae	*Myrsine variabilis*			C		1/1
plants	higher dicots	Myrsinaceae	*Tapeinosperma pallidum*			C		1/1
plants	higher dicots	Myrsinaceae	*Myrsine subsessilis subsp. cryptostemon*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca*			C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca uxorum*			E		2/2
plants	higher dicots	Myrtaceae	*Eucalyptus crebra*	narrow-leaved red ironbark		C		4
plants	higher dicots	Myrtaceae	*Melaleuca recurva*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus cullenii*	Cullen's ironbark		C		3/3
plants	higher dicots	Myrtaceae	*Corymbia intermedia*	pink bloodwood		C		3/2
plants	higher dicots	Myrtaceae	*Syzygium johnsonii*	Johnson's satinash		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca monantha*			C		3/3

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plants	higher dicots	Myrtaceae	*Gossia dallachiana*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus grandis*	flooded gum		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus exserta*	Queensland peppermint		C		1
plants	higher dicots	Myrtaceae	*Uromyrtus tenella*			C		2/2
plants	higher dicots	Myrtaceae	*Syzygium australe*	scrub cherry		C		3/3
plants	higher dicots	Myrtaceae	*Thaleropia queenslandica*	pink myrtle		R		4/4
plants	higher dicots	Myrtaceae	*Lophostemon grandiflorus*			C		1/1
plants	higher dicots	Myrtaceae	*Acmenosperma claviflorum*	grey satinash		C		1/1
plants	higher dicots	Myrtaceae	*Waterhousea unipunctata*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca trichostachya*			C		2/2
plants	higher dicots	Myrtaceae	*Leptospermum amboinense*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus tereticornis*			C		2
plants	higher dicots	Myrtaceae	*Rhodamnia sessiliflora*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus cloeziana*	Gympie messmate		C		1
plants	higher dicots	Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash		C		4/3
plants	higher dicots	Myrtaceae	*Corymbia ellipsoidea*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia dallachiana*			C		4
plants	higher dicots	Myrtaceae	*Syzygium luehmannii*			C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca viminalis*			C		1/1
plants	higher dicots	Myrtaceae	*Homoranthus porteri*			V	V	3/3
plants	higher dicots	Myrtaceae	*Gossia myrsinocarpa*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus shirleyi*			C		1
plants	higher dicots	Myrtaceae	*Melaleuca stenostachya*			C		4/3
plants	higher dicots	Myrtaceae	*Leptospermum neglectum*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus platyphylla*	poplar gum		C		5/3
plants	higher dicots	Myrtaceae	*Eucalyptus ochrophloia*	yapunyah		C		1
plants	higher dicots	Myrtaceae	*Eucalyptus melanoleuca*	Nanango ironbark		C		1
plants	higher dicots	Myrtaceae	*Eucalyptus leptophleba*	Molloy red box		C		13/6
plants	higher dicots	Myrtaceae	*Corymbia erythrophloia*	variable-barked bloodwood		C		2
plants	higher dicots	Myrtaceae	*Melaleuca viridiflora*			C		4
plants	higher dicots	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree		C		2/2
plants	higher dicots	Myrtaceae	*Corymbia leichhardtii*	rustyjacket		C		3/1
plants	higher dicots	Myrtaceae	*Corymbia clarksoniana*			C		12/6
plants	higher dicots	Myrtaceae	*Eucalyptus granitica*	granite ironbark		C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca sp. (Ropers Peak P.I.Forster PIF7208)*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus tereticornis subsp. tereticornis*			C		1/1
plants	higher dicots	Myrtaceae	*Lophostemon grandiflorus subsp. riparius*			C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca viridiflora var. viridiflora*			C		1/1
plants	higher dicots	Myrtaceae	*Corymbia citriodora subsp. citriodora*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca nervosa subsp. nervosa*			C		1/1
plants	higher dicots	Myrtaceae	*Leptospermum polygalifolium*	tantoon		C		1/1
plants	higher dicots	Myrtaceae	*Archirhodomyrtus beckleri*	rose myrtle		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca nervosa*			C		3
plants	higher dicots	Myrtaceae	*Syzygium oleosum*	blue cherry		C		7/7
plants	higher dicots	Myrtaceae	*Gossia bidwillii*			C		2/2
plants	higher dicots	Myrtaceae	*Leptospermum*			C		1

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plants	higher dicots	Myrtaceae	*Gossia hillii*			C		2/2
plants	higher dicots	Myrtaceae	*Syzygium wesa*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus*			C		1
plants	higher dicots	Nyctaginaceae	*Mirabilis jalapa*	four o'clock	Y			1/1
plants	higher dicots	Nyctaginaceae	*Pisonia aculeata*	thorny Pisonia		C		1/1
plants	higher dicots	Ochnaceae	*Brackenridgea australiana*			C		1/1
plants	higher dicots	Oleaceae	*Olea paniculata*			C		1/1
plants	higher dicots	Oleaceae	*Jasminum dallachii*	soft jasmine		C		2/2
plants	higher dicots	Oleaceae	*Notelaea sp. (Barakula A.R.Bean 7553)*			C		1/1
plants	higher dicots	Oleaceae	*Ligustrum australianum*			C		1/1
plants	higher dicots	Oleaceae	*Ligustrum sinense*	small-leaved privet	Y			1/1
plants	higher dicots	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		1
plants	higher dicots	Opiliaceae	*Opilia amentacea*			C		1/1
plants	higher dicots	Oxalidaceae	*Oxalis*			C		1/1
plants	higher dicots	Passifloraceae	*Passiflora herbertiana subsp. herbertiana*	native passionfruit		C		1/1
plants	higher dicots	Pentaphylacaceae	*Ternstroemia cherryi*	cherry beech		C		1/1
plants	higher dicots	Phyllanthaceae	*Breynia*			C		1
plants	higher dicots	Phyllanthaceae	*Antidesma bunius*	currantwood		C		1/1
plants	higher dicots	Phyllanthaceae	*Glochidion hylandii*			C		1/1
plants	higher dicots	Phyllanthaceae	*Sauropus macranthus*			V	V	7/7
plants	higher dicots	Phyllanthaceae	*Glochidion harveyanum*			C		1/1
plants	higher dicots	Phyllanthaceae	*Poranthera microphylla*	small poranthera		C		2/1
plants	higher dicots	Phyllanthaceae	*Glochidion harveyanum var. harveyanum*			C		1/1
plants	higher dicots	Phyllanthaceae	*Margaritaria dubium-traceyi*			C		2/2
plants	higher dicots	Phyllanthaceae	*Glochidion sumatranum*	umbrella cheese tree		C		1/1
plants	higher dicots	Phyllanthaceae	*Antidesma parvifolium*			C		1/1
plants	higher dicots	Phytolaccaceae	*Phytolacca octandra*	inkweed	Y			1/1
plants	higher dicots	Picrodendraceae	*Petalostigma banksii*			C		1/1
plants	higher dicots	Picrodendraceae	*Petalostigma pubescens*	quinine tree		C		2
plants	higher dicots	Picrodendraceae	*Pseudanthus ligulatus subsp. ligulatus*			C		1/1
plants	higher dicots	Pittosporaceae	*Bursaria incana*			C		2/1
plants	higher dicots	Pittosporaceae	*Pittosporum revolutum*	yellow pittosporum		C		1/1
plants	higher dicots	Polygalaceae	*Salomonia ciliata*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala paniculata*		Y			1/1
plants	higher dicots	Polygalaceae	*Comesperma*			C		2/2
plants	higher dicots	Polygalaceae	*Polygala persicariifolia*			C		1/1
plants	higher dicots	Polygalaceae	*Polygala sp. (Portland Roads L.Pedley 2757)*			C		1/1
plants	higher dicots	Polygonaceae	*Persicaria*			C		1
plants	higher dicots	Polygonaceae	*Muehlenbeckia zippelii*			C		2/2
plants	higher dicots	Polygonaceae	*Persicaria barbata*			C		1/1
plants	higher dicots	Polygonaceae	*Persicaria decipiens*	slender knotweed		C		3/3
plants	higher dicots	Proteaceae	*Xylomelum scottianum*			C		2
plants	higher dicots	Proteaceae	*Grevillea glossadenia*			V	V	3/3
plants	higher dicots	Proteaceae	*Grevillea pteridifolia*	golden parrot tree		C		2/1
plants	higher dicots	Proteaceae	*Stenocarpus angustifolius*			C		2/2
plants	higher dicots	Proteaceae	*Grevillea dryandri subsp. dryandri*			C		1/1

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plants	higher dicots	Proteaceae	*Banksia spinulosa var. spinulosa*			C		1/1
plants	higher dicots	Proteaceae	*Stenocarpus sinuatus*	wheel of fire		C		1/1
plants	higher dicots	Proteaceae	*Lomatia fraxinifolia*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea parallela*			C		5/1
plants	higher dicots	Proteaceae	*Alloxylon wickhamii*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea coriacea*			C		1/1
plants	higher dicots	Proteaceae	*Alloxylon flammeum*			V	V	4/4
plants	higher dicots	Proteaceae	*Persoonia falcata*			C		5
plants	higher dicots	Proteaceae	*Hakea persiehana*			C		4/1
plants	higher dicots	Proteaceae	*Grevillea glauca*	bushy's clothes peg		C		6/1
plants	higher dicots	Putranjivaceae	*Drypetes acuminata*			C		1/1
plants	higher dicots	Putranjivaceae	*Drypetes deplanchei*	grey boxwood		C		2/2
plants	higher dicots	Rhamnaceae	*Alphitonia*			C		1
plants	higher dicots	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		1/1
plants	higher dicots	Rhamnaceae	*Cryptandra debilis*			C		2/2
plants	higher dicots	Rhamnaceae	*Alphitonia pomaderroides*			C		2/1
plants	higher dicots	Rhamnaceae	*Emmenosperma alphitonioides*	yellow ash		C		1/1
plants	higher dicots	Rhamnaceae	*Rhamnus nipalensis*			C		1/1
plants	higher dicots	Rhamnaceae	*Alphitonia petriei*	pink ash		C		1/1
plants	higher dicots	Rubiaceae	*Coffea arabica*	Arabian coffee	Y			1/1
plants	higher dicots	Rubiaceae	*Ixora oreogena*			C		1/1
plants	higher dicots	Rubiaceae	*Psydrax attenuata*			C		2/2
plants	higher dicots	Rubiaceae	*Randia tuberculosa*			C		1/1
plants	higher dicots	Rubiaceae	*Larsenaikia ochreata*			C		1/1
plants	higher dicots	Rubiaceae	*Richardia brasiliensis*	white eye	Y			1/1
plants	higher dicots	Rubiaceae	*Pogonolobus reticulatus*			C		1
plants	higher dicots	Rubiaceae	*Atractocarpus fitzalanii subsp. fitzalanii*			C		1/1
plants	higher dicots	Rubiaceae	*Hodgkinsonia frutescens*			C	V	1/1
plants	higher dicots	Rubiaceae	*Opercularia diphylla*			C		1/1
plants	higher dicots	Rubiaceae	*Psydrax laxiflorens*			C		1/1
plants	higher dicots	Rubiaceae	*Mitracarpus hirtus*		Y			2
plants	higher dicots	Rutaceae	*Zieria whitei*			C		3/3
plants	higher dicots	Rutaceae	*Boronia bipinnata*	rock boronia		C		1/1
plants	higher dicots	Rutaceae	*Zieria cytisoides*	downy Zieria		C		1/1
plants	higher dicots	Rutaceae	*Flindersia schottiana*	bumpy ash		C		2/2
plants	higher dicots	Rutaceae	*Pitaviaster haplophyllus*			C		1/1
plants	higher dicots	Rutaceae	*Zanthoxylum ovalifolium*			C		2/2
plants	higher dicots	Rutaceae	*Acronychia crassipetala*			C		1/1
plants	higher dicots	Rutaceae	*Melicope broadbentiana*			C		2/2
plants	higher dicots	Rutaceae	*Flindersia bourjotiana*			C		1/1
plants	higher dicots	Rutaceae	*Zanthoxylum veneficum*			C		2/2
plants	higher dicots	Rutaceae	*Acronychia vestita*			C		1/1
plants	higher dicots	Rutaceae	*Halfordia kendack*	saffron heart		C		1/1
plants	higher dicots	Rutaceae	*Acronychia laevis*	glossy acronychia		C		3/3
plants	higher dicots	Rutaceae	*Melicope rubra*			C		1/1
plants	higher dicots	Santalaceae	*Exocarpos latifolius*			C		1/1

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plants	higher dicots	Santalaceae	*Santalum lanceolatum*			C		2/1
plants	higher dicots	Sapindaceae	*Guioa montana*			C		1/1
plants	higher dicots	Sapindaceae	*Arytera divaricata*	coogera		C		4/4
plants	higher dicots	Sapindaceae	*Dodonaea tenuifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Castanospora alphandii*	brown tamarind		C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea lanceolata var. subsessilifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Distichostemon dodecandrus*			C		1
plants	higher dicots	Sapindaceae	*Diploglottis bernieana*			C		1/1
plants	higher dicots	Sapindaceae	*Alectryon tomentosus*			C		4/4
plants	higher dicots	Sapindaceae	*Atalaya variifolia*			C		1
plants	higher dicots	Sapindaceae	*Guioa acutifolia*	northern guioa		C		3/3
plants	higher dicots	Sapotaceae	*Sersalisia sericea*			C		2/1
plants	higher dicots	Scrophulariaceae	*Striga parviflora*			C		1/1
plants	higher dicots	Scrophulariaceae	*Limnophila fragrans*			C		1/1
plants	higher dicots	Scrophulariaceae	*Limnophila aromatica*			C		1/1
plants	higher dicots	Scrophulariaceae	*Rhamphicarpa australiensis*			R		1/1
plants	higher dicots	Solanaceae	*Solanum torvum*	devil's fig	Y			1/1
plants	higher dicots	Solanaceae	*Cestrum nocturnum*		Y			3/3
plants	higher dicots	Solanaceae	*Physalis peruviana*		Y			1/1
plants	higher dicots	Solanaceae	*Solanum viridifolium*			C		1/1
plants	higher dicots	Solanaceae	*Nicandra physalodes*	apple of Peru	Y			1/1
plants	higher dicots	Solanaceae	*Solanum nodiflorum*		Y			1/1
plants	higher dicots	Solanaceae	*Nicotiana tabacum*		Y			2/2
plants	higher dicots	Solanaceae	*Solanum seaforthianum*	Brazilian nightshade	Y			1/1
plants	higher dicots	Sparrmanniaceae	*Grewia latifolia*	dysentery plant		C		1
plants	higher dicots	Sparrmanniaceae	*Grewia retusifolia*			C		8/2
plants	higher dicots	Sterculiaceae	*Brachychiton*			C		1
plants	higher dicots	Sterculiaceae	*Argyrodendron peralatum*	red tulip oak		C		1/1
plants	higher dicots	Sterculiaceae	*Brachychiton diversifolius subsp. orientalis*			C		1/1
plants	higher dicots	Sterculiaceae	*Franciscodendron laurifolium*			C		1/1
plants	higher dicots	Stylidiaceae	*Stylidium eriorhizum*			C		1/1
plants	higher dicots	Stylidiaceae	*Stylidium cordifolium*			C		2/2
plants	higher dicots	Surianaceae	*Guilfoylia monostylis*	guilfoylia		C		2/2
plants	higher dicots	Symplocaceae	*Symplocos cochinchinensis var. pilosiuscula*			C		1/1
plants	higher dicots	Thymelaeaceae	*Wikstroemia indica*	tie bush		C		4
plants	higher dicots	Thymelaeaceae	*Phaleria chermsideana*	scrub daphne		C		1/1
plants	higher dicots	Thymelaeaceae	*Phaleria clerodendron*	scented daphne		C		1/1
plants	higher dicots	Thymelaeaceae	*Pimelea trichostachya*	flaxweed		C		1
plants	higher dicots	Thymelaeaceae	*Thecanthes cornucopiae*			C		1/1
plants	higher dicots	Thymelaeaceae	*Pimelea sericostachya subsp. sericostachya*			C		1/1
plants	higher dicots	Ulmaceae	*Trema*			C		1
plants	higher dicots	Urticaceae	*Urtica incisa*	stinging nettle		C		1/1
plants	higher dicots	Verbenaceae	*Lantana camara cv. Gol Gol*		Y			1
plants	higher dicots	Violaceae	*Hybanthus enneaspermus*			C		1
plants	higher dicots	Viscaceae	*Viscum articulatum*	flat mistletoe		C		1/1
plants	higher dicots	Viscaceae	*Notothixos subaureus*	golden mistletoe		C		1/1

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plants	higher dicots	Vitaceae	*Cissus*			C		1
plants	higher dicots	Vitaceae	*Cissus hypoglauca*			C		2/2
plants	higher dicots	Vitaceae	*Cissus penninervis*			C		1/1
plants	higher dicots	Vitaceae	*Clematicissus opaca*			C		3/3
plants	higher dicots	Vitaceae	*Tetrastigma petraeum*			C		3/3
plants	higher dicots	Vitaceae	*Cissus cardiophylla*			C		1/1
plants	higher dicots	Vitaceae	*Cayratia trifolia*			C		4/1
plants	higher dicots	Zygophyllaceae	*Tribulus terrestris*	caltrop		C		1/1
plants	lower dicots	Annonaceae	*Polyalthia nitidissima*	polyalthia		C		1/1
plants	lower dicots	Cabombaceae	*Brasenia schreberi*			R		1/1
plants	lower dicots	Himantandraceae	*Galbulimima baccata*			C		2/2
plants	lower dicots	Lauraceae	*Litsea leefeana*			C		1/1
plants	lower dicots	Lauraceae	*Endiandra insignis*			C		1/1
plants	lower dicots	Lauraceae	*Neolitsea brassii*			C		1/1
plants	lower dicots	Lauraceae	*Neolitsea dealbata*	white bolly gum		C		1/1
plants	lower dicots	Lauraceae	*Cinnamomum camphora*	camphor laurel	Y			1/1
plants	lower dicots	Lauraceae	*Endiandra dielsiana*			C		1/1
plants	lower dicots	Lauraceae	*Beilschmiedia recurva*			C		1/1
plants	lower dicots	Lauraceae	*Cryptocarya densiflora*			C		1/1
plants	lower dicots	Lauraceae	*Cryptocarya triplinervis var. pubens*			C		1/1
plants	lower dicots	Lauraceae	*Cryptocarya hypospodia*	north Queensland purple laurel		C		1/1
plants	lower dicots	Lauraceae	*Cryptocarya cocosoides*			C		6/6
plants	lower dicots	Lauraceae	*Endiandra bessaphila*			C		4/4
plants	lower dicots	Lauraceae	*Cinnamomum laubatii*			C		1/1
plants	lower dicots	Lauraceae	*Cassytha filiformis*	dodder laurel		C		1/1
plants	lower dicots	Monimiaceae	*Steganthera macooraia*			C		1/1
plants	lower dicots	Nymphaeaceae	*Nymphaea*			C		1
plants	lower dicots	Nymphaeaceae	*Nymphaea immutabilis subsp. immutabilis*			C		1/1
plants	lower dicots	Ranunculaceae	*Clematis pickeringii*			C		1/1
plants	monocots	Alismataceae	*Caldesia parnassifolia*			C		1/1
plants	monocots	Araceae	*Spirodela punctata*	thin duckweed		C		3/3
plants	monocots	Arecaceae	*Laccospadix australasica*	Atherton palm		C		1/1
plants	monocots	Boryaceae	*Borya septentrionalis*			C		1/1
plants	monocots	Colchicaceae	*Iphigenia indica*			C		1/1
plants	monocots	Colchicaceae	*Schelhammera multiflora*			C		1/1
plants	monocots	Commelinaceae	*Murdannia vaginata*		Y			1/1
plants	monocots	Cyperaceae	*Cyperus*			C		1
plants	monocots	Cyperaceae	*Eleocharis*			C		1
plants	monocots	Cyperaceae	*Cyperus distans*			C		1/1
plants	monocots	Cyperaceae	*Cyperus aquatilis*			C		2/2
plants	monocots	Cyperaceae	*Fimbristylis nutans*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis cymosa*			C		1/1
plants	monocots	Cyperaceae	*Bulbostylis barbata*			C		1/1
plants	monocots	Cyperaceae	*Cyperus unioloides*			C		1/1
plants	monocots	Cyperaceae	*Schoenus falcatus*			C		1/1
plants	monocots	Cyperaceae	*Fuirena umbellata*			C		1/1

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plants	monocots	Cyperaceae	*Eleocharis minuta*		Y			1/1
plants	monocots	Cyperaceae	*Eleocharis dulcis*			C		1/1
plants	monocots	Cyperaceae	*Cyperus trinervis*			C		1/1
plants	monocots	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		1/1
plants	monocots	Cyperaceae	*Schoenoplectus laevis*			C		1/1
plants	monocots	Cyperaceae	*Lepidosperma laterale*			C		1
plants	monocots	Cyperaceae	*Eleocharis geniculata*			C		1/1
plants	monocots	Cyperaceae	*Eleocharis equisetina*			C		1/1
plants	monocots	Cyperaceae	*Lipocarpha chinensis*			C		2/2
plants	monocots	Cyperaceae	*Cyperus polystachyos*			C		2/2
plants	monocots	Cyperaceae	*Cyperus involucratus*		Y			1/1
plants	monocots	Cyperaceae	*Cyperus holoschoenus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus polystachyos var. polystachyos*			C		1/1
plants	monocots	Cyperaceae	*Cyperus haspan subsp. haspan*			C		1/1
plants	monocots	Cyperaceae	*Cyperus conicus var. conicus*			C		1/1
plants	monocots	Cyperaceae	*Rhynchospora subtenuifolia*			C		1/1
plants	monocots	Cyperaceae	*Schoenoplectus mucronatus*			C		4/3
plants	monocots	Cyperaceae	*Eleocharis atropurpurea*			C		2/2
plants	monocots	Cyperaceae	*Cyperus flavidus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus fulvus*			C		1/1
plants	monocots	Eriocaulaceae	*Eriocaulon nanum*			C		1/1
plants	monocots	Eriocaulaceae	*Eriocaulon scariosum*			C		1/1
plants	monocots	Hemerocallidaceae	*Dianella atraxis*			C		1/1
plants	monocots	Hydrocharitaceae	*Ottelia alismoides*			C		1/1
plants	monocots	Hypoxidaceae	*Curculigo ensifolia var. ensifolia*			C		1/1
plants	monocots	Johnsoniaceae	*Tricoryne anceps subsp. anceps*			C		2/1
plants	monocots	Laxmanniaceae	*Lomandra*			C		1/1
plants	monocots	Laxmanniaceae	*Lomandra filiformis*			C		1/1
plants	monocots	Laxmanniaceae	*Lomandra multiflora subsp. multiflora*			C		1/1
plants	monocots	Orchidaceae	*Diuris oporina*	northern white donkeys tails		R		1/1
plants	monocots	Orchidaceae	*Phaius australis*			E	E	1/1
plants	monocots	Orchidaceae	*Zeuxine oblonga*	hairy jewel orchid		C		1/1
plants	monocots	Orchidaceae	*Corybas cerasinus*			R		1/1
plants	monocots	Orchidaceae	*Acianthus borealis*			C		1/1
plants	monocots	Orchidaceae	*Octarrhena pusilla*			C		1/1
plants	monocots	Orchidaceae	*Drymoanthus minutus*			C		1/1
plants	monocots	Orchidaceae	*Pterostylis depauperata*			C		1/1
plants	monocots	Orchidaceae	*Arthrochilus oreophilus*			C		1/1
plants	monocots	Orchidaceae	*Spathoglottis paulinae*			R		1/1
plants	monocots	Orchidaceae	*Peristylus banfieldii*			R		1/1
plants	monocots	Orchidaceae	*Corybas aconitiflorus*			C		1/1
plants	monocots	Orchidaceae	*Acianthus fornicatus*	pixie caps		C		1/1
plants	monocots	Orchidaceae	*Pterostylis stricta*			C		1/1
plants	monocots	Orchidaceae	*Dipodium ensifolium*	leafy hyacinth orchid		C		1/1
plants	monocots	Orchidaceae	*Cheirostylis ovata*	caterpillar orchid		C		1/1
plants	monocots	Orchidaceae	*Empusa habenarina*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Pandanaceae	*Pandanus cookii*			C		1/1
plants	monocots	Pandanaceae	*Freycinetia excelsa*	climbing pandanus		C		1/1
plants	monocots	Poaceae	*Paspalum paniculatum*	Russell River grass	Y			1/1
plants	monocots	Poaceae	*Aristida superpendens*			C		1/1
plants	monocots	Poaceae	*Heteropogon contortus*	black speargrass		C		10/1
plants	monocots	Poaceae	*Schizachyrium fragile*	firegrass		C		2
plants	monocots	Poaceae	*Urochloa subquadripara*		Y			2/2
plants	monocots	Poaceae	*Panicum antidotale*	giant panic	Y			1/1
plants	monocots	Poaceae	*Oryza meridionalis*			C		1/1
plants	monocots	Poaceae	*Digitaria bicornis*			C		2/2
plants	monocots	Poaceae	*Arundinella setosa*			C		2
plants	monocots	Poaceae	*Aristida warburgii*			C		1/1
plants	monocots	Poaceae	*Urochloa pubigera*			C		4/4
plants	monocots	Poaceae	*Urochloa piligera*			C		1/1
plants	monocots	Poaceae	*Panicum coloratum*		Y			1/1
plants	monocots	Poaceae	*Themeda triandra*	kangaroo grass		C		11
plants	monocots	Poaceae	*Urochloa polyphylla*			C		1/1
plants	monocots	Poaceae	*Melinis minutiflora*	molasses grass	Y			2/1
plants	monocots	Poaceae	*Megathyrsus maximus*		Y			1/1
plants	monocots	Poaceae	*Cymbopogon ambiguus*	lemon grass		C		1
plants	monocots	Poaceae	*Urochloa distachya*		Y			1/1
plants	monocots	Poaceae	*Urochloa decumbens*		Y			1/1
plants	monocots	Poaceae	*Urochloa brizantha*		Y			2/2
plants	monocots	Poaceae	*Setaria sphacelata*		Y			1
plants	monocots	Poaceae	*Panicum incomtum*			C		1/1
plants	monocots	Poaceae	*Leersia hexandra*	swamp rice grass		C		2/1
plants	monocots	Poaceae	*Urochloa mutica*		Y			1
plants	monocots	Poaceae	*Panicum effusum*			C		1/1
plants	monocots	Poaceae	*Eriachne obtusa*			C		1/1
plants	monocots	Poaceae	*Panicum seminudum var. cairnsianum*			C		1/1
plants	monocots	Poaceae	*Chloris divaricata var. divaricata*	slender chloris		C		1/1
plants	monocots	Poaceae	*Megathyrsus maximus var. maximus*		Y			1/1
plants	monocots	Poaceae	*Ischaemum australe var. australe*			C		1/1
plants	monocots	Poaceae	*Sorghum nitidum forma aristatum*			C		1/1
plants	monocots	Poaceae	*Setaria pumila subsp. pumila*		Y			1/1
plants	monocots	Poaceae	*Aristida utilis var. utilis*			C		1/1
plants	monocots	Poaceae	*Mnesithea rottboellioides*			C		4
plants	monocots	Poaceae	*Capillipedium parviflorum*	scented top		C		1/1
plants	monocots	Poaceae	*Dactyloctenium aegyptium*	coast button grass	Y			2/2
plants	monocots	Poaceae	*Sporobolus jacquemontii*		Y			2/2
plants	monocots	Poaceae	*Eleusine indica*	crowsfoot grass	Y			1/1
plants	monocots	Poaceae	*Chloris virgata*	feathertop rhodes grass	Y			1/1
plants	monocots	Poaceae	*Bambusa balcooa*		Y			1/1
plants	monocots	Poaceae	*Sarga plumosum*			C		3
plants	monocots	Poaceae	*Melinis repens*	red natal grass	Y			1
plants	monocots	Poaceae	*Eriachne rara*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Arundinella*			C		3
plants	monocots	Poaceae	*Aristida*			C		2
plants	monocots	Poaceae	*Panicum*			C		1
plants	monocots	Poaceae	*Cenchrus caliculatus*	hillside burrgrass		C		1/1
plants	monocots	Poaceae	*Cyrtococcum deltoideum*		Y			1/1
plants	monocots	Poaceae	*Heteropogon triticeus*	giant speargrass		C		6/1
plants	monocots	Poaceae	*Cymbopogon bombycinus*	silky oilgrass		C		1
plants	monocots	Poaceae	*Whiteochloa airoides*			C		1/1
plants	monocots	Poaceae	*Themeda quadrivalvis*	grader grass	Y			3/2
plants	monocots	Pontederiaceae	*Monochoria cyanea*			C		1/1
plants	monocots	Potamogetonaceae	*Potamogeton*			C		1/1
plants	monocots	Typhaceae	*Typha domingensis*			C		1/1
plants	monocots	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*			C		2
plants	monocots	Xyridaceae	*Xyris complanata*	yellow-eye		C		1/1
plants	mosses	Meteoriaceae	*Aerobryopsis longissima*			C		1/1
plants	mosses	Sematophyllaceae	*Sematophyllum subpinnatum*			C		1/1
plants	uncertain	Indet.	*Indet.*			C		1
plants	whisk ferns	Psilotaceae	*Psilotum nudum*	skeleton fork fern		C		2/2
plants		Atherospermataceae	*Doryphora aromatica*			C		1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).
This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Appendix E

EPBC Act Protected Matters Report

Protected Matters Search Tool

You are here: Environment Home > EPBC Act > Search

4 May 2010 11:30

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

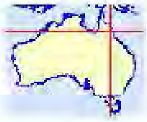
You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Search Type: Point

Buffer: 10 km

Coordinates: -17.16957,145.3898



This map may contain data which are © Commonwealth of Australia (Geoscience Australia) © PSMA Australia Limited

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: (Ramsar Sites)	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	1

Threatened Species:	37
Migratory Species:	19

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Places on the RNE:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Other Commonwealth Reserves:	None
Regional Forest Agreements:	None

Details

Matters of National Environmental Significance

Threatened Ecological Communities [Dataset Information]	Status	Type of Presence
Mabi Forest (Complex Notophyll Vine Forest 5b)	Critically Endangered	Community known to occur within area

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Casuarius casuarius johnsonii Southern Cassowary (Australian), Southern Cassowary	Endangered	Species or species habitat known to occur within area
Erythrotriorchis radiatus Red Goshawk	Vulnerable	Species or species habitat likely to occur within area

Erythrura gouldiae Gouldian Finch	Endangered	Species or species habitat may occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern)	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe	Vulnerable	Species or species habitat may occur within area
Frogs		
Litoria nannotis Waterfall Frog, Torrent Tree Frog	Endangered	Species or species habitat may occur within area
Litoria nyakalensis Mountain Mistfrog	Critically Endangered	Species or species habitat likely to occur within area
Litoria rheocola Common Mistfrog	Endangered	Species or species habitat may occur within area
Nyctimystes dayi Lace-eyed Tree Frog, Australian Lacelid	Endangered	Species or species habitat may occur within area
Pseudophryne covacevichae Magnificent Brood Frog	Vulnerable	Species or species habitat likely to occur within area
Taudactylus acutirostris Sharp-snouted Day Frog, Sharp-snouted Torrent Frog	Extinct	Species or species habitat likely to occur within area
Mammals		
Dasyurus hallucatus Northern Quoll	Endangered	Species or species habitat known to occur within area
Dasyurus maculatus gracilis Spotted-tailed Quoll or Yarri (North Queensland subspecies)	Endangered	Species or species habitat likely to occur within area
Hipposideros semoni Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat	Endangered	Species or species habitat may occur within area
Petaurus australis unnamed subsp. Fluffy Glider, Yellow-bellied Glider (Wet Tropics)	Vulnerable	Species or species habitat likely to occur within area
Pteropus conspicillatus Spectacled Flying-fox	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox	Vulnerable	Species or species habitat may occur within area
Rhinolophus philippinensis (large form) Greater Large-eared Horseshoe Bat	Endangered	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheathtail Bat	Critically Endangered	Species or species habitat may occur within area
Ray-finned fishes		
Melanotaenia eachamensis Lake Eacham Rainbowfish	Endangered	Species or species habitat likely to occur within area
Reptiles		
Egernia rugosa Yakka Skink	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Pristis microdon Freshwater Sawfish	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia guymeri	Vulnerable	Species or species habitat likely to occur within area
Acacia ramiflora	Vulnerable	Species or species habitat may occur within area
Alloxylon flammeum Red Silky Oak, Queensland Waratah, Tree Waratah	Vulnerable	Species or species habitat likely to occur within area

Chamaesyce carissoides	Vulnerable	Species or species habitat likely to occur within area
Cycas platyphylla a cycad	Vulnerable	Species or species habitat likely to occur within area
Dendrobium superbiens Curly Pinks	Vulnerable	Species or species habitat likely to occur within area
Grevillea glossadenia	Vulnerable	Species or species habitat likely to occur within area
Hodgkinsonia frutescens Atherton Turkey Bush	Vulnerable	Species or species habitat likely to occur within area
Huperzia filiformis Rat's Tail Tassel-fern	Endangered	Species or species habitat likely to occur within area
Huperzia marsupiiformis Water Tassel-fern	Vulnerable	Species or species habitat likely to occur within area
Huperzia phlegmarioides Layered Tassel-fern	Vulnerable	Species or species habitat likely to occur within area
Phalaenopsis rosenstromii	Endangered	Species or species habitat likely to occur within area
Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid	Vulnerable	Species or species habitat likely to occur within area
Tropilis callitrophilis Thin Feather Orchid	Vulnerable	Species or species habitat likely to occur within area
Tylophora rupicola	Endangered	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Erythrura gouldiae Gouldian Finch	Migratory	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Hirundo rustica Barn Swallow	Migratory	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Migratory	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Grus antigone Sarus Crane	Migratory	Species or species habitat likely to occur within area

Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose	Migratory	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Migratory Marine Species		
Reptiles		
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile	Migratory	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Anseranas semipalmata Magpie Goose	Listed - overfly marine area	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Hirundo rustica Barn Swallow	Listed - overfly marine area	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Listed - overfly	Breeding likely to occur within area

	marine area	
Mylagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Species or species habitat likely to occur within area
Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose	Listed - overfly marine area	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile	Listed	Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile	Listed	Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;

- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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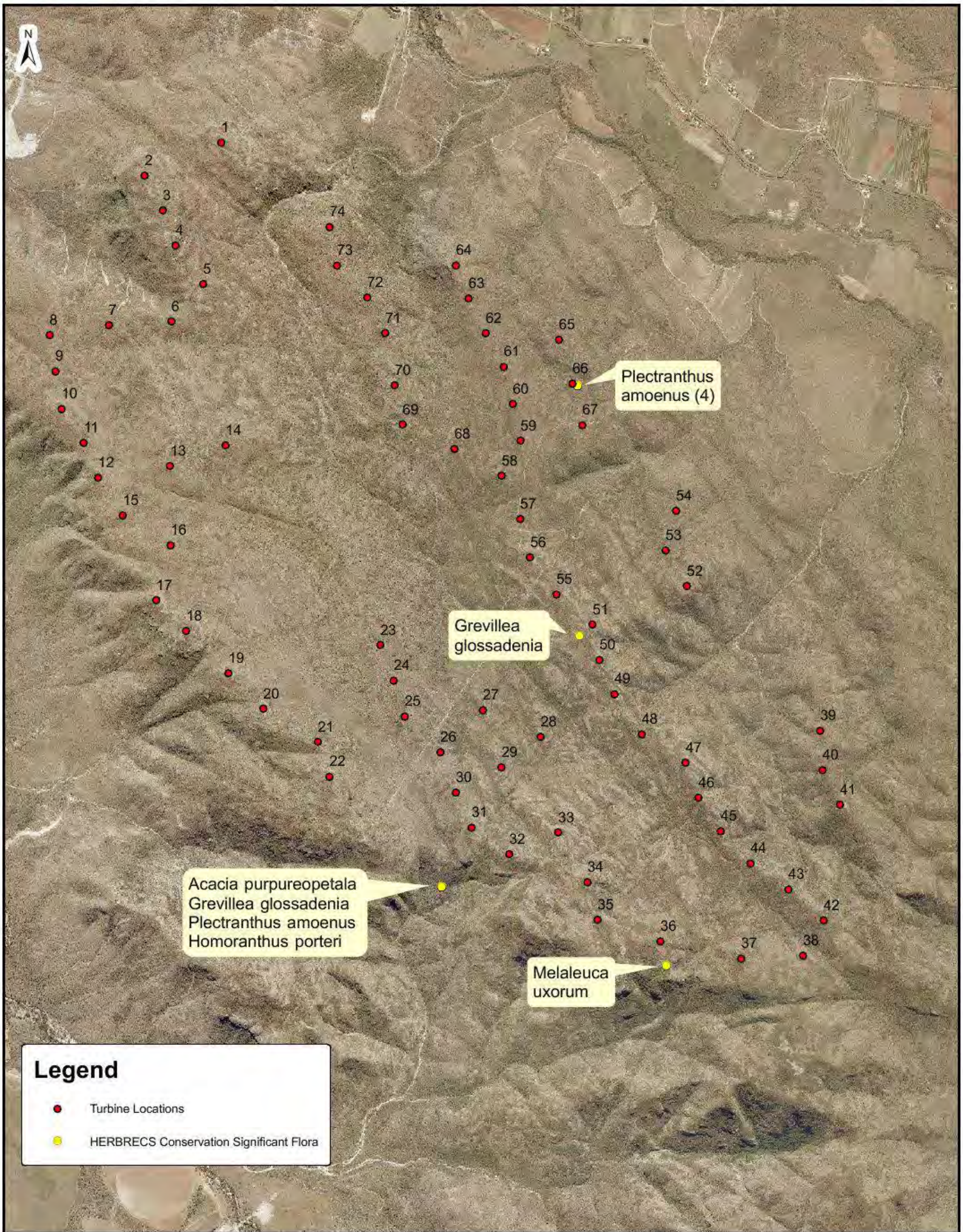
Last updated: Thursday, 20-Nov-2008 14:17:56 EST

Appendix F

HERBRECS – Conservation Significant Plants



Project Manager	D. Finney
Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR100246-7.mxd
Sheet Number	1 of 1
Client	Transfield Services
Title	HERBRECS Conservation Significant Flora
SCALE (A3)	1:25,000
DATE	12/8/2010
DRAWING NO.	PR100246-7
ISSUE	

RPS Australia East Pty Ltd
ACN 140 292 762
135 Abbott St
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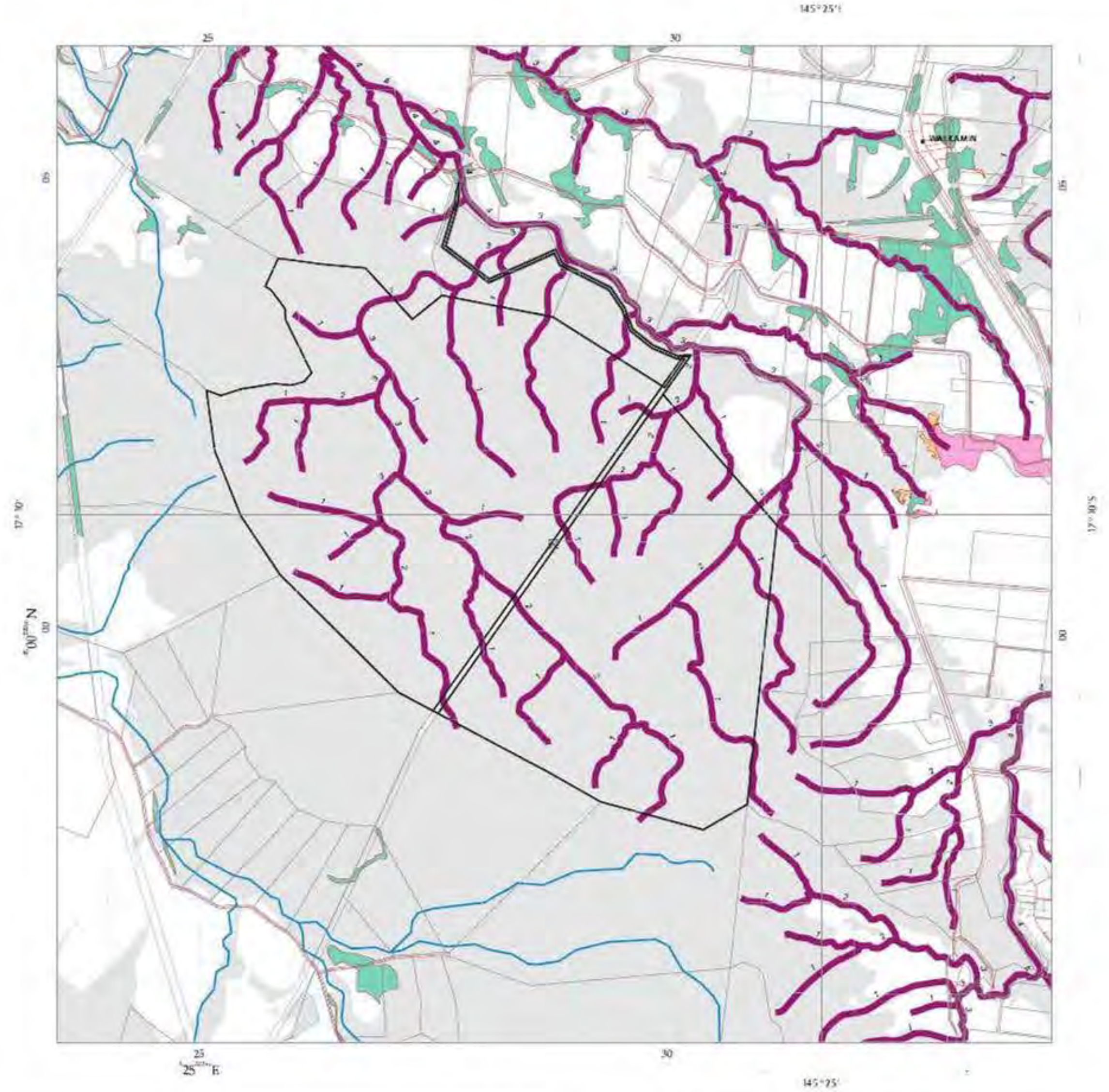
CAIRNS QLD 4870
T +61 7 4031 1336
F +61 7 4031 2942
W rpsgroup.com.au

Appendix G

Regional Vegetation Management Code

Appendix H

Watercourse Mapping



REGROWTH VEGETATION MAP - Version 2.0

- 1087 Vegetation Management Act Essential Regrowth Habitat with example label number
- Great Barrier Reef Wetland Protection Area
- High value regrowth vegetation containing Endangered regional ecosystems
- High value regrowth vegetation containing Of Concern regional ecosystems
- High value regrowth vegetation that is a Least Concern regional ecosystem
- Remnant Vegetation (Refer to the Vegetation Management Act Regional Ecosystem and Remnant Map also available from the Department of Environment and Resource Management website for further information on these areas)
- Non-remnant
- PMAV Category X area
- Regrowth watercourse (Stream order shown as black number against stream)
- Other watercourse(Stream order shown as black number against stream where available)
- Subject Lot
- Roads © MapInfo Australia Pty Ltd 2009
- Cadastral line The maximum spatial error of parcels extracted for this map from the Digital Cadastral Data Base(DCDB) range from: 14m to 251m at a 95% confidence level. Property boundaries shown are provided as a locational aid only.
- Towns
- Coordinate entered

Requested By: LYNDALL.HARVEY@RPSGROUP.COM.AU
Date: 07 Sep 10 Time: 09.30.56

Centered on point position:
Latitude: -17.1696 Longitude: 145.3898 (decimal degrees)

Queensland Government

LOCALITY DIAGRAM

1000 0 1000 m

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

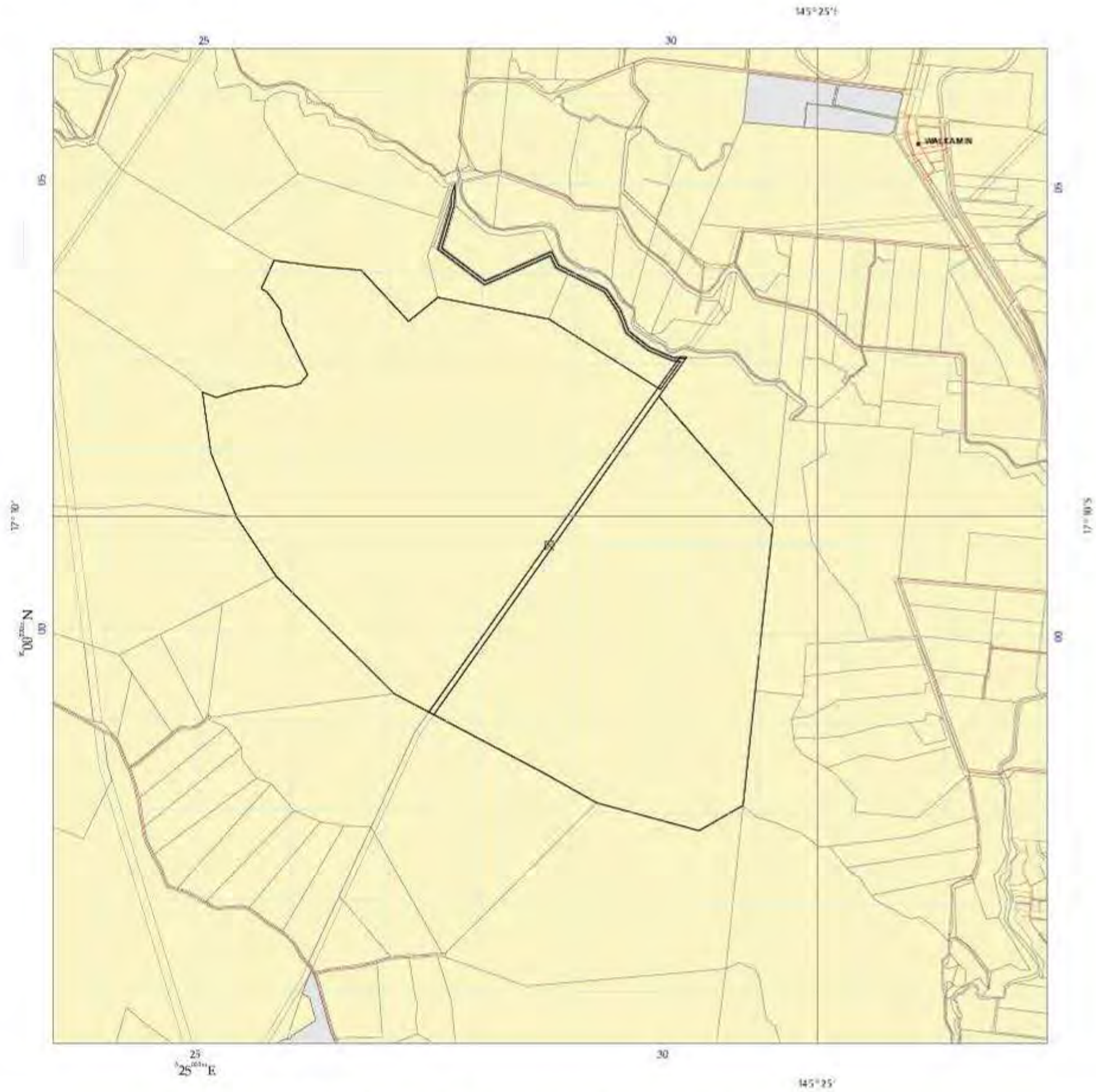
Labels for Vegetation Management Act Essential Regrowth Habitat are centred on the subject lot.
Labels correlate to the label field in the attached essential regrowth habitat database.

The high value regrowth, regrowth watercourse, other watercourse, Great Barrier Reef wetland protection area and essential regrowth habitat data shown on this map are representations of the preliminary data.

Some watercourse lines are derived from GeoScience Australia 1:250 000 mapping.

For further information go to the website: http://www.derm.qld.gov.au or contact Vegetation Management, Department of Environment and Resource Management.

Areas covered by a Property Map of Assessable Vegetation (PMAV) are represented on the map attached as Page 2 to this Regrowth Vegetation Map and provided with it.



Property Maps of Assessable Vegetation (PMAVs)

Requested By: LYNDALL.HARVEY@RPSGROUP.COM.AU
Date: 07 Sep 10 Time: 09.30.58

Centered on point position:
Latitude: -17.1696 Longitude: 145.3898 (decimal degrees)

The PMAV data shown on this map are a representation of the data used to create certified PMAVs. Variations may occur between PMAV boundaries and cadastral boundaries. PMAV data incorporates cadastral boundary data as at the time of certification of the PMAV. The cadastral boundaries shown on this map may have shifted relative to the PMAV boundaries as more accurate cadastral boundary data have become available.

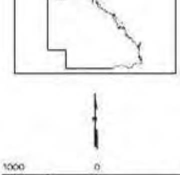
All datasets are updated as they become available to provide the most current information as of the date shown on this map.

For further information go to the website:
http://www.derm.qld.gov.au/vegetation/index.html
or contact Vegetation Management, Department of Environment and Resource Management.

Property Map of Assessable Vegetation
Vegetation Category Area

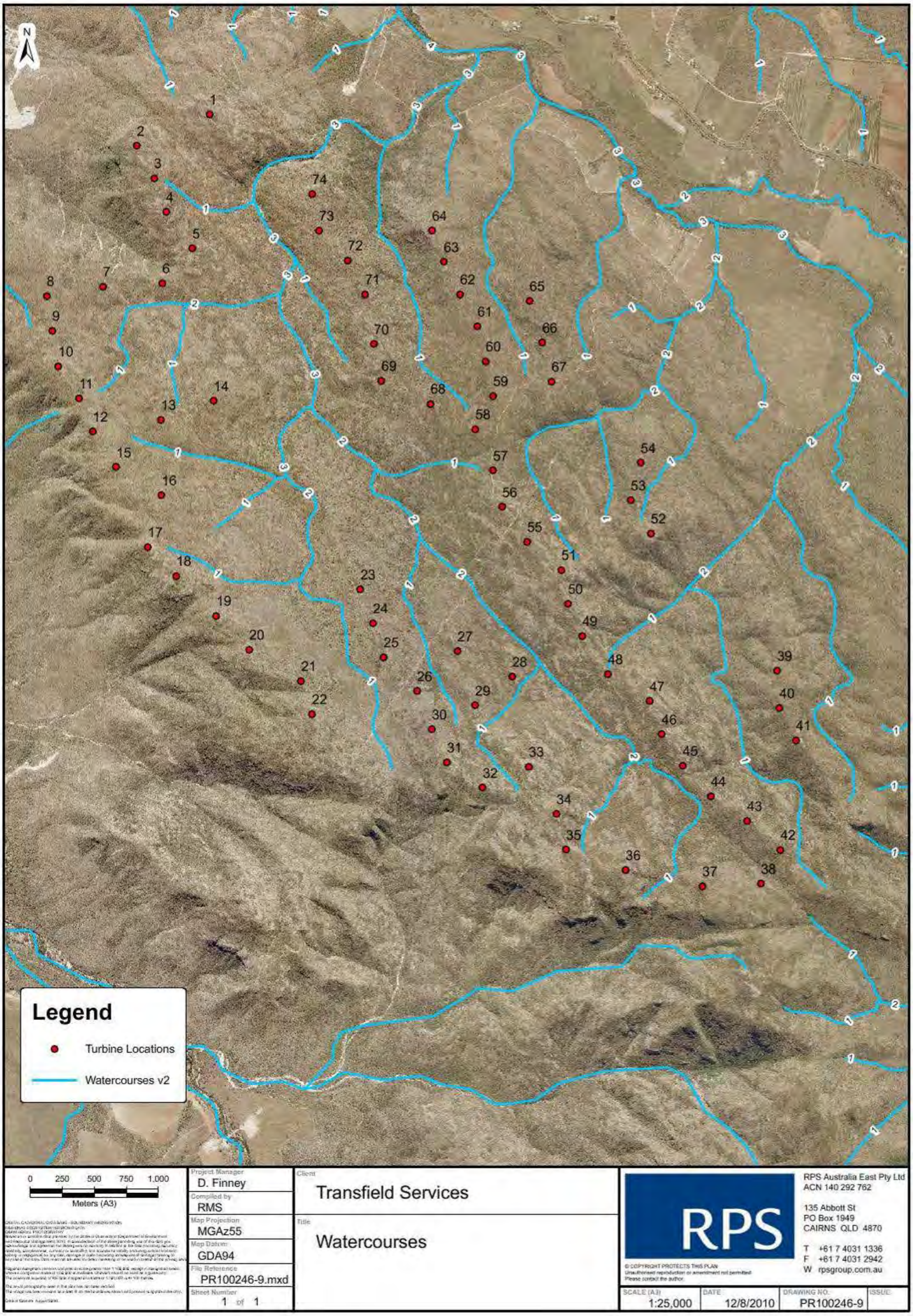
- Category A area
- Category B area
- Category C area
- Category X area
- Area that is subject to other PMAVs or, if no PMAV exists, a regional ecosystem map, remnant map or regrowth vegetation map
- Subject Lot
- Roads
  © MapInfo Australia Pty Ltd 2009
- Cadastral line
  The maximum spatial error of parcels extracted for this map from the Digital Cadastral Data Base(DCDB) range from: 14m to 251m at a 95% confidence level. Property boundaries shown are provided as a locational aid only.
- Towns
- Coordinate entered

Queensland Government



1000 0 1000 m

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)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Turbine Locations
Watercourses v2
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Meters (A3)
Project Manager
D. Finney
Compiled by
RMS
Map Projection
MGAz55
Map Datum
GDA94
File Reference
PR100246-9.mxd
Sheet Number
1 of 1
Client
Transfield Services
Title
Watercourses
RPS
RPS Australia East Pty Ltd
ACN 140 292 762
135 Abbott St
PO Box 1949
CAIRNS QLD 4870
T +61 7 4031 1336
F +61 7 4031 2942
W rpsgroup.com.au
SCALE (A3)
1:25,000
DATE
12/8/2010
DRAWING NO.
PR100246-9
ISSUE

Appendix I

Summary of Weather Conditions

Date	Day	Temperature (°c)		Rainfall (mm)	Humidity (%)	Wind Speed (km/hr)	Wind Direction	Comments
		Min	Max					
10/5/10	Monday	16.6	25.9	0.2	79	*13	SE	Hot, dry and sunny during the day. Breezy during the day at the creek camp site, increasing to very windy over night. Some cloud forming at dusk, but clearing to fine by 1845 hours.
11/5/10	Tuesday	17.3	26.0	0	76	*15	ESE	Fine, hot and dry during the day, with some light sirus clouds ($^{2}/_{8}$ cloud cover) developing around 0900 hours. Very windy all day, increasing wind speed over night. Cool night.
12/5/10	Wednesday	17.7	24.7	0	74	*19	SE	Very windy all day, with high, fast moving cloud ($^{3}/_{8}$ cloud cover) early morning, and some low, cumulus clouds developing by 0930 hours ($^{5}/_{8}$ cloud cover). Wind dropped in the late afternoon (approximately 1700 hours, but picked up again at approximately 1845 hours and very windy overnight. Heavy rain clouds developing by 1200 hours, and rain could be observed in the surrounding areas, with only a light drizzle falling on the site. Clearing to fine by 1845 hours.
13/5/10	Thursday	17.2	24.5	0	77	*11	SE	Very windy all day. Hot and dry, with some heavy rain clouds forming by approximately 1500 hours. Some rain overnight, falling between 2000 hours and 2200 hours. Very windy overnight.
14/5/10	Friday	16.7	25.5	4.0	73	*11	SE	Very windy all day. Hot, fine and sunny with some cloud cover developing by 0930 hours ($^{3}/_{8}$).

Source: Australian Government Bureau of Meteorology, Walkamin Queensland, May 2010 Daily Weather Observations

* Note: Wind speed observations obtained from the Walkamin Weather Station do not provide an accurate wind speed for the subject site, located at higher elevation on the plateau near the Walkamin Township.

Appendix J

Provisional Checklist of Flora

Appendix K

Summary of Fauna Survey Effort

Site (Turbine) Number	Survey Activity								Notes
	Pitfall traps	Elliott traps	Funnel traps	Harp trap	Anabat call recording	Spotlight	*Bird Survey	**Habitat Searches	
17	✓	✓				✓	✓	✓	
20	✓	✓				✓	✓	✓	
21							✓	✓	
22							✓	✓	
South 22							✓	✓	
Far South 22							✓	✓	
24							✓	✓	
25							✓	✓	
42							✓	✓	
43							✓	✓	
44							✓	✓	
45							✓	✓	
46							✓	✓	
47							✓	✓	
48							✓		Snapshot survey during brief walk through (restricted access to site)
49							✓		Snapshot survey during brief walk through (restricted access to site)
50						✓			Snapshot survey during brief walk through (restricted access to site)
51						✓			
55						✓			
56		✓				✓	✓	✓	
57		✓				✓	✓	✓	
67		✓				✓	✓	✓	
Granite Creek	✓	✓		✓	✓		✓	✓	
Creek Line on Power Line Access Track			✓						

* Minimum 45 minutes of bird surveys conducted at each site
** Minimum 45 minutes of habitat searches conducted at each site

Appendix L

Provisional Checklist of Fauna

Species	Common Name	Conservation status		Location of Observation																				
		EPBC	NCA	Granite Ck	17	20	21	22	South 22	Far south 22	24	25	42	43	44	45	46	47	48	49	50	56	57	67
REPTILES																								
Oedura coggeri	Northern Spotted Velvet Gecko			✓			✓	✓																
Gehyra nana	Spotted Gecko							✓																
Heteronotia binoei	Bynoe's Gecko												✓	✓	✓	✓	✓							
Carlia jarnoldae	Lined Rainbow Skink						✓	✓	✓						✓									
Carlia longipes	Rainbow Skink													✓	✓	✓								
Carlia munda	Rainbow Skink												✓			✓	✓							
Carlia mundivensis	Rainbow Skink			✓			✓			✓														
Carlia pectoralis	Open Litter Rainbow Skink			✓					✓						✓									
Ctenotus taeniolatus	Copper-tailed Skink			✓									✓	✓		✓								
Diporiphora australis	Tommy Roundhead Dragon			✓	✓											✓								
Cryptophis nigrostriatus	Black-striped Snake			✓																				
Tropidonophis mairii	Keelback			✓																				
AMPHIBIANS																								
Chaunus marinus syn. Bufo	Cane Toad		I	✓	✓	✓	✓	✓	✓				✓									✓	✓	✓
Litoria caerulea	Green Tree Frog			✓																	✓			
Litoria inermis	Bumpy Rocketfrog			✓	✓																			
Litoria latopalmata	Broad-palmed Frog			✓									✓											
Litoria lesueuri	Stony Creek Frog			✓																				
Litoria rubella	Naked Tree Frog			✓																				
Litoria nasuta	Striped Rocketfrog			✓				✓																
BIRDS																								
Unknown	Goshawk species			✓																				
Milvus migrans	Black Kite																							
Accipiter	Collared			✓																				

Species	Common Name	Conservation status		Location of Observation																				
		EPBC	NCA	Granite Ck	17	20	21	22	South 22	Far south 22	24	25	42	43	44	45	46	47	48	49	50	56	57	67
cirrocephalus	Sparrowhawk																							
Aquila audax	Wedge-tailed Eagle			✓			✓	✓							✓									
Falco cenchroides	Nankeen Kestrel						✓																	
Geopelia striata	Peaceful Dove			✓	✓	✓						✓										✓	✓	
Calyptorhynchus banksii	Red-tailed Black Cockatoo			✓		✓																		
Platycercus adscitus	Pale-headed Rosella			✓	✓	✓		✓	✓	✓		✓			✓	✓	✓							✓
Dacelo novaeguineae	Laughing Kookaburra			✓		✓	✓					✓												
Merops ornatus	Rainbow Bee-eater			✓	✓										✓	✓								
Pardalotus striatus	Striated pardalote			✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓				✓		
Acanthiza nana	Yellow Thornbill			✓																				
Philemon corniculatus	Noisy Friarbird			✓						✓														✓
Lichmera indistincta	Brown Honeyeater			✓	✓	✓	✓	✓	✓	✓	✓	✓			✓							✓	✓	✓
Oreoica gutturalis	Crested Bellbird						✓	✓	✓	✓			✓	✓	✓	✓								
Pachycephala rufiventris	Rufous Whistler														✓									
Rhipidura leucophrys	Willie Wagtail			✓	✓																			
Rhipidura albiscarpa	Grey Fantail			✓	✓						✓	✓												
Cracticus torquatus	Grey Butcherbird								✓	✓														
Cracticus nigrogularis	Pied Butcherbird							✓	✓	✓														
Grallina cyanoleuca	Magpie-lark			✓																				
Gymnorhina tibicen	Australian Magpie			✓	✓		✓	✓	✓	✓												✓	✓	
Strepera graculina	Pied Currawong			✓	✓	✓	✓			✓		✓	✓		✓				✓					
Corvus orru	Torresian Crow			✓	✓																			

Species	Common Name	Conservation status		Location of Observation																				
		EPBC	NCA	Granite Ck	17	20	21	22	South 22	Far south 22	24	25	42	43	44	45	46	47	48	49	50	56	57	67
Dicaeum hirundinaceum	Mistletoebird														✓	✓								
MAMMALS - TERRESTRIAL																								
Tachyglossus aculeatus	Short-beaked Echidna			✓	✓			✓				✓		✓	✓	✓	✓	✓						✓
Petrogale mareeba	*Mareeba Rock-wallaby		NT			✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓			✓	✓	✓
Equus caballus	**Horse		I	✓																				
MAMMALS - MICROBATS																								
Hipposideros diadema	Diadem's Leafnosed bat		NT	✓																				
Scotorepens sanborni	Northern Broad-nosed Bat			✓																				
Vespadelus troughtoni	Eastern Cave Bat			✓																				
Miniopterus australis	Little Bent-wing Bat			✓																				
Miniopterus orianae oceanensis	Eastern Bent-wing Bat			✓																				
Austronomus australis	White-striped Freetail Bat			✓																				
Chaerephon jobensis	Northern Freetail Bat			✓																				
Mormopterus ridei	Eastern Freetail Bat			✓																				
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat			✓																				
Chalinolobus nigrogriseus^{UC}	Hoary Wattled Bat			✓																				

* Unidentifiable scats collected from rocky ridge tops. No visual identification possible during this survey. Suspected Mareeba rock-wallaby based on habitat and current known distribution of species.

** Scats collected and tracks recorded, however, no visual observations were made during this survey.

UC Unconfirmed recording

CE: Critically Endangered; E: Endangered; V: Vulnerable; NT: Near Threatened; I: Introduced

Appendix M

Anabat Analysis

Anabat echolocation data interpretation summary

Client: RPS (Cairns/Townsville) **Job no.:** RPS-1002 **Analysis Date:** 11/06/2010

Project name/location: Arriga Palteau (May 2010 Survey)

Numbers in columns represent number of calls attributed to each species or species group

Species	10-May	11-May	12-May	13-May	Total calls for species
Calls positively identified					
Hipposideros diadema			1		1
Scotorepens sanborni	3				3
Vespadelus troughtoni	1				1
Miniopterus australis	5		1	4	10
Miniopterus orianae oceanensis	20	3	13	21	57
Austronomus australis	1		4		5
Chaerephon jobensis	1				1
Mormopterus ridei				2	2
Saccolaimus flaviventris	1				1
Total calls positively identified	32	3	19	27	81
Calls NOT positively identified					
Chalinolobus nigrogriseus / S. sanborni	1				1
S. flaviventris / C. jobensis	2	1		2	5
unknown bat call	24	1	4	13	42
Total calls NOT positively identified	88	8	41	69	206
Total calls for night	59	5	23	42	129

Species nomenclature:

Species names used in this summary follow Churchill (2008).

Call identification & reporting standard:

Call identification was based on published call descriptions for southern Queensland (Reinhold *et al* 2001) and the Northern Territory (Milne 2002) and on reference calls collected from central and northern Qld.

Determination of species' identification was further refined by considering probability of occurrence based on distributional information presented in Churchill (2008) and van Dyck & Strahan (2008).

The format and content of this report complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon 2003); latest version available from the Australasian Bat Society on-line at http://www.ausbats.org.au/.

Notes to the table - discussion of species/groups with low reliability of identification

Chalinolobus nigrogriseus / S. sanborni	calls are at similar frequencies; usually differentiated on slightly different pulse shapes but one call form this survey with intermediate shape and could have been either species
S. flaviventris / C. jobensis	call frequency overlaps; usually have different pulse shapes but a few brief calls could have been either species
Unknown calls	these are calls that were too brief, weak or noisy to enable reliable species identification; they represent species already listed above, not additional species

References:

Churchill, S. (2008). *Australian Bats* . Jacana Books, Allen & Unwin; Sydney.

Milne, D.J. (2002). *Key to the Bat Calls of the Top End of the Northern Territory* . Technical Report No. 71, Parks and Wildlife Commission of the Northern Territory, Darwin.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales.* Department of Natural Resources and Mines, Brisbane.

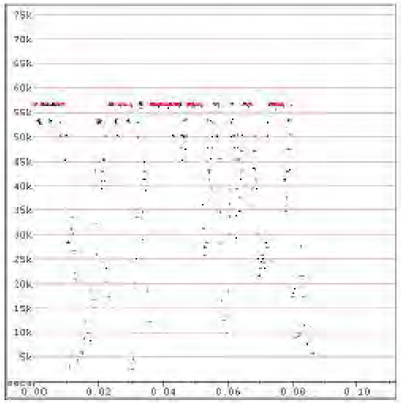
van Dyck, S. and Strahan, R. (ed.) (2008). *The Mammals of Australia* (Third Edition); New Holland; Sydney.

Anabat Data Analysis Summary

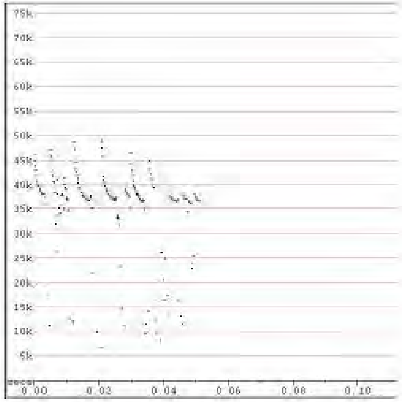
Sample calls extracted from theArriga Plateau survey data (RPS Townsville; May 2010)

Scale: 10 msec per tick; time between pulses removed (*AnalookW* F7 compressed mode)

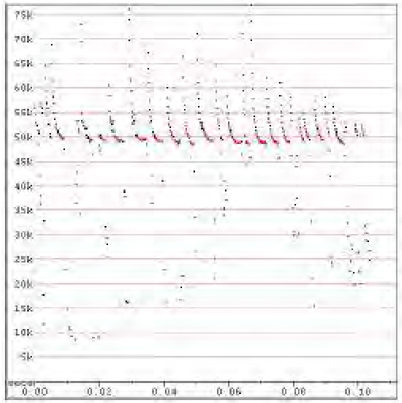
Species positively identified



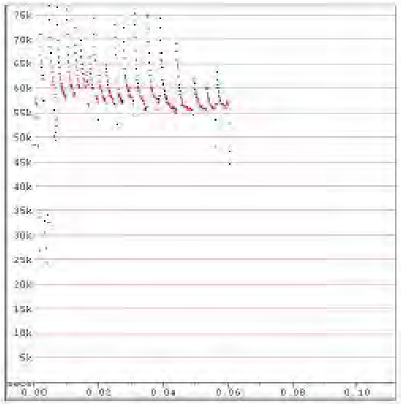
Hipposideros diadema



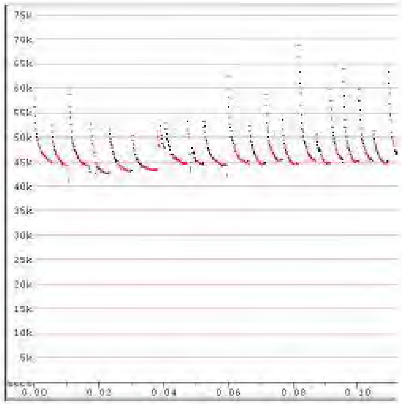
Scotorepens sanborni



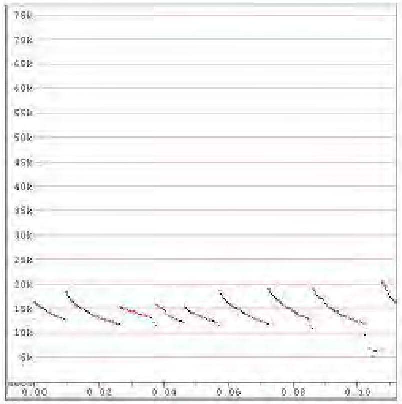
Vespadelus troughtoni



Miniopterus australis



Miniopterus orianae oceanensis



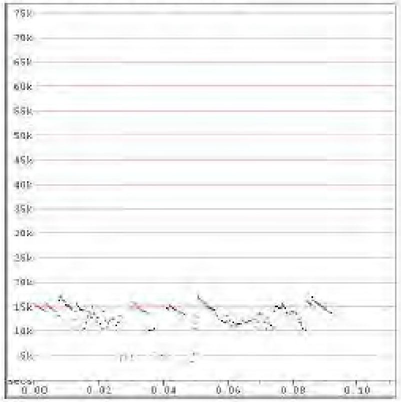
Austronomus australis

Anabat Data Analysis Summary

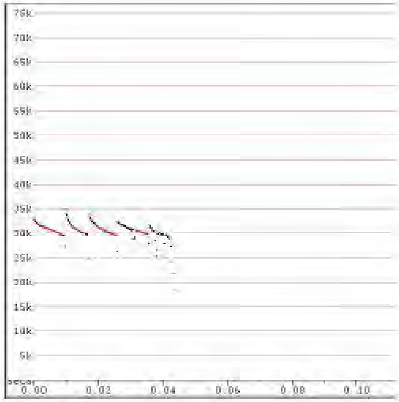
Sample calls extracted from theArriga Plateau survey data (RPS Townsville; May 2010)

Scale: 10 msec per tick; time between pulses removed (*AnalookW* F7 compressed mode)

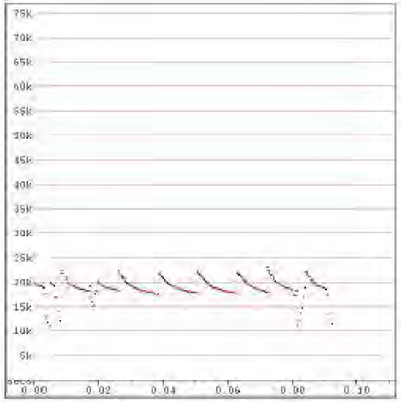
Species positively identified



Chaerephon jobensis

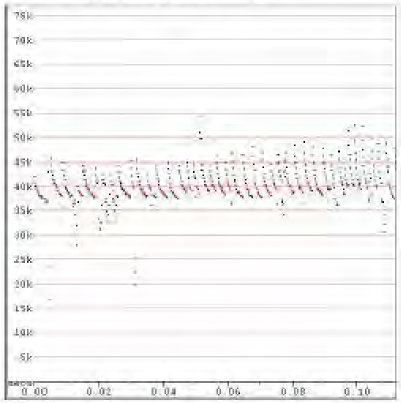


Mormopterus ridei

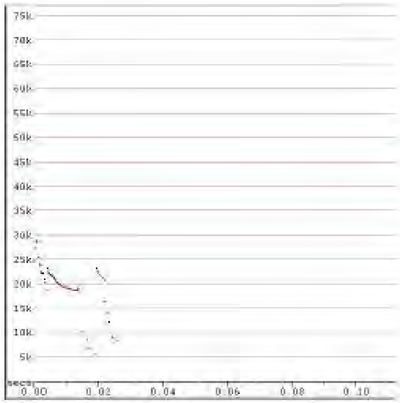


Saccolaimus flaviventris

Calls NOT positively identified



Chalinolobus nigrogriseus / S. sanborni



S. flaviventris / C. jobensis

Prepared by Greg Ford
11/06/2010

balance
PO Box 1744, Toowoomba Qld 4350

Appendix 14

Mount Emerald Wind Farm – Threatened Fauna Species Desktop Assessment (October 2013)

Prepared by RPS

Mount Emerald Wind Farm

Threatened Fauna Species Desktop Assessment

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Report Number: PR100246
Version / Date: V2.0 / October 2013

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1.0	Draft Threatened Species Desktop Assessment	G. Calvert	J. Middleton	03/10/2013
2.0	Final Threatened species desktop assessment	G. Calvert	J. Middleton	03/10/2013

Approval for Issue

Name	Signature	Date
G. Calvert		03/10/2013

Contents

Tables

1.0 Introduction

Under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), actions that have, or are likely to have, a significant impact on a Matter of National Environmental Significance (MNES) require approval from the Australian Government Minister for Sustainability, Environment, Water, Population and Communities (the minister). As identified in Chapter 1, a delegate of the Minister determined that the proposed development was a controlled action under the provision of the EPBC Act as the action has the potential to have a significant impact on a number of MNES and therefore required an EIS before approval could be considered.

The controlling provisions for the proposal under the EPBC Act are:

(a) Listed threatened species and ecological communities;

(b) Listed migratory species;

(c) World Heritage Properties; and

(d) National Heritage Places.

This report assesses the likelihood of occurrence of listed threatened and migratory fauna species on a 2,422ha rural property on the northern end of the Herberton Range, described as Lot 7 on SP235244, and is referred to hereafter in this report as ‘Mt Emerald’. The establishment of a wind farm is proposed for the site by Mt Emerald Wind Farm Pty Ltd.

This report is produced as a supplement to a preliminary flora and fauna assessment (RPS 2012), which included both desktop and extensive field surveys.

2.0 Threatened Species Ecological Assessments

The EPBC Protected Matters Search Tool and Queensland Department of Environment and Heritage Protection Wildlife Online Database (DEHP 2013a) returned a total of 35 threatened fauna species as being known to occur or having the potential to occur within a 10 km of the centroid of the project area (-17.166736, 145.386955).

This EPBC Protected Matters database is a predictive model that identifies all species that could potentially occur or suitable habitat for threatened species that could potentially occur within a given radius of the site. It applies a range of bio-models to predict the presence of those species and does not necessarily mean the species has been previously recorded in the area. This tool only predicts species listed as threatened or migratory under the EPBC Act, and does not predict species listed as Threatened under state legislation only.

The information used to produce the Wildlife Online lists is based on collated species lists and wildlife records acquired by the department through a range of sources including;

- Specimen collections;
- Research and monitoring programs;
- Inventory programs including extension activities;
- Literature records;
- Wildlife permit returns; and
- Community wildlife recording programs.

Two fauna species were added to these assessments that were not predicted to occur by either fauna database. The Buff-breasted Button Quail was not included in the EPBC Protected Matters Search Tool, but is considered as potentially occurring within the site, based on the presence of suitable habitat in open *Eucalyptus* woodland and known records from nearby Mareeba and Mt Molloy. The ‘Near-threatened’ Diadem Horseshoe Bat was not predicted using the EPBC Protected Matters Search Tool as it has no threatened species status under the EPBC, and there were no nearby records that had been incorporated into the Wildlife Online database. However, this species was recorded on the subject site during field surveys.

To assist in assessing the likelihood of occurrence, locations of fauna sightings and museum records were obtained from the Atlas of Living Australia, Qld Museum fauna record databases and previous studies undertaken on the site (RPS 2012). Likelihood of occurrence was determined for the species utilising the site for any purpose, including overflying. The site has a number of wetlands in proximity, and several wetland species (e.g. Little pied cormorants, Darters, Australian pelicans, unidentified ducks, Little black cormorants) have been observed overflying, but not actually utilising any habitats within the subject site.

Of the 37 species assessed for likelihood of occurrence in **Table 1** below, 15 species are not considered likely to occur on the site due to the lack of suitable habitats: principally closed rainforest, wet sclerophyll forest, permanent wetlands or streams. An additional five species, the Squatter Pigeon, Eastern Bristlebird, Star finch (eastern), Northern Bettong, Grey-headed Flying-fox, and Brush-tailed Rabbit Rat are also considered unlikely to occur on the site given knowledge of their known current distributions. Thirteen species are considered to have a ‘Moderate’ likelihood of occurrence either due to the presence of suitable habitat or likelihood of overflying, but no positive sightings during field investigations. Of the EPBC-listed fauna, three threatened species, the Northern Quoll (*Dasyurus hallucatus*), Spectacled Flying-fox (*Pteropus conspicillatus*) and Bare-rumped Sheathtail (*Saccolaimus saccolaimus nudiclatus*) bat were positively confirmed during the field surveys along with the NCA listed Diadem Horseshoe Bat (*Hipposideros diadema reginae)*

Table 1 Threatened Fauna and Flora Known To Occur or Having The Potential To Occur On The Site

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
FISH					
Lake Eacham Rainbowfish	*Melanotaenia eachamensis*	C, E	This small freshwater fish prefers small streams and lakes, but has disappeared from much of its former range. It is now restricted to the headwaters of the Johnstone, Tully and Barron Rivers above an altitude of 500m (Curtis *et al* 2012).	**LOW:** The site is in the Barron River catchment and is above 500m elevation but the site does not contain permanent streams or lakes.	Yes
Freshwater Sawfish	*Pristis microdon*	C, V	This large fish species inhabits sandy or muddy bottoms of shallow coastal waters, estuaries, river mouths, freshwater rivers and isolated water holes (Curtis *et al* 2012).	**LOW:** The site does not contain the preferred habitat of this species. There are no permanent streams on the site and is a significant distance and elevation from suitable coastal environments.	No
FROGS					
Waterfall Frog	*Litoria nannotis*	E, E	This species is patchily distributed across the Wet tropics of north-eastern Queensland across an altitudinal range of 100-1,300m. It inhabits fast flowing streams in rainforest and adjacent sclerophyll forest (Hoskin & Hero 2008).	**LOW:** The site does not contain the preferred habitat of this species. There are no permanent streams, rainforest or wet sclerophyll vegetation communities on the site.	No
Mountain Mist Frog	*Litoria nyakalensis*	E, CE	This frog species has not been recorded since 1990; however, there is still insufficient data to list it as extinct. Suitable habitat is considered to be fast flowing streams in rainforest and wet sclerophyll, where they were found near riffles or cascade (Hoskin & Hero 2008).	**LOW:** The site does not contain the preferred habitat of this species. There are no permanent streams, rainforest or wet sclerophyll vegetation communities on the site.	No
Common Mist Frog	*Litoria rheocola*	E, E	The Common mist frog occurs from Broadwater Creek National Park (north of Ingham) to Amos Bay (south of Cooktown) in northern Queensland, at altitudes between 0 and 1,180m above sea level. The species is restricted to fast flowing rocky creeks and streams in rainforest or wet sclerophyll forest (SEWPaC 2012a).	**LOW:** The site does not contain the preferred habitat of this species. There are no permanent streams, rainforest or wet sclerophyll vegetation communities on the site	No
Australian Lacelid	*Nyctimystes dayi*	E, E	The Lace-eyed tree frog occurs throughout the Wet Tropics Bioregion from Paluma to Cooktown, at altitudes between 0 and 1,200m. It is associated with rainforests and rainforest margins. At low elevations, the Lace-eyed Tree Frog favours rock soaks, narrow ephemeral streams and rock	**LOW:** The site does not contain the preferred habitat of this species. There are no permanent streams or rainforest communities on the site	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			outcrops in larger watercourses (SEWPaC 2012b).		
Magnificent Brood Frog	*Psuedophryne covacevichae*	V, V	Populations of this brightly coloured frog are known from a small area 27km by 9km near Millstream Falls, Ravenshoe (McDonald *et al*. 2000), in open eucalypt woodlands with grassy understoreys (Curtis *et al* 2012). Known locations are on acid volcanic and granitic hills above 800m. Adults have mostly been located in seepage areas however dry season habitat use, movement patterns, and habitat use by tadpoles and metamorphs is unknown (McDonald *et al*. 2000). Museum records are known from vegetation contiguous and within 50km of the Mt Emerald.	**MODERATE:** Although this species is not known not known from outside current distribution near Millstream Falls, areas of *Xanthorrhoea/ Themeda triandra* understory habitats at Mt Emerald fit the broad habitat description but extent of seepage areas is unknown. The current limited distribution size may be an artefact of low sampling effort across its potential range.	No
REPTILES					
Salt-water Crocodile, Estuarine Crocodile	*Crocodylus porosus*	V,-	The Estuarine crocodile inhabits coastal rivers and swamps and extends inland along major drainage systems. It is also occasionally observed in the open ocean (Wilson & Swan 2010).	**LOW:** The site does not contain the preferred habitat of this species. There are no permanent streams or deep waterholes necessary for this species.	No
Common death adder	*Acanthophis antarcticus*	NT, -	This is a relatively short, squat elapid snake found in a broad range of vegetation types including rainforest, woodland and grassland, but in association with deep leaf litter (DEHP 2013). Refuge within suitable habitat includes fallen logs, leaf litter and rocks (DEHP 2013). It should be noted that the taxonomy of this species is poorly known with some known populations possibly being the 'Least-Concern' Northern Death adder *A. praelongus* (Pers.comm. Keith McDonald).	**MODERATE**. Mt Emerald is within the currently accepted range for this species and its broad tolerance to vegetation types would not exclude it from here. They are very difficult to detect in low abundances but if present on site may occur in fire-protected areas where leaf litter is able to accumulate. Other microhabitat potentially suitable as daytime refuges includes fallen timber, exfoliating rock slabs and boulder piles.	Yes
BIRDS					
Southern Cassowary	*Casuarius casuarius johnsonii*	E, E	This large and conspicuous bird generally requires dense tropical rainforest (such as complex/non-complex notophyll/ mesophyll vine forest) and associated habitat (such as mangrove Melaleuca, eucalypt woodland, swamp and swamp forest), that provides a year-round supply of fleshy fruit (SEWPaC 2012c).	**LOW:** The site does not contain the preferred habitat of this species. None of the Regional Ecosystem types listed as Essential Habitat factors for this species occur on site.	No
Australian Cotton Pygmy-goose	*Nettapus coromandelianu*	NT,-	Normally found on permanent water such as deeper freshwater swamps, lagoons, and dams with water lilies and other semi-emergent water plants (Pizzey & Knight,	**MODERATE**: No suitable habitat (permanent water) is present on the subject site and unlikely to utilise small ephemeral water	Yes

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
	s albipennis		2007). Although often seen in pairs or small groups, they congregate in larger flocks on permanent water-bodies during the dry season.	bodies. However, the species may fly over site at rotor height between suitable nearby water bodies.	
square-tailed kite	*Lophoictinia isura*	NT, -	The Square-tailed Kite typically inhabits the coastal forested and wooded lands of tropical and temperate Australia (Marchant & Higgins 1993). The species occupies a broad range of habitats including heathlands, woodlands, forests, tropical rainforests, timbered watercourses, hills and gorges (Pizzey & Knight 2007). Wildnet records indicate that this species has been sighted within 10km of the site.	**MODERATE**. Mt Emerald is within the currently accepted range for this species and vegetation communities are within the broad range of habitats used by this species. No breeding places have been recorded.	Yes
Red Goshawk	*Erythrotriorchis radiatus*	E, V	The Red goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia (Marchant & Higgins 1993). It nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within 1km of permanent water. Habitat must be open enough for fast attack and manoeuvring in flight, but provide cover for ambushing of prey. Therefore, forests of intermediate density are favoured, or ecotones between habitats of differing densities, such as between rainforest and eucalypt forest, between gallery forest and woodland, or on edges of woodland and forest where they meet grassland, cleared land, roads or watercourses (SEWPAC 2012d).	**MODERATE.** There is potential for this species to fly over and utilise the site for foraging from time to time. However, no nests or suitable nesting sites were identified during the field investigations, so breeding places are unlikely to exist.	Yes
grey goshawk	*Accipiter novaehollandiae*	NT, -	The Grey goshawk generally favours tall, wet forests, particularly in gullies, for roosting and hunting. It depends on mature forests for breeding, rarely using forest regrowth less than 30 years old (Marchant & Higgins 1993). The Grey goshawk is an opportunistic hunter preying mostly on mammals, such as rabbits, possums and sometimes bats. They also prey on birds, reptiles and insects and hunt from either concealed or exposed perches and often take prey both in flight and on the ground.	**LOW - MODERATE**: The site does not contain the preferred habitat of this species, particularly tall, mature wet forests. There is potential for this species to fly over and utilise the site for foraging from time to time. No breeding places are likely to exist.	Yes
Buff-breasted Button Quail	*Turnix olivii*	V, E	This ground-dwelling bird is most often recorded from stony and/or grassy woodlands and forest with a mid-storey of *Melaleuca viridiflora* or *M. minutifolia*, but is known to use sparsely wooded, well-drained bases of hills during the breeding season (Curtis *et al.* 2012). Rarely seen,	**MODERATE**: Suitable habitat is potentially widespread on the subject site, however, based on limited habitat records for this species, open woodland areas with a grassy understorey and a mid storey on *Melaleuca*	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			however, there are a number of recorded observations from the Lake Mitchell/ Big Mitchell Creek area north of Mareeba.	*monantha* and/or *M. viridiflora* may represent the most likely habitat.	
Australian Painted Snipe	*Rostratula australis*	V, V	The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (SEWPAC 2012e). Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire. Although there are records from within 30km of the subject area centroid, this species is only rarely observed and the region is not considered to be important for it.	**LOW**: The subject site does not contain the preferred habitat of this species, particularly vegetated wetland habitats. They are unlikely to utilise the small ephemeral water bodies present during the wet season. No breeding places are likely to exist and they are only rarely observed in the broader region.	No
Squatter Pigeon (southern)	*Geophaps scripta scripta*	V, V	The Squatter pigeon (southern) occurs mainly in dry grassy eucalypt woodlands and open forests, mostly in sandy sites near permanent water (Curtis *et al.* 2012). It has also been recorded in highly modified grassland environments and remains common in heavily-grazed country (Curtis *et al* 2012). It is almost always found close to bodies of water (SEWPaC 2012f). The threatened southern subspecies occurs as far north as Townsville, where it is generally found in drier areas or where there are large expanses of thinly wooded grassland.	**LOW:** The subject site occurs well outside the recognised range of the threatened southern subspecies. One individual (northern race) was sighted in the vicinity of turbine #11 in Jan 2013. It is presumed that incursions for foraging are made during the wet season when there is standing water available since there are no suitable permanent water bodies to facilitate a dry season presence. Not present in 2011 EPBC Search.	Yes (northern)
Macleay's fig-parrot	*Cyclopsitta diophthalma macleayana*	V, -	This small frugivorous parrot prefers rainforest, semi-deciduous vine forest and gallery forest that include *Ficus* spp, from lowland habitats to 1200m elevation (Curtis *et al.* 2012).	**LOW**: The subject site does not contain the preferred habitat of this species.	Yes
Masked Owl (northern)	*Tyto novaehollandiae kimberli*	V, V	This owl species typically occurs in sclerophyll forest and woodland with a grassy understorey or with a mosaic of sparse and dense ground cover (Curtis *et al.* 2012). Preferred roosting sites are in tree hollows, caves or dense foliage 3-8 metres above the ground (Curtis *et al.* 2012). A historic record from 1958 exists from within 10km of the subject site.	**MODERATE**. Historic records indicate that they have occurred in the area in the past and suitably wooded areas exist in sheltered valleys where it is presumed that fire intensity is less. Not present in 2011 EPBC Search.	No
Eastern Bristlebird	*Dasyornis*	E, E	This small brown passerine bird is restricted to upland open forest and montane heath in Southern Queensland in the	**LOW:** The subject site occurs well outside the recognised range of this species. Museum	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
	brachypterus		Conondale Range, Lamington National Park and Mt Barney National Park (Curtis *et al* 2012).	records and Eremaea Birds databases do not show any records for North Queensland. Communication received from Canberra EPBC mapping department that the record was incorrect (9:74am 27-9-2013)	
Gouldian Finch	*Erythrura gouldiae*	E, E	This small brightly coloured granivorous bird prefers open tropical woodland with a grassy understorey, often in rocky hills or low escarpment country (Curtis *et al* 2012). They have now undergone a significant contraction in their range, particularly in Queensland (Garnett & Crowley 2000). The Atlas of Living Australia includes a Gouldian finch record from approximately 7km north of Mt Emerald from October 1976. There were attempts to reintroduce this species to the Mareeba area but no birds have been recorded since 2007.	**LOW – MODERATE**: The open woodland with a grassy understorey on rocky hills that dominates the project site is considered suitable habitat but it is doubtful any populations persist in the region.	Yes
Star Finch (eastern)	*Neochmia ruficauda ruficauda*	E, E	The distribution of the Star Finch (eastern) is very poorly known. The Star Finch (eastern) occurs only in central Queensland. Based on the small number of accepted records, the distribution of the Star Finch (eastern) is believed to extend north to Bowen, west to beyond Winton and, based on recent records, south to near Wowan. Within this range it occurs mainly in grasslands and grassy woodlands that are located close to bodies of fresh water (SEWPaC 2012g).	**LOW:** The subject site occurs well outside the recognised range of the Endangered eastern subspecies which is currently only known from a $20km^2$ area in Central Queensland. A 2010 record from the Atherton Tablelands is not thought to be this subspecies..	No
Black-throated Finch (southern)	*Poephila cincta cincta*	E, E	The Black-throated finch (southern) (BTF) occurs mainly in grassy, open woodlands and forests, typically dominated by *Eucalyptus* (especially *E. tetradonta* & *E. platyphylla*), *Corymbia* and *Melaleuca*, and occasionally in tussock grasslands or other habitats (for example freshwater wetlands), often along or near watercourses, or in the vicinity of water (SEWPaC 2012h). It is likely that permanent sources of water provide refuge for this species during the dry season, especially during drought years.	**LOW:** Although the endangered subspecies occurs as far north as the Mareeba Wetlands, the subject site does not contain permanent water needed for this species to persist in an area. The species predominantly occurs on Land Zone 3 while the subject site is dominated by Land Zone 12. Not present in 2011 EPBC Search.	No
MAMMALS					
Northern Quoll	*Dasyurus hallucatus*	C, E	The Northern quoll is known to occur as far south as Gracemere and Mt Morgan, south of Rockhampton, and as far north as Cooktown. It occupies a diversity of habitats	**CONFIRMED**: A number of individuals of both sexes and different ages were detected across the subject site, predominantly in rocky areas	Yes

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			including rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. However, habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes (SEWPAC 2012i).	in both ridges and valleys. Quolls were detected through cage trapping, camera traps and scat identification. It was concluded that Northern quolls are abundant and widespread across the site (RPS 2012).	
Spotted-tailed Quoll	*Dasyurus maculatus gracilis*	E, E	The subspecies is mostly confined to the relatively cool, wet and climatically equable upland closed-forests (mostly above 900 m altitude) that occur in the upper catchments of rivers draining east and west of the Eastern Escarpment. It is also suggested that the species occurs in lower altitude notophyll, mesophyll and wet sclerophyll forests in lesser numbers. The subspecies utilises dens for resting and for raising young. Dens have been found in tree hollows, logs, rock crevasses and even among building materials (SEWPaC 2012j).	**LOW**: The subject site does not contain the preferred habitat of this species, particularly rainforest habitat above 900m.	No
Koala	*Phascolarctos cinereus*	C, V	The range of this population extends from approximately the latitude of Cairns to the New South Wales-Victoria border (SEWPaC 2012k). Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the genus *Eucalyptus* (Martin & Handasyde 1999). The koalas diet is restricted mainly to foliage of *Eucalyptus* species but may also consume foliage of related genera, including *Corymbia, Angophora* and *Lophostemon* and at times supplement its diet with other species, including species from the genera *Leptospermum* and *Melaleuca* (Martin and Handasyde 1999; Moore and Foley 2000). There are very few records for the area west of the Wet Tropics rainforest, however, a 2005 record from Koah, between Kuranda and Mareeba probably represents the northern-most record for this species. .	**MODERATE**: The subject site does not contain and is not contiguous with any known koala habitat or population. Not present in 2011 EPBC Search.	No
Mareeba rock-wallaby	*Petrogale mareeba*	NT, -	This highly variable rock wallaby can only be distinguished from Allied and Sharman's rock wallaby based on genetics (Van Dyke & Strahan 2008). It prefers rocky habitats in	**MODERATE**. The subject site contains suitable habitat for this species and has unbroken connectivity to an area with a known	Yes

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			open forest, grassy woodland or sometimes vine thicket (Van Dyke & Strahan 2008). Records exist for Granite Gorge, which is contiguous with Mt Emerald.	population.	
Northern Bettong	*Bettongia tropica*	E, E	The preferred habitat of the Northern Bettong is tall or medium open eucalypt forest with grassy understorey along the western edge of rainforest (SEWPaC 2012l). Structure and floristic composition of forests vary within their range, but the limiting factor is the presence and abundance of truffle fungi (Curtis *et al.* 2012). Historically, the Northern Bettong occurred in Queensland, from Rockhampton to the present northern distribution near Cairns. The species currently occurs in only three geographically isolated locations - the Lamb Range, Paluma and Mt Zero.	**LOW:** Habitat is not considered likely to support Northern bettongs, which are currently only known from Seaview Range, Lamb Range, Mt Carbine Tablelands & Mt Windsor.	No
Green Ringtail possum	*Pseudochirops archeri*	NT, -	This species is endemic to north-eastern Queensland and occurs over a restricted range between Paluma (north of Townsville) and the Mount Windsor Tableland (west of Mossman). It inhabits dense upland rainforest and is rarely found below 300m elevation (Van Dyke and Strahan 2008).	**LOW**: The subject site does not contain the preferred habitat of this species, particularly dense upland rainforest.	Yes
Fluffy Glider	*Petaurus australis un-named subspecies*	V, V	This glider species is restricted to tall eucalypt forest above 600m altitude that always includes *Eucalyptus grandis, E resinifera* and usually *Syncarpia glomulifera* and *Banksias* (Curtis *et al.* 2012).	**LOW**: The subject site does not contain the preferred habitat of this species, particularly wet sclerophyll forest containing essential feed and denning trees (*Eucalyptus resinifera* or *Eucalyptus grandis).*	No
Spectacled Flying-fox	*Pteropus conspicillatus*	C, V	The Spectacled Flying-fox occurs in north-eastern Queensland, between Ingham and Cooktown, and between the McIlwraith and Iron Ranges of Cape York (SEWPaC 2012m). The species is associated primarily with tropical rainforest but may also occur in mangroves, eucalypt forests, melaleuca swamps, littoral and coastal mixed forests, farmland and urban gardens (Curtis *et al.* 2012). Bats may forage up to 50-100km each night (Curtis *et al.* 2012), but roosts are always found within 6 km of rainforest (SEWPaC 2012m). The Atlas of Living Australia show records from Mareeba and Tolga, within 20km of the subject site.	**CONFIRMED**: No suitable roosting habitat (rainforest) is present on the subject site, however, the species may forage on site during mass flowering of Myrtaceous trees, and/or fly over site at rotor height between suitable nearby foraging areas.	Yes

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
Grey-headed Flying-fox	*Pteropus poliocephalus*	C, V	This flying fox species occurs in a variety of forest and woodland communities along the east coast of Australia, from Melbourne to Mackay (Curtis *et al.* 2012).	**LOW**: The site is outside the known geographic range for this species (Mackay) and does not contain the preferred habitat.	No
Diadem Horseshoe Bat	*Hipposideros diadema reginae*	NT, -	This microbat utilises a broad range of vegetation types including lowland rainforest, eucalypt woodland, Melaleuca forests, vine thicket and open woodland (Churchill 2008). However, roosting preferences are for large caves, although they will also use disused caves and road culverts (Churchill 2008).	**CONFIRMED**: This bat species was positively confirmed to occur on the site from single call recorded during May 2010 (RPS 2012). Potential roost locations exist on the site, but are generally limited in abundance and size. Not predicted on any database searches.	No
Semon's Leaf-nosed Bat	*Hipposideros semoni*	E, E	The known broad-scale distribution for Semon's Leaf-nosed Bat includes coastal Queensland from Cape York to just south of Cooktown. There is an outlier population at Kroombit Tops, near Gladstone (Churchill 2008). Semon's Leaf-nosed Bat is found in tropical rainforest, monsoon forest, wet sclerophyll forest and open savannah woodland (Churchill 2008). This species does not have an obligatory requirement for cave roosts. Daytime roost sites include tree hollows, deserted buildings in rainforest, road culverts and shallow caves amongst granite boulders or in fissures (SEWPaC 2012n).	**MODERATE**. The subject site contains suitable habitat for this species, including suitable vegetation communities and abundant potential roost sites. No records could be located for any area in or west of the Wet Tropics rainforest between Cedar Bay National Park and Townsville.	No
Greater Large-eared Horseshoe Bat	*Rhinolophus philippinensis maros*	E, E	This species occurs only in northern Queensland, from the Iron Range southwards to Townsville and west to Chillagoe (Churchill 2008). The species is found in lowland rainforest, along gallery forest-lined creeks within open eucalypt forest, *Melaleuca* forest with rainforest understorey, open savanna woodland and tall riparian woodland of *Melaleuca*, Forest red gum (*E. tereticornis*) and Moreton Bay ash (*C. tesselaris*) (SEWPaC 2012o). It mainly roosts in caves and underground mines located in rainforest, and open eucalypt forest and woodland, however roosts have also been observed in road culverts, and it is suspected that the species also uses basal hollows of large trees, dense vegetation, rockpiles and areas beneath creek banks (SEWPaC 2012o).	**MODERATE**. The subject site contains suitable habitat for this species, including suitable vegetation communities and potential roost sites.	No
Bare-rumped Sheathtail Bat	*Saccolaimus saccolaimus nudicluniatus*	E, CE	Occasional individuals have been collected from a narrow coastal region (less than 40 km inland) between Ayr and Cooktown, North Queensland, with one isolated specimen	**CONFIRMED**. The subject site contains suitable habitat for this species, particularly in the lower reaches of Granite Creek where *E.*	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			from north of Coen on Cape York Peninsula (SEWPaC 2012p). The species inhabits tropical woodland and tall open forests where it roosts in long, wide hollows in the trunks of various Eucalypts, especially *E. tetradonta* and *E. platyphylla* (Churchill 2008). It appears to prefer coastal Eucalypt forests with high annual rainfall (Curtis *et al*. 2012).	*platyphylla* is present. Calls potentially belong to this species have been recorded in the vicinity of turbine #30 and turbine #38 (RPS 2012).	
Brush-tailed Rabbit Rat	*Conilurus pencillatus*	C, V	This small rodent lives in mixed eucalypt open forest and woodland, or on *Casuarina*-dominated sand dunes, but occurs mostly in the Kimberley (Western Australia), and Cobourg Peninsula and Kakadu in the Northern Territory. The only known Queensland population is on Bentinck Island, Gulf of Carpentaria (Van Dyke and Strahan 2008).	**LOW**: The subject site is a significant distance outside the known geographic range for this species, and does not contain likely habitat.	No

[1] Conservation status as listed under the NCA, where E: Endangered, V: Vulnerable, NT: Near Threatened; C: Common and the EPBC Act, where CE*: Critically Endangered, E*: Endangered, V*: Vulnerable, -: No listing.

[2] Likelihood of occurrence is based on the known distribution and ecological requirements of the species in the context of the site, where **Low**: No recent records or suitable habitat present on the site; **Moderate**: Recent records and/or suitable/preferred habitat present and/or species that they commonly associated with are present on the site, or likely to overfly the site, however, the species was not recorded during the field investigations; and **High**: Known to occur on the site through direct observation within or immediately adjacent to the site.

[3] Previous records exist within 10km of the site (Wildlife Online).

3.0 Migratory Species Assessments

Under the EPBC, an action will require approval from the Federal Environment Minister if the action has, will have or is likely to have a significant impact on a listed migratory species. Significant impacts are defined as impacts which degrade areas of important habitat for listed migratory species, or which disrupt the lifecycle of ecologically significant populations of the listed migratory species.

DEWHA (2009) notes that an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Important habitat is defined in terms of

(a) Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or

(b) Habitat that is of critical importance to the species at particular life-cycle stages; and/or

(c) Habitat utilised by a migratory species which is at the limit of the species range; and/or

(d) Habitat within an area where the species is declining (DEWHA 2009).

Criteria are not specified for determining the ecological significance of a population of a migratory species. Exactly what constitutes an 'ecologically significant proportion' of the population is different for each species, and may need to consider the species' population status, genetic distinctiveness and species specific behavioural patterns (DEWHA 2009).

The EPBC Protected Matters Search Tool lists a total of 17 species (16 birds and the Estuarine Crocodile) as known or having the potential to occur up to 10km around the project site (refer **Table 2**). Of these, nine species were recorded in the DEHP Wildnet search as having been recorded within 10km of the centroid of the subject site.

Due to the lack of suitable habitat, principally permanent vegetated water bodies, it is not considered likely that six of these migratory listed species will utilise the site as roosting, nesting or foraging habitat (refer **Table 2**). Four species were assessed as having a Moderate likelihood of occurrence, in that suitable habitat exists but were not recorded during site surveys. Bird species that are unlikely to utilise the subject site but possibly fly over the site whilst moving between suitable surrounding habitats were also given a Moderate likelihood of occurrence.

A total of five EPBC migratory listed species were recorded during the field surveys(refer **Table 2**). It is not considered that the subject site represents Important Habitat for any of the listed migratory species. It is also not considered that the construction phase of the proposed project is likely to have a significant impact; however, mortality to animals in transit through the site during the operational phase of the project is an unknown level of impact and outside the scope of the current report to assess.

Table 2 Migratory Species Potentially Occurring Within The Project Site

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
REPTILES					
Salt-water Crocodile, Estuarine Crocodile	*Crocodylus porosus*	V,-	The Estuarine crocodile inhabits coastal rivers and swamps and extends inland along major drainage systems. It is also occasionally observed in the open ocean (Wilson & Swan 2010).	**LOW:** The subject site does not contain the preferred habitat of this species. There are no permanent streams or deep waterholes necessary for this species.	No
BIRDS					
Australian Cotton Pygmy-goose	*Nettapus coromandelianus albipennis*	MW	Normally found on permanent water such as deeper freshwater swamps, lagoons, and dams with water lilies and other semi-emergent water plants (Pizzey & Knight, 2007). Although often seen in pairs or small groups, they congregate in larger flocks on permanent water-bodies during the dry season.	**MODERATE**: No suitable habitat (permanent water) is present on the subject site and unlikely to utilise small ephemeral water bodies. However, the species may fly over site at rotor height between suitable nearby water bodies.	Yes
Great Egret, White Egret	*Ardea alba*	MM, MW	Great egrets are widespread and occur in all states/territories. They have been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial) (SEWPAC 2012q). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Marchant & Higgins 1993).	**MODERATE:** The site does not contain the preferred habitat of this species and unlikely to utilise small ephemeral water bodies. However, the species is common in surrounding areas and may fly over site at rotor height between suitable nearby water bodies.	No
Cattle Egret	*Ardea ibis*	MM, MW	The Cattle egret is widespread and common according to migration movements and breeding localities surveys (SEWPAC 2012r). The species occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It is commonly associated with the habitats of farm animals, particularly cattle, and is known to follow earth-moving machinery. It also uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and	**MODERATE**. The subject site contains potential seasonal habitat for this species.	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			abundant aquatic flora (Marchant & Higgins 1993).		
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	MT	The White-bellied sea-eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia (SEWPAC 2012s). The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded at or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs, saltmarsh and sewage ponds, as well as in (or flying over) a variety of terrestrial habitats (Marchant & Higgins 1993).	**HIGH**: This species has been recorded during site surveys. There is potential for this species to fly over at rotor height. No nests or suitable nesting sites were identified during the field investigations.	Yes
Sarus Crane	*Grus antigone*	MW	This large crane prefers well-vegetated shallow freshwater wetlands, isolated swamps in eucalypt forest, grasslands, paddocks, ploughed fields, irrigated pastures, bore drains, claypans, crops, grain stubbles and sometimes tidal areas (Pizzey & Knight 2007). Locally common on the Atherton Tablelands (Pizzey & Knight 2007).	**HIGH:** Several flocks and aggregations have been seen on or adjacent to the subject site (RPS 2012). No suitable foraging/roosting habitat present on site and unlikely to utilise small ephemeral water bodies. There is potential for this species to fly over at rotor height between suitable nearby habitat.	Yes
Latham's Snipe, Japanese Snipe	*Gallinago hardwickii*	MW	Latham's snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (i.e. it travels through northern Australia to reach non-breeding areas located further south) (Higgins & Davies 1996). It occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level and usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (SEWPAC 2012t).	**LOW**: The site does not contain the preferred wetland habitat of this species and is unlikely to utilise small ephemeral water bodies.	No
Painted Snipe	*Rostratula benghalensis s. lat.*	MW	The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (SEWPAC 2012e). Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire.	**LOW**: The subject site does not contain the preferred habitat of this species, particularly vegetated wetland habitats. They are unlikely to utilise the small ephemeral water bodies present during the wet season. No breeding places are likely to exist.	No
Fork-tailed Swift	*Apus pacificus*	MMB	The Fork-tailed swift is a non-breeding visitor to all states	**MODERATE**. The subject site contains	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			and territories of Australia (Higgins 1999). In north-east Queensland there are many records east of the Great Divide from near Cooktown and south to Townsville. The species is almost exclusively aerial, and mostly occur over inland plains, over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They also occur over settled areas, including towns, urban areas and cities (SEWPAC 2012u).	suitable habitat for this species. The Atlas of Living Australia has a 2010 record 10.2km north of the Mt Emerald centroid. The species may fly over site at rotor height between suitable nearby water bodies.	
White-throated Needletail	*Hirundapus caudacutus*	MT	The White-throated needletail breeds in the Northern Hemisphere but is widespread in eastern and south-eastern Australia during summer months (Barrett *et al*. 2003; Higgins 1999). In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (SEWPAC 2012v). The species is almost exclusively aerial, from heights of less than 1m up to more than 1,000m above the ground. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest (Higgins 1999).	**HIGH:** - Several flocks (up to 50 individuals) have been recorded flying within the rotor sweep area in the vicinity of turbines #62, 65, 66 and 70 (RPS 2012).	No
Rainbow Bee-eater	*Merops ornatus*	MT	The Rainbow bee-eater is distributed across much of mainland Australia, where it is both a migratory and wintering resident species. The species occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (SEWPAC 2012w). It also occurs in inland and coastal sand dune systems, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (Higgins 1999).	**HIGH**: This species is regarded as being among the most common bird species on the site (RPS 2012). No nest sites were observed on the subject site.	Yes
Black-faced Monarch	*Monarcha melanopsis*	MT	The Black-faced monarch is found along the coast of eastern Australia, becoming less common further south. The species inhabits rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. It forages for insects among foliage, or catches flying insects on the wing	**LOW:** The site does not contain the preferred rainforest habitat of this species. It is likely to utilise patches of rainforest and gallery forest to disperse, reducing likelihood of flying within rotor strike zone.	Yes

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			(Marchant & Higgins 1993).		
Spectacled Monarch	*Monarcha trivirgatus*	MT	The Spectacled monarch is found throughout coastal north-eastern and eastern Australia and coastal islands, from Cape York (Qld) to the Watson River on the west coast and to Port Stephens (NSW) on the east coast. It inhabits the understorey of mountain and lowland rainforests, thickly wooded gullies, waterside vegetation including mangroves, mostly well below the canopy (Pizzey & Knight 2007).	**LOW:** The site does not contain the preferred rainforest habitat of this species. . It is likely to utilise patches of rainforest and gallery forest to disperse, reducing likelihood of flying within rotor strike zone.	Yes
Satin Flycatcher	*Myiagra cyanoleuca*	MT	The Satin flycatcher is widespread in eastern Australia. In Queensland, it is widespread but scattered in the east (SEWPAC 2012x). Satin flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands. They especially prefer wet sclerophyll forest with a tall shrubby understorey of tall acacias (Blakers *et al.* 1984). They are mainly insectivorous, preying on mostly insects, although very occasionally they will also eat seeds. They are arboreal foragers, feeding high in the canopy and subcanopy of trees, usually sallying for prey in the air or picking prey from foliage and branches of trees (Pizzey & Knight 2007).	**MODERATE**. The subject site contains suitable habitat for this species, particularly along heavier wooded valleys.	Yes
Rufous Fantail	*Rhipidura rufifrons*	MT	The Rufous fantail is found throughout coastal eastern Australia and coastal islands (Pizzey & Knight 2007). It inhabits the understorey of rainforest, wetter eucalypt forest, thickly wooded gullies, monsoon forest, paperbarks, sub-inland and coastal scrubs, and vegetation along watercourses. They are mainly insectivorous, preying on arthropods, mostly insects which are gleaned from leaves, branches, the ground and logs (Pizzey & Knight 2007).	**HIGH**: This species has been sighted at least once on the subject site (RPS 2012). The open woodland vegetation on the subject site is considered to represent potential habitat for this species, particularly along the ephemeral watercourses.	Yes
Gouldian Finch	*Erythrura gouldiae*	MT	This small brightly coloured granivorous bird was formerly common in tropical woodland with a grassy understorey (Garnett & Crowley 2000), but has now undergone a significant contraction in their range, particularly in Queensland.	**LOW**: The open woodland with a grassy understorey on rocky hills that dominates the project site is considered suitable habitat but it is doubtful any populations persist in the region.	Yes
Barn Swallow	*Hirundo rustica*	MT	The Barn swallow is a non-breeding migrant to Australia, usually occurs patchily along the north coast from the Pilbara region, Western Australia, to Fraser Island in Queensland (SEWPAC 2012y). It is recorded in open	**MODERATE**. The subject site contains woodland areas suitable for this species. The Atlas of Living Australia has a 1976 record from the 10 minute grid square containing the	No

Common Name	Scientific Name	Status[1]	Habitat	Assessed Likelihood of Occurrence[2]	DEHP Record[3]
			country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires (Blakers *et al*. 1984), and also in or over freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland (Schodde & Mason 1999).	Mt Emerald centroid and there are confirmed 2013 records from Kairi approximately 16 from the centroid. This is an uncommon bird unlikely to ever be present in significant numbers in the subject site. .	

[1] Migratory status as listed under the EPBC, where MW – migratory wetland species, MT - migratory terrestrial species, MM – migratory marine species MMB - migratory marine birds, -: No listing.

[2] Likelihood of occurrence is based on the known distribution and ecological requirements of the species in the context of the site, where **Low**: No recent records or suitable habitat present on the site; **Moderate**: Recent records and/or suitable/preferred habitat present and/or species that they commonly associated with are present on the site, or likely to overfly the site, however, the species was not recorded during the field investigations; and **High**: Known to occur on the site through direct observation within or immediately adjacent to the site.

[3] Previous records exist within 10km of the site (Wildlife Online).

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Appendix 15

Mount Emerald Wind Farm - Camera Trapping Results

Prepared by RPS

Camera trapping Results – MEWF project

The 13 camera traps were active at the Mt Emerald Wind Farm site with photographs collected over 213 days for a collective 1,600 camera trapping days. The longest period a camera was installed for was CDF16 for 202 days and the shortest period of time was for CDF1 installed for 33 days (Table 1).

Table 1 Camera trap locations and activity.

Camera Trap	Location (UTM)	Active Days	Number of times data was collected	Date installed at location	Date removed from location
CDF1	55 K 327420 8099401	33	3	8-1-2013	20-2-2013
CDF2	55 K 326500 8100299	193	7	8-1-2013	8-8-2013
CDF3	55 K 326669 8100205	44	2	8-1-2013	20-2-2013
CDF4	55 K 327277 8099727	44	2	8-1-2013	20-2-2013
CDF7	55 K 328464 8101079	44	1	9-1-2013	20-2-2013
CDF8	55 K 328652 8100799	44	1	9-1-2013	20-2-2013
CDF10	55 K 328340 8100272	171	4	9-1-2013	8-8-2013
CDF11	55 K 327875 8099492	86	1	19-2-2013	16-5-2013
CDF12	55 K 327361 8099406	171	6	20-2-2013	23-8-2013
CDF13	55 K 327321 8099774	185	5	20-2-2013	23-8-2013
CDF14	55 K 326786 8100287	184	6	21-2-2013	23-8-2013
CDF15	55 K 327855 8099972	199	5	21-2-2013	6-9-2013
CDF16	55 K 328340 8101041	202	5	21-2-2013	9-9-2013

A total of 33 species were positively identified at the camera traps. The most commonly recorded species were the Rufous Bettong, Black-footed Tree Rat and an unidentified Rodent (Muridae).

Table 2 List of species identified through camera trapping

	Scientific Name	Common Name	Number of Images
1	*Aepyprymnus rufescens*	Rufous Bettong	3991
2	*Boiga irregularis*	Brown Tree Snake	3
3	*Carlia* spp.	Rainbow Skink - unknown species	43
4	*Centropus phasianinus*	Pheasant Coucal	14
5	Class *Insecta*	Insecta - unknown	6
6	*Coturnix ypsilophora*	Brown Quail	240
7	*Cracticus tibicen*	Australian Magpie	129
8	*Dacelo novaeguineae*	Laughing Kookaburra	13
9	*Dasyurus hallucatus*	Northern Quoll	138
10	*Dendrelaphis punctulata*	Common Tree Snake	36
11	*Diporiphora bilineata*	Two-lined Dragon	78
12	*Family Elapidae*	Snake - unknown front-fanged species	55
13	*Family Muridae*	Rodent - unknown species	4112
14	*Family Scincidae*	Skink - unknown species	74
15	*Felis cattus*	Feral Cat	113
16	*Isoodon macrourus*	Northern Brown Bandicoot	198
17	*Litoria rubella*	Desert Tree-frog	15
18	*Lymnodynastes ornatus*	Ornate Burrowing-frog	6
19	*Macropus parryi*	Pretty-faced Wallaby	332
20	*Macropus robustus*	Common Wallaroo	66
21	*Melomys burtoni*	Grassland Melomys	18
22	*Mesembriomys gouldii*	Black-footed Tree Rat	5597
23	Order *Anura*	Frog	2
24	Order *Diptera*	Fly	14
25	Order *Hymenoptera*	Wasp	28
26	Order *Lepidoptera*	Butterfly	32
27	Order *Orthoptera*	Grasshopper	125
28	*Psuedomys* spp.	Native mouse - species unknown	6
29	*Rhinella marina*	Cane Toad	159
30	*Tachyglossus aculeatus*	Short-beaked Echidna	24
31	*Trichosurus vulpecula*	Brush-tailed Possum	24
32	*Turnix varius*	Painted Button-quail	179
33	*Varanus tristis*	Black-headed Monitor	12

Appendix 16

Mount Emerald Wind Farm Flora Report (R72444)

Prepared by RPS

Mount Emerald Wind Farm

Flora Report

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In this note, a reference to loss and damage includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential or financial or other loss.

Document Status

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Glossary of Terms, Terms & Acronyms

Term	Definition
ASL	Above Sea Level
Edaphic	Referring to the qualities of the soil (e.g. drainage, fertility, structure).
Endemic	Restricted to a geographical area. Narrow endemic refers to plants with a very restricted distribution range and usually only found in a particular environment, rock or soil type (e.g. ridges, rock pavements and other niche habitats).
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
Land zone	Land zones are categories that describe the major geologies and associated landforms and geomorphic processes of the State of Queensland (Wilson and Taylor, 2012).
Montane	Referring to the mountain environment; and in this report, especially above 900 m ASL.
NCA	*Nature Conservation Act 1992* (Queensland).
Nomenclature	The names of plants. Nomenclature for plants in this report follows Bostock and Holland (2010).
RE	Regional Ecosystem
Regional ecosystem	Vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil (Sattler and Williams, 1999).
Rhyolite	A close grained, igneous, acid-volcanic rock. The primary geological unit of the site is described as the Walsh Bluff Volcanics.
Rock outcrop	A soil-less group of rocks exposed and pronounced beyond the surrounding ground surface.
Rock pavement	An area of continuous rock more or less in a near-horizontal plane. Can be exposed or obscured by a thin veneer soil and plant cover. May also be referred to in this report as rock plates or rock platforms.
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Federal Government). Administers the EPBC Act.
Skeletal	Pertaining to the thin veneer of soil matter which develops on rocky landscapes, scoops on rock pavement surfaces and on rocky ridges.
VMA	*Vegetation Management Act 1999* (Queensland).

Executive Summary

The Mount Emerald Wind Farm project proposed by RAC (RATCH-Australia Corporation) intends to develop a wind farm comprising up to 70 turbines and associated power generation infrastructure on land located in the vicinity of Walkamin, north Queensland. The land is properly described as Lot 7 on SP235244 and occupies an area of 2422 ha.

This report details the findings relevant to the spot locations of the wind turbines and the potentially affected environment where the interconnecting access and cabling tracks are proposed. It also discusses vegetation and flora-related matters relevant to Kippen Drive - the main access road into the site.

The project is subject to the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) because of the presence of matters of National Environmental Significance (NES). It has been determined by the administering Department of the Environment (DotE) that the appropriate level of assessment under the EPBC Act for the wind farm project is by Environmental Impact Statement (EIS). The matters of NES discussed in this report are plants.

As a component of the EIS, investigations were completed of the project site and regional environs to characterise the vegetation and its flora, and to understand the landscape and biophysical attributes that underpin and constitute the habitats for plants of interest to conservation.

Numerous field surveys of the site and in environmentally relevant regional locations have been conducted from May 2010 to the most recent in May 2013. These surveys were performed to elucidate and describe the ecology of the vegetation and its flora, and to determine the level of impacts that could occur as a result of construction and operation of the wind farm. A strategic focus has been on the presence and dynamics of conservation significant and poorly known flora, with attention given to those species listed under the EPBC Act.

The Mount Emerald wind farm project area is characterised by elevated and dissected mountainous landforms on rhyolite geology with skeletal soils. The highest point is 1089 m ASL (above sea level) in the south of the project area; while Kippen Drive is the lowest point at 540 m ASL. Because of the combination of elevation, exposure and landform, unique and poorly represented vegetation communities are supported in some locations of the site.

Virtually the entire site, with the exception of cleared land along the existing access tracks and below the powerline is covered by remnant vegetation as defined under Queensland's *Vegetation Management Act 1999* (VMA). Applicable under the VMA is the presence of two bioregions: the Wet Tropics and the Einasleigh Uplands, where the former is mapped at a scale of 1:50 000 and the latter at 1:100 000. Remnant vegetation across the site has a conservation status under the VMA of Least Concern and Of Concern. The Of Concern communities are only found in the Wet Tropics bioregion section. The entire Einasleigh Uplands section is shown on mapping to have a conservation status of Least Concern.

The boundary between the two bioregions is approximately demarcated by the route of the Chalumbin to Woree 275 kV electrical transmission line. The section between Woree and Springmount was completed in 1998. This bioregion boundary also broadly corresponds with the change in landform of dissected rhyolite ridges and precipitous slopes of the Wet Tropics bioregion, to the more gentler landform and different vegetation communities of the Einasleigh Uplands bioregion section. Within the project site, all the significant populations of conservation significant plants listed under the EPBC Act are found in the Wet Tropics bioregion section, while only a few isolated populations are found north of the transmission line in the Einasleigh Uplands.

The Wet Tropics bioregion is also the location of the montane heath vegetation, which characterises the ridge country and rock pavements at elevations greater than 900 m ASL, where "cloud stripping" of moisture is a key determinant of its position in the landscape and its unique floristic composition. The montane heath community is equivalent to the subunit remnant vegetation type regional ecosystem (RE) 7.12.57c, which is listed under the VMA as Of Concern. This RE is the hosting community for at least two species of conservation significant plants listed under the EPBC Act: *Grevillea glossadenia* and *Homoranthus porteri*; whilst the unit also hosts other conservation significant plants including *Melaleuca uxorum* and *Plectranthus amoenus* (endangered and vulnerable respectively under Queensland's *Nature Conservation Act 1992*). Although not being listed under the EPBC Act, the highly restricted *M. uxorum* is considerably 'rarer' and at threat than the species cited here for the EPBC Act. Two populations of this shrub have been recorded from ridges in the SW of the site.

RE 7.12.57c is constrained to high elevation, exposed country in the southwest sector of the wind farm site. Consequently, the community is found at locations where a number of wind turbines are proposed to be constructed. Due to the width constraint of ridges, the montane heath community is at greatest risk of being impacted by construction pads and the interconnecting cabling tracks that link the turbine arrays. In some instances, the formation of tracks along ridges could result in an almost total loss of heath vegetation.

In contrast to the highly diverse Wet Tropics bioregion section of the site, all woodland communities in the Einasleigh Uplands bioregion section of the project site are listed as Least Concern under the VMA. Interestingly, this bioregion section also hosts the fewest plant species of conservation interest - both at the species level and the number of individuals present (i.e. population sizes are smallest). Two species of plants listed under the EPBC Act have been located in relation to proposed access tracks and turbine footprints of the wind farm in this section: *Grevillea glossadenia* and *Homoranthus porteri*. Another species, *Plectranthus amoenus* (vulnerable under the NCA) is also present on rock pavements in the vicinity of one turbine. Generally though, the north and east-facing sections of the project area are least constrained in terms of important vegetation communities and conservation significant plants.

Direct impacts such as vegetation clearing will result in the loss of hosting vegetation communities for conservation significant plants, and in some instances the possible total loss of individual populations. If the project were to proceed in the areas associated with narrow ridges south of the transmission line, the plant species populations most at risk are *Homoranthus porteri* (vulnerable under the EPBC Act); and *Melaleuca uxorum* (endangered under the NCA) and *Plectranthus amoenus* (vulnerable under the NCA).

Less conspicuous, but long-term impacts include the introduction of weeds adjacent to access tracks and cabling routes. A range of other impacts are associated with the establishment of weeds, and these include altered fire regimes, shifts in floristic composition; species replacement and displacement; and the introduction of pathogens. The potential for deleterious pathogens such as Phytophthora and more recently, myrtle rust is increased with the presence of vehicles, machinery and construction activities in formerly pathogen-free areas.

Following an assessment of the categories of impacts, a range of strategic mitigation measures are recommended. Given the unique qualities of large sections of the project area, these mitigation measures are focussed on site-specific characteristics and landscape situations. Included are measures and concepts regarding environmental offsets, identification and preservation of high value ecological zones within the project site, land rehabilitation, weed control, fire management and production of training material and interpretive media for construction workers, as well as project managers.

It is recognised that when the wind farm is operational and environmental controls have been put in place, there are additional opportunities for managing impacts. Fencing, property access constraints, the role of land caretakers and maintenance of the operational footprint are important strategies that will need to be considered if the ongoing nature of the project is to be sustainably managed with a commensurate level of environmental due diligence. Management of the project in this sense does not incur an environmental imposition, but has merits in cost-saving efficiencies (weed control for example) and sets the precedent and ethos for sustainable energy generation - the platform from which the wind farm is presented.

1.0 Introduction

1.1 Overview

RATCH-Australia Corporation Limited (RACL) is the proponent of the Mount Emerald Wind Farm project near Walkamin, north Queensland. A referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted to the administering Federal Government authority SEWPaC (Department of Sustainability, Environment, Water, Population and Communities) for assessment. Subsequently, the project was deemed by SEWPaC to be a *Controlled Action* under the Act and designated to be further assessed through an Environmental Impact Statement (EIS).

RPS were commissioned on behalf of RAC to prepare selected components of the EIS, one of these being an account of the flora and the potential impacts.

The assessment of impacts discussed in this report are based on the design layout and concept provided by the proponent of the project and dated July 2012, with the amended plan from March 2013 (see **Appendix A**). This report does not account for new turbine layouts, construction designs or information provided after March 2013. Certain calculations (e.g. impacted areas) therefore, should be treated as provisional in light of new information or design changes being submitted.

1.2 Terms of Reference and Scope of Works

The Terms of Reference (ToR) for the EIS were developed by SEWPaC (2012) in accordance with the guidelines set out under the EPBC Act. RPS (Australia East Coast) were commissioned on behalf of RAC to prepare the EIS document. This report presents the information relating to plant species listed under the EPBC Act and other conservation significant matters, such as habitats for plants, special vegetation types, and narrowly restricted species with limited habitat ranges.

Part 5, and specifically section 5.9 and 5.10 of the EIS Guidelines (SEWPaC (DotE), 2012) outline the content for the EIS for assessing the wind farm proposal and its potential impacts. The EIS Guidelines provides the framework for the scope of this report, and is centred around providing information relating to the potential impacts to the existing environment and Matters of National Environmental Significance (MNES), and a description of the proposed mitigation measures and strategies to reduce or eliminate such impacts.

1.3 Project Summary

RACL proposes to construct the "Mt Emerald Wind Farm" on elevated land located approximately 20 km SSW of the town of Mareeba on the Atherton Tablelands in north Queensland. The project site occupies a total area of 2422 ha.

The wind farm's electrical energy generation facility and infrastructure will comprise 63 wind turbines and associated tracks for underground cabling and access between the turbine arrays (**Appendix A**). An electricity substation is also proposed and will feed energy generated from the wind farm into the existing Chalumbin to Woree 275 kV transmission line. A conspicuous section of this transmission line more or less dissects the site and closely corresponds with bioregional boundaries.

The wind farm site occurs at the northern extent of the Herberton Range and includes the prominent landmark of Walsh Bluff at the most northern end. Mount Emerald (proper) is located off the site at the southern boundary. The undisturbed landform and vegetation is contiguous with Mt Emerald. Land to the north, east and west is characterised by agriculture and is generally cleared and modified.

1.4 The Study Area - Project Site

1.4.1 Overview of Landscape

The Mount Emerald wind farm project site is situated over mountainous terrain coinciding with the northern extent of the Herberton Range. The site is characterised by acid igneous rhyolite geology forming windswept ridges and rock outcrops interspersed with rock pavements, which support skeletal soils. Between these prominent features are undulating valleys with sheltered aspects and with deeper, more improved soil.

Thin veneers of soil with low fertility, wind-shearing and exposure to extremes of temperature and solar radiation prevent the growth of tall vegetation on ridges and rock pavements. Soils developed from rhyolite parent rock are naturally low in important plant nutrients such as nitrogen and phosphorus. Exposure, depth, drainage, water availability and the nutrient status of soil are factors affecting the physiognomy of the vegetation (Groves, 1981). This is notably relevant to the heath-like vegetation which occurs as a mosaic along ridges and upper slopes. It is this landscape position where several turbines and connecting tracks are proposed to be established.

Specialist habitats for plants are afforded by the fireproof nature of rock outcrops and rock pavements. These habitats support heath, low woodland and shrublands, which are also the preferred habitats for plants of interest to conservation. The montane heath vegetation of the Herberton Range is known for its special qualities and important habitats for a range of conservation significant plants and narrow endemic species (Craven and Ford, 2004).

Generally within the site, taller woodlands found on lower slopes and in valleys with areas of deeper soil support fewer conservation significant plants; although poorly known terrestrial orchids exist in the grassy ground layer of these communities and include *Habenaria elongata* and possibly *Diuris oporina*.

The site is broadly divided in terms of the degree of surface relief. This has bearing on the landforms, vegetation types and ultimately, the constructability of the project. To the south of the Chalumbin to Woree 275 kV transmission line the land is conspicuously dissected, rugged and characterised by narrow, high ridges and in some instances, precipitous slopes. Heath vegetation and low, windswept sparse woodlands characterise this landform. This area falls into the Wet Tropics bioregion section of the site and corresponds with the highest level of biodiversity in terms of vegetation and conservation significant flora, as well as being the least disturbed. It is a contiguous tract of land with Mt Emerald on the southern boundary and holds exceptionally high levels of environmental integrity.

The land to the north of the transmission line exhibits less surface relief, dissected ridges and steep slopes become far less frequent, and the landform generally becomes more undulating. Consequently, different vegetation types are hosted; where woodlands are generally taller, more widely represented on a regional basis, and conspicuously fewer conservation significant plants are present. This part of the site corresponds with the Einasleigh Uplands bioregion section of the site, and holds the lower environmental values than the Wet Tropics section. From a constructability viewpoint, the Einasleigh Uplands section is least constrained and offers the most opportunities with the potential for notably reduced environmental impacts on important plant habitats and conservation significant plant species.

1.4.2 Geology

The primary geological unit described for the entire site is the Walsh Bluff Volcanics. The Walsh Bluff Volcanics (Pb) are included in the Early Permian, Koolmoon Volcanic Group and described as "Buff, greenish-grey or dark grey, welded rhyolitic ignimbrite; minor rhyolite lava, quartzose sandstone, volcanic breccia, tuff." (Donchack and Bultitude, 1998).

Regionally, the Walsh Bluff Volcanics (Pb) unit is not represented elsewhere on the ATHERTON 1:250 000 geological series map sheet (Donchak, *et al*., 1997). The unit's northern limit is the landmark of Walsh Bluff. It extends southwards to incorporate Hoot Hill and Mount Emerald, east to Bones Knob, and includes parts of the ranges west of Atherton, and Rocky Bluff north of the Walsh River. The distribution of the unit is shown in **Figure 1**.

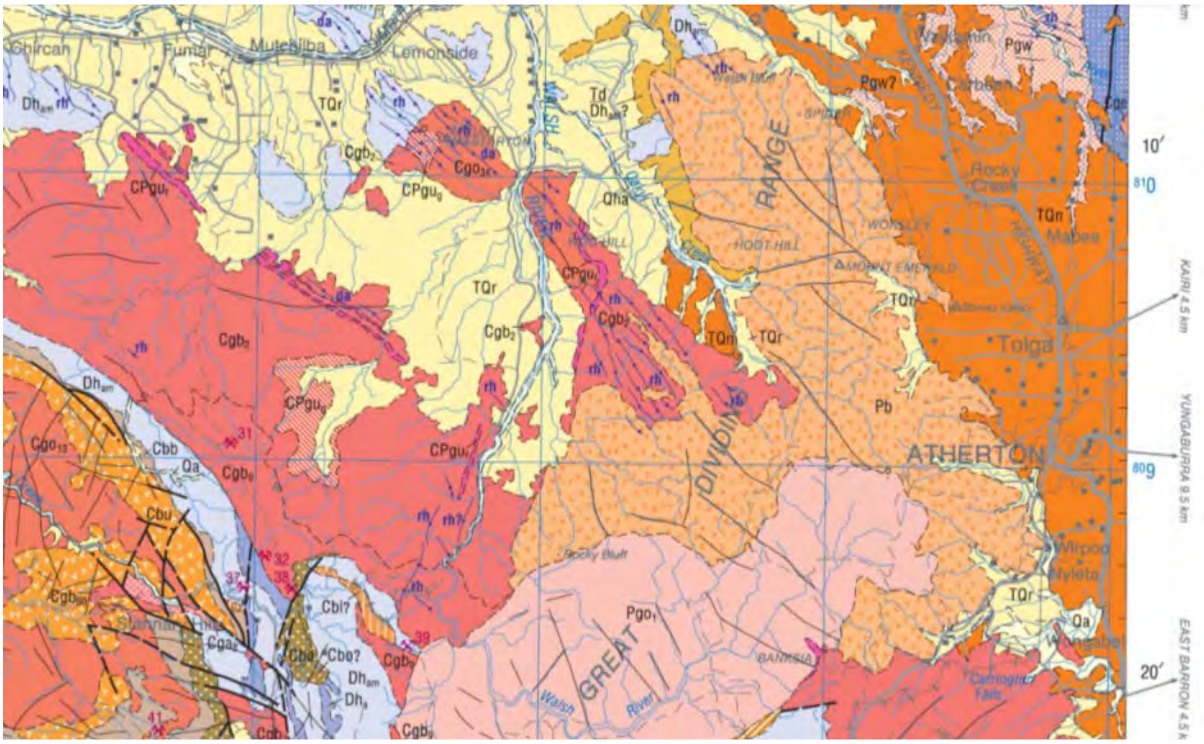

Figure 1 Extract from the ATHERTON 1:250 000 geological map sheet (Donchak, *et al*., 1997) showing the limit of the Walsh Bluff Volcanics (Pb).

1.4.3 Queensland Land Zone Concept

Land zones are central to the concept and categorisation of Queensland's remnant vegetation communities and the regional ecosystem classification (RE) after Sattler and Williams (1999). Wilson and Taylor (2012) define land zones as major geologies and associated landforms. Queensland is classified into 12 land zones.

The site is mapped as land zone 12, which is broadly defined as older Mesozoic to Proterozoic igneous rocks. Another wide definition is given as "Metamorphosed Cretaceous and older igneous rocks" (Wilson and Taylor, 2012).

The detailed description of land zone 12 (Wilson and Taylor, 2012) is "Mesozoic to Proterozoic igneous rocks, forming ranges, hills and lowlands. Acid, intermediate and basic intrusive and volcanic rocks such as granites, granodiorites, gabbros, dolerites, andesites and rhyolites, as well as minor areas of associated interbedded sediments. Excludes serpentinites (Land Zone 11) and younger igneous rocks (Land Zone 8). Soils are mainly Tenosols on steeper slopes with Chromosols and Sodosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility."

1.4.4 Natural Integrity and Specialist Habitats

The wind farm site holds high levels of natural landscape integrity. Highest integrity broadly coincides with the highest points and elevated land across the site, and notably in the southern portion of the site - south of the 275 kV transmission line in the Wet Tropics bioregion. The environmental qualities of the site are reported by Craven and Ford (2004) and Ford and Hardesty (2012), who note the environmental diversity of the western side of the Atherton Tableland, and furthermore summarise the unique and special habitat characteristics created by the interaction between altitude, climate and geology. The EIS compiled for the Chalumbin to Woree 275 kV transmission line (Kutt*, et al*., 1995) also records the very high biodiversity and environmental values associated with the Wet Tropics bioregion section of the site.

1.4.5 Past Disturbance and Land Use

The site is part of the former Springmount Cattle Station. The higher elevation sections of the site where the wind farm is proposed is not fenced, and it possible that some incursions by cattle may have been made several years ago. Evidence of grazing though is very limited and might account for at least one species of introduced pasture plant (*Stylosanthes scabra*).

Some sections of lower land on east facing slopes and areas north of the powerline shows signs of past disturbance: possibly from cattle grazing on the most fertile ground (protected, wetter and flatter sites). This disturbance is evidenced by moderate to heavy occurrences of the introduced grass *Melinis minutiflora* (molasses grass) and the pasture legume *Stylosanthes scabra* (shrubby stylo). The herbaceous Asteraceae weed *Praxelis clematidea* (Praxelis) is widespread across the site, with higher densities observed on rock pavements and around outcropping rock. This species is wind-dispersed; hence its broad distribution. It is possible that seed of Praxelis may also be carried on the fur of mammals, and definitely by machinery (CRC Weed Management, 2003).

1.4.6 Landscape Condition

The rugged and remote south-west portion of the site is in a near-pristine state. This condition is evidenced by large-class trees of *Eucalyptus reducta* (white stringybark) forming well-structured woodlands, where weeds are absent. The ridge country in this section of the site is of exceptionally high natural value and is the principal habitat for many conservation significant and locally endemic plant species including *Grevillea glossadenia*, *Homoranthus porteri*, *Melaleuca borealis*, *M. uxorum*, *Cryptandra debilis*, and numerous other species reliant on the particular biophysical character created by geology, altitude and climate, as well as separation from coastal influences (Craven, *et al*., 2003; Craven and Ford, 2004).

The plants with very narrow distributions grow in a mosaic of outcropping rock and rock pavements with skeletal soils supporting heath and sparse low woodland vegetation (**Plate 1**). With the exception of *G. glossadenia*, they have a particularly restricted habitat range. Their distribution coincides with some of proposed turbine locations and the connecting tracks and cabling network in the southern sector of the project site.

Plate 1 Ridges and rock pavements shape the preferred habitat for plants of conservation significance. (*Melaleuca uxorum* site).

In contrast to the Wet Tropics bioregion section, the northern sector of the site (mainly north of the 275 kV transmission line) supports far less plant species with narrow distribution. This land hosts significantly fewer plants of conservation interest; where for example, *Homoranthus porteri* is found only at two locations associated with rock pavements. Narrow endemic species such as *Melaleuca borealis*, *Cryptandra debilis*, *Indigofera bancroftii*, *Hovea nana*, *Mirbelia speciosa* subsp. *ringrosei* and *M. pungens* plus others occur much less frequently, and in the case of many species, do not occur at all or are represented by a few individuals found in micro-sites of suitable habitat and usually at elevations greater than 900 m ASL.

With the exception of the gorge associated with Granite Creek at the northern end of the site, plus a number of outlying rocky features and steeper slopes, the northern portion of the site has a more uniform surface, with fewer dissected features and rocky drop-offs. Because of the less dramatic landscape, gentler slopes and wider reaching zones of flat land found in relation to the plateau, different vegetation types are present on differently textured and slightly better quality soils.

The differences in vegetation in the northern section are both structural and floristic. Heath vegetation is only found in very small areas along the ridge and spur of land just north of the transmission line on the most western edge. Again, these patches of heath are found at elevations higher than 900 m ASL. Woodlands however, predominate even on higher parts of the site such as Walsh Bluff. These woodlands do not support the same component of flora with limited distributions and rarely support conservation significant plants (**Plate 2**).

Plate 2 The gentler and more uniform landscape of the northern half of the project site supports woodlands and notably fewer conservation significant plants. Here at Walsh Bluff, kangaroo grass (*Themeda triandra*) is the dominant species under a woodland of lemon-scented gum (*Corymbia citriodora*).

1.4.7 Regional Significance

Regionally, the site has physiographic affinities with the Baal Gammon-Watsonville landscape to the southwest. Although geologically different, there are many floristic similarities - notably in the ground flora - with the mountainous, dissected terrain that broadly follows the route of the existing Chalumbin to Woree 275 kV transmission line. The wind farm site is also located and forms the most northern extent of the Mount Emerald and Herberton Range mountain country, which subsequently corresponds with the distribution limit for many important populations of plant species.

Due to the high elevation vegetation affinities with Mt Emerald, the site is considered regionally significant for its montane heath vegetation and many plant species solely reliant on the specific mountain environment.

These plants include *Melaleuca uxorum*, *Homoranthus porteri* and several narrow endemic species described elsewhere in this report.

1.4.8 Modified Plant Habitats

Landscape modification and alienation by weeds is prevalent along both sides of the unsealed entry road of Kippen Drive from where it enters the property from Springmount Road to the base of the ascent into the wind farm site. The length of this disturbance zone is approximately 4.5 km. Grader grass (*Themeda quadrivalvis*), shrubby stylo (*Stylosanthes scabra*) and Hyptis (*Hyptis suaveolens*) are dominant species forming exclusive stands, and are a legacy of intensive agricultural land use and road maintenance (**Plate 3**). Along Kippen Drive, vegetation integrity is at its lowest and it is only the riparian fringe of Granite Creek and at the major stream crossings where the situation improves because of vegetation shading and seasonal flood pulses that scour surface vegetation.

Plate 3 Weeds such as grader grass, stylo and Hyptis form dominant stands either side of the main access road into the site (Kippen Drive).

On the wind farm site proper (i.e. the mountain country of dissected landform above the farms and cropping lands of Walkamin and Arriga), anthropogenic disturbance is limited to an existing powerline easement and associated tracks providing access to towers; plus two tracks associated with the wind farm development.

Entry to the wind farm site is from the end of Kippen Drive, where a winding track of 3.98 km provides access to the powerline corridor. Initially, the track is steep as it enters the rocky, rhyolite landform that characterises the site at higher elevation. On this track weeds are conspicuously less evident in both abundance and the number of species. Isolated occurrences of thatch grass (*Hyparrhenia rufa*) are found on the climb into the site's interior, but the species is absent thereafter. Other notable incidences of weeds are found on the cleared land and track associated with the powerline corridor. Species include small populations of *T. quadrivalvis*, sparse to moderate populations of *P. clematidea*, and isolated incidences of *Stylosanthes scabra* (stylo)

The power line corridor coincides with the boundary between the Wet Tropics and Einasleigh Uplands bioregions and represents a linear clearing disturbance footprint of 2.96 km across the site in an approximate east-west orientation. Along this corridor and restricted to the land affected by the immediate influence of the vehicle track are weeds such as Lantana (*Lantana camara*), molasses grass (*Melinis minutiflora*) and pigeon grass (*Setaria pumila*). In May 2013, a small population of a tall rat's tail grass (*Sporobolus* sp.) was recorded from two powerline tower pads. It is most likely that this grass is introduced and poses a noteworthy environmental threat if allowed to spread.

Lantana occurs as a small, isolated thicket at the base of a powerline tower; whilst a swath of pigeon grass (*Setaria* sp.) and molasses grass (*Melinis minutiflora*) has a more deleterious presence on the slope leading into the most eastern stream crossing along the main powerline maintenance track. After the stream crossings (heading west) weeds become less frequent, with common species such as red natal grass (*Melinis repens*), and Praxelis (*Praxelis clematidea*) and the legacy of grazing - stylo (*Stylosanthes scabra*) mostly concentrated around bases of powerline towers. Weeds along the powerline corridor in the western sector of the project site are progressively replaced by native successional species: typically *Acacia umbellata*, which form thickets in response to maintenance clearing of the low open woodland of silver-leaf ironbark (*Eucalyptus shirleyi*) below the powerline.

Praxelis is found even in remote areas of windswept ridges elsewhere on the site, but is less abundant in developed woodland where the native kangaroo grass (*Themeda triandra*) is dominant. Based on seasonal observations of Praxelis, the species readily responds to disturbed, rocky ground and the spoil of pushed-up track edges, and may have an effect on influencing the growth and reproduction of native species, particularly grasses and the low subshrubs that typically grow on undisturbed rocky ground with skeletal soil (**Plate 4**).

Plate 4 The weed Praxelis (*Praxelis clematidea*) rapidly colonises skeletal soil and disturbed rocky ground.

Two unrelated tracks branch from the powerline corridor and give access to a wind monitoring tower on the south of the site, and another wind monitoring tower in the northern half. These tracks, when measured from their junctions with the powerline corridor, have a length of 0.81 km and 3.9 km respectively.

The main 80 m wind monitoring tower to the south of the powerline has the largest footprint and consequently, a higher level of associated ground disturbance. A suite of weeds have established in the construction pad soil-base mix imported into the site. These included sicklepod (*Senna obtusifolia*) - a Class 2 declared plant under Queensland's *Land Protection (Pest and Stock Route Management) Act 2002* - and wynn cassia (*Chamaecrista rotundifolia* var. *rotundifolia*): both are leguminous species that can suppress native plant development. In contrast, the conservation significant native shrub *Grevillea glossadenia* has successfully colonised disturbed, rocky ground around the tower and subsequently constitutes one of the commonest woody plants in the ground and lower shrub layer.

1.4.9 The Role of Cloud Stripping and Water Harvesting

Much of the literature regarding cloud stripping concerns vine forest or closed forest vegetation (for example, McJannet, *et al*., 2011). Given the scarcity of information relating to montane sclerophyll heathlands in the

Wet Tropics, some concepts underpinning the phenomenon of cloud stripping and water harvesting can be extrapolated to the montane environment of the Mt Emerald wind farm site.

Cloud stripping is reported to produce potentially up to 40% of the total water input for upland forests in the Wet Tropics (Laurance and Peres, 2006). Tracey (1982) provides an altitudinal scale of four zones in relation to the vegetation types which broadly correlates with the communities which occur within the Wet Tropics bioregion boundary. This scale describes the altitudinal zone of between 400-800 m ASL as the *Uplands*. A majority of the proposed locations for wind turbines intersects contours between 790 and 1040 m ASL. Tracey (1982) defines this zone as *Highlands*, and given the site's position on the western and drier fringe of the Wet Tropics bioregion where sclerophyll vegetation is considerably more dominant than vine forest (closed forests), it can be expected that the water budget available through cloud stripping is lower (i.e. there are greater sunlight hours and less rainfall than for example, on the Lamb Range).

Ford and Hardesty (2012) identify the cloud base in the vicinity of the Mt Emerald wind farm site as being approximately 900 m ASL; and further describe the role that cloud interception and moisture stripping has in relation to the distribution and presence of conservation significant plants and the heath community identified as being specific to the ridge country of that region. Personal observations (S. Gleed) of the cloud base over the site confirm the findings of Ford and Hardesty (2012) and the correlation between altitude, vegetation community, water harvesting from the local cloud base (**Plate 5**), and the occurrence of montane heath vegetation.

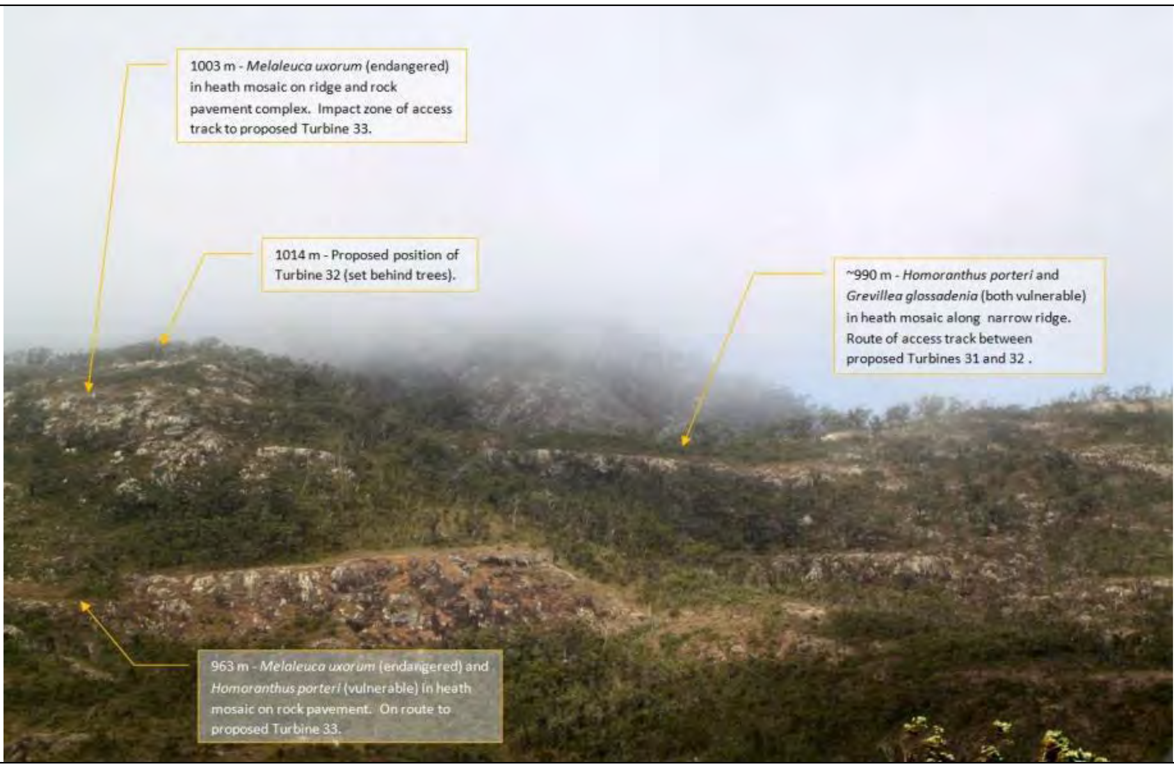

Plate 5 The cloud base over the south western portion of the site, which corresponds with the presence of tropical montane heath communities and several conservation significant plants as well as the primary habitat for many narrow endemic species. Photo taken in February 2013.

GPS tracking of the montane heath community south of the powerline determined that key plant indicator species of the community 'dropped out' at an elevation of approximately 900 m (± 30 m) and below. For example, characteristic plants of montane heath on the site include *Cryptandra debilis*, *Homoranthus porteri*, *Mirbelia pungens*, *M. speciosa* subsp. *ringrosei*, *Melaleuca borealis* and *Plectranthus* sp.

2.0 Methodology

The extensive area of land to be covered and the difficulty and time constraints associated with accessing remote parts of mountainous terrain, necessitated several field surveys. These comprised walking surveys between proposed turbine locations (i.e. surveying the interconnecting track network), and point surveys of the proposed turbine construction area. Several turbine location revisions became apparent during the course of the fieldwork and this presented a number of spatial challenges in terms of identifying the correct survey site.

Interpretation of high resolution multi-spectral imagery and aerial photography informed the route planning and investigation areas for specialist habitats. Navigation on foot was primarily by handheld GPS with a stated accuracy of ±3 m.

Sample size for the heath community was derived from the minimal area recommended by Mueller-Dombois and Ellenberg (1974), which is 10-25 m^2. In reality this sampling area was considerably larger given the linear orientation of ridges where the community occurs, and the route of foot traverses which followed the line of the ridges and the proposed location of the interconnecting tracks.

Woodland communities were sampled with a view of investigating a minimum area of 500 m^2 recommended by Neldner, *et al*. (2012). Again, due to a number of repeated surveys, a larger area was often investigated. This had the benefit of elucidating a wider range of species.

Surveys over three years were completed in February, March, April, May, June and August. Effectively this leaves a six-month gap in survey effort and this has been identified as a knowledge gap in the investigation process. Wannan (2009) advises that additional dry season surveys may be appropriate for the Herberton-Wairuna subregion of the Einasleigh Uplands bioregion; and therefore, ideally, surveys would have been completed during every month to account for seasonal changes and fluctuations.

As many of the turbine sites and interconnecting tracks were surveyed on foot. At each turbine location (several revisions), the entire vascular flora was recorded including the tree layers, shrub layers and ground layer. Particular attention was given to the ground layer component as this is generally considered to be the most diverse in woodland and sclerophyll communities.

Opportunities were also taken to participate in a number of CORVEG sites completed by botanists from the Queensland Herbarium. Improved vegetation mapping and descriptions were compiled during this time.

With the exception of common, easily identifiable species, all vascular plant species were collected and photographed. A voucher collection extending back to May 2010 has been compiled and is awaiting formal submission and identification by the Queensland Herbarium.

Additional surveys were undertaken of regional areas for conservation significant plants to determine their preferred habitats and centres of distribution. The species targeted included: *Acacia purpureopetala*, *Grevillea glossadenia*, *Homoranthus porteri*, *Prostanthera clotteniana* and other *Prostanthera* species, *Micromyrtus delicata*, *Zieria obovata* and *Melaleuca sylvana.* A majority of these surveys were in the Herberton, Stannary Hills, Silver Valley, Mount Misery, Watsonville and Irvinebank areas to the south and south-west of the wind farm site.

A literature review was made of the most relevant information, published articles and some key texts.

3.0 Information Gaps

3.1 Seasonality of Flora Surveys & Detection of Cryptic Species

In excess of 140 sites were investigated between May 2010 and May 2013 of vegetation and the presence of flora of interest to conservation, as well as locally endemic and restricted plant species. These surveys were performed over a range of months. On all occasions, new species occurrences were recorded. For survey completeness, flora surveys to detect ground layer plants would ideally take place each month of the year, and preferably with an overlap period extending into a second year to capture seasonal variation in flowering phenology.

Although nearly 250 species of vascular plants (including naturalised species) were recorded over the three-year period, concerns have been expressed regarding detection of transient plants (R. Jenson, J. Kemp, pers. comms.). Many of these types of plants have short periods of vegetative and flowering phenology and emerge after seasonal rain periods or pulses. Because of their diminutive size they are often obscured by taller growing grasses.

Highlighting this was the discovery of the ground orchid *Habenaria elongata* some 100 km south of its known southern distribution. Unfortunately, because of time and financial constraints, a voucher specimen was unable to be collected and the record therefore remains anecdotal and unconfirmed, although the photograph was sufficient for positive identification (**Plate 6**). The range extension of this orchid is considerable in terms of plant distribution, and further evidences the biodiversity importance of the Wet Tropics bioregion section of the project area.

Plate 6 The ground orchid *Habenaria elongata* was found in the grass layer below a ridge in the southwest of the project area.

3.2 Plant Succession in Tropical Montane Environments

Little is known or documented about plant succession in montane environments in north Queensland. Some parallels and related information can be gained from literature documenting range of disturbances in alpine regions of southern Australia and also some areas of New South Wales. However, the effects of linear clearing in these types of environment are not fully understood.

The Springmount section of the Chalumbin-Woree 275 kV electrical transmission line was completed in 1998 (Powerlink, n.d.). The corridor of this transmission line passes through the project area and approximately forms the boundary between the Wet Tropics and Einasleigh Uplands bioregions. This is the only firsthand reference from which to gauge the responses to linear clearing and disturbance to the rhyolite landform of the project area. However, there are subtle, but nevertheless important differences between the soil composition, flora and vegetation attributes of the Einasleigh Uplands section to those of the Wet Tropics section.

For example, it is understood of the Einasleigh Uplands section that plant succession on cleared ground generally results in thickets of *Acacia umbellata* and a suite of weeds such as Praxelis (*Praxelis clematidea*) establishing on silty clay soils which have accumulated after surface washing following heavier seasonal rainfall events.

Only a short section of track traverses a morphologically similar ridge found elsewhere in this bioregion section.

The Wet Tropics bioregion section of the project area has very high ecological and biodiversity value because of its isolation through rugged, inaccessible topography; altitude; and proximity and landscape connectivity to the Mt Emerald mountain region immediately to the south.

Floristically and in a vegetation sense, there are several examples that reinforce the regional significance of this zone in the project area; and include the presence of the exceptionally rare and endangered shrub *Melaleuca uxorum*, healthy populations of *Homoranthus porteri* and *Grevillea glossadenia*, pristine montane heath communities along high elevation ridges which host several narrow endemic plant species, contiguous landscape connectivity plus physical separation from areas susceptible to ecological modification (e.g. no edge effects, transformer weeds or surface alienation).

A more complete understanding of the effects and impacts associated with clearing narrow ridgelines is required. Appropriate methods for rehabilitation will need to be investigated because of the unique characteristics of this landform and the poorly represented heath communities that rely on ridges. As yet, there is limited evidence to suggest that heath communities will recover to the original floristic composition and structure. Moreover, there is reasonable evidence which supports the tendency for deflected climax (plagioclimax) communities to establish along track edges. These communities more or less stagnate and regenerate their own species composition, often precluding the regeneration of formerly-present climax species.

Observations of numerous disturbed sites indicate that the floristic component will become relatively stable once colonisers such as *Acacia umbellata*, *A. calyculata* and *A. whitei* have established thickets. In many situations the ground layer is also colonised by the heath-like plant *Jacksonia thesioides*. In virtually all situations where rocky ground is disturbed and turned over, the weed *Praxelis clematidea* colonises. Rarely however, do narrow endemic species restricted to ridge topography recuperate following disturbance. There is a concentration of these species in the southwest of the project area, which include: *Cryptandra debilis*, *Boronia bipinnata*, *Homoranthus porteri*, *Hovea nana*, *Indigofera bancroftii*, *Mirbelia pungens*, *M. speciosa* subsp. *ringrosei*, *Sannantha angusta* and others. These narrow endemics are a component of the original climax montane heath community and could be permanently displaced if the ground surface is disturbed.

3.3 Population Viability Analysis

Statistical methods and rigorous scientific approaches to understanding the viability of populations of plants of interest to conservation have not been undertaken.

3.4 Ramifications of Incomplete Data and Knowledge

Due to the limited understanding of the successional traits of montane heath in the project area, robust and site-specific mitigation strategies cannot be proposed for the Wet Tropics section of the project area. Generic rehabilitation methods for re-establishing functional plant communities in this dissected country are unlikely to be successful for the heath environment, but may have better success for woodland communities on gentle slopes found elsewhere on the site, and more so north of the Chalumbin - Woree 275 kV transmission line.

Addressing the data gaps discussed above can be achieved by formulating a focussed research investigation into plant succession in montane heath communities. It is recommended in this report that a specific zone derived from the 900 m contour, which coincides with the mean height of the cloud base and subsequently, the presence of montane heath communities, is set aside and quarantined from track construction and earthworks.

Currently, there is insufficient knowledge and practical examples to support successful rehabilitation of high elevation ridges and the montane heath community. Although a local plant nursery has successfully propagated a number of species from the local region, and quite possibly from the wind farm site, these have been for maintained garden environments and not for rehabilitation of remote tracts of linear clearing. Large scale rehabilitation of dryland and sclerophyll communities cannot rely on tube stock plantings, and to date, has mostly depended on direct-seeding with varying rates of success.

4.0 Desktop Review

Two sources of vegetation mapping were reviewed and are discussed.

4.1 Historical Vegetation Mapping

Earlier mapping and ecological accounts of vegetation are used under the RE framework as supplementary descriptions to the most current work. Tracey and Webb (1975) compiled the first detailed maps of vegetation of the wet tropics bioregion at a scale of 1:100,000.

Although the associated ecological descriptions of vegetation and bioregional perspective published by Tracey in 1982 focussed on vine forests due to its dominance in the region, useful accounts of sclerophyll communities within the mapping area were also given. These descriptions and mapping later formed the basis for Stanton and Stanton (2005).

4.2 Stanton and Stanton (2005)

Tracey and Webb's (1975) vegetation mapping was revised by Stanton and Stanton (2005) and produced with amendments at a scale of 1:50,000. This mapping provided finer resolution for the wet tropics bioregion and subsequently has greater effectiveness for environmental management and planning purposes. The descriptions, which are derived primarily from geology and floristic associations, forms a basis and broad floristic framework for the current regional ecosystem mapping concept and the vegetation descriptions for the Wet Tropics bioregion. Stanton and Stanton 2005 report on the high conservation value of the highland areas mainly extending southwards from the northern limit of the Herberton Range.

4.3 Regional Ecosystems (1999 - current)

Under Queensland's *Vegetation Management Act 1999* (VMA), the State's remnant vegetation is classified, mapped and described as regional ecosystems (Sattler and Williams, 1999). Vegetation is broadly defined as remnant and non-remnant, after which it is more accurately classified and described according to three main criteria: the bioregion in which the unit occurs (Thackway and Cresswell, 1995); the associated land zone (Wilson and Taylor, 2012); and the structural formation (modified from Specht, 1970) and floristic composition of the community (plant nomenclature follows Bostock and Holland, 2010). A unique three-number code is used to signify this combination, and a site-specific example is given below for Regional ecosystem 7.12.57: where:

- **7** corresponds with the biogeographic region (bioregion) in which the ecosystem occurs (Wet Tropics)
- **12** corresponds with the land zone (hills and lowlands on granitic rocks); and
- **57** typifies the structural and floristic characteristics of the vegetation community (Shrubland and low woodland mosaic with *Syncarpia glomulifera*, *Corymbia abergiana*, *Eucalyptus portuensis*, *Allocasuarina littoralis*, and *Xanthorrhoea johnsonii*, on moist and dry uplands and highlands on granite and rhyolite).

The wind farm site is bisected by the boundary of two bioregions, where the Wet Tropics bioregion covers the southern half of the site, and the Einasleigh Uplands bioregion covers the approximate northern half of the site. Regional ecosystem (RE) mapping for the wet tropics bioregion is at a scale of 1:50,000; whereas the Einasleigh Uplands bioregion mapping scale is 1:100,000.

Effectively, the Wet Tropics bioregion is therefore mapped at approximately twice the resolution of Einasleigh Uplands. Consequently, this affects the number of vegetation communities mapped; their conservation status under the VMA; and the spatial accuracy of the mapping. The RE mapping covering the whole wind farm site is provided in **Appendix B**. The Wet Tropics and Einasleigh Uplands RE mapping is provided in **Appendix C** and **Appendix D** respectively.

The following REs are mapped over the site:

Wet Tropics Bioregion Section (Appendix C)

7.12.30: Woodland to open forest mosaic with variable dominance, often including *Eucalyptus cloeziana*, *Corymbia abergiana*, *C. citriodora*, *E. portuensis*, *E. reducta*, *E. lockyeri*, *C. leichhardtii*, *E. atrata*, *E. pachycalyx* and *E. shirleyi*, on rhyolite and granite.

7.12.57: Shrubland and low woodland mosaic with *Syncarpia glomulifera*, *Corymbia abergiana*, *Eucalyptus portuensis*, *Allocasuarina littoralis*, and *Xanthorrhoea johnsonii*, on moist and dry uplands and highlands on granite and rhyolite.

Shrubland/low woodland mosaic with variable dominance, often including *Eucalyptus cloeziana*, *Corymbia abergiana, E. portuensis*, *E. reducta*, *E. lockyeri*, *C. leichhardtii*, *E. atrata*, *E. pachycalyx*, *E. shirleyi* and *Homoranthus porteri*, on rhyolite and granite

7.12.58: *Eucalyptus reducta*, *E. granitica*, *Corymbia dimorpha*, *C. citriodora* and *Syncarpia glomulifera* woodland, on granite and rhyolite.

7.12.65: Rock pavements or areas of skeletal soil, on granite and rhyolite, mostly of dry western or southern areas, often with shrublands to closed forests of *Acacia* spp. and/or *Lophostemon suaveolens* and/or *Allocasuarina littoralis* and/or *Eucalyptus lockyeri* subsp*. exuta*.

Einasleigh Uplands Bioregion Section (Appendix D)

9.12.4/9.12.2: (9.12.4) - *Eucalyptus shirleyi or E. melanophloia* with *Corymbia peltata* and/*or C. leichhardtii* low open woodland to low woodland on acid volcanic rocks. / (9.12.2) - Open forest commonly including *Eucalyptus portuensis*, *E. crebra* (sens. lat.), *Corymbia clarksoniana*, *C. citriodora* on steep hills and ranges on acid and intermediate volcanics close to Wet Tropics boundary.

9.12.30/9.12.20/9.12.4: (9.12.30) - *Corymbia leichhardtii +/- Callitris intratropica +/- Eucalyptus shirleyi* low woodland to low open woodland on rhyolite hills. / (9.12.20) - *Eucalyptus pachycalyx* and *E. cloeziana* woodland on acid volcanics. / (9.12.4) - *Eucalyptus shirleyi* or *E. melanophloia* with *Corymbia peltata* and/or *C. leichhardtii* low open woodland to low woodland on acid volcanic rocks.

Wet Tropics Bioregion (1:50 000)

Regional Ecosystem 7.12.30d

7.12.30d	
Description	Open-woodland to open-forest (10-20m tall) mosaic with variable dominance, often including *Eucalyptus cloeziana*, *C. citriodora*, *E. portuensis*, *E. lockyeri*, *C. leichhardtii*, *E. atrata*, *E. pachycalyx*, *E. reducta*, *C. intermedia* and *E. shirleyi.* There is often a very sparse to mid-dense secondary tree layer of *C. abergiana* and/or *C. stockeri*. A very sparse to sparse tall shrub layer may be present and can include *Acacia flavescens*, *Persoonia falcata*, *Bursaria spinosa* subsp. *spinosa*, *Allocasuarina inophloia*, *Petalostigma pubescens* and *Grevillea glauca*. A sparse to dense lower shrub layer may include *Jacksonia thesioides*, *Acacia calyculata*, *Xanthorrhoea johnsonii* and *Grevillea glossadenia*. The ground layer may be dominated by species such as *Themeda triandra*, *Heteropogon triticeus*, *Mnesithea rottboellioides*, *Arundinella setosa*, *Cleistochloa subjuncea*, *Eriachne pallescens* var. *pallescens*, *Lepidosperma laterale* and *Xanthorrhoea johnsonii*.
Special Values	Habitat for several locally restricted and disjunct species. Threatened species include *Micromyrtus delicata*, *Melaleuca sylvana*, *Diuris oporina*, *Homoranthus porteri*, *Grevillea glossadenia*, *Prostanthera* sp. (Dinden P.I.Forster+ PIF17342), *Acacia purpureopetala*, *Corymbia rhodops* and *Prostanthera clotteniana*. Other species of local significance are *Eucalyptus lockyeri*.
VMA Status	Least Concern
Biodiversity Status	No Concern at Present

Regional Ecosystem 7.12.57c

7.12.57c	
Description	Shrubland/low woodland (1.5-9m tall) mosaic with variable dominance, often including *Eucalyptus cloeziana*, *Corymbia abergiana*, *E. portuensis*, *E. reducta*, *E. lockyeri*, *C. leichhardtii*, *Callitris intratropica*, *E. atrata*, *E. pachycalyx*, *E. shirleyi*, *E. drepanophylla* and *Homoranthus porteri*, on rhyolite and granite. There is occasionally a very sparse to sparse secondary tree layer of *C. abergiana* and/or *C. stockeri*. A very sparse to sparse tall shrub layer may be present and can include *Persoonia falcata*, *Exocarpos cupressiformis* and *Melaleuca viridiflora* var. *viridiflora*. A sparse to dense lower shrub layer may include *Jacksonia thesioides*, *Acacia calyculata*, *Pogonolobus reticulatus*, *Xanthorrhoea johnsonii*, *Acacia humifusa*, *Dodonaea lanceolata* var. *subsessilifolia*, *Grevillea dryandri* subsp. *dryandri*, *Grevillea glossadenia*, *Acacia umbellata* and Ericaceae spp. The ground layer may be dominated by species such as *Themeda triandra*, *Xanthorrhoea johnsonii*, *Eriachne pallescens* var. *pallescens*, *Cleistochloa subjuncea*, *Borya septentrionalis*, and *Eriachne* spp. Includes open rocky areas dominated by herbs and grasses. This RE includes areas of 7.12.65k (rocky areas with shrubby/herbaceous cover) which are too small to map.
Special Values	Habitat for several locally restricted and disjunct species. Threatened species include *Micromyrtus delicata*, *Melaleuca sylvana*, *Melaleuca uxorum*, *Diuris oporina*, *Homoranthus porteri*, *Grevillea glossadenia*, *Prostanthera* sp. (Dinden P.I.Forster+ PIF17342), *Acacia purpureopetala*, *Corymbia rhodops* and *Prostanthera clotteniana*. Other species of local significance are *Eucalyptus lockyeri.*
VMA Status	Of Concern
Biodiversity Status	Of Concern

Regional Ecosystem 7.12.58

7.12.58	
Description	*Eucalyptus reducta* (Queensland stringybark), *E. granitica* (granite ironbark), *Corymbia dimorpha* (yellow jacket), *C. citriodora* (lemon-scented gum) and *Syncarpia glomulifera* (turpentine) woodland to open-forest. Granite and rhyolite. (BVG1M: 9d)
Special Values	None listed.
VMA Status	Of Concern
Biodiversity Status	Of Concern

Regional Ecosystem 7.12.65k

7.12.65k	
Description	Bare granite and rhyolite rock, of dry western areas, associated with shrublands to closed forests of *Acacia* spp. (wattles) and/or *Lophostemon suaveolens* (swamp mahogany) and/or *Allocasuarina littoralis* (black sheoak) and/or *Eucalyptus lockyeri* subsp. *exuta*. Dry western areas. Granite and rhyolite. (BVG1M: 28e).
Special Values	None listed; although habitat for several narrow endemic and threatened species including: *Grevillea glossadenia*, *Homoranthus porteri*, *Melaleuca uxorum* and *Plectranthus amoenus*.
VMA Status	Least Concern
Biodiversity Status	Of Concern

Einasleigh Uplands Bioregion (1:100 000)

Regional Ecosystem 9.12.4c/9.12.2 (mixed polygon)

9.12.4c	
Description	Low woodland to low open-woodland of *Callitris intratropica* (cypress pine) and *Eucalyptus shirleyi* (silver-leaved ironbark) and/or *E. melanophloia* (silver-leaved ironbark) +/- *Corymbia leichhardtii* (yellowjacket). The sparse mid layer can include juvenile canopy species, *Melaleuca* spp., *Dolichandrone heterophylla* (lemonwood), *Alphitonia pomaderroides*, *Petalostigma pubescens* (quinine), *Acacia bidwillii* (corkwood wattle) and *Grevillea* spp. The dominants in the grassy ground can include *Schizachyrium fragile* (firegrass), *Heteropogon contortus* (black speargrass) or *Themeda triandra* (kangaroo grass). Occurs predominantly on sandy shallow soils derived from granite on rolling low hills to hills. (BVG1M: 20a).
Special Values	None listed
VMA Status	Least Concern
Biodiversity Status	No Concern at Present

9.12.2	
Description	Mixed open-forest to occasionally low open-woodland including combinations of the species *Eucalyptus portuensis* (white mahogany), *Corymbia citriodora* (lemon-scented gum), *E. granitica* (granite ironbark) or *E. crebra* (narrow-leaved ironbark), *C. intermedia* (pink bloodwood) or *C. clarksoniana* (Clarkson's bloodwood) +/- *E. cloeziana* (Gympie messmate) +/- *Corymbia* spp. There is often an open to mid-dense sub-canopy containing canopy species +/- *Melaleuca viridiflora* (broad-leaved paperbark) +/- *Lophostemon suaveolens* (swamp mahogany) +/- *C. leichhardtii* (yellowjacket). The shrub layer varies from scattered shrubs to mid-dense and includes juvenile canopy species, *Acacia flavescens* (yellow wattle), *Callitris intratropica* (cypress pine), *L. suaveolens*, *Xanthorrhoea johnsonii* (grasstree) and *Petalostigma pubescens* (quinine). The dense grassy ground layer is generally dominated by *Themeda triandra* (kangaroo grass) +/- *Heteropogon triticeus* (giant speargrass) +/- *Mnesithea rottboellioides* (northern canegrass). In some areas, patches dominated by *E. moluccana* (gum-topped box) or *E. cloeziana* may occur. Occurs on rises, hill and ranges. (BVG1M: 9d).
Special Values	Old growth of this ecosystem is significant for a number of species including arboreal mammals. Habitat for vulnerable flora species including *Corymbia rhodops*.
VMA Status	Least Concern
Biodiversity Status	No Concern at Present

Regional Ecosystem 9.12.30a/9.12.20/9.12.4c (mixed polygon)

9.12.30a	
Description	Woodland to open-forest of *Corymbia leichhardtii* (yellowjacket) and *Eucalyptus cloeziana* (Gympie messmate) +/- E. portuensis (white mahogany) +/- *C. citriodora* (lemon-scented gum) +/- *E. cullenii* (Cullen's ironbark) +/- *Callitris intratropica* (cypress pine). Some canopy species can occur as emergents. The sparse to mid-dense shrub layer is dominated by juvenile canopy species, *Persoonia falcata*, *Grevillea glauca* (bushman's clothes peg) and *Allocasuarina inophloia* (stringybark sheoak) and a lower shrub with *Jacksonia thesioides* and *Xanthorrhoea johnsonii* (grass-tree) can occur. The sparse to mid-dense ground layer is dominated by *Themeda triandra* (kangaroo grass). Rocky rhyolite hills to steep hills. (BVG1M: 13a)
Special Values	The vulnerable species *Homoranthus porteri* is associated with this regional ecosystem.
VMA Status	Least Concern
Biodiversity Status	No Concern at Present

9.12.20	
Description	Woodland to low woodland of *Eucalyptus pachycalyx* (pumpkin gum) +/- *E. cloeziana* (Gympie messmate) +/- *Corymbia leichhardtii* (yellowjacket) +/- *Callitris intratropica* (cypress pine) +/- *E. portuensis* (white mahogany) +/- *E. cullenii* (Cullen's ironbark) or *E. atrata*. The mid-dense shrub layer includes juvenile canopy species, *Grevillea glauca* (bushman's clothes peg), *Persoonia falcata* and *Xanthorrhoea johnsonii* (grass-tree). The medium to dense grassy ground layer is mostly dominated by *Themeda triandra* (kangaroo grass). Occurs on steep rugged hills on acid volcanics. (BVG1M: 13a)
Special Values	This regional ecosystem contains a number of vulnerable species including *Corymbia rhodops*, *Grevillea glossadenia* and *Acacia purpureopetala*.
VMA Status	Least Concern
Biodiversity Status	No Concern at Present

9.12.4c	
Description	Low woodland to low open-woodland of *Callitris intratropica* (cypress pine) and *Eucalyptus shirleyi* (silver-leaved ironbark) and/or *E. melanophloia* (silver-leaved ironbark) +/- *Corymbia leichhardtii* (yellowjacket). The sparse mid layer can include juvenile canopy species, *Melaleuca* spp., *Dolichandrone heterophylla* (lemonwood), *Alphitonia pomaderroides*, *Petalostigma pubescens* (quinine), *Acacia bidwillii* (corkwood wattle) and *Grevillea* spp. The dominants in the grassy ground can include *Schizachyrium fragile* (firegrass), *Heteropogon contortus* (black speargrass) or *Themeda triandra* (kangaroo grass). Occurs predominantly on sandy shallow soils derived from granite on rolling low hills to hills. (BVG1M: 20a).
Special Values	None listed
VMA Status	Least Concern
Biodiversity Status	No Concern at Present

4.4 Aerial Photography Interpretation

Prior to field surveys, the aerial photography of the site was reviewed to identify a range of structural categories of vegetation. A stereoscope and stereo pairs of photographs were used for this purpose and later confirmed using digital imagery used in combination with a number of environmental layers (Geographical Information System - GIS). High resolution multi-band spectral imagery was also interpreted.

4.4.1 Development of Vegetation and Flora Survey Plan

A review was made of aerial photography and other digital imagery and layers to assist with developing a structured plan for sampling the vegetation and habitats likely to be intercepted by the proposal. The main focus of field investigations was along ridges and at proposed turbine sites, given that it was considered that these areas would receive the highest level of direct impact.

LiDAR was flown over the site and the mean height ranges of vegetation were derived through GIS. The following height classes were assigned to structural categories of vegetation across the site:

<1 m - Heathland with many areas of rock pavement and outcropping rock. Occurs above 900 m ASL and along exposed, windswept ridges. A majority of its representation is south of the transmission line. Characteristic species include: *Grevillea glossadenia*, *G. dryandri*, *Jacksonia thesioides*, *Pultenaea millarii*, *Acacia aulacocarpa*, *Eucalyptus lockyeri* subsp*. exuta* as isolated windswept specimens, *Gompholobium nitidum*, *Schizachyrium fragile*, *Cleistochloa subjuncea*, *Tripogon loliiformis*, *Eriachne humilis*, *E. mucronata*, *Panicum simile*, *Borya septentrionalis* (patches on scooped rock pavements), *Melaleuca uxorum*, *Cryptandra debilis* and *Melaleuca borealis*

1-2 m - Low woodland to shrubland with elements of heathland. Occurs primarily south of the transmission line and generally along ridges and exposed high points. Characteristic species include *Eucalyptus lockyeri* subsp*. exuta and Corymbia abergiana* as isolated windswept shrubs, *Homoranthus porteri*, *Acacia aulacocarpa*, *Allocasuarina littoralis*, *Corymbia abergiana*, *Grevillea glossadenia* and *Arundinella setosa*.

2- 10 m Low woodland and open woodland comprising trees, shrubs and a ground layer characterised by grasses, creepers, forbs and ferns. Many areas of exposed rock may be present, such as along ridges and rugged slopes. Also occurs on flatter land. Characteristic species include: *Corymbia abergiana (ridge tops)*, *Eucalyptus shirleyi* (mostly on flat land), *Eucalyptus lockyeri* subsp*. exuta*, *E. granitica*, *E. portuensis*, *Persoonia falcata*, *Grevillea mimosoides*, *Themeda triandra*, *Arundinella setosa*, *Hibbertia longifolia*, *Pseudopogonatherum contortum* and *Heteropogon triticeus.*

>10 m Mid-height woodland comprising trees, shrubs and a ground layer characterised by grasses, creepers, forbs and ferns. Exposed rocks may occur, but this category generally occurs on rolling hills, undulating land, gentle slopes and broad flay zones. Characteristic species include: *Corymbia citriodora*, *C. leichhardtii*, *Eucalyptus cloeziana*, *E. drepanophylla*, *E. portuensis*, *E. reducta*, *Pogonolobus reticulatus*, *Themeda triandra*, *Lepidosperma laterale* (wetter, well-developed woodlands), *Allocasuarina torulosa*, *Eucalyptus pachycalyx* (patchy distribution) and *Heteropogon triticeus.*

4.4.2 Identification of Habitats for R&Ts

Using the LiDAR described above, plus 8-band satellite imagery of the site, key habitats were identified on mapping. Given a majority of the habitats are associated with rocks, dissected ridges and high elevation areas, these habitats could be further assigned to the predicted presence of a number of conservation significant species, particularly *Homoranthus porteri*, *Grevillea glossadenia* and *Melaleuca uxorum.*

4.4.3 Identification of Conservation Significant Vegetation Types (REs)

The conservation significant vegetation types are associated with regional ecosystems 7.12.57c and 7.12.58 - both listed as Of Concern under the *Vegetation Management Act 1999*. Both these communities occur in the Wet Tropics bioregion section of the site, south of the transmission line on rocky landscapes. They are also associated with the presence of rare and threatened plants and a number of regionally restricted plant species (narrow endemics).

4.4.4 Identification of Significant Flora Diversity Areas

A key factor affecting the presence of the constrained plant species (conservation significant and narrow endemics species) is an approximate altitudinal demarcation of land which occurs above 900 m ASL. This is due to the exposure of the ridges in these zones and their inception of moisture from the cloud base (Ford and Hardesty, 2012). By applying the 900 m contour to mapping, a majority of the key biodiversity habitats were identified (**Appendix E**).

Mapping of rock outcrops and pavements also assisted in the identification fire-proof niches (**Appendix F**).

4.5 Database Searches

4.5.1 HERBRECS

HERBRECS is the Queensland Herbarium's (Department of Science, Information Technology, Innovation and the Arts) herbarium records management database. The herbarium is the repository for voucher collections of the Queensland flora. Records maintained in the HERBRECS data provide solid evidence of the presence of a species of plant at a particular location and at a given point in time. HERBRECS data and the specimen label information is therefore essential for mapping and predictive distribution modelling of plants of conservation interest and narrow endemic species. The HERBRECS data discussed in this report relates to voucher specimens of plants collected from within the area indicated in **Figure 2** and defined by the following coordinates (AMG Zone 55):

- Northwest corner: 307633 E, 8103872 S (480 m ASL) - approximately 8.5 km east of Dimbulah.
- Northeast corner: 341270 E, 8111535 S (504 m ASL) - approximately 10.5 km northeast of Walkamin, lower western slopes of Lamb Range.
- Southwest corner: 307945 E, 8070669 S (807 m ASL) - approximately 2 km southwest of Irvinebank.
- Southeast corner: 349529 E, 8073787 S (751 m ASL) - approximately 2.5 km northwest of Tarzali.

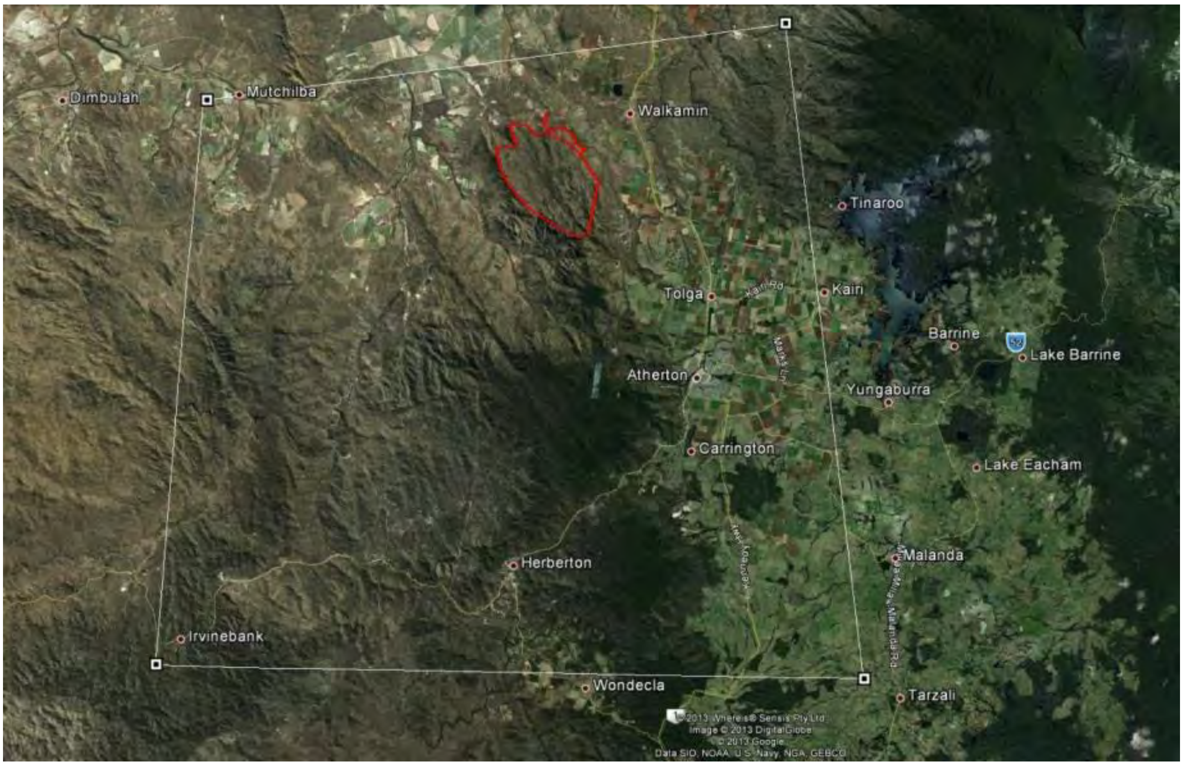

Figure 2 Queensland Herbarium HERBRECS search area (inside white line). The wind farm site is outlined in red.

A large proportion of the HERBRECS search area primarily east of the Kennedy Highway captures landforms supporting vine forest and mesic vegetation. The floristic composition of these communities is therefore of limited relevance to the sclerophyll woodlands and montane heathlands of the project site west of Walkamin. The broad zone of land and its rugged topography extending roughly southwest from the project site has noteworthy relevance however, and coincides with the geographical region encompassing the recognised floristically diverse areas of Baal Gammon, Stannary Hills, Irvinebank and Herberton. This region is a refuge for a large number of narrow endemic and conservation significant plants which are discussed in this report.

4.5.2 Naturalised Plants

The Queensland Herbarium defines naturalised plants as "non-native species that have successfully established and are reproducing without human intervention." In broad terms these are often considered to be weeds. Some species of naturalised plants have significant deleterious effects on the environment; whereas others can be relatively benign.

An examination of the Queensland Herbarium's current HERBRECS data indicates that 287 species of naturalised plants have been collected from region extending to south of Herberton, east to the Lamb Range and north to approximately Mareeba.

4.5.3 Wildlife Online

The Wildlife Online searches and discussion of species is given in RPS' report of 2011"Fauna, Vegetation & Flora Assessment - Proposed Mt Emerald Wind Farm" (RPS, 2011).

4.5.4 Protected Matters (EPBC)

The Protected Matters report of the EPBC Act 1999 and discussion of species is given in RPS' report of 2011"Fauna, Vegetation & Flora Assessment - Proposed Mt Emerald Wind Farm" (RPS, 2011).

4.6 Review of Conservation Significant and Important Flora

The following species of conservation significant plants were identified in searches of the EPBC Act's Protected Matters database, the Wildlife Online database and the Queensland's Herbarium database - HERBRECS. Because HERBRECS is based on validated and formally identified plants specimens held in the herbarium collection at Brisbane (BRI), they are considered the accurate and reliable account of what conservation significant plants are likely or do occur on the wind farm site. The species are summarised in **Table 1**.

Table 1 Summary of Conservation significant plant species confirmed to occur in region (HERBRECS data). Bolded species are confirmed to occur on the site. Vine forest taxa are excluded.

Family	Status	Botanical Name	Locality
Asteraceae	E	*Glossocardia orthochaeta* (F.Muell.) Veldkamp	STANNARY HILLS
Asteraceae	N	*Peripleura scabra* (DC.) G.L.Nesom	GREAT DIVIDING RANGE, C. 1.5KM NNW OF WALSH BLUFF, OFF CHANEL ROAD - SPRINGMOUNT ROAD.
Asteraceae	N	*Peripleura sericea* (N.T.Burb.) G.L.Nesom	STANNARY HILLS
Cycadaceae	V	*Cycas platyphylla* K.D.Hill	MUTCHILBA 17KM FROM RD TO IRVINEBANK VIA STANNARY HILLS
Euphorbiaceae	V	*Euphorbia carissoides* F.M.Bailey	STANNARY HILLS
Fabaceae	E	*Cajanus mareebensis* (S.T.Reynolds & Pedley) Maesen	PARADA NR DIMBULAH
Goodeniaceae	V	*Goodenia stirlingii* F.M.Bailey	GREAT DIVIDING RANGE, C. 200M NE OF WALSH BLUFF.
Lamiaceae	**V (NCA)**	***Plectranthus amoenus* P.I.Forst.**	**EX MT SPIDER TOP NR MAREEBA CULT THE GAP BRISBANE**
Lamiaceae	E	*Prostanthera clotteniana* (F.M.Bailey) A.R.Bean	NEAR BOUNDARY OF MT BALDY SF, WESTERN LOGGING AREA
Lamiaceae	E	*Prostanthera* sp. (Dinden P.I.Forster+ PIF17342)	TRIBUTARY OF OAKY CREEK OFF LEMONGRASS DRIVE C. 2KM WSW OF MT EMERALD
Mimosaceae	V	*Acacia guymeri* Tindale	SPRINGMOUNT ROAD, CA 2.3KM FROM CHISARI ROAD TOWARDS MAREEBA-DIMBULAH ROAD
Mimosaceae	N	*Acacia longipedunculata* Pedley	STANNARY HILLS
Mimosaceae	V	*Acacia purpureopetala* F.M.Bailey	NR MT EMERALD SW OF WALKAMIN (GPS 17 11 30 145 22 55)
Myrtaceae	V	*Corymbia rhodops* (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson	STANNARY HILLS, WNW OF HERBERTON
Myrtaceae	**V**	***Homoranthus porteri* (C.T.White) Craven & S.R.Jones**	**HERBERTON RANGE, NORTH-WEST OF TOLGA.**
Myrtaceae	E	*Melaleuca sylvana* Craven & A.J.Ford	HERBERTON RANGE, UPPER SLOPE OF MOUNT EMERALD, WEST OF TOLGA.
Myrtaceae	**E (NCA)**	***Melaleuca uxorum* Craven, G.Holmes & Sankowsky**	**HERBERTON RANGE, NEAR TOPO '967', NORTH-WEST OF TOLGA.**
Myrtaceae	E	*Micromyrtus delicata* A.R.Bean	BAAL GAMMON MINING LEASE
Orchidaceae	N	*Diuris oporina* D.L.Jones	W OF HERBERTON
Proteaceae	**V**	***Grevillea glossadenia* McGill.**	**WALSH BLUFF ON HEADWATERS OF GRANITE CK CA 4KM SSW OF WALKAMIN**
Rutaceae	V	*Zieria obovata* (C.T.White) J.A.Armstr.	STANNARY HILLS
Solanaceae	E	*Solanum angustum* Domin	STANNARY HILLS

4.7 Distribution of Conservation Significant Species

4.7.1 *Acacia purpureopetala*

A single collection has been made of this species on the south-western boundary of the project area. This collection represents the most northern and north-eastern distribution limit for *Acacia purpureopetala*. The population 'centres' (e.g. represented by the number of voucher specimens held in herbaria and plotted on mapping) are in the Irvinebank, Stannary Hills and the Silver Valley region to the south-west of the project area. A significant population has been confirmed on the scree slopes of Toy Creek (S. Gleed, pers. obs.). The species was not found during field surveys of the project area.

4.7.2 *Grevillea glossadenia*

Several collections and numerous sightings have been made from the project area of this distinctive species. It is also recorded from the Mt Emerald area immediately to the south of the project boundary. The species was frequently observed in the project area and across a range of habitats, including disturbed sites and vehicle track edges. In virtually all cases, it occurs on rocky ground. *Grevillea glossadenia* is the commonest occurring conservation significant species in the project area.

A single collection of *G. glossadenia* was taken from Abattoir Swamp between Mount Molloy and Julatten. This record represents the most northern distribution for the species and appears to be an outlier when plotted on mapping (i.e. mapping shows an obvious cluster of collections from the Irvinebank – Silver Valley region to the south the project area). Further, this is a single collection and details regarding the population size in this area are not known.

The most southern distribution of the species is from Ben Lomond mining lease west of the Harvey Range and west of Townsville. This collection also appears as an outlier and details regarding the population size are unknown.

4.7.3 *Homoranthus porteri*

This species was recorded at a number of sites within the project area growing directly on rock pavements in fissures, or on skeletal soils associated with shallow deposits on rock pavements. Occasionally it is found at the periphery of the rock pavement where rock gives way to deeper soils of a different landform. Where *H. porteri* grows in the project area, it forms monotypic thickets, but over a limited and relatively small area. The largest population observed on the site on the southwest ridge, formed a thicket approximately 6 x 6 m. Occasionally it is observed as scattered seedlings growing in rock crevices, and primarily in otherwise harsh environments in less than favourable growing conditions.

These observations are supported by a number of herbarium records from immediately south of the project area (Mt Emerald and surrounding slopes and ridges) where the same geology and similar vegetation formations are present.

A conspicuous population cluster appears on the mapping and from herbarium data to be around the Tumoulin-Archer Creek-Kaban region northwest of Ravenshoe.

A number of collections representing a population concentration have been made from the Baal Gammon Mine area between Watsonville and Herberton, and the species has been observed growing in association with *Acacia purpureopetala* on scree slopes above Toy Creek north of Baal Gammon.

The most northern distribution of the species is from the Mt Windsor region, assumed to be from 'dry' sclerophyll vegetation and from granite or rhyolite geology. This collection is represented by one herbarium specimen and the population size is not known.

The most southern distribution of the species is Puzzle Creek, Mt Zero – northwest of Townsville. This is represented by a single collection and no details are known regarding the population size in this area.

4.7.4 *Melaleuca uxorum*

Two populations are confirmed on the site. Listed as endangered under NCA, but not under EPBC Act. This species is considerably rare and at threat given the population centres are on the site and immediately south on Mt Emerald. It is a low-growing, scale-leaved shrub found on rocky ground in exposed, windswept situations along the southern ridge. One population had approximately 40-50 individuals, and the other at slightly lower elevation supported approximately 50 individuals. The species is confined to heath vegetation.

Populations of the species outside of the site are all found only a few hundred metres away on Mount Emerald. An outlier population occurs in the Silver Valley region.

4.8 Regional Endemic Species and Narrowly Distributed Plants

The following Queensland endemic plants (after Blake, 1954; Burbidge, 1960) have been recorded from the wind farm site (60 species):

Acacia bidwillii, *Acacia calyculata*, *Acacia flavescens*, *Acacia leptoloba*, *Acacia leptostachya*, *Acacia nesophila*, *Acacia whitei*, *Acrothamnus spathaceus*, *Astrotricha pterocarpa*, *Boronia bipinnata*, *Borya septentrionalis*, *Bursaria tenuifolia*, *Cajanus confertiflorus*?, *Capparis canescens*, *Cleistochloa subjuncea*, *Corymbia abergiana*, *Corymbia erythrophloia*, *Corymbia leichhardtii*, *Cryptandra debilis*, *Eriachne humilis*, *Eucalyptus cloeziana*, *Eucalyptus drepanophylla*, *Eucalyptus granitica*, *Eucalyptus lockyeri*, *Eucalyptus platyphylla*, *Eucalyptus portuensis*, *Eucalyptus reducta*, *Eucalyptus shirleyi*, *Gompholobium nitidum*, *Grevillea glossadenia*, *Hakea persiehana*, *Hakea plurinervia*, *Helichrysum newcastlianum*, *Helichrysum rupicola*, *Heliotropium tabuliplagae*, *Hibbertia longifolia*, *Hibbertia melhanioides*, *Homalium brachybotrys*, *Homoranthus porteri*, *Hovea nana*, *Indigofera bancroftii*, *Keraudrenia lanceolata*, *Larsenaikia ochreata*, *Leptospermum neglectum*, *Melaleuca borealis*, *Melaleuca monantha*, *Melaleuca uxorum*, *Notelaea punctata*, *Phyllanthus dallachyanus*?, *Phyllanthus simplex* var. *filicaulis*, *Pimelea sericostachya*, *Platysace valida*, *Plectranthus amoenus*, *Pseudanthus ligulatus*, *Pultenaea millarii*, *Stylidium confertum*?, *Stylidium eriorhizum*, *Trachymene bivestita*, *Velleia pubescens*?, *Xylomelum scottianum.*

Of the species listed above, the following have a particular habitat preference and are confined to ridges and rock pavements or a narrow band of fringing vegetation adjacent to this type of exposed, rocky topography on the site (23 species):

Acacia whitei, Astrotricha pterocarpa, Boronia bipinnata, Borya septentrionalis, Cleistochloa subjuncea, Corymbia abergiana, Cryptandra debilis, Eriachne humilis, Eucalyptus lockyeri subsp. exuta, Grevillea glossadenia, Heliotropium tabuliplagae?, Homoranthus porteri, Hovea nana, Indigofera bancroftii, Leptospermum neglectum, Melaleuca borealis, Melaleuca uxorum, Notelaea punctata?, Phyllanthus dallachyanus?, Plectranthus amoenus, Pseudanthus ligulatus, Pultenaea millarii, Stylidium eriorhizum.

Other species found on the site but not listed by Blake (1954) and Burbridge (1960) due to new species developments and taxonomic work could be present.

4.9 Regional Surveys

Ground surveys were completed of regional areas to gather information relating to the size of populations, their health and particular ecological characteristics that may be determinants of species presence on a certain landform or habitat type. Initially, surveys were completed of locations where the species are known to occur, and from where confirmed voucher collections have been made (e.g. herbarium records). Subsequently, surveys were carried out in habitats with similar physical attributes and characteristics as known sites, but where voucher collections have not been previously made.

Reference was made to population size estimates given in the SPRATS profiles for species where this data is available. In some instances, particularly *Acacia purpureopetala*, significant increases in population size (i.e. number of individuals) were recorded in the Silver Valley region south of Irvinebank (S. Gleed & S. De Ridder, pers. obs.). The Silver Valley populations of *A. purpureopetala* represent the most southern distribution of the species; and based on field observations in August 2012, one of the largest and most productive series of sub-populations.

Observations of several hundred seedlings of *A. purpureopetala* in skeletal, gravelly soils of granitic origin (Elizabeth Creek Granite) and with evidence of fire in the form of charcoal may indicate that the species responds to germination in a post-fire landscape.

A notable refuge and 'centre' for conservation significant plants, especially *A. purpureopetala*, was identified in a regional survey of Toy Creek, just north of the existing Baal Gammon mining lease near Watsonville.

5.0 Results

5.1 Description of Vegetation Communities

Eight vegetation communities were identified across the site. These are summarised below in **Table 2**, and profiles of each community provided in **Appendix G**.

Table 2 Vegetation communities of the wind farm site

Community Description	
Rustyjacket Woodland Woodland to open woodland of *Corymbia leichhardtii*, *Callitris intratropica* with *Eucalyptus shirleyi* and *Eucalyptus granitica* to 8 - 12 m. Occurs mainly the centre of the site in the EU bioregion section.	
Silver-leaf Ironbark Woodland Woodland to low open woodland of *Eucalyptus shirleyi* to 4 m with emergent *Callitris intratropica* (12 m). Best representation is near the centre of the site close in the EU and WT bioregion sections.	
Yellow Stringybark Woodland Grassy woodland of *Eucalyptus portuensis* with *Corymbia citriodora* to 7-12 m. Occurs on slopes of WT and EU bioregion sections.	

Community Description	
White Stringybark Woodland Tall, grassy woodland of *Eucalyptus reducta* with *Eucalyptus portuensis* and occasional *Corymbia citriodora* and *Eucalyptus drepanophylla* (sens. lat.) to 12-18 m. Occurs mainly in the WT bioregion section on slopes.	
Range Bloodwood Woodland and Shrubland Low, windswept woodland to open woodland and shrubland of *Corymbia abergiana* to 4 m on exposed ridges. Mainly occurs in the WT bioregion section close to ridge tops and edges.	
Montane Heathland Low heathland with scattered shrubs or isolated, wind-sheared and stunted trees of *Corymbia abergiana* and *Eucalyptus lockyeri* subsp. *exuta*. Includes patches of rock pavements and outcropping rock. Occurs above 900 m in the WT bioregion section.	

Community Description	
Narrow-leaf Ironbark and Lemon-scented Gum Woodland Woodland of *Eucalyptus drepanophylla* (sens. lat.) and *Corymbia citriodora* to 15 m. Occurs in northern aspects of the site mainly in the EU bioregion section.	
Dead Finish Woodland Grassy woodland to 8-10 m of *Eucalyptus cloeziana*, *Corymbia citriodora* and *E. portuensis*. Occurs mainly around the boundary junction of the WT and EU bioregion sections.	
WT - Wet Tropics, EU - Einasleigh Uplands	

5.2 Flora Composition

Over the period of study of the wind farm and investigations of more than 140 sites since May 2010, a voucher collection, photographic records and observations of the flora have been compiled. The checklist of vascular plants currently represents 279 species (see **Appendix H**) and has been validated by the Queensland Herbarium (**Appendix H1**).

The key findings of the flora surveys are the confirmed presence of the following conservation significant plants on the site: *Grevillea glossadenia*, *Homoranthus porteri*, *Plectranthus amoenus* and *Melaleuca uxorum*.

The cumulative checklist still has gaps given that surveys have not been completed every month of the year, and certain taxonomic groups are underrepresented (for example, ephemeral, short-lived taxa and herbs that may only be present during a particular month and under special climatic conditions.

5.2.1 Naturalised Plants - Weeds

From the HERBRECS data and observations, 43 weed species have been identified on the site, with a majority occurring along Kippen Drive (see **Table 3**).

Table 3 Naturalised plants recorded from the site (44 spp.)

Family Name	Botanical Name
Asteraceae	*Ageratum conyzoides* L. subsp. *conyzoides*
Asteraceae	*Bidens bipinnata* L.
Asteraceae	*Bidens pilosa* L.
Asteraceae	*Crassocephalum crepidioides* (Benth.) S.Moore
Asteraceae	*Emilia sonchifolia* (L.) DC.
Asteraceae	*Praxelis clematidea* R.M.King & H.Rob.
Asteraceae	*Synedrella nodiflora* (L.) Gaertn.
Asteraceae	*Tridax procumbens* L.
Caesalpiniaceae	*Chamaecrista rotundifolia* (Pers.) Greene var. *rotundifolia*
Caesalpiniaceae	*Senna occidentalis* (L.) Link
Caesalpiniaceae	*Senna pendula* var. *glabrata* (Vogel) H.S.Irwin & Barneby
Convolvulaceae	*Ipomoea hederifolia* L.
Fabaceae	*Centrosema molle* Mart. ex Benth.
Fabaceae	*Desmodium tortuosum* (Sw.) DC.
Fabaceae	*Macroptilium atropurpureum* (DC.) Urb.
Fabaceae	*Stylosanthes humilis* Kunth
Fabaceae	*Stylosanthes scabra* Vogel
Lamiaceae	*Hyptis suaveolens* (L.) Poit.
Malvaceae	*Sida cordifolia* L.
Malvaceae	*Sida rhombifolia* L.
Malvaceae	*Urena lobata* L.
Mimosaceae	*Mimosa pudica* var. *unijuga* (Walp. & Duchass.) Griseb.
Passifloraceae	*Passiflora foetida* L.
Poaceae	*Chloris virgata* Sw.
Poaceae	*Cynodon dactylon* (L.) Pers. var. *dactylon*
Poaceae	*Dactyloctenium aegyptium* (L.) Willd.
Poaceae	*Eleusine indica* (L.) Gaertn.
Poaceae	*Hyparrhenia rufa* subsp. *altissima* (Stapf) B.K.Simon
Poaceae	*Megathyrsus maximus* (Jacq.) B.K.Simon & S.W.L.Jacobs var. *maximus*
Poaceae	*Melinis minutiflora* P.Beauv.
Poaceae	*Melinis repens* (Willd.) Zizka
Poaceae	*Setaria pumila* (Poir.) Roem. & Schult. subsp. *pumila*
Poaceae	*Sporobolus jacquemontii* Kunth
Poaceae	*Sporobolus pyramidalis* P.Beauv.
Poaceae	*Themeda quadrivalvis* (L.) Kuntze
Poaceae	*Urochloa decumbens* (Stapf) R.D.Webster
Polygalaceae	*Polygala paniculata* L.
Rubiaceae	*Mitracarpus hirtus* (L.) DC.
Rubiaceae	*Richardia brasiliensis* Gomes
Sparrmanniaceae	*Triumfetta rhomboidea* Jacq.
Verbenaceae	*Lantana camara* L.
Verbenaceae	*Stachytarpheta australis* Moldenke
Verbenaceae	*Stachytarpheta cayennensis* (Rich.) Vahl
Verbenaceae	*Stachytarpheta jamaicensis* (L.) Vahl

5.3 Description of Specialist Habitats

The flora of the rock pavements and ridges within the wind farm site have special and unique qualities. Many of the plant species found in these harsh montane environments do not occur in other habitats and are almost entirely restricted to ridges and rocky ground with skeletal soil.

The simplest expression of plant niche utilisation can be determined from basic presence/absence observations, where for example, the conservation significant shrub *Homoranthus porteri* is rarely, if ever, encountered in woodlands where a grass layer of *Themeda triandra* is present, but is always found on rock pavements, ledges or rocky ridges with the barest of soil cover.

Repeated field surveys, plant collections and species mapping confirm that the rock-dominant habitat outlined here is the unique environment in which a majority of the conservation significant and narrow endemic species are found.

5.3.1 Rock Pavements

Description: These features are characterised by an expanse of rhyolite in a near horizontal plain. The surface is relatively unbroken (cf. ridges). They are variously referred to as rock plates, rock platforms and rock shelves.

The florisitics structure and composition of vegetation of rock pavements is sparse and typically supports relatively few species of plants. A reason for this is the absence or very limited development of soil and growth media, which congregates in fissures, crevices, settles in hollows or is captured by woody debris and in surface irregularities.

Soil: Soil formation is slow and dependent in the early stages on the presence of foliose lichens, mosses and small plants that are able to establish in rock cracks and fissures. The soil veneer is thin but can have a very high organic content which is subsequently rich in humus. When not integrated with sand or clay, it has a loamy, peat-like structure with good water-holding capacity. These peaty soils (**Plate 6**) are derived from foliose and crustose lichens, mosses, and decomposing leaf litter from shrubs with microphyll leaves such as *Homoranthus porteri*, *Polycarpaea spirostylis* and *Borya septemtrionalis*. The roots of herbaceous plants and grasses and the rock ferns *Cheilanthes nitida* and *C. nudiuscula* play an important soil-contributing role, where the fronds die-back in the driest times, remaining dormant through underground rhizomes until new foliage regenerates during more favourable growing periods.

Plate 7 Humus rich soil associated with rock pavements is derived from mosses, lichens and decaying plant matter.

Floristic composition: *Acacia humifusa*, *Polycarpaea corymbosa*, *Pseudanthus ligulatus* subsp. *ligulatus*, *Borya septentrionalis*, *Tripogon loliiformis*, *Eriachne humilis*, *E. mucronata*, *Schizachyrium fragile*, *Aristida superpendens*, *Sedopsis* sp. (Bulimba Station P.I.Forster+ PIF14742), *Cheilanthes nitida*, *C. nudiuscula*. Stunted trees and shrubs are infrequent, and are usually widely spaced and grow in crevices or between larger rocks and can include *Acacia aulacocarpa* (forming dominant thickets), *Maytenus disperma*, *Homoranthus porteri*, *Grevillea glossadenia* and *Eucalyptus lockyeri* subsp. *exuta*, and occasionally *Corymbia abergiana*. Representatives of the genus *Plectranthus* are usually represented on rock pavements and includes the species *P. amoenus* and *P. graveolens*.

In some instances, wattles (*Acacia* spp.) dominate a rock pavement, where they form tangled thickets typically comprising a single species. For example, *Acacia aulacocarpa* forms dense, woody thickets to 1.8 m tall on high altitude rock pavements in the southwest of the site. At slightly lower elevation, and often in association with surrounding low open woodland of *Eucalyptus shirleyi*, *A. humifusa* forms a layer to 40 cm on more fractured rock pavements. *Acacia umbellata* may also form dominant stands in this zone. North of the transmission line A*. leptostachya* grows as a dense shrubland to 3 m usually at the periphery of the rock pavement. Where the rock pavement grades into the ridge (see below), two species of wattle become more frequent: *A. calyculata* and *A. whitei*.

Ecological values: Rock pavements and their perimeters are the unique habitat environment for conservation significant plants including *Homoranthus porteri*, *Melaleuca uxorum* and *Plectranthus amoenus*. These species rely on the soil-deficient surfaces and are not found in adjacent woodlands where soil conditions are improved.

Because of the near-absence of flammable plant material on rock pavements, fires are more or less excluded; and hence this habitat has refugial qualities because of the fire-proof niche.

When disturbed, rock pavements are prone to invasion by wind dispersed Asteraceae weeds (daisies); particularly the environmental weed *Praxelis clematidea*.

Distribution: The most floristically diverse rock pavements occur south of the transmission line at elevations above 900 m, where cloud stripping for moisture is a driver of montane heath vegetation communities. Less diverse features are found north of the transmission line and support significantly fewer regionally restricted species.

5.3.2 Ridges

Description: Ridges and large areas of outcropping rhyolite are separate as a topographical unit from the more uniform surfaces of rock pavements. Stony ridges are characterised by sections of outcropping rock and large angular boulders. Some of these ridges give way abruptly to precipitous drop-offs, the faces of which are sometimes broken by a series of rock shelves and narrow terraces. Some sections of the ridges south of the transmission line are narrow and not much wider than 20 m.

The presence of taller woodlands usually comprising *E. reducta* and *E. drepanophylla* with *Allocasuarina torulosa* in the lower tree layer on west-facing slopes or sheltered valleys signifies a change in landform and the presence of improved soil conditions and more sheltered aspects.

Floristic composition: Typical trees on ridges include *E. lockyeri* subsp. *exuta*, *Corymbia abergiana*, *C. intermedia* and *Maytenus disperma*. *Allocasuarina littoralis* and *E. portuensis* may also be present. Shrubs include *Homoranthus porteri* (south of transmission line), *Xanthorrhoea johnsonii*, *A. calyculata* and *A. whitei*. A secondary shrub layer can be dominated by *Jacksonia thesioides*, *Gompholobium nitidum*, *Grevillea dryandri* subsp. *dryandri*, as well as younger generation plants of *G. glossadenia*. Less frequently low heath-type plants are present including *Boronia bipinnata*, *Zieria minutiflora*, *Cryptandra debilis*, *Pultenaea millarii*, *Mirbelia pungens*, *M. speciosa* subsp. *ringrosei*, *Sannantha angusta*, *Melaleuca borealis* and *Jacksonia thesioides*. The grasses *Cleistochloa subjuncea*, *Arundinella setosa*, *Eriachne mucronata* and *Themeda triandra* are relatively common.

Ecological values: Ridges south of the transmission line are narrow and accordingly host narrowly distributed plant communities. They are also key habitat for *Homoranthus porteri* and *Grevillea glossadenia*, as well as the narrow endemic species similarly found on rock pavements. One of the populations of *Melaleuca uxorum* found on the site, occurs on a windswept ridge.

Because of the narrow definition of ridges, they act as important conduits and pathways for genetic flow between plants that are restricted to them.

Above 900 m ASL and south of the transmission line, ridges are the main environment of the montane heath vegetation type.

Distribution: The most floristically diverse ridges occur south of the transmission line. North of the transmission line, ridges become wider and less dissected and rocky. Here, more widespread woodland types occupy ridges and notably fewer conservation significant plants are found.

5.4 Population Viability

Population viability refers to a species' capacity to retain a persistent and viable local population in the wild (i.e. within the location and habitat where each population occurs). A definition of *viable* in reference to population viability analysis and conservation planning is given by Akçakaya and Sjögren-Gulve (2000) as: "Viability of a species in a given geographic region is often expressed as its risk of extinction or decline, expected time to extinction, or chance of recovery."

The viability of a plant population relies on a number of factors, including but not limited to:

- population size (number of individuals);
- specificity of habitat (reliance on certain habitat attributes); and
- area and ordination of habitat (linear features are prone to change and external influence).

Negative consequences for the viability of a population of plants can occur as a result of habitat fragmentation and isolation (Klank, *et al*. 2010). These effects are obviously more profound for species of plants that grow in spatially constrained environments (e.g. ridges, rock pavements, fringes of wetlands).

Plant populations on the wind farm site of species such as *Homoranthus porteri* and *Melaleuca uxorum*, which both grow in specific, poorly represented habitats associated with ridges and rock pavements could be adversely threatened by clearing for tracks and the turbine footprint (assuming the respective species grows within the disturbance footprint). Falk (1991) suggests that these types of species could be considered as *edaphic specialists*: relying on a particular geology and soil environment and consequently may be prone to population demise at the micro-scale.

Grevillea glossadenia exhibits greater plasticity in its preference for habitat, and is found in a variety of environments ranging from ridges, to track edges and infrequently, in woodland adjoining ridges. Given this species' propensity for greater habitat tolerance, plus its capability of forming significantly larger and spatially diffuse populations, it is likely to be more resilient to the effects of habitat modification. This shrub is often encountered as seed-derived plants growing in rock spoil and even in stockpiled road base material. It is also one of the descendants of the horticultural Grevillea 'Orange Marmalade' - recognised by the nursery trade and growers alike to be an exceptionally hardy plant resilient to even errant encounters with lawnmowers.

The approximate population sizes for conservation significant plants are summarised in **Table 4**, and are based on observations made during walking traverses of ridges and the proposed routes of the access and cabling tracks linking each turbine.

Table 4 Approximate population size and descriptions of conservation significant and narrow endemic plants

Species	Status	Distribution - within site	Distribution - regional	Population estimate - overall site	Population estimate - impacted zone	Habitat	Notes
Cryptandra debilis	-	Restricted to ridges and rocky ground dominated by heath vegetation, but occasionally in sparse open woodland. Greatest representation in Wet Tropics bioregion, with isolated individuals found on ridge approaching Walsh Bluff.	Narrow - found in rocky country extending SW through Baal Gammon to Silver Valley and along Herberton Range.	?	<200 individuals	Confined to rocky substrates, ridges and more exposed situations. Found in montane heath and sparse open woodland.	Narrow endemic to region.
Grevillea glossadenia	V	Widespread in rocky habitat of the Wet Tropics bioregion section of site. Relatively common along ridges above 900 m, but rarely found under woodland cover.	Found in Herberton Range and south to Ravenshoe. Mt Garnet Road, Silver Valley, Irvinebank.	>500	300-400	Most common on exposed ridges, but also found on track edges and very well-lit woodlands close to ridges and almost exclusive to Wet Tropics bioregion section of site. Responds to ground disturbance of rocky sites and will regenerate in rock spoil.	With Grevillea dryandri, this species is the commonest Grevillea on the site in the southern portion.
Homoranthus porteri	V	More or less confined to SW ridges of the Wet Tropics bioregion section, with isolated populations (x2) in Einasleigh Uplands bioregion section.	?	>400	300-350	When mature, forms thickets on rock pavements or their edges, and along exposed rocky ridges. Not found in woodland on slopes.	Can be common in patches on exposed ridges and frequently on rock pavements or their edges.
Hovea nana	-	Generally found south of the transmission line on woodland edges but in association with surface rocks.	?	?	<100	Edges of woodlands and along ridges.	Narrow endemic to region.
Indigofera bancroftii	-	Primarily south of the transmission line and along ridges at altitude ~ above 850 m.	In the Irvinebank-Herberton-Watsonville region.	?	<100	Rocky ground on ridges and edges of woodlands.	Narrow endemic to region.

Species	Status	Distribution - within site	Distribution - regional	Population estimate - overall site	Population estimate - impacted zone	Habitat	Notes
Melaleuca uxorum	E	Very limited and narrow distribution on southern part of ridge in SW portion of site. Two separate populations confirmed.	Restricted to Mt Emerald, the site and an outlier population in the Silver Valley region.	~120+	<120	Very restricted on windswept east-facing rock pavement/ridge complex.	Highly restricted and exceptionally rare - only two populations found in site, although extreme SW corner not surveyed.
Mirbelia pungens	-	Very uncommon plant found only along windswept ridge of SW portion of site in one location.	?	<100	<100	Narrow - on exposed ridge with outcropping rock and small rock pavements - with *Corymbia abergiana*.	Narrow endemic to region. Restricted to exposed ridges in SW sector of site.
Mirbelia speciosa subsp. *ringrosei*	-	Uncommon plant found only along windswept ridge of SW portion of site in one location.	Irvinebank, Watsonville region.	<200	<100	Narrow - on exposed ridge with outcropping rock and small rock pavements - with *Corymbia abergiana*.	Narrow endemic to region. Restricted to exposed ridges in SW sector of site.
Plectranthus amoenus	V	Recorded from near Turbine 66, but possibly found on rock pavements of SW portion of site. Species identification difficult and may intergrade with other species of *Plectranthus*.	?	?	<50	Confined to rock pavements with no tree cover on ridges or pavements at lower elevation interspersed in woodland with *Callitris intratropica* and *Corymbia leichhardtii*.	Difficult taxon to identify in field, but *Plectranthus* favours rock pavements and very rocky ground. Rarely found under woodland cover.

6.0 Constraints and Opportunities

An assessment of the environmental constraints and opportunities relative to the wind farm project area can help inform decisions on the positioning of turbines and access tracks. This section identifies and describes the environmental limitations and prospects for practical options aimed at precluding and restricting impacts to environmentally sensitive matters such as conservation significant plants and unique vegetation types.

6.1 Constraints - Vegetation and Flora

The south-west section of the project area and a majority of the land south of the 275 kV transmission line possesses the highest status in regard to the landscape condition, vegetation integrity, floristic composition of conservation significant and restricted plant species, and near-absence of weeds.

The elevation increase to 900 m and greater, plus the degree to which the land is dissected by ravines, rocky bluffs, rock shelves and narrow ridges gives rise to unusual and poorly represented montane heath vegetation along the southwest ridge of the project site. Proposed turbines (as shown in **Appendix A**) 35 to 42 are situated in this area. Other turbines located above outliers of the 900 m contour include 43, 44, 45, and 46.

6.2 Opportunities - Vegetation and Flora

The least constrained aspects of the project area are found to the north of the 275 kV transmission line and across the east-facing slopes of the eastern section of the property. With the exception of the most south-eastern section of the site (i.e. the land that approaches Mt Emerald), these zones have lower diversity in relation to the presence of plants of interest to conservation, and also support less diverse vegetation types.

Across the broad areas of the site described above, mixed woodlands occur. These typically comprise combinations of trees such as lemon-scented gum (*Corymbia citriodora*), rusty jacket (*C. leichhardtii*), *Eucalyptus lockyeri* subsp. *exuta* (no common name), narrow-leaf ironbark (*E. drepanophylla* sens. lat.), granite ironbark (*E. granitica*), yellow stringybark (*E. portuensis*) silver-leaved ironbark (*Eucalyptus shirleyi*) and cypress pine (*Callitris intratropica*). The ground layer of these woodlands is nearly always dominated by kangaroo grass (*Themeda triandra*) and broombush (*Jacksonia thesioides*).

The dominance of kangaroo grass is an indicator of better soil conditions; whereas, the presence of the tufted grass *Cleistochloa subjuncea* usually indicates harder, less fertile ground conditions. Kangaroo grass, when the dominant species, is generally found on wetter, gentle slopes, valleys and flat areas. It is also found on ridges, where it is noticeably less abundant and generally replaced by *C. subjuncea*.

Two plant species of interest to conservation were observed in low abundance in the woodlands described above: *Grevillea glossadenia* and the ground orchid *Habenaria elongata*. The latter species was observed in a sheltered valley in the centre of the southern portion of the site and represent a new southern distribution limit of some 100 km from its previously known southern limit. It is not listed under conservation legislation; however, the record highlights the significance of the southern portion of the site. Given its presence in a valley, the population of this orchid is unlikely to be affected by the proposal.

Weedy grasses also feature more prominently north of the 275 kV transmission line and in the eastern sector of the site. Molasses grass (*Melinis minutiflora*) forms dense patches on wet, eastern slopes closer to the Kennedy Highway side of the site. A number of these high points which are suited to turbine placement are topographically constrained by steep gradients and longer access approaches. They nevertheless, hold the lowest vegetation-ground layer floristic integrity because of the presence of modifying weedy grasses. Unfortunately, strategic repositioning of turbines from this area (as shown on early project layouts) because of visual amenity may result in significant impacts to environmental values in other areas of the site where biodiversity integrity is highest.

The comparatively lower vegetation and flora values associated with the land described above provide the best opportunities for limiting and greatly decreasing the level of impact on matters of National Environmental Significance, as well as reducing the impact on the unique montane heath vegetation community, which commensurately supports the highest numbers and most significant populations of conservation significant plants.

6.3 Constraints - Geological and Landform

Although a detailed geological investigation is not included in the scope of this report, rock type and characterisation and the position in the landscape are important determinants of unique vegetation communities, notably the montane heath vegetation which is restricted to windswept, exposed ridges above 900 m ASL.

The series of ridges south of the 275 kV transmission line are narrowest, and in some instances not much wider than 15 m with eastern-facing precipitous drop-offs. The ridge tops between proposed turbines 36 and 41 (and possibly 42, which has not been investigated) form the niche environment for montane heath communities and the specific habitat for the most significant populations of *Homoranthus porteri*, plus two critically important populations of the endangered *Melaleuca uxorum*.

Sections of ridge between proposed turbines 43 and 48 are also narrow with steep sides. Between this section though, conservation significant plant species are less abundant, but include populations of *Homoranthus porteri* and more commonly, *Grevillea glossadenia*.

Access tracks and cabling to a constructed cleared width of 10 m, and 20 m wide (minimum) at turbine pads will effectively remove major components of populations of *Homoranthus porteri*, with the greatest impact expected along the narrowest ridges between proposed turbines 36 and 42 (see **Appendix A**). More concerning, would be the loss of one of only two populations of the endangered *Melaleuca uxorum* found in the vicinity of turbine 38. Another population of *M. uxorum* is encountered between turbine 37 and 38

The population density of conservation significant plants, and the presence of a noteworthy number of narrow endemic plant species between proposed turbines 36 and 42 render this section of the project site highly constrained.

6.4 Opportunities - Geological and Landform

The undulating and more moderate landform characteristic of the northern section of the project area beyond the 275 kV transmission line affords a number of construction and turbine placement opportunities. These include greatly improved access; less rugged terrain; comparatively low abundance of conservation significant plants; limited availability of niche habitats for narrow endemic and rare and threatened plants; a majority of the land is below the crucial 900 m contour associated with unique and important vegetation types; and the land has a higher level of pre-disturbance than the land south of the transmission line.

6.5 Constraints and Opportunities Mapping

Mapping showing the environmentally constrained zones of the project area is provided in **Appendix I**. The mapping shows environmentally sensitive features such as watercourses; highlights the importance of the land south of the 275 kV transmission line; delineates key plant habitat areas; identifies pre-existing disturbance zones such as tracks; shows the proposed turbine footprints and interconnecting tracks; and demarcates quarantine areas of high ecological significance.

The mapping is based on the confirmed presence of significant environmental features that are not found elsewhere in the project area, and in some instances, are poorly represented at a regional scale. It is derived from a combination of a range of results gathered from field investigations over three years, plus observations made of *ex situ* populations of plants.

The balance of the project area shown on the mapping (i.e. land not included in the mapping as constrained) is considered to be relatively unconstrained. On the condition that the highest level of impact avoidance and mitigation is practiced during the construction and operation of the wind farm, losses to environmental values could be manageable.

7.0 Assessments of Impacts

The assessment of impacts is based on the layout provided by the proponent in July 2012 and further more June 2013. Classifying and determining the severity of potential impacts is important in order to formulate the most appropriate mitigation strategies, measures and site specific management practices to preclude or offset the impacts.

This report has described and highlighted the significant ecological zones of the project site, with an emphasis on identifying priority vegetation and flora areas. The report also identifies parts of the site with lower environmental values and fewer constraints. A key part of the assessment is to determine what areas are likely to be prone to irreversible or difficult to manage impacts. Avoidance of the impact is the first line of sustainable environmental practice, and because of the sensitivity of certain parts of the site, this report strongly recommends that avoidance is practiced as the foremost priority.

Construction of the wind farm however, will result in a range of unavoidable impacts. These will range in severity from low to relatively high. Direct impacts will occur primarily as a result of vegetation cover clearing and consequently from disturbance and alteration of the soil and ground features.

Less prominent, indirect impacts could become evident over time after the project's construction and when the frequency of machinery and surface disturbance reduces or is finalised. Due to the unknown nature and subtlety of these indirect impacts, a number of predictions have been made and based on the most landscape-relevant information available. Some of these predictions were derived from regional surveys of similar landforms with floristic affinities to the project site; and where these surveys did not yield sufficient information, some predictions were derived from an interpretation of pertinent literature.

7.1 Project Description

The project proposes to establish 63 wind turbines each with a construction pad measuring a minimum of 40 x 30 m. In real terms (i.e. the area of land modified beyond its natural condition) this equates to 6 ha of land being cleared, levelled and prepared with a range of imported or introduced materials including road base, concrete, sand and other construction materials. Areas given in this report are minimum, and it is expected that larger areas of clearing will be required for certain construction aspects of the project.

Based on the project layout supplied by the proponent (**Appendix A**), the network of tracks that will be created between each turbine for access and underground cabling will a proposed construction width of 10 m. This network of tracks will require 51 ha of land to be cleared and modified as described above, with the main modification being trenching to accommodate underground cabling. The depth of the trenching is unknown.

Other clearing and construction modifications that could impact on the environmental values of the site include the construction of the associated substation, and the separately proposed concept of the Asia Pacific Energy Innovation Centre (APEIC), which is understood to be planned at the northern end of the project site.

7.2 Impacting Processes

7.2.1 Habitat Loss and Landform Modification

Loss of rock pavements south of the transmission line could have a higher level of impact significance, given that these features are represented by small areas, and that access tracks are likely to traverse or intersect them. Therefore the probability of direct impacts to specific plant habitats represented as rock pavements is reasonably high.

7.2.2 Erosion and Sedimentation

Following track and pad construction, an increased potential for soil erosion will be present. Different sections of the site have different soil textures and structures, and therefore, the potential for erosion is varied. Slope and rainfall intensity will also affect the rate and severity of soil erosion.

No sodic soils have been observed on the site, and therefore, deep erosion comprising tunnelling and gullies is not expected on moderately inclined landforms. The track ascending into the site however, is steeply inclined, and it is expected that erosion and soil movement will be at its greatest along this section of the track. Interconnecting sections of track between turbines will also be affected differently by erosion - again, dependent on the degree of slope and severity of rainfall events.

7.2.3 Weed Incursion

Weeds pose a great threat to the integrity and function of the vegetation of all aspects of the wind farm site. Some weeds have established in the site in recent times, and most probably as a result of construction of transmission line and its associated track network.

Some zones of the site have probably suffered longer term weed incursions possibly as a result of grazing at lower elevation. The most significant manifestation of weed invasion can be seen adjacent to both sides of the main access road into the site along Kippen Drive. In this section, loss of native woodlands through prior land clearing, plus road verge maintenance have resulted in large areas being infested and dominated by weedy grasses and shrubs including grader grass (*Themeda quadrivalvis*), stylo (*Stylosanthes scabra* and other species), Hyptis (*Hyptis suaveolens*) and stinking passion flower (*Passiflora foetida*).

Higher on the site, where traffic and human movement is lower and less frequent, weed presence is found wherever land has been cleared and modified. Weeds observed on the site at higher elevation include Praxelis (*Praxelis clematidea*), molasses grass (*Melinis minutiflora*), guinea grass (*Megathyrsus maximus* var. *maximus*), thatch grass (*Hyparrhenia rufa*) and pigeon grass (*Setaria pumila*). Isolated occurrences of a tall rat's tail grass (*Sporobolus* sp.) and Lantana (*Lantana camara*) can be found around transmission line tower pads.

Weed incursion results in loss of vegetation and landscape integrity. Weeds affect vegetation function, alter the floristic composition, impede or stop natural regeneration and can have a profound effect on the fire ecology of a region.

Species of weeds that have a high potential to enter the site through construction will be those found along the access road edges; those which are already present at higher elevation; and a range of other deleterious species generally found in drier landscapes. An indicative list is provided below, but is by no means exhaustive.

Grasses: Rat's tail grasses (*Sporobolus pyramidalis*, *S. natalensis*, *S. jacquemontii*), thatch grass (*Hyparrhenia rufa* and *H. hirta*), graders grass (*Themeda quadrivalvis*), pigeon grasses (*Setaria pumila* and other weedy *Setaria* species), fountain grasses (*Pennisetum setaceum* and other weedy *Pennisetum* species), molasses grass (*Melinis minutiflora*), guinea grass (*Megathyrsus maximus*), red natal grass (*Melinis repens*), signal grass (*Urochloa decumbens*). **Potential other species:** gamba grass (*Andropogon gayanus*), buffel grass (*Cenchrus ciliaris*).

Vines: scarlet morning glory (*Ipomoea hederifolia*), black-eyed Susan (*Thunbergia alata*), rubber vine (*Cryptostegia grandiflora*), siratro (*Macroptilium atropurpureum*), stinking passion flower (*Passiflora foetida*), glycine (*Neonotonia wightii*), climbing Asparagus (*Asparagus plumosus*)

Creepers/ground layer forbs - Praxelis (*Praxelis clematidea*), blue top (*Ageratum conyzoides*), thickhead (*Crassocephalum crepidioides*), cobbler's pegs (*Bidens pilosa* and *B. bipinnata*), Tridax daisy (*Tridax procumbens*), snakeweed (Stachytarpheta jamaicensis, S. cayennensis), wynn cassia (*Chamaecrista rotundifolia*), Singapore daisy (*Sphagneticola trilobata*), white eye (*Mitracarpus hirtus*), Mexican clover (*Richardia brasiliensis*).

Succulents: sisal and century plant (*Agave sisalana* and *A. vivipara*), mother-of-millions (*Bryophyllum* species). **Potential other species:** Parthenium (*Parthenium hysterophorus*), cactus (horticultural species and others).

Shrubs: Hyptis (*Hyptis suaveolens*), stylo (*Stylosanthes scabra* and other species), Japanese sunflower (*Tithonia diversifolia*), Cinderella weed (*Synedrella nodiflora*), Lantana (*Lantana camara*), sicklepods (*Senna* spp.), Urena burr (*Urena lobata*), flannel weed (*Sida cordifolia*)

7.2.4 Loss of Vegetation Integrity

Loss of species and structural integrity of the original vegetation cover will occur as a result of land clearing. Large-class trees are generally found on sheltered slopes and in valleys, and rarely along ridges and high points. Nevertheless, larger trees form the framework of woodlands and also provide numerous habitat niches for fauna.

Vegetation integrity of the shrub layer and ground layer of heath and shrublands along ridges is at most risk of being impacted. These communities are unlikely to recover to their original floristic or structural composition, and the most likely scenario is a species poor community dominated by wattles (*Acacia* spp), and the heath plant *Jacksonia thesioides*.

The introduction and potential replacement of native floristic elements by weeds is a probability. The daisy weed Praxelis (*Praxelis clematidea*) will invade disturbed rocky areas and could preclude the establishment of native species.

7.2.5 Slow Vegetation Succession

Colonisation of cleared track edges by native plants could be slow and result in disclimax communities of wattles or grasses, with limited representation of the original floristic component. This could be further exacerbated by opportunistic weed establishment.

7.2.6 Altered Fire Ecology

The introduction of weedy grasses with tall growth habits and bulk dry material could promote unnatural fire dynamics, which has many follow-on negative effects for both flora and fauna ecology.

7.3 Identification of Impacted Areas

7.3.1 Description of Construction Zones

Based on the current information available, construction zones for the wind farm project are understood to comprise two main features: turbine construction pads and interconnecting tracks, which will also serve as the routes for underground electrical cabling. An electrical substation will also need to be incorporated into the project.

The turbine construction pads are proposed to be of a minimum area of 40 x 30 m, with the longest side orientated with the direction of the ridge (if applicable).

The interconnecting tracks are proposed to be cleared to an initial minimum width of 10 m; however, wider tracks will need to be constructed to allow for long, heavy machinery and trailers to negotiate bends and switchbacks when bringing the infrastructure into the site from lower elevations.

The depth of cabling (trenching) to be installed in the approximate centre of the interconnecting tracks is not known, but is expected to be a minimum of 1 m below the finished ground surface for safety reasons.

A number of vehicle (trucks and heavy machinery) turnaround areas will need to be incorporated into the "disturbance footprint". The location and size of these is not known.

The substation will occupy an area 200m x 200m and is situated along the current transmission line (**Appendix A**).

Other zones of potential impact which will be required include workers and site management facilities and depots; concrete batching plant/s, and possibly sources of roadbase and other construction materials. It is not known where or what size these facilities will be.

7.3.2 Area of Impact

The areas identified to be directly impacted by construction of the wind farm are shown on the mapping in **Appendix A Site layout.** Impacted land shown on the mapping is only applicable to the known construction zones outlined above.

From the current information available the total area of new impacts (i.e. new tracks and construction pads) is estimated to be 51 ha.

7.4 Impacted Conservation Significant Plant Species & Habitats

7.4.1 Known Species and Habitats to be Cleared

The conservation significant plant species that will be impacted by construction of the wind farm are *Grevillea glossadenia*, *Homoranthus porteri* and *Plectranthus amoenus* - all of which occur along ridges and on rock pavements.

It is not possible to calculate the exact numbers of individuals that will be impacted due to the uncertainties surrounding the precise turbine construction zones and the configuration of the interconnecting track network.

7.4.2 Potentially Affected Habitats

Habitats most at risk are those which are restricted to ridges. South of the transmission line is where the greatest representation of key habitats for montane heath communities and conservation significant plants occur. More precisely, the critical habitat zone is above the 900 m contour.

7.5 Impacts on Ecological Function

7.5.1 Vegetation Integrity

The integrity of the composition and structure of vegetation is likely to be compromised wherever vegetation clearing and surface disturbance will occur. One of the drivers of these changes will be the plant community that replaces the original community. Shifts in integrity can be structural and / or floristic. For example, wattles (*Acacia* spp.) are recognised as a group, for their capacity to recolonise and reshape the floristic composition of plant communities that they succeed. Examples of this can be seen across a range of edge-affected woodland types on the site. The shrubby wattle *Acacia umbellata* for example, readily forms mono-specific thickets over cleared tracks edges adjacent to existing transmission line access tracks (S. Gleed, pers. obs.).

Acacia- dominated thickets have no structural or floristic resemblance to the original woodland, which in the example given above, was characterised by a tree layer to 6 m of *Corymbia leichhardtii* with scattered *Callitris intratropica*. The ground layer originally comprised the grass *Themeda triandra* with the heath *Jacksonia thesioides*, overtopped by a secondary shrub layer of the grass tree *Xanthorrhoea johnsonii*. Effectively, thickets of *A. umbellata* preclude the regeneration of the original floristic composition; and therefore the integrity of the vegetation is compromised, and may never attain the original status and composition prior to its clearing. This type of scenario has implications for plant communities which possess high numbers of endemic and conservation significant species.

7.5.2 Connectivity

Linear clearing for tracks that are required between the turbine arrays will contribute to breaks and disjunctions of vegetation connectivity. Vegetation connectivity with high levels of structural and floristic integrity (described above) is important for the gene flow and the persistence of vegetation communities; and populations of plants - particularly those species which are narrow endemics; have limited distribution and habitat tolerance; and/or are important to conservation. The importance of connectivity therefore becomes even more crucial for species and communities that exhibit contracted habitat and edaphic ranges: plants with limited tolerance for differentiation in their growth environment.

Removal of the surface soil medium from ridges has the potential to have the most deleterious impacts, since plants that grow in this spatially narrow environment tend to be highly constrained to the particular depauperate soil qualities. Montane heath communities along narrow and exposed ridges will be most at risk because of the limited surface area available as habitat.

Woodland vegetation with taller stature, higher structural characteristics, and greater regional representation, is by contrast to the ridge-top vegetation, less prone to long-term and irreversible impacts. The configuration of this structural unit across slopes, valleys and undulating land renders it less susceptible to adverse impacts associated with breaks in connectivity and displacement of gene flow. This is one of the primary reasons why the section of the project site north of the 275 kV transmission line is least constrained in terms of environmental impacts associated with vegetation and flora species of interest to conservation, because of the decrease in presence of ridges and narrowly defined plant communities.

7.5.3 Refugia

Refugia could be defined as special habitats: niches and protected places where plants and discrete vegetation communities can survive and persist beyond the perturbations of extreme environmental events such as fire, flood, desiccation, drought or even predation.

A range of refugial plant habitats are present within the project site and include riparian fringes affording longer-term moisture and denser vegetation; rock outcrops with deep fissures and pockets of peat-like soils which retain moisture to sustain plant growth in otherwise desiccated environments; rock pavements , with naturally fireproof or fire-protecting qualities because of the minimalist presence of flammable material and low fire-bearing vegetation; ridges which by virtue of their steeply inclined sides have narrow surface area and support special plant communities.

The limited spatial representation of refugia adds to their conservation significance (for example, heath communities above 900 m). The most profound impacts that could be expected to these specialist habitats are likely to be associated with clearing of ridges for interconnecting tracks and the turbine construction pads in these areas. Due to the narrowness of ridges, notably south of the 275 kV transmission line, there are limited opportunities to avoid the impact of clearing, except on the widest ridge crests.

7.5.4 Critical Habitats

Critical habitats are mostly associated with the presence of conservation significant plants - notably those species found in narrowly represented habitats found south of the transmission line and mostly above the 900 m contour. These habitats support the montane heath community where species such as *Homoranthus porteri*, *Grevillea glossadenia and Melaleuca uxorum* are found. Several narrow endemic, and regionally restricted plants are also found in this high elevation, exposed plant communities.

Given that these critical habitats occur primarily south of the 275 kV transmission line, construction of turbines and access tracks along the ridges in this part could have significant impacts on populations of conservation significant plants. In some cases, surface modification of the ridge top will result in loss of complete habitat niches, and particularly disrupt connectivity and the capacity for these populations to regenerate.

Significant habitat and populations of conservation significant plants are present at and between turbines 38 to 42. Turbines 43 to 46 also occur in areas of significant high quality habitat (as shown in **Appendix A**).

7.5.5 Botanical Values

Parts of the project site associated with habitats between 36 and 46 have significant botanical values. The concentration of conservation significant and narrow endemic species in this region renders their populations sensitive to disturbance.

The primary disturbance factors are ridge clearing and surface modification, loss of soil and a growth medium, and colonisation by weeds. The introduced daisy Praxelis (*Praxelis clematidea*) has been observed to quickly colonise disturbed rocky sites south of the transmission line between turbines 48 and 49 at the 80 m wind monitoring tower. This weed exhibits allelopathic traits which preclude or retard the establishment and recovery of land by native species.

Mapping showing the core botanical zone and corresponding habitats is given in **Appendix E**.

7.6 Threatening Processes

A number of threatening processes, impacts and landscape modifications will result from construction and maintenance of the proposed wind farm. Some of these impacts will be direct and require immediate mitigation. Others will be more subtle and indirect and may occur over a period of time - possibly months or even years after the project has been constructed.

Direct impacts include vegetation clearing and surface levelling for road and turbine construction. Whilst this is considered to be the largest impact requiring a commensurate level of mitigation, the area impacted represents approximately 2.1% of the site.

Indirect impacts include the introduction of weeds and pathogens into once weed-free and healthy vegetation zones.

7.6.1 Phytophthora

One of the insidious and potentially harmful indirect impacts could be the introduction of the Phytophthora plant pathogen (*Phytophthora cinnamomi*). The negative effects this disease has had on discrete plant communities in Western Australia is documented by Barrett (2000), where it is was identified that *P. cinnamomi* was the most serious threat to montane heath vegetation above 900 m ASL in the Stirling Ranges. At the taxon level Barrett (1996) reports the disease *P. cinnamomi* significantly impacts Proteaceous and Epacrid plants. Therefore, there is potential for the disease, if introduced to the wind farm site to affect conservation significant species such as *Grevillea glossadenia* (Proteaceae) plus a number of regionally restricted endemic species in the family Ericaceae (formerly referred to Epacridaceae). Phytophthora is a soil borne pathogen and would need to be managed through rigorous attention to equipment and machinery cleanliness (i.e. wash downs guarantees of no imported soil or plant material from diseased areas).

7.6.2 Myrtle Rust

Another recently described fungal plant pathogen myrtle rust (*Puccinia psidii* syn. *Uredo rangelii*) also poses a threat to plants in the family Myrtaceae. Myrtle rust spreads by microscopic spores and is readily dispersed by wind. It can also be spread by any vector that is able to carry the spores; therefore, vehicle movements, water, soil, on equipment and machinery and even plant nursery stock imported into the site have the potential to mobilise the pathogen.

Because of the significance of the Myrtaceae in the Australian environment (i.e. eucalypts, bloodwoods, bottlebrushes, tea-trees and paperbarks, etc), myrtle rust has been identified as a high to extreme risk biosecurity threat (Pegg, *et al.*, 2012).

7.6.3 Surface Clearing and Scraping

Ground surface clearing and increased levels of substrate disturbance will occur as a result of establishing a series of tracks and construction pads for wind turbines. Due to the topography and the preferred location for wind turbines on the highest elevation points on the site, clearing will mostly affect the ridges connecting these high points.

Ridges and rock pavements form the geomorphologic habitat basis for montane heath vegetation (Ford and Hardesty, 2012). Slopes falling away from the ridges generally support a taller woodland of different physiognomic structure and floristic composition (S. Gleed, pers. obs., J. Kemp, unpublished data) and are unlikely to receive similar levels of disturbance as the ridges.

Clearing of vegetation and modification of the ground layer along ridges for the construction of tracks (proposed initial width of 10 m) and turbine pads (proposed minimum width of 30 m) is predicted to result in the following impacts:

- Transportation and relocation of the upper soil horizon.
- Modification of the underlying geology and edaphic conditions.
- Relocation and re-stratification of the soil seed bank.
- Potential exposure and desiccation of plant propagules including roots, rhizomes and seed.
- Alteration of soil drainage, water retention and rates of evaporation.
- Complete removal of vegetation cover and loss of habitat-obligated species.
- Initiate plant succession with the potential for species replacement and exclusion (e.g. *Acacia* replacing habitat specific plants such as *Homoranthus porteri*, *Melaleuca uxorum*, *Cryptandra debilis* and many

others).

- Potential introduction of weeds and pathogens.

Observations were made on the site's western boundary of a recently cleared 3.5 m wide track through similar country as what is found on higher ridges (**Plate 8**). The track passes over the same rhyolite-derived soil and geology to that found along ridges south of the 275 kV transmission line. Plant regeneration at this site on road spoil was primarily by the wattle *Acacia leptostachya*, forming low, species-limited thickets.

Plate 8 Recently cleared track 3.5 m wide close to ridge country on western boundary of site. Track is estimated to have been cleared in 2012. Person on right of picture is standing 10 m from left-hand side of track, which represents the proposed clearing width of tracks between turbines.

Following Clarke (2002), parallels could be drawn between the effects of fire on species composition in heathlands and the capacity for regeneration of floristic components of the original montane heath flora following disturbance. For example, if fire is seen to be a significant disturbance factor and determinant of floristic composition of vegetation on ridges and rock pavements (Clarke, 2002), then species composition after disturbance such as clearing could be influenced by the ratio of obligate seeders (species that are killed by fire) and sprouters (species that resprout after fire) present in the original flora (Clarke, 2002; Bond and Midgley, 2001; Ford and Hardesty, 2012).

For species that recuperate by reshooting after disturbance (sprouters), there must be at the very least some functional primary root matter or vegetative propagule for the plant to recover. Track clearing and trenching will remove roots and stems of shallow-rooted shrubby species, and any successional vegetation will probably comprise mainly obligate seeders (i.e. species able to germinate from the soil seed bank). Obligate seeders are only able to recuperate if there is some semblance of the original seed carrying soil remaining *in situ*, such as in rock crevices. Therefore, increased or deeper removal of soil and substrate will result in lower species recovery rates and potential reduced species diversity.

Williams *et al*. (2005) identified that 97% of the montane heath species found on Bishop's Peak in the Wet Tropics bioregion are sprouters, with only one species being an obligate seeder (*Banksia plagiocarpa*). Based on these figures specifically relating to montane heath vegetation in the Wet Tropics bioregion, it is reasonable to expect that the floristic composition of ridges and rock pavements will significantly change following construction work.

7.6.4 Inter-turbine Cabling

Inter-turbine cabling is expected to be underground and buried to a depth that meets Australian Standards and any Queensland standards for safety. At a minimum, it is expected that cabling will need to be buried to a depth below the formed ground surface of 1 m. Based on the design provided by the proponent (**Appendix A**), the route for this cabling is assumed to follow the access tracks and aligned with the centre of these tracks.

Construction of the cabling trenches will require methods that employ the use of heavy earth-moving and trenching machinery. Additionally, it is possible that explosive blasting of solid rock substrates will be necessary in some areas. Solid rock is associated with many sections and linear stretches along ridges - sometimes in excess of 400 m. Fracturing of this geological landform may result in the total loss or significant modification of vegetation communities constrained to ridge formations.

7.7 Post-construction Environmental Responses

7.7.1 Vegetation Recovery After Disturbance

Fire has had a profound effect on the survival of certain plant species and the species that have recovered over the site. Ford and Hardesty (2012) record a fire event in the Mount Emerald location as taking place in late December 2007. Initial observations of the vegetation for the wind farm project began in May 2010. During this time access was gained to the most easterly ridges and the southwest and western ridges. Vegetation had been particularly affected in some locations, whereas some zones, mostly ridges and rock pavements, had remained relatively unscathed - reinforcing the fire-proof niche concept of these features (Clarke, 2002). Elsewhere, trees such as *Callitris intratropica* have not since recovered. By 2013, some eucalypts and bloodwoods showed some signs of recovery through the development of epicormic shoots. Judging by observations of vegetation recovery over successive field visits, it appears that the ridge vegetation recovers from gross disturbance and modifying events very slowly. Taller woodlands on slopes and in valleys on the other hand show signs of more rapid recovery.

The wattle *Acacia umbellata* is one of the commonest shrubs to regenerate after fire. This species forms monotonous low thickets, sometimes interspersed with a secondary shrub layer of grass trees (*Xanthorrhoea johnsonii*) and a low, uniform layer of the heath-like shrub *Jacksonia thesioides* (**Plate 9**). In places (mainly woodlands), the hemi-parasitic *Exocarpos cupressiformis* has emerged as a response to fire. The presence of these post-disturbance species, plus the suite of successional plants established in the existing powerline corridor give an insight into the possible species composition that could develop following construction of the tracks and turbine pads.

Plate 9 Regeneration of the wattle *Acacia umbellata* and the resultant allelopathic community following a severe fire event.

Observations of the floristic composition of various successional stages of plant communities on the site confirm that wattles (*Acacia* spp.) are the predominant group to take effect on disturbed ground. Few species of wattle tolerate fire and generally recover from germination of seed stored in the soil. The commonest species of Acacia occupying rocky ground and amongst rock pavement mosaics include *A. aulacocarpa* (rock pavements), *A. calyculata* (ridges), *A. humifusa* (ridges and rock pavements), *A. umbellata* (ridges, rock pavements and edge of tracks - **Plate 8**) and *A. whitei* (ridges).

The ability for some conservation significant species and narrow endemics to re-establish after track clearing may be limited - possibly because of displacement and allelopathic soil conditions created by wattles. As a group, narrow endemic plants are reported to have a reduced capacity for colonization than widespread congeners (Lavergne *et al.* 2004). This further explains why a majority of the conservation significant plants (with the exception of *Grevillea glossadenia*), plus a great proportion of the narrow endemic species encountered, are restricted to a poorly represented habitat unit of montane heath found along ridges (see also Thompson *et al*. 2005).

Interestingly, the conservation significant shrub *Grevillea glossadenia*, despite being a narrow endemic, favours disturbance and appears to be an obligate seeder. Evidence of this species' capacity to regenerate *en masse* following ground perturbation can be seen around the 80 m wind monitoring tower between proposed turbines 48 and 49 (**Plate 10**). The shrub also survives healthily on and around stockpiled road base material near the Stannary Hills turnoff road to the south-west of the site (S. Gleed, pers.obs.).

Plate 10 The shrub *Grevillea glossadenia* regenerating from seed around the 70 m wind monitoring tower on the site.

For obligate seeders, if the soil seed bank is displaced, translocated or physically altered beyond a state whereby its regenerative germination capacity is diminished there is likely to be a corresponding decrease in the number of species represented in the original floristic complement consequently surviving. Similarly, for those species that are sprouters, complete loss of their vegetative parts will result in a loss of individuals from the disturbance footprint. This is particularly important to a number of locally endemic plants with contracted distribution ranges, including the shrubs *Melaleuca uxorum* (endangered), *Cryptandra debilis*, *Melaleuca borealis* and *Hovea nana*, *Indigofera bancroftii* plus others that are not found in woodlands on slopes, but are restricted to ridge environments on the site. Other examples of niche-specific plants that could be affected by clearing include *Borya septentrionalis*, *Mirbelia pungens*, *M. speciosa* subsp. *ringrosei*, *Sannantha angusta* and at least two species of unidentified orchid lithophytes.

The species described above exhibit minimal tolerance for habitat types and are constrained to depauperate rocky surfaces. Ford and Hardesty (2012) recorded their regeneration capacity as resprouting from the base of stems and from epicormic buds on branches and stems; and therefore, the probability that this group of plants will recover to form viable populations following major ground modification is low, unless they can be replanted or successfully propagated.

However, pads around turbines will be a mixture of scalped and pushed rock debris, which if respread in close proximity to its origin should have some capacity to supply surrogate habitats. Some regeneration of the original floristic component may occur from the soil seed bank, remains of roots, corms, rhizomes and tubers. Given the predicted limited success rate of tube stock planting as a rehabilitation method for the wind farm site, long-term observations and records of regeneration provide a sound opportunity for an ongoing research project.

7.7.2 Impacts on Soil Formation

The formation of soil on the surfaces of rock pavements and along skeletal zones of ridges is slow and results in the barest of growing medium in which higher order plants can later establish. Soil development from rhyolite is reliant on basic seral stages in vegetation succession, where a bare impervious surface is gradually colonised by lower order plants: foliose and crustose lichens, mosses and later by ferns (*Cheilanthes* spp.) and then by sparsely distributed short grasses such as *Eriachne humilis* and *Tripogon loliiformis*. The so-called resurrection plant *Borya septentrionalis* forms a patchwork cover over some rock pavement surfaces: usually in hollows and scoops, attaining a thickness of 15 cm; where the vestiges of roots and decomposing foliage provide the main constituent of the underlying humus rich, peat-like soil medium (**Plate 11**).

Plate 11 The resurrection plant *Borya septentrionalis* is an important contributor to the formation of skeletal peat-like soils on some rock pavements. Decaying root matter and spent leaves blend with exfoliating rock particles to form the medium that is capable of retaining water on an otherwise impervious rock surface.

Ramsey and Cairns (2004) recognise the importance of lower order plants, particularly bryophytes (mosses), in the development of soil and other physiological factors such as water harvesting, storage and slow release on rock pavements (**Plate 12**). Due to the depauperate nature of rock-derived lithosols, the retention and development of lower order plants in the primary successional phases as well as later stages is critical. These types of montane soils are uniquely associated with rock pavement floristics and are intrinsically linked to the presence of montane heath vegetation.

Plate 12 Mosses and lichens are crucial to the early development of a growing medium for higher order plants on rock pavements and subsequently are a key contribution to the montane heath environment.

Woodlands on the site are found mainly on deeper, more well-developed soils and grow almost exclusively on the slopes and in valleys between ridges. The depth, structure and profiles of the soils supporting taller vegetation types in markedly different from the skeletal soils of ridges and associated rock pavements. Greater soil depth and improved structure contribute to vegetation of different stature and physiognomy, where for example, the tallest and most developed woodlands occur on the west-facing slopes in the south-western quadrant of the site. Here, large-class trees of *Eucalyptus reducta* over a lower tree layer of *Allocasuarina torulosa* reach their best development (**Plate 13**). Many trees have significant hollows giving evidence to their age and longevity in the landscape. The ground layer is markedly different from the ridges, where there are fewer shrubs and sub-shrubs, and the ubiquitous kangaroo grass (*Themeda triandra*) is invariably dominant.

Plate 13 Woodland of *Eucalyptus reducta* is found on sheltered parts of the southern section of the site. These woodlands exhibit the best structural development of all vegetation types in the project area, and evidenced by the size classes of trees, may also be the oldest.

7.7.3 EPBC Act Significant Impact Criteria

The significant impact criteria of the EPBC Act is applied to the three EPBC Act listed species known to occur on the site and in very close proximity (*Acacia purpureopetala*), and summarised in **Table 5**.

Table 5 Significant impact criteria of the EPBC Act as it applies to the three most relevant species on or adjacent to the site

EPBC Significant Impact Criteria	***Acacia purpureopetala*** **Presence not confirmed in project area**	***Grevillea glossadenia*** **Confirmed presence in project area**	***Homoranthus porteri*** **Confirmed presence in project area**
Lead to a long-term decrease in the size of an important population of a species	Unlikely – most collections of the species are from Irvinebank and Stannary hills – possible limited habitat on south-western boundary of project area.	Unlikely due to relative high abundance and ability to tolerate a wide range of ecological conditions.	Possible if not managed appropriately – need to identify important sub-populations within the site and conserve areas of rock pavement south of transmission line.
Reduce the area of occupancy of an important population	Unlikely – most records of the species are from Irvinebank/Stannary Hills region to the south-west of the project area. One collection from the south-west of the project area. Major population in Toy Creek (off-site).	Unlikely – a widespread species across the southern half of the project area. Disturbance triggers growth responses/seed germination.	Possible given that the species occupies a naturally small niche around rock pavements and on rocky ridges.
Fragment an existing important population into two or more populations	Unlikely – see comments above.	Unlikely due to evenness of distribution.	Unlikely, as the species is represented elsewhere on the site where wind turbines are not proposed to be constructed.
Adversely affect habitat critical to the survival of a species	Unlikely – more significant populations mapped over the Irvinebank/Stannary Hills region –lower rainfall and possibly more preferential habitat. Evidence indicates that the species is adapted to disturbed environments (road edges, mine sites).	Unlikely due to wide tolerance by the species of habitat types –even on disturbed land.	Some possibility - the species has a comparatively narrow ecological tolerance.
Disrupt the breeding cycle of an important population	Unlikely – important population not identified on the site.	Unlikely due to capacity for mass germination – assuming soil seed bank is left intact.	Low probability if turbines are appropriately micro-sited.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely – drier, and possibly more preferential habitat in the Irvinebank/Stannary Hills region.	Unlikely – habit for the species is well represented across the southern half of the project area.	Yes – see comments below for weeds. Also, rock pavements, which are the preferred habitat for this species, occupy small areas mostly associated with ridges and points of highest or exposed elevation.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Unlikely - important populations not identified on the site.	Possible – introduction of deleterious weeds such as sicklepod, grader grass, molasses grass, and a range of other naturalised plants that could outcompete the species and preclude successful regeneration.	Possible – introduction of deleterious weeds such as sicklepod, grader grass, molasses grass, and a range of other naturalised plants that could outcompete the species and preclude successful regeneration. The weed *Praxelis clematidea* poses a threat to disturbed rocky ground.

EPBC Significant Impact Criteria	*Acacia purpureopetala* Presence not confirmed in project area	*Grevillea glossadenia* Confirmed presence in project area	*Homoranthus porteri* Confirmed presence in project area
Introduce disease that may cause the species to decline, or	Unlikely - important populations not identified on the site.	Possible if appropriate weed hygiene and other protocols for the management of pathogens are not implemented and maintained throughout the duration of the wind farm. Phytophthora could be deleterious.	Possible if appropriate weed hygiene and other protocols for the management of pathogens are not implemented and maintained throughout the duration of the wind farm. Myrtle Rust and Phytophthora could be deleterious.
Interfere substantially with the recovery of the species.	There is no recovery plan in place for this species.	There is no recovery plan in place for this species.	There is no recovery plan in place for this species.

7.7.4 Likelihood of Recovery after Disturbance

In the event that a particular site and corresponding habitat is modified or drastically changed from its natural state, the following notes have been compiled regarding the predicted (but not guaranteed) potential for a particular EPBC listed plant species to recover at the site. The notes are based on observations and label data (i.e. HERBRECS) of the responses of the species to modified environments in other areas with similar geological and broad vegetation characteristics.

Acacia purpureopetala – likely, but not able to quantify. Evidence of regeneration at mine sites on benches where no other plants are able to establish. Known recovery and observations of regeneration on scraped road verges at the Stannary Hills road turnoff near Irvinebank (S. Gleed, pers. obs.)

Grevillea glossadenia – highly probable this species will recover and populations will not be adversely impacted. Observational evidence at several sites within the project area of recovery following ground disturbance and modification of habitat. Mass germination of seed following fire events (note: recent fires may have destroyed these new populations before they had time to mature and set seed. The species appears to have a wide tolerance of a range of edaphic conditions – providing the base geology is rhyolite.

Homoranthus porteri – little evidence of recovery after disturbance because habitats have yet to be grossly modified. Possible resilience to fire, but not fully understood. The species has been observed to have survived in patches where ridge trees have otherwise been affected by fire. The species is thicket-forming and is likely to set high quantities of seed. Seed is probably small (not observed). This species has a relatively small ecological tolerance, and is strongly reliant on rock-pavement surfaces and the skeletal soil environment of rocky ridges.

8.0 Mitigation of Impacts

8.1 Alternatives to the Proposed Layout

A notable reduction in impacts can be gained by careful locating of each turbine with stringent consideration given to avoiding key habitats, zones of high concentrations of conservation significant plants, and essential habitat areas. In this regard, the most significant area of the project sites is south of the 275 kV transmission line. The primary habitat for important populations of many narrow endemic plants is found in this area. By not establishing tracks and turbine footprints in this zone, a considerable proportion of high value environment could be preserved. This zone is shown in **Appendix I**.

8.2 Mitigation Measures

A range of mitigation measures will need to be negotiated with the proponent, designed and implemented prior to construction. Some of these measures will be required throughout the operation of the wind farm.

8.2.1 Mitigation of Impacts on Vegetation Communities

The aims of the mitigation strategies are to maintain to the highest level the following vegetation-related matters: ecological function, vegetation integrity, connectivity, refugia and critical habitats.

The most prudent mitigation measure with respect to maintaining integrity to vegetation communities is to not clear the vegetation or modify the landscape beyond the current condition; the exception to this being the control and management of weeds that have existed on the site prior to the wind farm development. Based on this principle, any clearing should be undertaken according to a prescribed route and clearly defined turbine footprints, and kept to the absolute minimum necessary. Therefore, the layout of the turbine arrays and track network should be carefully and thoughtfully designed and clearly articulated on survey accurate plans.

Mechanical clearing of sensitive communities should be avoided as the only means of establishing the turbine construction pads and track network. Selective hand clearing of vegetation is preferred, and with qualified environmental advisors on hand to provide guidance to the least impacting methods of site preparation.

Maintaining the structure of the vegetation by not entirely clearing all trees and altering the architecture and framework of the community is important. Therefore, larger-class trees, hollow-bearing trees and shrubs should not be cleared if not necessary. Notwithstanding that, the highest representation of large-class trees tends to be in sheltered valleys, gorges and in the south of the site on west-facing slopes; and such specimens should be protected. Trees with a stem diameter at breast height of 30 cm or greater fit into this category.

Maintaining the floristic integrity of the ground layer is equally as important, as this stratum is the most diverse in terms of flora species in sclerophyll communities. This is particularly pertinent for any vegetation communities occurring along narrow ridges or bands of land where the community is not widespread.

Heath vegetation on ridges south of the transmission line will be prone to loss of floristic and structural integrity if cleared; therefore, it is critical that turbine construction pads are carefully planned and situated in the least susceptible vegetation types. Vegetation and track clearing will need to be constrained to the absolute minimum in these circumstances; and in some situations avoided altogether (see **Appendix I** for proposed conservation area).

Linear and broad-scale clearing are notable impacts that affect ecological function. With clearing, the potential for weed invasion is substantially increased - another major contributing factor to the disruption of ecological function.

Sensitive zones of vegetation (riparian, heath vegetation and key habitats for rare and threatened plants) should be defined and clearly marked on the ground. These areas should be quarantined from machinery activity, materials storage and other potentially impacting factors.

The management and control of weeds is critical and of the highest importance. A dedicated weed management plan will need to be prepared and implemented prior to construction. Any new incidences of weeds in formerly "clean" areas should be dealt with immediately, and a record kept of the incidence for future reference and monitoring.

Weeds, pathogens, machinery and land modification are all interrelated. Therefore an integrated approach to construction is essential. Machinery and vehicles should pass through a washdown bay and be regularly cleaned at a designated point outside of the wind farm project construction zone (i.e. in the vicinity of Kippen Drive).

Unplanned fires and burn-offs should be avoided. A dedicated and strategic fire management plan should be developed and integrated into an overarching Environmental Management Plan. Therefore, burning as a means of clearing and cleaning-up a site should not be permitted. Similarly, burning windrowed vegetation should not occur.

8.2.2 Mitigation of Impacts on Plant Species of Conservation Significance

All plants of conservation significance should be clearly identified prior to clearing and construction activities progressing. Important populations of such species should be protected from impacts and identified on mapping. On the ground, these populations should be marked with fluorescent flagging tape, and where practicable, be allocated a buffer zone of at least 10 m in which no vegetation disturbance should occur.

Protection of supporting habitat for rare and threatened plants should be afforded where identified on mapping and in a similar fashion to that described above for vegetation communities. Again, weed management and control, is critical.

To assist with identification, plant guides, which describe important species and have good photographs of their characteristics should be compiled and issued to contractors.

Plants of interest to conservation that are to be cleared or damaged (i.e. in the construction footprint) will need to be recorded: noting the numbers to be cleared, the health of the population and other relevant information. Advice should be sought from a botanist prior to contractors undertaking work where rare and threatened plants are located.

A translocation plan will need to be developed in accordance with the EPBC Act guidelines and following the associated technical advice reported in Vallee, *et al*. (2004). Suitable recipient translocation sites should be identified and opportunities for relocating the conservation plants to these sites undertaken.

8.2.3 Mitigation of Impacts on Refugia and Critical Habitats

Refugial, protected zones for plants are often expressed in sheltered places: amongst larger rock outcrops, remote rock pavements, riparian niches and fireproof habitats, with minimal soil development, sparse vegetation and usually a dominance of rock on the surface. On the site these refugia area found adjacent to streams and ephemeral drainage lines, along ridges, in gorges, and in the remote section of the site south of the transmission line - particularly in the region of the most western ridge.

The mapping in **Appendix I** shows the section of the site with the highest proportion of important plant habitats and consequently, refugia. Also, the rock pavement and outcrop mapping in **Appendix F** provides a spatial indication of micro-habitats for plants and could assist with the design of construction and placement of roads and turbine pads.

All key refugia should be identified and clearly demarcated prior to construction.

The refugial habitats summarised above should not be modified or have the vegetation cleared. This is most relevant to the ridge and heath vegetation found south of the transmission line.

Preservation of the ground surface is an important mitigation strategy in these sensitive habitats and notably for the heath vegetation. Here, any soil removal should be kept to an absolute minimum. Soil and rock spoil should be stockpiled immediately adjacent to where it will be excavated. It should then be returned and respread over the disturbed site as soon as possible.

Under no circumstances should weed-infested soil be introduced into these environments. Any imported road base and fill material will need to be sourced from local supplies and be certified weed-free.

For riparian niches, minimal clearing can be achieved by using existing tracks and stream crossings. Upgrading and installing culverts where necessary is advised. Weed control is required at some stream crossings.

8.3 Environmental Offsets

A number of impacts will occur as a result of construction of the wind farm. Some of these impacts may not be able to be avoided in their entirety, and therefore, the application of environmental offsets will be required. The main triggers for initiating offsets include:

- Clearing remnant vegetation listed as Of Concern under the *Vegetation Management Act 1999;*
- Clearing of species of plants listed under the *Environment Protection and Biodiversity Conservation Act 1999;* and
- Clearing of species of plants listed under the *Nature Conservation Act 1992*

Other matters that can trigger interest with respect to environmental offsets include the loss of habitat that is critical to sustaining populations of plants listed under the EPBC Act and the NCA.

8.3.1 The Need for Offsets

If impacts cannot be avoided, then consideration might be given to providing conservation area offsets – this process is complex and the preferred option is clearly to avoid the impact by repositioning turbine construction pads and re-routing tracks.

In real terms, environmental offsets are the least preferred option for impact mitigation. It is far more ecologically sustainable to avoid creating the impact rather than environmental trade-offs such as land swaps, rehabilitation, monetary offsets and so on. Nevertheless, where the impact is unavoidable, such as in situations where plants of conservation significance occur in the disturbance/clearing footprint, then environmental offsets to supplement practical mitigation measures will need to be negotiated with respective government departments and administering authorities.

8.3.2 Types of Offsets

This report does not outline the range of environmental offsets in practice in Australia. This aspect should be considered as a separate component to this report, and focus on strategic approaches which could incorporate:

- Rehabilitation initiatives: for example, identifying *ex situ* land with an important landscape position, where the conservation values could be enhanced and improved through a long-term rehabilitation programme.
- Land swaps and purchases: acquisition of land with important values (similar to above), with the intention of maintaining the land in perpetuity as a conservation area.
- Designating *in situ* conservation zones: the land to the south of the transmission line is identified as having significant conservation value. This land could be considered as a key conservation zone (see mapping in **Appendix I**).
- Financial offsets: a complex area; nevertheless, monetary negotiations should be directed at achieving a net conservation benefit.
- Instigating research initiatives: research initiatives and concepts are discussed in the following section in this report, and could be supported through grants or bursaries issued by the proponent.

8.4 Concepts for Environmental Offsets and Conservation-based Initiatives

8.4.1 Plant Translocation Plan

There is a requirement under the EPBC Act to identify and confirm opportunities for the translocation of wild plants if they are to be cleared from the construction footprint. A translocation plan based on the criteria and guidelines detailed in Vallee, *et al*. (2004) should be developed with site specific objectives clearly outlined.

Recipient and target translocation sites across the project area should be described and mapped and integrated into the plan accordingly.

8.4.2 Literature and Interpretive Material

Affiliated with offsets could be a series of interpretive literature and associated material which describes and recognises the importance of the project site from a range of perspectives. For example, the northern Quoll (*Dasyurus hallucatus*), noted for its conservation status, is relatively widespread in the project area and worthy of documenting. Such documentation would include photographs of the species including infra-red photographs taken during the population survey of the species in the project area; as well as its habitat requirements, feeding needs and notes on its natural history. Similar short communications could be developed for other species of fauna of interest to conservation.

The rare and threatened plants found in the project area lend themselves to interpretation both through literature and as design elements in an arboretum for example, and in revegetation. Given the static nature of plants they are readily photographed and described. The ecology of plant species can also be easily interpreted. Interestingly, the flora of the project area is poorly represented in the current literature, apart from occasional taxonomic work (Craven, *et al*. 2003; Craven and Ford, 2004; Ford and Hardesty, 2012). These forms of documentation generally have a narrow audience, and arguably have limited effect in informing wider, more generalist audiences; therefore, there are reasonable opportunities to interpret the local flora and unique vegetation types in the form of plant guides, booklets and so on.

Of importance in this regard, is the need for contractors and managers to be able to identify the plants that are the subject of this report, and which form a basis for the site's distinctive environmental qualities. Accordingly, a plant guide should be developed as a matter of course.

8.4.3 Revegetation

Rehabilitation and replacement of weeds with native plants along both sides of the existing road verges from the Granite Creek crossing to the base of the project area is essential, and would increase visual amenity into the site, and more importantly will increase the capacity to slow down the establishment of invasive weeds such as grader grass and molasses grass amongst many others. This section of the road poses a significant risk to weed invasion higher into the project area.

Other revegetation activities should be undertaken around and in the vicinity of each turbine. These sites also afford opportunities to study the effects of weed establishment and native plant regeneration in rocky landscapes.

8.4.4 Research Opportunities

Several areas have been identified where information gaps in relation to the project's construction and operation exist. The summaries below do not constitute a comprehensive assessment of the information gaps; however, research into these areas would greatly benefit an understanding of the special environmental qualities of the project site.

Vegetation succession: Comparatively limited understanding of how mountain vegetation (montane heath) responds and recovers after disturbance and clearing.

Weeds: Unknown effects of potential ecological "modifier" weeds such as Praxelis (*Praxelis clematidea*) as well as others - particularly tall grass weeds such as thatch grass (*Hyparrhenia rufa*). Early observations indicate that *P. clematidea* hinders the establishment and possibly precludes secondary and climax phase montane heath plants.

Fire ecology: Insufficient understanding of fire ecology and its role or impact on montane heath communities. This important facet of ecology is critical to understand in greater depth given that it may have bearing on vegetation succession and the ability for populations of conservation significant plants to survive and perpetuate future, viable generations that maintain the current level of genetic diversity. Similarly, maintenance of the level of high endemism could be influenced by the local fire ecology.

Floristic inventory: Over 140 sites have been surveyed to elucidate the flora of the project site. Ground surveys are moderated by the degree of accessibility, availability of time and resources, and obvious safety factors. The final survey that was undertaken on the site located the exceptionally uncommon (endangered) shrub *Melaleuca uxorum* along the southern-most ridge. Opportunistic sightings of the ground orchid *Habenaria elongata* confirmed a new southern distribution limit of approximately 100 km from its previously known location in southern Cape York Peninsula. One-off sightings and chance encounters such as these highlight the need to undertake monthly flora monitoring and recording surveys to compile a more complete and seasonal floristic inventory.

Plant endemism: The site sits at the northern end and terminus of the Herberton Range. This geographical feature at this location holds a concentration of narrow endemic plant species and species with restricted distribution ranges. The determinants of this endemic focus for the montane heath flora is not fully understood and is poorly represented in the scientific and taxonomic literature.

Population viability: The population viability of key conservation significant plants could not be ascertained because of time and resource constraints to complete detailed studies. The results of a Population Viability Analysis investigation would be beneficial to inform a range of mitigation measures for clearing vegetation along ridges, and also to determine acceptable levels of clearing in order not to adversely affect the population dynamics of certain plant species, mainly *Homoranthus porteri* and *Melaleuca uxorum*.

Landscape rehabilitation: The wet tropics region is well regarded for its attention to tropical restoration and rehabilitation. These efforts however, have primarily focussed on rain forest (vine forest) vegetation types and land that formerly supported vegetation communities dominated by mesic plant species. Broad methods, typically tube-stock planting and direct-seeding have been used with varying levels of success; nevertheless, very little is known or has been practiced in sclerophyll-dominant vegetation other than mine site rehabilitation and direct-seeding efforts associated with recovering borrow pits and road verges.

***Horticulture of specialist plants*:** A rehabilitation programme and strategy for the Mt Emerald Wind Farm project could include the use of plants sourced from the horticulture industry (plant nurseries). As with many aspects of tropical montane heath vegetation, which is common along the ridges of the southern half of the project area, there is a small body of information pertaining to the propagation of the plants that typify this community. Generally much is understood regarding the nursery production of eucalypts and bloodwoods (*Eucalyptus* and *Corymbia* spp.), as well as a range of common northern woodland plants such as wattles (*Acacia* spp.); the heath plants however, are not so well recognised in horticulture.

There are a number of species which are found in the project site which have been propagated by a local, commercial plant nursery with some success, and include *Homoranthus porteri* and "*Baeckea* sp. Herberton Range", which could refer to *Sannantha angusta* - a local endemic. Given the high proportion of endemic plants and the uniqueness of the site's flora, any plant stock used in rehabilitation should be derived from material whose provenance is from the site or the immediate region from the same rhyolite geology and vegetation type. More information is required about the species hardiness and resilience to being transplanted into the natural environment with no post-human intervention or assistance.

***Soil-seed bank dynamics*:** The soil-seed bank of the montane heath community is not completely understood and research could consider transplanting sub-sets of topsoil from different site locations and monitoring germination. Research efforts would ideally be performed in a controlled plant nursery setting. Basic data to collect would include species, categorising plant functional groups, species names and number of individuals germinating per unit area. Seedlings germinated from the trials could be used in site-specific rehabilitation and landscaping.

8.5 Monitoring of Impacts

A strategic approach to monitoring environmental impacts in relation to flora is required. A monitoring programme should be developed and be integrated into an overarching Environmental Management Plan for the project. The result of the monitoring may have to be submitted to SEWPaC for compliance.

The purpose of the monitoring programme will be to record and document the impacts to conservation significant plant species and their habitats. The monitoring should not be limited to those species listed under the EPBC Act, as there are considerably rarer and more poorly represented species present on the site that require an increased level of conservation in order to maintain viable populations.

The monitoring programme must be designed with the intent of recording and measuring the impacts (predicted and non-predicted), and should include the following information:

- Impacts to ecosystems and specialist vegetation types: changes in floristic composition, structure and integrity. To be recorded twice each year according to most marked seasonal changes (i.e. wet and dry season).
- Reproductive phenology: flowering and fruiting times, events and frequency; production of viable seed or propagules, and germination / recruitment of new individuals (seedlings). Baseline data required (i.e. flowering and fruiting phenology). Possible recording period of each month.
- Stability of plant populations (conservation significant): reductions or increases in population size - number of individuals. To be recorded according to baseline data. Probable recording period of once each year per taxon.

- Strategic monitoring component for rehabilitation and any associated environmental offsets that may have been negotiated.
- The level (severity) of effect caused by predicted and actual impacts and a categorisation of these impacts.
- Weed monitoring: records of new weed incidences; new weed species; dates of establishment; proposed control measures; efficacy of control; follow-up weed management practices and events.

Concurrent with the monitoring programme, a series of key performance indicators will need to be developed. These may include predetermined rates of vegetation succession, measures of abundance; records of species composition; ratios of pioneer/successional communities to original vegetation composition/type; spatial measurements of land recovery/vegetation establishment - particularly adjacent to tracks and turbine construction pads.

Information gained from the monitoring programme will be used to gauge and assess the effectiveness of the mitigation measures proposed; and also inform new or adapted mitigation strategies that may develop as the project progresses. For example, unforeseen impacts may become evident when the wind farm is operational.

9.0 Conclusion

The Mt Emerald wind farm site is a unique area, hosting interesting vegetation types and habitats - some of which are poorly represented on a regional scale because of the mountainous topography.

The project site, located at the northern end of the Herberton Range, a mountainous feature of rhyolite geology, takes in sections of the Wet Tropics and the Einasleigh Uplands bioregions. The Wet Tropics bioregion section is characterised by rugged and broken topography of narrow ridges and steep slopes. The Einasleigh Uplands section has gentler landforms of less dissected character and also takes in the prominent landscape feature of Walsh Bluff at the most northern end. The southern section of the site comprises undisturbed land which is contiguous with Mount Emerald (proper).

Sixty three wind turbines are proposed to be constructed across the project site on cleared and levelled pads, each measuring a minimum of 30 x 40 m. Wind turbines are to be interconnected by an unsealed track which will also incorporate the underground electrical cabling network. These tracks are proposed to be cleared to an initial width of 10 m. In places the tracks will necessitate wider clearing to allow for bends and machinery manoeuvring space.

Four plant species of conservation interest have been positively confirmed to occur in the wind farm project site, and in areas identified to be impacted (cleared) for turbine construction pads or tracks. These are *Homoranthus porteri* (listed as vulnerable under the EPBC Act and NCA), *Grevillea glossadenia* (listed as vulnerable under the EPBC Act and NCA), *Plectranthus amoenus* (listed as vulnerable under the NCA) and *Melaleuca uxorum* (listed as endangered under the NCA).

In order of rarity (number of individuals observed on the site, plus comparison with regional populations), *Melaleuca uxorum* is exceptionally rare and only occurs in two isolated populations on the site with a total of approximately 100 individuals in the Wet Tropics bioregion section.

Plectranthus amoenus is poorly represented on rock pavements in the Wet Tropics and Einasleigh Uplands sections (total numbers unknown).

Homoranthus porteri populations are centred in the Wet Tropic bioregion section only high elevation ridges, with two outlier populations in the Einasleigh Uplands section. The number of individuals could not be accurately determined; however, the species is confined mostly to exposed, narrow ridges. The wind farm site represents an important population centre for the species because of its relatively narrow habitat tolerance and the possible northern distribution limit of significant populations.

The most frequently occurring of the conservation significant species is *Grevillea glossadenia*, which is widespread in the Wet Tropics section with individuals also found on disturbed track edges in the Einasleigh Uplands section. Of the conservation significant plants described here, this species has the widest habitat tolerance and appears to favour disturbance to some extent (disturbed rock spoil may trigger germination of seed). The numbers of individuals of this species extend into the hundreds.

The montane heath community, reliant on elevation separation and cloud stripping of moisture above 900 m, is a rare and narrowly defined vegetation type, which hosts a major proportion of conservation significant plants and narrow endemic species. This community is largely confined to the Wet Tropics bioregion section of the project site. It supports considerable floristic diversity, which on a regional scale is only found locally and is an extension of the Mount Emerald environment.

Floristic diversity and structural uniqueness (vegetation) decrease in the northern half of the site, which coincides with the Einasleigh Upland bioregion section. The landform here is markedly less rugged and dissected and a majority of it sits lower than 900 m ASL. Because of this, vegetation types are more broadly represented on a regional scale, and hold less intrinsic value. Most areas are however, in very good condition with few signs of modification and weed incursion. Nevertheless, conservation significant plants are rarely found in the northern section, even on the most rocky, exposed ridges or points.

The key impacts identified which will influence the recovery of the landscape post-construction are those associated with clearing and removing the thin veneer of rocky soil. Along narrow ridges in the Wet Tropics section, a return of the vegetation to its natural floristic composition is unlikely within approximately 15 years, when compared with disturbance events on similar landforms (e.g. existing tracks). This is evidenced by the cleared tracks associated with the transmission line infrastructure, which was commissioned in 2002. The most probable scenario for plant succession is colonisation by low, shrubby wattles. *Grevillea glossadenia* will probably respond in some areas favourably by germinating *en masse* in rocky spoil adjacent to tracks. No evidence was found to indicate that *Homoranthus porteri* will respond to disturbance in a similar, positive manner. *Melaleuca uxorum* is by virtue of its rarity and exceptionally limited distribution on a regional scale, a montane heath specialist species that is at risk of decline if the populations are disturbed or influenced by edaphic changes and altered hydrological regimes (runoff and drainage). *Plectranthus amoenus* is restricted to rock pavements and it is not understood from observations how this species will respond to disturbance. The genus is however, known to be easily propagated in horticulture.

Weed colonisation will be inevitable after ground disturbance of the site. Praxelis (*Praxelis clematidea*) poses a risk to communities on rocky ground such as along ridges, and it is expected that this species will be one of the first to establish on newly cleared land. Later incursions by weedy grasses such as thatch grass (*Hyparrhenia rufa*), grader grass (*Themeda quadrivalvis*) and signal grass (*Urochloa decumbens*) are possible if stringent, long-term weed control protocols are not followed. Other weeds noted for their 'roadside' colonisation traits include Hyptis (*Hyptis suaveolens*), Sida (*Sida* spp.) and stinking passionflower (*Passiflora foetida*). The list is not inclusive, and the project site is considered vulnerable to the deleterious effects of weeds. Of concern would be the import of a range of introduced legumes in construction material, such as sicklepods (*Senna* spp.), Wynn cassia (*Chamaecrista rotundifolia*), sensitive weeds (*Mimosa* spp.), siratro (*Macroptilium atropurpureum*), rattlepods (*Crotalaria* spp.) and many other species.

Because of the sensitive nature of the environment of the project site, impact mitigation strategies and measures will need to be carefully thought out and be focussed on the unique qualities and challenges posed by the elevated, mountainous aspect. This report recommends demarcating specific zones of the site and quarantining them from construction and disturbance activities. Of special relevance in this context is the rugged country to the south of the transmission line in the Wet Tropics section. This land clearly holds the highest and most significant environmental values and modification of the landform will most probably result in irreversible changes to rare and unique vegetation communities, floristic composition and ecological function.

The best construction opportunities for the wind farm are to be found in the Einasleigh Uplands section north of the transmission line. The more undulating and level landform holds lower environmental value, does not support poorly represented vegetation communities, and conservation significant plants are found is considerably lower abundance. From a feasibility perspective, the limited presence of precipitous drop-offs and steeply inclined slopes in the northern section offers easier construction prospects, whereby environmental impacts to the landscape values appear, at this stage, to be more practicably manageable and reversible.

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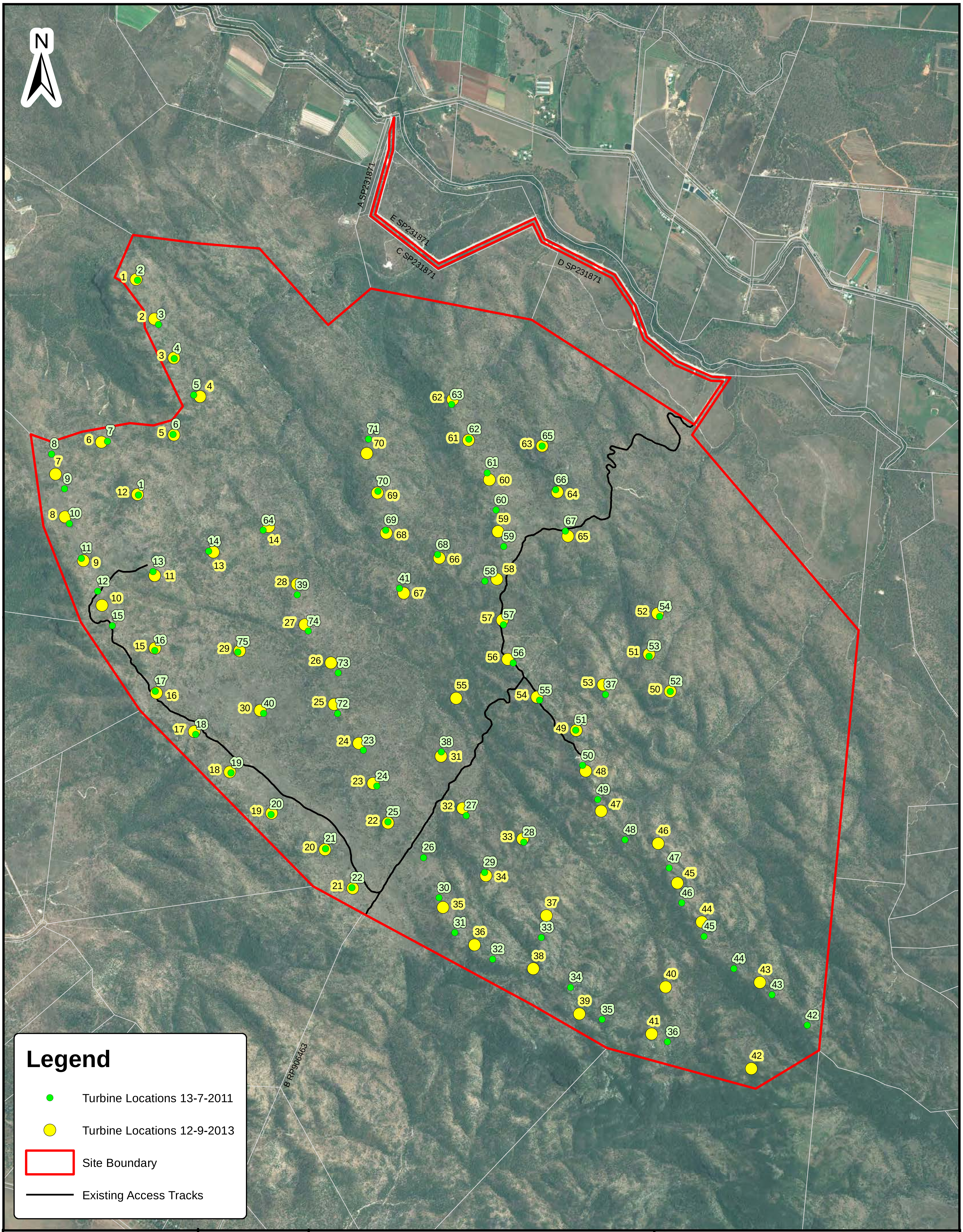
Appendix A

Mt Emerald Wind Farm Project Layout (July 2012)



0 250 500 750 1,000
Meters (A3)

DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
DERM AERIAL PHOTOGRAPHY.
Based on or contains data provided by the State of Queensland (Department of Environment and Resource Management) 2010. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.

Date of Capture: August 2006.

Draft SP248138 - area to be opened as road
(DERM ref 2011/006477)

Project Manager	M. Jess
Compiled by	N.Watts
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR100246-147.mxd
Sheet Number	1 of 1

Client
RATCH Australia Corporation Limited

Title
Appendix A: Project Layout

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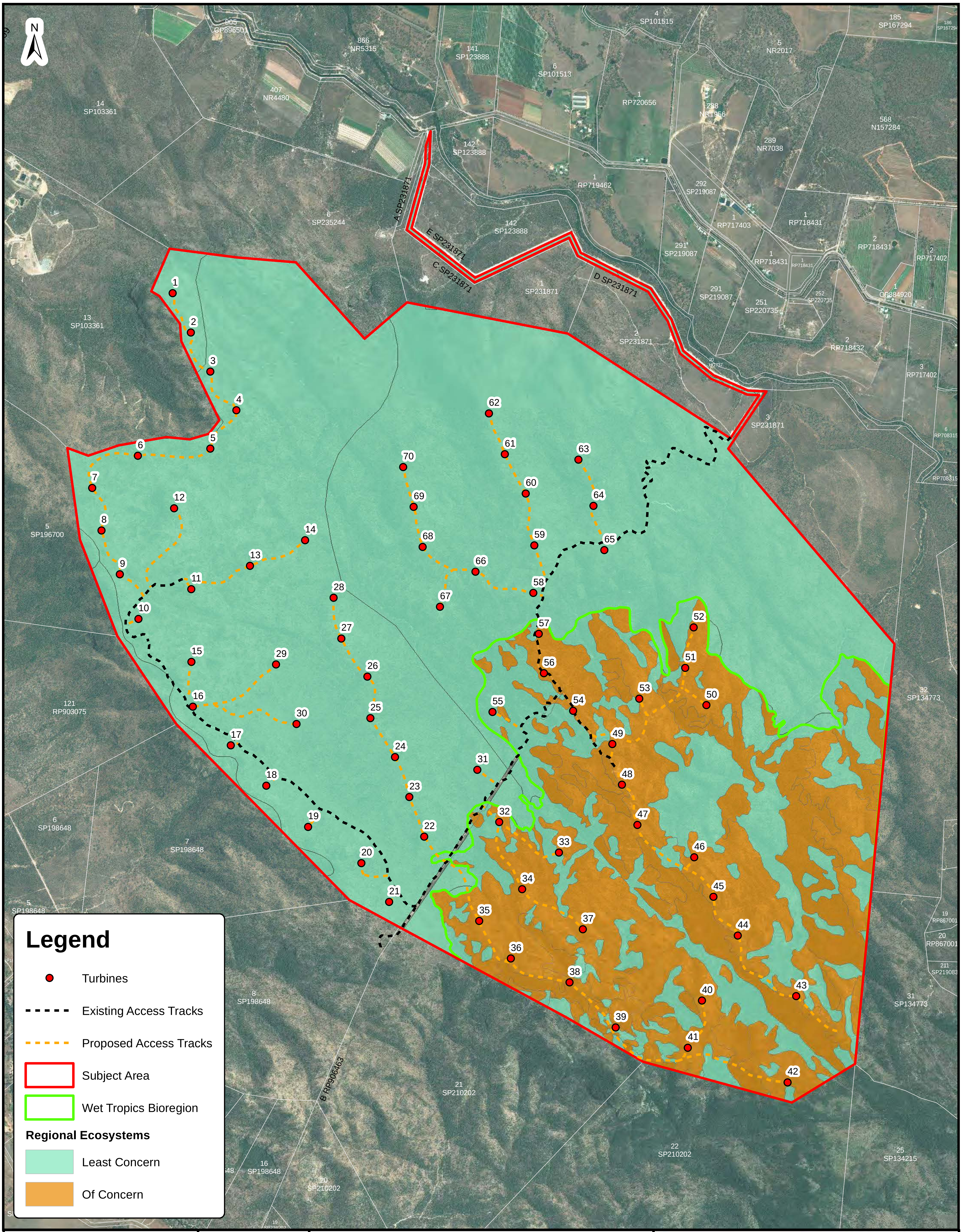
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:25,000	20-9-2013	PR100246-147	1

Appendix B

Regional Ecosystem Mapping - Entire Site



0 250 500 750 1,000

Meters (A3)

DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
REGIONAL ECOSYSTEM VERSION 6 DATA
DERM AERIAL PHOTOGRAPHY.

Regional ecosystem linework compiled at scale greater than 1:100,000, except in designated areas, where a compilation scale of 1:50,000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100,000 is +/-100 metres.

The aerial photography used in this plan has not been rectified. The image has been overlaid as a best fit on the boundaries shown and position is approximate only.

Date of Capture: August 2006.

Draft SP248138 - area to be opened as road
(DERM ref 2011/006477)

Project Manager	M. Jess
Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR100246-141.mxd
Sheet Number	1 of 1

Client

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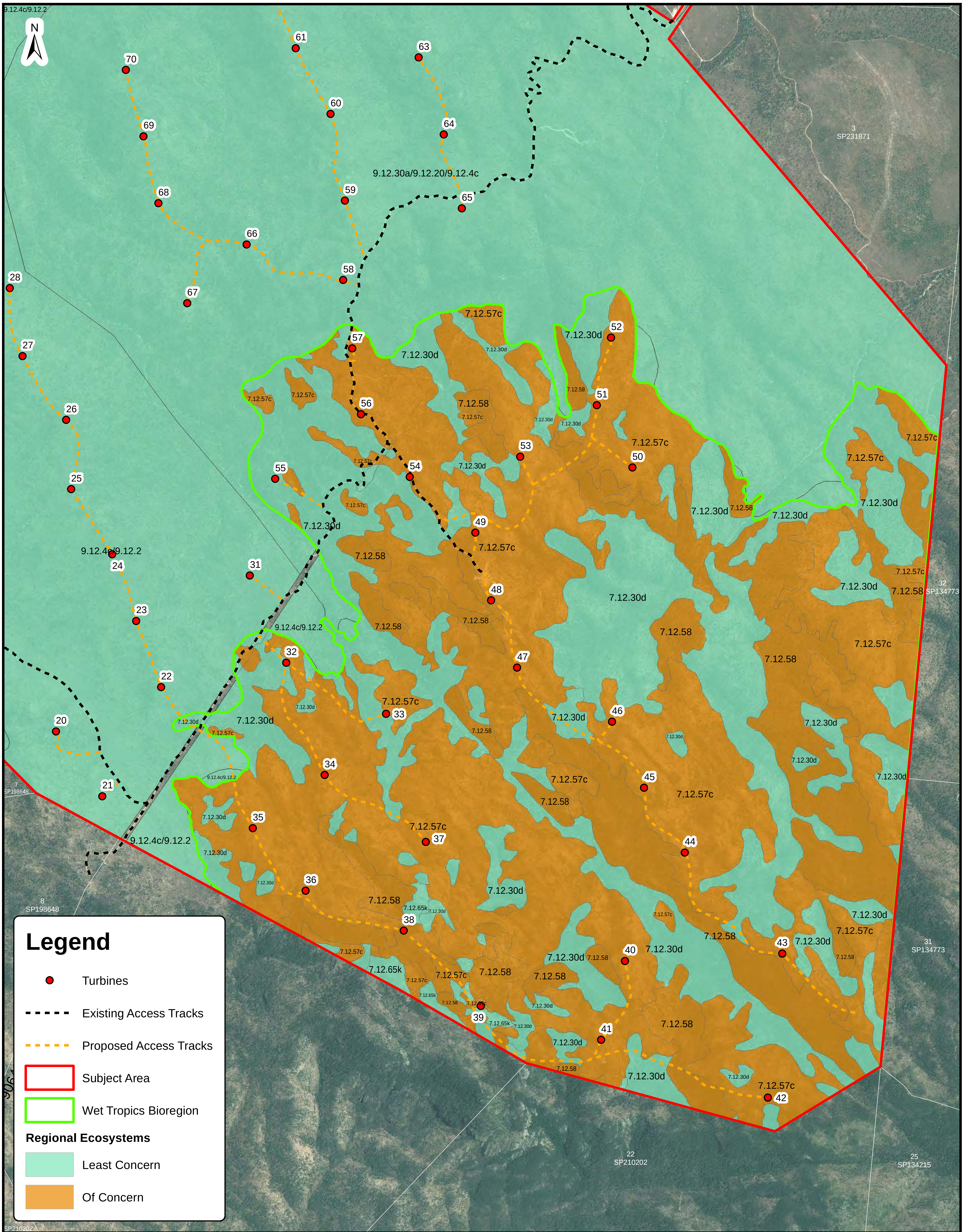
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:25,000	18/07/2013	PR100246-141	

Appendix C

Regional Ecosystem Mapping - Wet Tropics Bioregion Section



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Meters (A3)

DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
REGIONAL ECOSYSTEM VERSION 6 DATA
DERM AERIAL PHOTOGRAPHY.
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Regional ecosystem linework compiled at scale greater than 1:100,000, except in designated areas, where a compilation scale of 1:50,000 is available. Linework should be used as a guide only.
The positional accuracy of RE data mapped at a scale of 1:100,000 is +/-100 metres.

The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.

Date of Capture: August 2006.

Draft SP248138 - area to be opened as road
(DERM ref 2011/006477)

Project Manager	M. Jess
Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR100246-139.mxd
Sheet Number	1 of 1

Client

Ratch Australia Corporation Limited

Title

Regional Ecosystem Mapping Wet Tropics Area

RPS Australia East Pty Ltd
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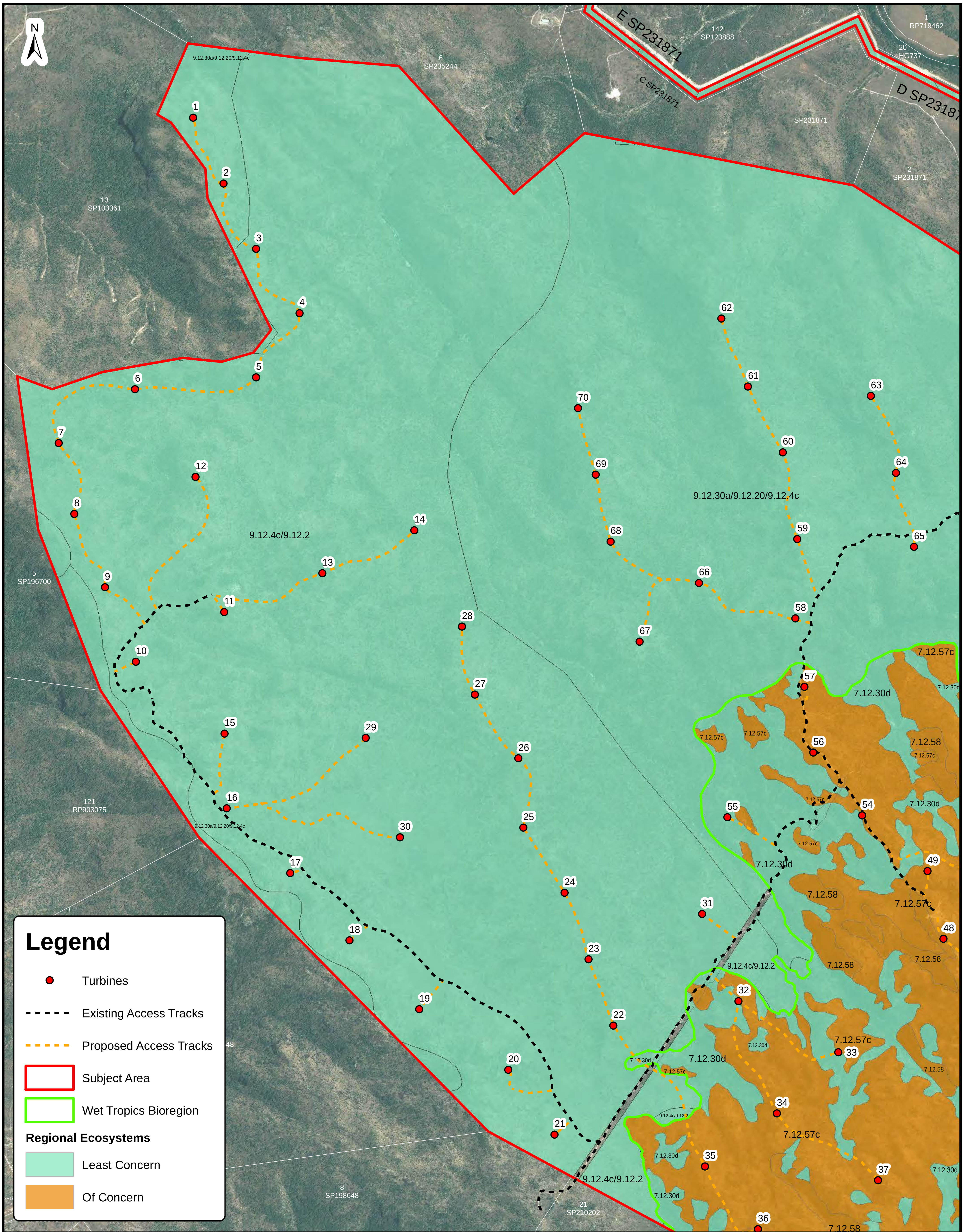
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:15,000	5/07/2013	PR100246-139	

Appendix D

Regional Ecosystem Mapping - Einasleigh Uplands Bioregion Section



0 150 300 450 600

Meters (A3)

DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
REGIONAL ECOSYSTEM VERSION 6 DATA
DERM AERIAL PHOTOGRAPHY.
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Regional ecosystem linework compiled at scale greater than 1:100,000, except in designated areas, where a compilation scale of 1:50,000 is available. Linework should be used as a guide only.
The positional accuracy of RE data mapped at a scale of 1:100,000 is +/-100 metres.

The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.

Date of Capture: August 2006.

Draft SP248138 - area to be opened as road
(DERM ref 2011/006477)

Project Manager	M. Jess
Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
File Reference	PR100246-138.mxd
Sheet Number	1 of 1

Client

Ratch Australia Corporation Limited

Title

Regional Ecosystem Mapping Einasleigh Uplands

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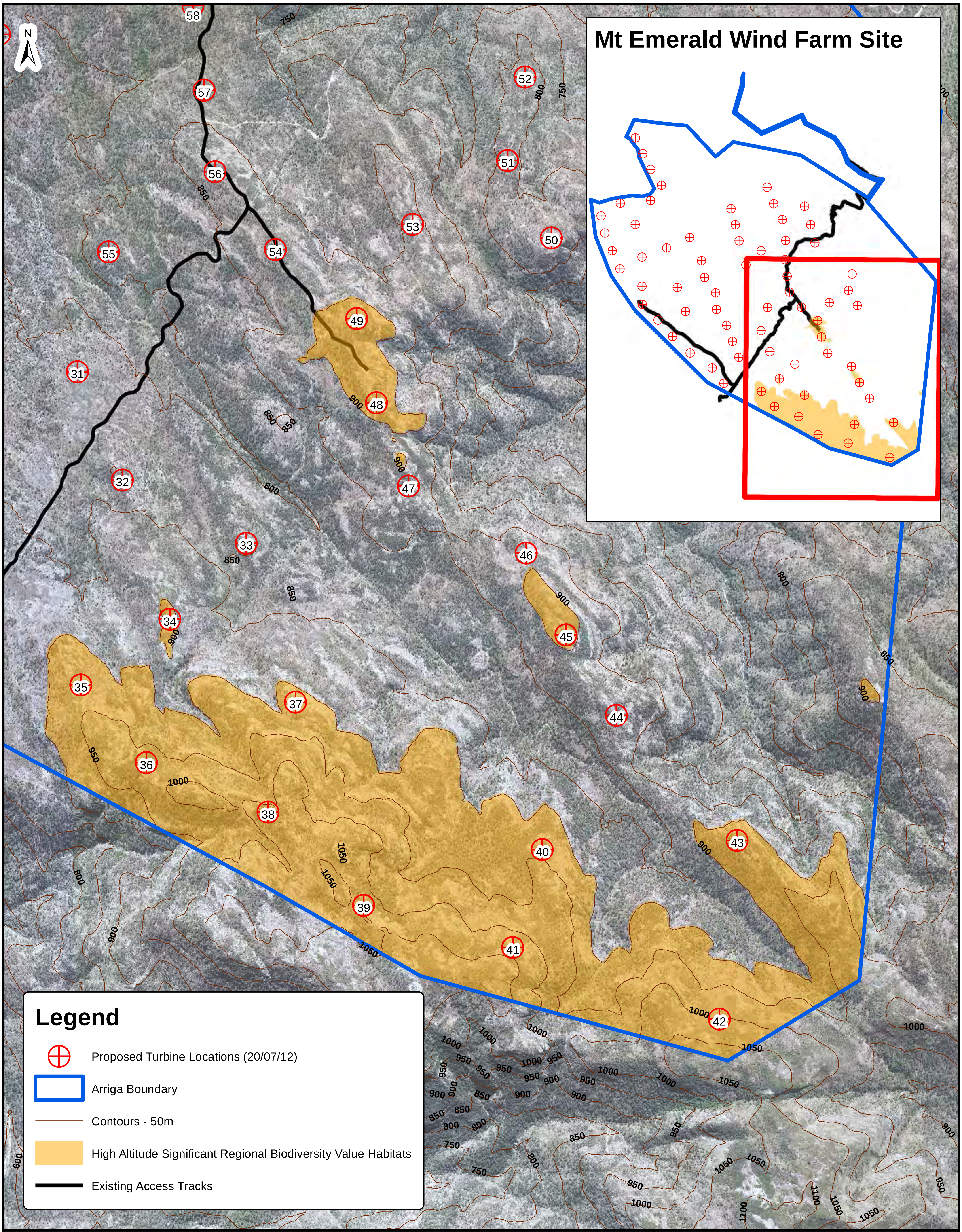
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:15,000	5/07/2013	PR100246-138	

Appendix E

High Altitude Significant (900 m) Regional Biodiversity Value Habitats



0 160 320 480 640
Meters (A3)

Project Manager	M. JESS
Compiled by	J. MIDDLETON
Map Projection	UTM 55S
Map Datum	WGS84
File Reference	PR100246-137.mxd
Sheet Number	1 of 1

Client

RATCH AUSTRALIA PTY LTD

Title

High Altitude Significant Regional Biodiversity Value Habitats

RPS

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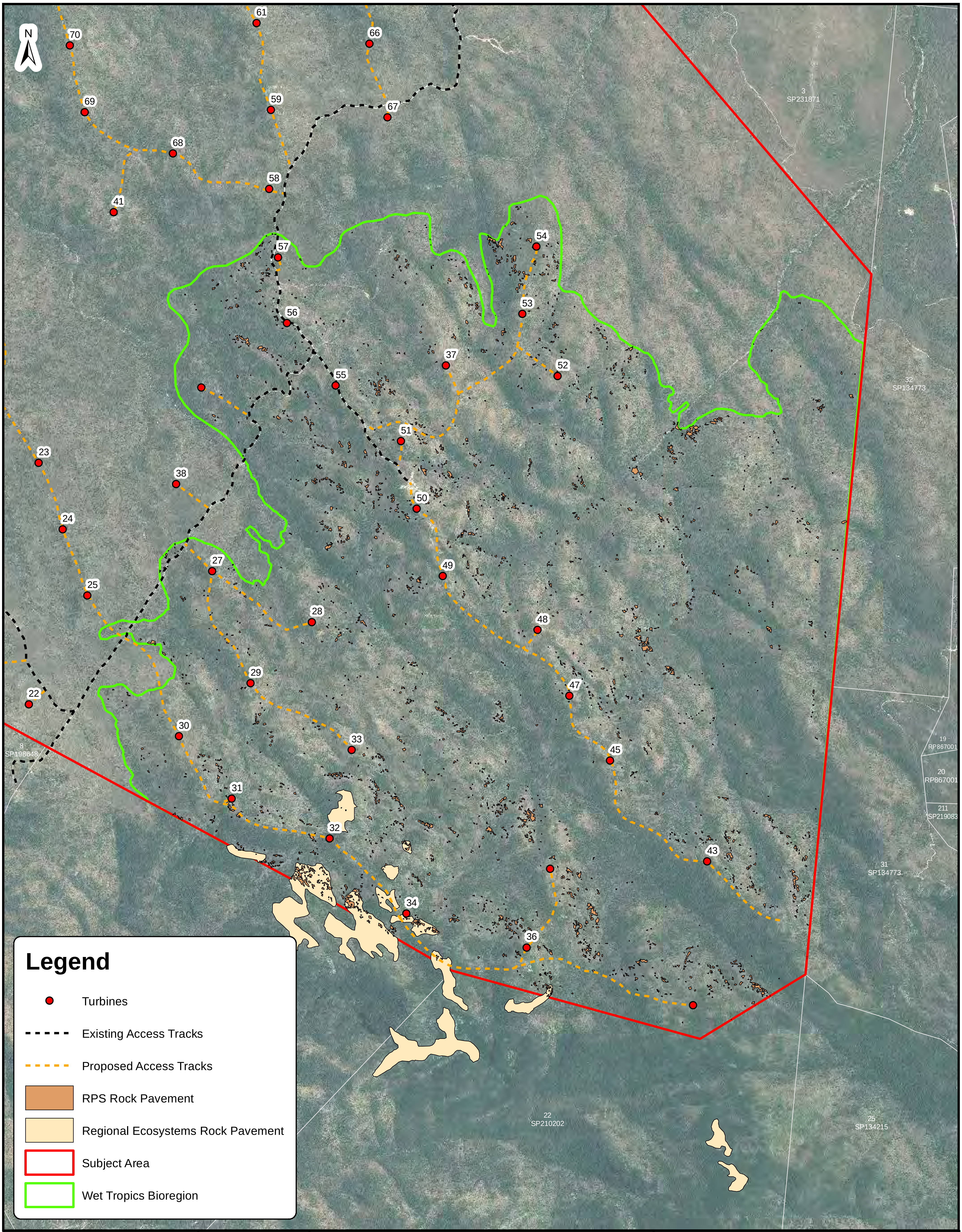
SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:12,074	06/05/2013	PR100246-137	1

Appendix F

Rock Pavement and Outcrop Mapping - Wet Tropics Bioregion Section



0 100 200 300 400 500
Meters (A3)

DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
REGIONAL ECOSYSTEM VERSION 6 DATA
DERM AERIAL PHOTOGRAPHY.

Regional ecosystem linework compiled at scale greater than 1:100,000, except in designated areas, where a compilation scale of 1:50,000 is available. Linework should be used as a guide only.
The positional accuracy of RE data mapped at a scale of 1:100,000 is +/-100 metres.

The aerial photography used in this plan has not been rectified.
The image has been overlaid as a best fit on the boundaries shown and position is approximate only.

Date of Capture: August 2006.

Draft SP248138 - area to be opened as road
(DERM ref 2011/006477)

Project Manager: D. Finney
Compiled by: RMS
Map Projection: MGAz55
Map Datum: GDA94
File Reference: PR100246-132.mxd
Sheet Number: 1 of 1

Client: Ratch Australia Corporation Limited

Title: Rock Pavement Mapping

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SCALE (A3)	DATE	DRAWING NO.	ISSUE
1:15,000	18/4/2013	PR100246-132	

Appendix G

Description of Vegetation Communities

Description of Vegetation Communities

Rustyjacket Woodland

Woodland to open woodland of *Corymbia leichhardtii*, *Callitris intratropica* with *Eucalyptus shirleyi* and *Eucalyptus granitica* to 8 - 12 m.

This community is widespread across the northern section of the site and concentrated on flat to undulating landforms north of the transmission line. It occurs of finely textured soils derived from rhyolite, usually with a high clay content. Rock plates occasionally break the grass layer.

Floristics

T1 *Corymbia leichhardtii*, *Callitris intratropica*.

T2 *Eucalyptus granitica*, *Corymbia leichhardtii*, *Eucalyptus lockyeri* subsp. *exuta*, (*Eucalyptus portuensis*).

T3 *Eucalyptus shirleyi*, (*Eucalyptus lockyeri* subsp. *exuta*), *Corymbia leichhardtii*. *Melaleuca viridiflora*

S1 *Xanthorrhoea johnsonii*, *Eucalyptus shirleyi*, *Melaleuca viridiflora*, *Exocarpos cupressiformis*, *Bursaria incana*.

S2 *Xanthorrhoea johnsonii*, *Acacia umbellata*.

G Themeda triandra, *Alloteropsis semialata*, *Arundinella setosa*, *Acacia umbellata*, *A. calyculata*, *Schizachyrium fragile*, *Hypericum gramineum*, *Jacksonia thesioides*, *Lomandra multiflora*, *Vellea pubescens*, *Pseudopogonatherum contortum*, *Thysanotus tuberosus*, *Thecanthes cornucopiae*, *Melaleuca viridiflora*, *Hibbertia stirlingii*.

Conservation values: By comparison with other vegetation types on the project site, this community hosts virtually no conservation significant species. Two outlying specimens of *Grevillea glossadenia* were observed at its margin and junction with woodland on rockier soils. The presence of grass trees (*Xanthorrhoea johnsonii*) and bloodwoods (*Corymbia leichhardtii*) provide habitat and food sources for gliders and arboreal mammals.

Weeds: The main species of weeds that have been observed to establish in or at the edges of cleared zones in this vegetation type include: *Megathyrsus maximus*, *Themeda quadrivalvis*, *Praxelis clematidea*, *Bidens bipinnata*, *Sporobolus pyramidalis* and *Hyparrhenia rufa*.

Silver-leaf Ironbark Woodland

Woodland to low open woodland of *Eucalyptus shirleyi* to 4 m with emergent *Callitris intratropica* (12 m).

This community occurs on flat land in the centre of the site and is common around the transmission line where it crosses the project area.

Floristics

T1 *Eucalyptus shirleyi*, (*Corymbia leichhardtii*), *Callitris intratropica* (E)

T2 *Eucalyptus shirleyi*.

T3 Not present

S1 *Exocarpos cupressiformis*, *Melaleuca viridiflora*, *Eucalyptus shirleyi*, *Grevillea mimosoides*, *Xanthorrhoea johnsonii*.

S2 Not present

G *Schizachyrium fragile*, *Arundinella setosa*, *Eriachne humilis*, *Pseudopogonatherum contortum*, *Themeda triandra*, *Acacia humifusa*, *Thysanotus tuberosus*, *Vellea pubescens*, *Drosera petiolaris*, *Utricularia chrysantha*.

Conservation Values: No plants of conservation interest have been observed in this community. The ground in wetter zones supports a number of interesting species such as *Drosera* and *Utricularia*.

Weeds: Very few weed species were observed in this community. Scattered occurrences of Praxelis (*Praxelis clematidea*).

Yellow Stringybark Woodland

Grassy woodland of *Eucalyptus portuensis* with *Corymbia citriodora* to 7-12 m.

This community is relatively widespread across many sections of the site on rocky slopes and more rugged hills.

Floristics

T1 *Eucalyptus portuensis*, *Corymbia citriodora*.

T2 *Eucalyptus portuensis*

T3 Not clearly defined, but can include *Eucalyptus portuensis* and *Corymbia abergiana*.

S1 *Xanthorrhoea johnsonii*, *Pogonolobus reticulatus*

S2 *Xanthorrhoea johnsonii*

G *Themeda triandra*, *Arundinella setosa* (more rockier soils), *Mnesithea rottboellioides*, *Heteropogon triticeus*, *Galactia tenuiflora*, *Hibiscus meraukensis*, *Grevillea dryandri*, *Hibbertia longifolia*, *Acacia calyculata*, *A. whitei*, *A. humifusa*

Conservation Values: May host narrow endemic species such as *Hovea nana* and *Indigofera bancroftii* on drier, rocky slopes and short ridge sections. Occasional occurrences of *Grevillea glossadenia* at the edge of the community where it meets exposed ridges.

Weeds: Few weeds are encountered in this type, except for incidences of Praxelis (*Praxelis clematidea*) on more rockier ground and Red Natal Grass (*Melinis repens*). At more easterly aspects of the site (e.g. slopes facing Walkamin), Molasses Grass (*Melinis minutiflora*) becomes more evident and forms dense swards across marginally moister slopes and in valleys.

White Stringybark Woodland

Tall, grassy woodland of *Eucalyptus reducta* with *Eucalyptus portuensis* and occasional *Corymbia citriodora* and *Eucalyptus drepanophylla* (sens. lat.) to 12-18 m.

This community occurs primarily on more protected western facing slopes with rocky soils, with the main representation south of the transmission line. It reaches its best structural development in the most remote aspects of the site closer to Mt Emerald.

Floristics

T1 Eucalyptus reducta

T2 *Eucalyptus portuensis*, *E. drepanophylla* (sens. lat.), *Corymbia citriodora*.

T3 *Allocasuarina torulosa*, *Corymbia citriodora*, *Eucalyptus portuensis*, *Acacia flavescens*.

S1 *Acacia falciformis*, *Hakea plurinervia*, *Pimelea linearis*, *Allocasuarina torulosa*, *Xanthorrhoea johnsonii*

S2 Not present

G *Themeda triandra*, *Jacksonia thesioides*, *Pimelea linifolia*, *Galactia tenuiflora*, *Desmodium rhytidophyllum*, *Lepidosperma laterale*, *Crotalaria montana*, *C. medicaginea*.

Conservation Values: Areas of this woodland with significant structural and floristic integrity occur in the SW of the site. Although no conservation significant plant species were recorded from this community, the narrowly represented and endangered *Melaleuca uxorum* occurs on ridges in close proximity. This type is possibly the most well-developed woodland community in the project area. Large, hollow-bearing trees are present at the western and southern sections of the site and form impressive stands on west-facing slopes. Potential for well-protected, high value fauna habitats.

Weeds: Virtually weed free with the exception of isolated occurrences of Praxelis (*Praxelis clematidea*).

Range Bloodwood Woodland and Shrubland

Low, windswept woodland to open woodland and shrubland of *Corymbia abergiana* to 4 m on exposed ridges.

Restricted to exposed ridges and their edges primarily south of the transmission line and along eastern ridges near the centre of the site in the Wet Tropics section.

Floristics

T1 *Corymbia abergiana*, *Eucalyptus lockyeri* subsp. *exuta*, (*Corymbia citriodora*), *Allocasuarina littoralis*

T2 Merges with T1.

T3 Not present

S1 *Acacia aulacocarpa*, *Persoonia falcata*, *Allocasuarina littoralis*, *Corymbia abergiana*, *Grevillea glossadenia*, *Homoranthus porteri*, *Pultenaea millarii*

S2 Generally not present; but sometimes formed by wide thickets of *Acacia umbellata*.

G *Grevillea dryandri*, *Jacksonia thesioides*, *Schizachyrium fragile*, *Eriachne mucronata*, *E. humilis*, *Tripogon loliiformis*, *Melaleuca borealis*, *Pultenaea millarii*, *Mirbelia speciosa* subsp. *ringrosei*, *Hovea nana*, *Mirbelia pungens*, *Acacia whitei*, *Acacia calyculata*, *Hibbertia longifolia*, *Grevillea glossadenia*, *Sannantha angusta*, *Cleistochloa subjuncea*, *Panicum simile*, *Panicum* sp.

Conservation Values

Key habitat for a number of conservation significant plants and narrowly restricted, endemic plants including: *Homoranthus porteri*, *Grevillea glossadenia*, *Melaleuca uxorum*, *M. borealis*, *Hovea nana*, *Cryptandra debilis*, *Mirbelia speciosa* subsp. *ringrosei* and *Indigofera bancroftii*.

Weeds

Praxelis (*Praxelis clematidea*), *Bidens bipinnata* and *Melinis repens* were observed to take hold in this community.

Montane Heathland

Low heathland with scattered shrubs or isolated, wind-sheared and stunted trees of *Corymbia abergiana* and *Eucalyptus lockyeri* subsp. *exuta*. Includes patches of rock pavements and outcropping rock.

Occupies a very constricted niche above 900 m in the cloud base zone. Occurs only in the Wet Tropics bioregion section of the site south of the transmission line.

Floristics

T1 Not present

T2 Not present

T3 Not present

S1 (*Eucalyptus lockyeri* subsp*. exuta*), (*Corymbia abergiana*), *Homoranthus porteri*, *Grevillea glossadenia*, *Xanthorrhoea johnsonii*, *Acacia aulacocarpa*.

S2 Not usually present; however, sometimes formed by a combination of *Jacksonia thesioides, Gompholobium nitidum* and *Grevillea dryandri*

G *Tripogon loliiformis*, *Eriachne humilis*, *E. mucronata*, *Cleistochloa subjuncea*, *Jacksonia thesioides*, *Grevillea dryandri*, *G. glossadenia*, *Pseudanthus ligulatus*, *Melaleuca uxorum*, *M. borealis*, *Themeda triandra*, *Zieria minutiflora* subsp. *trichocarpa*, *Panicum simile*, *Coronidium newcastlianum*, *Melichrus urceolatus* and other Epacrids.

Conservation Values: Very high conservation values because of the limited habitat area available for numerous conservation significant plant species and highly restricted endemics, including *Homoranthus porteri*, *Grevillea* glossadenia, *Melaleuca uxorum*, *M. borealis*, *Cryptandra debilis*, *Borya septemtrionalis*,

Weeds: Virtually weed free. Very isolated incidences of Praxelis (*Praxelis clematidea*). The community is susceptible to invasion by this species if disturbed.

Narrow-leaf Ironbark and Lemon-scented Gum Woodland

Woodland of *Eucalyptus drepanophylla* (sens. lat.) and *Corymbia citriodora* to 15 m.

The main component occurs at the northern end of the site on flat to undulating land and gentle slopes and rises with stony soils.

Floristics

T1 *Eucalyptus drepanophylla* (sens. lat), *Corymbia citriodora.*

T2 *Corymbia citriodora*

T3 Not present

S1 *Xanthorrhoea johnsonii*, *Persoonia falcata*, *Bursaria incana*

S2 *Xanthorrhoea johnsonii*

G *Themeda triandra*, *Dichanthium sericeum*, *Galactia tenuifolia*, *Crotalaria medicaginea*, *Bursaria incana*

Conservation Values: No conservation significant plants observed in this community. A comparatively simple vegetation type which exhibits limited diversity. Possibility of restricted species such as *Indigofera bancroftii*.

Weeds: More or less weed free. Praxelis (*Praxelis clematidea*) is encountered infrequently.

Dead Finish Woodland

Grassy woodland to 8-10 m of *Eucalyptus cloeziana*, *Corymbia citriodora* and *E. portuensis*.

Found on gentle slopes and rises with stony to rocky soil mainly to the north of the transmission line, but patchily distributed in discrete locations elsewhere.

Floristics

T1 <u>*Eucalyptus cloeziana*</u>, *Corymbia citriodora*, (*E. portuensis*), (*E. pachycalyx*)

T2 (*Eucalyptus portuensis*), *Corymbia citriodora*, (*E. pachycalyx*)

T3 *Corymbia citriodora*.

S1 *Xanthorrhoea johnsonii*, *Indigofera pratensis*, *Pogonolobus reticulatus*, *Persoonia falcata*, *Bursaria incana*, *Eucalyptus portuensis*, *Bursaria incana*

S2 *Xanthorrhoea johnsonii*

G *Themeda triandra*, *Dichanthium sericeum*, *Grevillea dryandri*, *Galactia tenuiflora*, *Cartonema spicatum*, *Arundinella setosa*, *Themeda triandra*, *Schizachyrium fragile*, *Xanthorrhoea johnsonii*, *Lomandra multiflora*, *Jacksonia thesioides*, *Bursaria incana*, *Hibbertia longifolia*, *Pogonolobus reticulatus*, *Coronidium newcastlianum*, *Lomandra longifolia*, *Pultenaea millarii*, *Eucalyptus portuensis*, *Crotalaria montana*, *Grewia mesomischa*, *Phyllanthus simplex*, *Pimelea sericostachya*, *Aeschynomene micranthos*, *Indigofera bancroftii*.

Conservation Values: No conservation significant species were observed in this community; although *Grevillea glossadenia* occurs at its fringes along the access track into the site. The locally endemic *Indigofera bancroftii* was found in this type. The restricted tree *Eucalyptus pachycalyx* (Pumpkin gum) occurs in this community.

Weeds: The commonest weed encountered in this type is Praxelis (*Praxelis clematidea*) and occasionally, *Bidens bipinnata*.

Appendix H

Checklist of Flora (Provisional)

Provisional Checklist of Plant Species - Mt Emerald Wind Farm[1]

[1] Voucher collection to be confirmed by Queensland Herbarium.

Nomenclature follows: Bostock, P.D. & Holland, A.E. (eds) (2010). *Census of the Queensland Flora 2010*. Queensland Herbarium, Department of Environment and Resource Management, Brisbane.

ANGIOSPERMS (Status: * Naturalised; E - Endangered; V - Vulnerable; NT - Near Threatened)		
Family Name	**Status**	**Botanical Name**
Acanthaceae		Brunoniella australis (Cav.) Bremek.
Acanthaceae		Pseuderanthemum variabile (R.Br.) Radlk.
Acanthaceae		Rostellularia adscendens (R.Br.) R.M.Barker
Anacardiaceae		Euroschinus falcatus var. angustifolius Benth.
Apiaceae		Platysace valida (F.Muell.) F.Muell.
Apocynaceae		Alyxia spicata R.Br.
Apocynaceae		Hoya australis R.Br. ex Traill subsp. australis
Apocynaceae		Sarcostemma viminale subsp. brunonianum (Wight & Arn.) P.I.Forst.
Araliaceae		Astrotricha pterocarpa Benth.
Araliaceae		Trachymene bivestita (Domin) L.A.S.Johnson var. bivestita
Aristolochiaceae		Aristolochia thozetii F.Muell.
Asparagaceae		Asparagus racemosus Willd.
Asteraceae	*	Ageratum conyzoides L. subsp. conyzoides
Asteraceae	*	Bidens bipinnata L.
Asteraceae	*	Bidens pilosa L.
Asteraceae		Coronidium newcastlianum (Domin) Paul G.Wilson
Asteraceae		Coronidium rupicola (DC.) Paul G.Wilson
Asteraceae	*	Crassocephalum crepidioides (Benth.) S.Moore
Asteraceae		Cyanthillium cinereum (L.) H.Rob.
Asteraceae	*	Emilia sonchifolia (L.) DC.
Asteraceae		Peripleura diffusa (N.T.Burb.) G.L.Nesom
Asteraceae	*	Praxelis clematidea R.M.King & H.Rob.
Asteraceae		Pterocaulon serrulatum (Montrouz.) Guillaumin var. serrulatum
Asteraceae	*	Synedrella nodiflora (L.) Gaertn.
Asteraceae	*	Tridax procumbens L.
Asteraceae		Wedelia spilanthoides F.Muell.
Asteraceae		Xerochrysum bracteatum (Vent.) Tzvelev
Bignoniaceae		Pandorea linearis (F.M.Bailey) Guymer
Boraginaceae		Heliotropium tabuliplagae Craven
Boryaceae		Borya septentrionalis F.Muell.
Burseraceae		Canarium australianum var. glabrum Leenh.
Byblidaceae		Byblis liniflora Salisb.
Byttneriaceae		Keraudrenia lanceolata (Steetz) Benth.
Byttneriaceae		Waltheria indica L.
Caesalpiniaceae		Chamaecrista absus (L.) H.S.Irwin & Barneby var. absus
Caesalpiniaceae		Chamaecrista nomame (Siebold) H.Ohashi var. nomame
Caesalpiniaceae	*	Senna occidentalis (L.) Link
Caesalpiniaceae	*	Senna pendula var. glabrata (Vogel) H.S.Irwin & Barneby
Campanulaceae		Wahlenbergia caryophylloides P.J.Sm.
Capparaceae		Capparis canescens Banks ex DC.
Caryophyllaceae		Polycarpaea corymbosa (L.) Lam.
Casuarinaceae		Allocasuarina inophloia (F.Muell. & F.M.Bailey) L.A.S.Johnson
Casuarinaceae		Allocasuarina littoralis (Salisb.) L.A.S.Johnson
Casuarinaceae		Allocasuarina torulosa (Aiton) L.A.S.Johnson
Casuarinaceae		Casuarina cunninghamiana Miq. subsp. cunninghamiana
Celastraceae		Denhamia cunninghamii (Hook.) M.P.Simmons
Celastraceae		Denhamia disperma (F.Muell.) M.P.Simmons
Clusiaceae		Hypericum gramineum G.Forst.
Colchicaceae		Iphigenia indica (L.) Kunth
Commelinaceae		Cartonema spicatum R.Br.
Commelinaceae		Commelina ensifolia R.Br.
Commelinaceae		Commelina lanceolata R.Br.
Commelinaceae		Murdannia graminea (R.Br.) G.Brueckn.
Convolvulaceae		Evolvulus alsinoides (L.) L.

ANGIOSPERMS (Status: * Naturalised; E - Endangered; V - Vulnerable; NT - Near Threatened)		
Family Name	**Status**	**Botanical Name**
Convolvulaceae		Ipomoea gracilis R.Br.
Convolvulaceae	*	Ipomoea hederifolia L.
Convolvulaceae		Ipomoea polpha R.W.Johnson subsp. polpha
Convolvulaceae		Xenostegia tridentata (L.) D.F.Austin & Staples
Cyperaceae		Gahnia aspera (R.Br.) Spreng.
Cyperaceae		Lepidosperma laterale R.Br.
Cyperaceae		Rhynchospora subtenuifolia Kuek.
Cyperaceae		Scleria brownii Kunth
Dilleniaceae		Hibbertia longifolia F.Muell.
Dilleniaceae		Hibbertia melhanioides F.Muell.
Droseraceae		Drosera burmanni Vahl
Droseraceae		Drosera indica L.
Droseraceae		Drosera petiolaris R.Br. ex DC.
Ericaceae		Acrothamnus spathaceus (Pedley) Quinn
Ericaceae		Melichrus adpressus A.Cunn. ex DC.
Ericaceae		Melichrus urceolatus R.Br.
Eriocaulaceae		Eriocaulon
Fabaceae		Cajanus confertiflorus F.Muell.
Fabaceae		Crotalaria brevis Domin
Fabaceae		Crotalaria medicaginea Lam. var. medicaginea
Fabaceae		Crotalaria montana var. angustifolia (Gagnep.) Niyomdham
Fabaceae		Desmodium rhytidophyllum F.Muell. ex Benth.
Fabaceae		Flemingia parviflora Benth.
Fabaceae		Galactia tenuiflora (Spreng.) Willd. ex Wight & Arn.
Fabaceae		Gastrolobium grandiflorum F.Muell.
Fabaceae		Gompholobium nitidum Sol. ex Benth.
Fabaceae		Hovea nana I.Thomps. & J.H.Ross
Fabaceae		Indigofera bancroftii Peter G.Wilson
Fabaceae		Indigofera hirsuta L.
Fabaceae		Indigofera pratensis F.Muell.
Fabaceae		Jacksonia thesioides A.Cunn. ex Benth.
Fabaceae		Mirbelia pungens A.Cunn. ex G.Don
Fabaceae		Mirbelia speciosa subsp. ringrosei (F.M.Bailey) Pedley
Fabaceae		Pultenaea millarii F.M.Bailey
Fabaceae		Tephrosia juncea Benth.
Fabaceae		Zornia
Fabaceae		Zornia prostrata S.T.Reynolds & A.E.Holland var. prostrata
Flacourtiaceae		Homalium brachybotrys (F.Muell.) F.Muell.
Goodeniaceae		Goodenia
Goodeniaceae		Velleia spathulata R.Br.
Haemodoraceae		Haemodorum coccineum R.Br.
Haloragaceae		Gonocarpus acanthocarpus (Brongn.) Orchard
Hemerocallidaceae		Dianella caerulea var. vannata R.J.F.Hend.
Hypoxidaceae		Curculigo ensifolia R.Br. var. ensifolia
Johnsoniaceae		Tricoryne anceps subsp. pterocaulon (Baker) Thongp.
Johnsoniaceae		Tricoryne elatior R.Br.
Lamiaceae		Clerodendrum longiflorum var. glabrum Munir
Lamiaceae	V	Plectranthus amoenus P.I.Forst.
Lamiaceae		Plectranthus sp.
Lauraceae		Cassytha filiformis L.
Laxmanniaceae		Eustrephus latifolius R.Br. ex Ker Gawl.
Laxmanniaceae		Lomandra longifolia Labill.
Laxmanniaceae		Lomandra multiflora (R.Br.) Britten subsp. multiflora
Laxmanniaceae		Thysanotus tuberosus R.Br. subsp. tuberosus
Lentibulariaceae		Utricularia chrysantha R.Br.
Loranthaceae		Dendrophthoe glabrescens (Blakely) Barlow
Malvaceae		Hibiscus meraukensis Hochr.
Malvaceae	*	Sida cordifolia L.
Malvaceae	*	Sida rhombifolia L.
Malvaceae	*	Urena lobata L.

ANGIOSPERMS (Status: * Naturalised; E - Endangered; V - Vulnerable; NT - Near Threatened)		
Family Name	**Status**	**Botanical Name**
Menyanthaceae		Nymphoides crenata (F.Muell.) Kuntze
Mimosaceae		Acacia aulacocarpa A.Cunn. ex Benth.
Mimosaceae		Acacia calyculata A.Cunn. ex Benth.
Mimosaceae		Acacia falciformis DC.
Mimosaceae		Acacia flavescens A.Cunn. ex Benth.
Mimosaceae		Acacia holosericea A.Cunn. ex G.Don
Mimosaceae		Acacia humifusa A.Cunn. ex Benth.
Mimosaceae		Acacia leptoloba Pedley
Mimosaceae		Acacia leptostachya Benth.
Mimosaceae		Acacia multisiliqua (Benth.) Maconochie
Mimosaceae		Acacia nesophila Pedley
Mimosaceae		Acacia simsii A.Cunn. ex Benth.
Mimosaceae		Acacia umbellata A.Cunn. ex Benth.
Mimosaceae		Acacia whitei Maiden
Mimosaceae		Vachellia bidwillii (Benth.) Kodela
Moraceae		Ficus obliqua G.Forst.
Moraceae		Ficus opposita Miq.
Myrtaceae		Corymbia abergiana (F.Muell.) K.D.Hill & L.A.S.Johnson
Myrtaceae		Corymbia citriodora (Hook.) K.D.Hill & L.A.S.Johnson subsp. citriodora
Myrtaceae		Corymbia clarksoniana (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson
Myrtaceae		Corymbia erythrophloia (Blakely) K.D.Hill & L.A.S.Johnson
Myrtaceae		Corymbia intermedia (R.T.Baker) K.D.Hill & L.A.S.Johnson
Myrtaceae		Corymbia leichhardtii (F.M.Bailey) K.D.Hill & L.A.S.Johnson
Myrtaceae		Eucalyptus cloeziana F.Muell.
Myrtaceae		Eucalyptus crebra F.Muell.
Myrtaceae		Eucalyptus granitica L.A.S.Johnson & K.D.Hill
Myrtaceae		Eucalyptus leptophleba F.Muell.
Myrtaceae		Eucalyptus lockyeri subsp. exuta Brooker & Kleinig
Myrtaceae		Eucalyptus pachycalyx Maiden & Blakely subsp. pachycalyx
Myrtaceae		Eucalyptus platyphylla F.Muell.
Myrtaceae		Eucalyptus portuensis K.D.Hill
Myrtaceae		Eucalyptus reducta L.A.S.Johnson & K.D.Hill
Myrtaceae		Eucalyptus shirleyi Maiden
Myrtaceae		Leptospermum neglectum Joy Thomps.
Myrtaceae		Lophostemon grandiflorus subsp. riparius (Domin) Peter G.Wilson & J.T.Waterh.
Myrtaceae		Lophostemon suaveolens (Sol. ex Gaertn.) Peter G.Wilson & J.T.Waterh.
Myrtaceae		Melaleuca borealis Craven
Myrtaceae		Melaleuca monantha (Barlow) Craven
Myrtaceae		Melaleuca nervosa (Lindl.) Cheel
Myrtaceae	E	Melaleuca uxorum Craven, G.Holmes & Sankowsky
Myrtaceae		Melaleuca viridiflora Sol. ex Gaertn. var. viridiflora
Myrtaceae		Melaleuca viridiflora var. attenuata Byrnes
Myrtaceae	V	Homoranthus porteri (C.T.White) Craven & S.R.Jones
Myrtaceae		Sannantha angusta (A.R.Bean) Peter G.Wilson
Myrtaceae		Syncarpia glomulifera (Sm.) Nied. subsp. glomulifera
Oleaceae		Notelaea sp.
Orchidaceae		Acianthus borealis D.L.Jones
Orchidaceae		Dendrobium canaliculatum R.Br.
Orchidaceae		Dockrillia calamiformis (Lodd.) M.A.Clem. & D.L.Jones
Orchidaceae		Habenaria elongata R.Br.
Orchidaceae		Thelymitra fragrans D.L.Jones & M.A.Clem.
Passifloraceae	*	Passiflora foetida L.
Phyllanthaceae		Breynia oblongifolia (Muell.Arg.) Muell.Arg.
Phyllanthaceae		Phyllanthus dallachyanus Benth.
Phyllanthaceae		Phyllanthus fuernrohrii F.Muell.
Phyllanthaceae		Phyllanthus virgatus G.Forst.
Phyllanthaceae		Poranthera microphylla Brongn.
Picrodendraceae		Petalostigma banksii Britten & S.Moore
Picrodendraceae		Petalostigma pubescens Domin
Picrodendraceae		Pseudanthus ligulatus Halford & R.J.F.Hend. subsp. ligulatus

ANGIOSPERMS (Status: * Naturalised; E - Endangered; V - Vulnerable; NT - Near Threatened)		
Family Name	**Status**	**Botanical Name**
Poaceae		Aristida superpendens Domin
Poaceae		Aristida utilis F.M.Bailey var. utilis
Poaceae		Arundinella setosa Trin.
Poaceae		Capillipedium parviflorum (R.Br.) Stapf
Poaceae	*	Chloris virgata Sw.
Poaceae		Chrysopogon fallax S.T.Blake
Poaceae		Cleistochloa subjuncea C.E.Hubb.
Poaceae		Cymbopogon bombycinus (R.Br.) Domin
Poaceae		Cymbopogon obtectus S.T.Blake
Poaceae	*	Cynodon dactylon (L.) Pers. var. dactylon
Poaceae	*	Dactyloctenium aegyptium (L.) Willd.
Poaceae		Dichanthium sericeum (R.Br.) A.Camus subsp. sericeum
Poaceae		Ectrosia confusa C.E.Hubb.
Poaceae	*	Eleusine indica (L.) Gaertn.
Poaceae		Eragrostis cumingii Steud.
Poaceae		Eriachne humilis W.Hartley
Poaceae		Eriachne mucronata forma (Alpha C.E.Hubbard 7882)
Poaceae		Heteropogon contortus (L.) P.Beauv. ex Roem. & Schult.
Poaceae		Heteropogon triticeus (R.Br.) Stapf
Poaceae	*	Hyparrhenia rufa subsp. altissima (Stapf) B.K.Simon
Poaceae	*	Megathyrsus maximus (Jacq.) B.K.Simon & S.W.L.Jacobs var. maximus
Poaceae	*	Melinis minutiflora P.Beauv.
Poaceae	*	Melinis repens (Willd.) Zizka
Poaceae		Mnesithea formosa (R.Br.) de Koning & Sosef
Poaceae		Mnesithea rottboellioides (R.Br.) de Koning & Sosef
Poaceae		Panicum simile Domin
Poaceae		Perotis rara R.Br.
Poaceae		Pseudopogonatherum contortum (Brongn.) A.Camus
Poaceae		Sarga plumosum (R.Br.) Spangler
Poaceae		Schizachyrium sp.
Poaceae		Schizachyrium fragile (R.Br.) A.Camus
Poaceae	*	Setaria pumila (Poir.) Roem. & Schult. subsp. pumila
Poaceae		Setaria surgens Stapf
Poaceae	*	Sporobolus jacquemontii Kunth
Poaceae	*	Sporobolus pyramidalis P.Beauv.
Poaceae		Thaumastochloa major S.T.Blake
Poaceae		Themeda arguens (L.) Hack.
Poaceae	*	Themeda quadrivalvis (L.) Kuntze
Poaceae		Themeda triandra Forssk.
Poaceae		Tripogon loliiformis (F.Muell.) C.E.Hubb.
Poaceae	*	Urochloa decumbens (Stapf) R.D.Webster
Poaceae		Vacoparis laxiflorum (F.M.Bailey) Spangler
Polygalaceae	*	Polygala paniculata L.
Portulacaceae		Portulaca bicolor F.Muell.
Portulacaceae		Sedopsis sp. (Bulimba Station P.I.Forster+ PIF14742)
Proteaceae		Grevillea dryandri R.Br. subsp. dryandri
Proteaceae		Grevillea glauca Banks & Sol. ex Knight
Proteaceae	V	Grevillea glossadenia McGill.
Proteaceae		Grevillea mimosoides R.Br.
Proteaceae		Grevillea parallela Knight
Proteaceae		Hakea lorea (R.Br.) R.Br. subsp. lorea
Proteaceae		Hakea persiehana F.Muell.
Proteaceae		Hakea plurinervia F.Muell. ex Benth.
Proteaceae		Persoonia falcata R.Br.
Proteaceae		Xylomelum scottianum (F.Muell.) F.Muell.
Rhamnaceae		Alphitonia excelsa (Fenzl) Benth.
Rhamnaceae		Cryptandra debilis A.R.Bean
Rubiaceae		Larsenaikia ochreata (F.Muell.) Tirveng.
Rubiaceae	*	Mitracarpus hirtus (L.) DC.
Rubiaceae		Oldenlandia laceyi (Halford) Halford

ANGIOSPERMS (Status: * Naturalised; E - Endangered; V - Vulnerable; NT - Near Threatened)		
Family Name	**Status**	**Botanical Name**
Rubiaceae		Psydrax attenuata (Benth.) S.T.Reynolds & R.J.F.Hend.
Rubiaceae	*	Richardia brasiliensis Gomes
Rutaceae		Boronia bipinnata Lindl.
Rutaceae		Zieria minutiflora subsp. trichocarpa J.A.Armstr.
Santalaceae		Exocarpos cupressiformis Labill.
Santalaceae		Exocarpos latifolius R.Br.
Santalaceae		Santalum lanceolatum R.Br.
Sapindaceae		Dodonaea lanceolata var. subsessilifolia J.G.West
Sapindaceae		Dodonaea malvacea (Domin) M.G.Harr.
Sapotaceae		Sersalisia sericea (Aiton) R.Br.
Scrophulariaceae		Buchnera gracilis R.Br.
Scrophulariaceae		Centranthera cochinchinensis (Lour.) Merr.
Scrophulariaceae		Striga curviflora (R.Br.) Benth.
Sparrmanniaceae		Grewia mesomischa Burret
Sparrmanniaceae		Grewia retusifolia Kurz
Sparrmanniaceae	*	Triumfetta rhomboidea Jacq.
Stackhousiaceae		Stackhousia intermedia F.M.Bailey
Sterculiaceae		Brachychiton diversifolius subsp. orientalis Guymer
Stylidiaceae		Stylidium eriorhizum R.Br.
Stylidiaceae		Stylidium graminifolium Sw.
Taccaceae		Tacca leontopetaloides (L.) Kuntze
Thymelaeaceae		Pimelea linifolia Sm.
Thymelaeaceae		Pimelea sericostachya F.Muell.
Thymelaeaceae		Thecanthes cornucopiae (Vahl) Wikstr.
Thymelaeaceae		Wikstroemia indica (L.) C.A.Mey.
Verbenaceae	*	Lantana camara L.
Verbenaceae	*	Stachytarpheta australis Moldenke
Verbenaceae	*	Stachytarpheta cayennensis (Rich.) Vahl
Verbenaceae	*	Stachytarpheta jamaicensis (L.) Vahl
Violaceae		Hybanthus enneaspermus (L.) F.Muell.
Vitaceae		Cayratia trifolia (L.) Domin
Vitaceae		Clematicissus opaca (F.Muell.) Jackes & Rossetto
Xanthorrhoeaceae		Xanthorrhoea johnsonii A.T.Lee
Xyridaceae		Xyris complanata R.Br.

GYMNOSPERMS		
Family Name	**Status**	**Botanical Name**
Cupressaceae		Callitris intratropica R.T.Baker & H.G.Sm.
Cycadaceae		Cycas media subsp. banksii K.D.Hill

PTERIDOPHYTES		
Family Name	**Status**	**Botanical Name**
Adiantaceae		Cheilanthes brownii (Kuhn) Domin
Adiantaceae		Cheilanthes nitida (R.Br.) P.S.Green
Adiantaceae		Cheilanthes nudiuscula (R.Br.) T.Moore
Adiantaceae		Paraceterach muelleri (Hook.) Copel.
Davalliaceae		Davallia denticulata (Burm.f.) Mett. var. denticulata
Dennstaedtiaceae		Pteridium esculentum (G.Forst.) Cockayne
Ophioglossaceae		Ophioglossum gramineum Willd.
Polypodiaceae		Drynaria rigidula (Sw.) Bedd.
Thelypteridaceae		Christella dentata (Forssk.) Brownsey & Jermy

Appendix H1

Checklist of Flora – Queensland Herbarium Validation

Queensland Herbarium
Brisbane Botanic Gardens Mt Coot-tha • Toowong 4066 Queensland • Australia
Telephone +61 7 3896 9326 • Facsimile +61 7 3896 9624
e-mail Queensland.Herbarium@science.dsitia.qld.gov.au
www.qld.gov.au/environment/plants-animals/plants/herbarium/

Queensland Government
Department of
Science, Information Technology, Innovation and the Arts

Enquiries	Nigel Fechner/Lorna Ngugi/Jian Wang
Telephone	07 3896 9318
Your reference	
Our reference	NF/LN/JW:196/14

16 April 2014

Simon Gleed
RPS Australia
PO Box 1949
CAIRNS Qld 4870

Amended copy

Dear Simon

The botanical specimens received by the Queensland Herbarium on 17 March 2014 have been identified as:

SG 500	*#Velleia pubescens*
SG 501	*Cymbopogon bombycinus*
SG 502	*Eriachne mucronata*, confirmed
SG 503A	*Notelaea* sp. Specimen sterile.
SG 503B	*Eriachne ciliata*
SG 504	*Gonocarpus acanthocarpus*
SG 505A	*Cryptandra debilis*, confirmed
SG 505B	*Melaleuca borealis*, confirmed
SG 506	*#Waltheria indica*
SG 507	*Polycarpaea spirostylis* subsp. *spirostylis*
SG 508	*Phyllanthus collinus*
SG 509	*#Plectranthus mirus*
SG 512	*#Hibiscus meraukensis*
SG 513	*Hibbertia longifolia*
SG 514	*#Homoranthus porteri*, confirmed
SG 515	*#Grevillea glossadenia*
SG 516	*#Cryptandra debilis*, confirmed
SG 517	*Pseudopogonatherum contortum*, confirmed
SG 518	*Panicum seminudum* var. *cairnsianum*
SG 519	*Xenostegia tridentata*
SG 520	*Crotalaria montana* var. *exserta*
SG 521	*#Thecanthes cornucopiae*
SG 522	*#Aristida perniciosa*
SG 523	*#Poranthera microphylla*

SG 526	*Dodonaea dodecandra*
SG 527	*Tephrosia juncea*
SG 528A	*Indigofera sp.,* infertile material
SG 528B	*Chamaecrista nomame*
SG 529	*Pterocaulon redolens*
SG 531	*#Dodonaea lanceolata* var. *subsessilifolia*
SG 532	*Stackhousia intermedia*
SG 533	*Trachymene tenuifolium*
SG 534	*Buchnera gracilis*
SG 536	*Melaleuca borealis,* confirmed
SG 537	*Eragrostis schultzii*
SG 538	*#Rhynchospora heterochaeta*
SG 539	*Setaria surgens, confirmed*
SG 540	**Melinis repens,* confirmed
SG 542	*Thelymitra fragrans,* confirmed
SG 543	*Evolvulus alsinoides* var. *decumbens*
SG 545	**Crassocephalum crepidioides,* confirmed
SG 546	*#Bulbostylis densa*
SG 547	*Panicum simile,* confirmed
SG 548	*Eriachne obtusa*
SG 549	*#Schizachyrium pachyarthron*
SG 550	*Eriachne obtusa*
SG 551	*#Phyllanthus virgatus*
SG 552	*Eragrostis schultzii*
SG 554	*#Phyllanthus collinus*
SG 557	*Cyanthillium cinereum*
SG 558	*Eriachne obtusa*
SG 559	*Melichrus urceolatus*
SG 561	*Hovea nana*
SG 562	*Galactia tenuiflora*
SG 563	*Crotalaria medicaginea* var. *medicaginea*
SG 564	*#Spermacoce brachystema*
SG 565	*Clematicissus opaca*
SG 567	*#Cleistochloa subjuncea*
SG 568	*Rostellularia adscendens*
SG 569	*Crotalaria montana* var. *exserta*
SG 570	*#Hypericum gramineum,* confirmed
SG 571	*#Thecanthes cornucopiae*
SG 572	*Acacia whitei,* confirmed
SG 573	*Zieria minutiflora* subsp. *trichocarpa*
SG 574	*#Zieria whitei*
SG 575	*#Leptospermum neglectum*
SG 576	*Coronidium newcastlianum,* confirmed
SG 577	*Acacia whitei,* confirmed
SG 578	*Gompholobium nitidum*
SG 579	*Peripleura diffusa*
SG 580	*Apowollastonia spilanthoides*
SG 581	*Clerodendrum floribundum* var. *ovatum*
SG 582	*#Euphorbia mitchelliana* var. *mitchelliana*
SG 583	*#Drosera peltata*
SG 584	*Tripogon loliiformis*

SG 585 *#Dianella nervosa*
SG 586 *Cajanus acutifolius*
SG 587 *Hibbertia longifolia*
SG 588 *#Plectranthus amoenus*
SG 589 *#Heliotropium tabuliplagae*
SG 590 *#Heliotropium peninsulare*
SG 591 *Clematicissus opaca*
SG 592 *#Cheilanthes nitida*
SG 593 *Cheilanthes brownii,* confirmed
SG 594 *Melichrus urceolatus*
SG 595 *Eriachne obtusa*
SG 596 *#Melaleuca monantha,* confirmed, kept as refset only
SG 597 *#Pultenaea millarii* var. *millarii*
SG 598 *Homalium brachybotrys*
SG 599 *#Sannantha angusta,* confirmed
SG 600 *#Aristida sp.*
SG 601 *#Jacksonia thesioides*
SG 602 *Boronia occidentalis*
SG 603 *#Mirbelia pungens*
SG 604 *#Homoranthus porteri,* confirmed
SG 605 *Panicum simile,* confirmed
SG 606 *#Stylidium graminifolium*
SG 607 *#Mirbelia speciosa* subsp. *ringrosei*
SG 608 *Grevillea dryandri subsp. dryandri*
SG 609 *#Commelina diffusa*
SG 610 *Acacia multisiliqua,* confirmed
SG 611 *#Coronidium newcastlianum,* confirmed
SG 612 *Alphitonia excelsa,* confirmed
SG 613 *#Zieria whitei*
SG 614 *#Larsenaikia ochreata*
SG 615 *Hybanthus enneaspermus*
SG 616 *#Melaleuca uxorum,* confirmed. This species is listed as Endangered under Queensland's *Nature Conservation Act 1992.*
SG 617 *#Buchnera gracilis*
SG 618 *#Centranthera cochinchinensis*
SG 619 *Thecanthes cornucopiae,* confirmed
SG 620 *Glossocardia refracta*
SG 621 *#Acacia aulacocarpa,* confirmed
SG 622 *#Cenchrus polystachios*
SG 623 *Sannantha angusta,* confirmed
SG 624 *Urochloa holosericea*
SG 625 *Wahlenbergia queenslandica*
SG 626 *Xenostegia tridentata*
SG 627 *#Cymbopogon bombycinus*
SG 628 *#Cheilanthes caudata*
SG 629 *#Cheilanthes nudiuscula*
SG 630 *Setaria surgens*
SG 631 *Rhynchospora heterochaeta*
SG 632 *#Pimelea sericostachya* subsp. *sericostachya*
SG 633 *Cajanus marmoratus*
SG 634 *Crotalaria montana* var. *angustifolia*

SG 635 *Melichrus urceolatus*
SG 636 *#Thaumastochloa rariflora*
SG 637 *#Cartonema brachyantherum*
SG 638 *#Pandorea linearis*
SG 639 *Melaleuca monantha,* confirmed
SG 640 *Polycarpaea spirostylis* subsp. *spirostylis*
SG 641 *Tephrosia filipes* forma *vestita*
SG 642 **Sporobolus jacquemontii.* This species is declared a Class 2 weed under the *Land Protection (Pest and Stock Route Management) Act 2002.*
SG 643 *#*Setaria pumila* subsp. *subtesselata*
SG 644 *#*Sporobolus natalensis* confirmed. This species is declared a Class 2 weed under the *Land Protection (Pest and Stock Route Management) Act 2002.*
SG 645 *Eragrostis schultzii*
SG 646 **Hyparrhenia rufa* subsp. *rufa*
SG 647 **Dactyloctenium aegyptium*
SG 648 *#*Mitracarpus hirtus*
SG 649 *#*Richardia scabra*
SG 650 *#Melaleuca uxorum,* confirmed. This species is listed as Endangered under Queensland's *Nature Conservation Act 1992.*
SG 651 probably *Melaleuca sylvana,* but fertile material required
SG 652 *Velleia pubescens*
SG 653 *#Pimelea linifolia*
SG 654 *Crotalaria montana*
SG 657 *#Leptospermum amboinense*
SG 658 *Cryptandra debilis,* confirmed
SG 659 *#Hybanthus monopetalus*
SG 660 #*Cladia muelleri* previously *Heterodea muelleri*
SG 661 *Phyllanthus collinus*
SG 662 *#Fimbristylis simplex*
SG 663 *#Borya septentrionalis*
SG 664 *Zornia muriculata*
SG 665 *Zornia muelleriana*
SG 666 *Fimbristylis dichotoma*
SG 667 *Eragrostis schultzii*
SG 668 *Urochloa holosericea*
SG 669 *#Platysace valida*
SG 670 *#Hibbertia bicarpellata*
SG 671A *Boronia bipinnata*
SG 671B *Sannantha angusta*
SG 672 *#Hakea plurinervia*
SG 673 *#Plectranthus parviflorus*
SG 674 *Acacia falciformis,* confirmed
SG 675 *Setaria surgens, confirmed*
SG 676 *Arundinella setosa*
SG 678 *#Alloteropsis semialata*
SG 679 *#*Conyza sumatrensis*
SG 680 **Bidens pilosa,* confirmed
SG 681 *Indigofera pratensis*
SG 682 *#Hypericum gramineum,* confirmed
SG 683 *#Eriachne obtusa*

SG 684 *Bothriochloa bladhii* subsp. *bladhii*
SG 685 *Gonocarpus acanthocarpus*
SG 686 *Hovea nana*
SG 687 *Tricoryne anceps* subsp. *pterocaulon*
SG 688 *Murdannia graminea,* confirmed
SG 689 *Notelaea sp.,* possibly *N. microcarpa*- sterile
SG 690 *Crotalaria montana*
SG 691 *Melaleuca borealis,* confirmed
SG 692 *#Cleistochloa subjuncea*
SG 693 *Grevillea glossadenia*
SG 694 *Tephrosia juncea*
SG 695 *Crotalaria medicaginea* var. *medicaginea*
SG 696 *Phyllanthus collinus*
SG 697 *Rhynchospora heterochaeta*
SG 698 *Mnesithea formosa*
SG 699 *#Cajanus acutifolius*
SG 700 *#Eriachne* sp. (Dugald River)
SG 701 *#Fimbristylis pterigosperma*
SG 702 *Heliotropium tabuliplagae*
SG 703 *#Ectrosia confusa,* confirmed
SG 704 *Eragrostis schultzii*
SG 705 *#Eriachne pallescens*
SG 706 *Psydrax sp.,* sterile
SG 707 *Gompholobium nitidum*
SG 708 *Dodonaea lanceolata* var. *subsessilifolia*
SG 709 *Pimelea sericostachya* subsp. *sericostachya*
SG 710 *Cyanthillium cinereum*
SG 711 *Melichrus urceolatus*
SG 712 *#Isotropis filicaulis*
SG 713 *Apowollastonia spilanthoides*
SG 714 *Hibbertia longifolia*
SG 715 *Scleria brownii*
SG 716 *Grevillea glossadenia*
SG 717 *Galactia tenuiflora*
SG 718 *#Hybanthus stellarioides*
SG 719 *Buchnera gracilis*
SG 720 *Aristida superpendens,* confirmed
SG 721 *Glossocardia refracta*
SG 722 *Cryptandra debilis,* confirmed
SG 723 *#Eriachne pallescens*
SG 724 *Hibiscus meraukensis*
SG 725 *#Pandorea linearis*
SG 726 *Apowollastonia spilanthoides*
SG 727 *#Melaleuca borealis,* confirmed
SG 728 *Fimbristylis simplex*
SG 729 *Cyanthillium cinereum*
SG 730 *#Wahlenbergia queenslandica*
SG 731 *Crotalaria montana* var. *angustifolia*
SG 732 *Tephrosia filipes* forma *vestita*
SG 733 *#Hypericum gramineum,* confirmed
SG 734 *Waltheria indica*

SG 735 *#Plectranthus mirus*
SG 736 *Heliotropium tabuliplagae*

* Naturalised, non-native species

These specimens have been retained for incorporation into the Herbarium collection, with thanks.

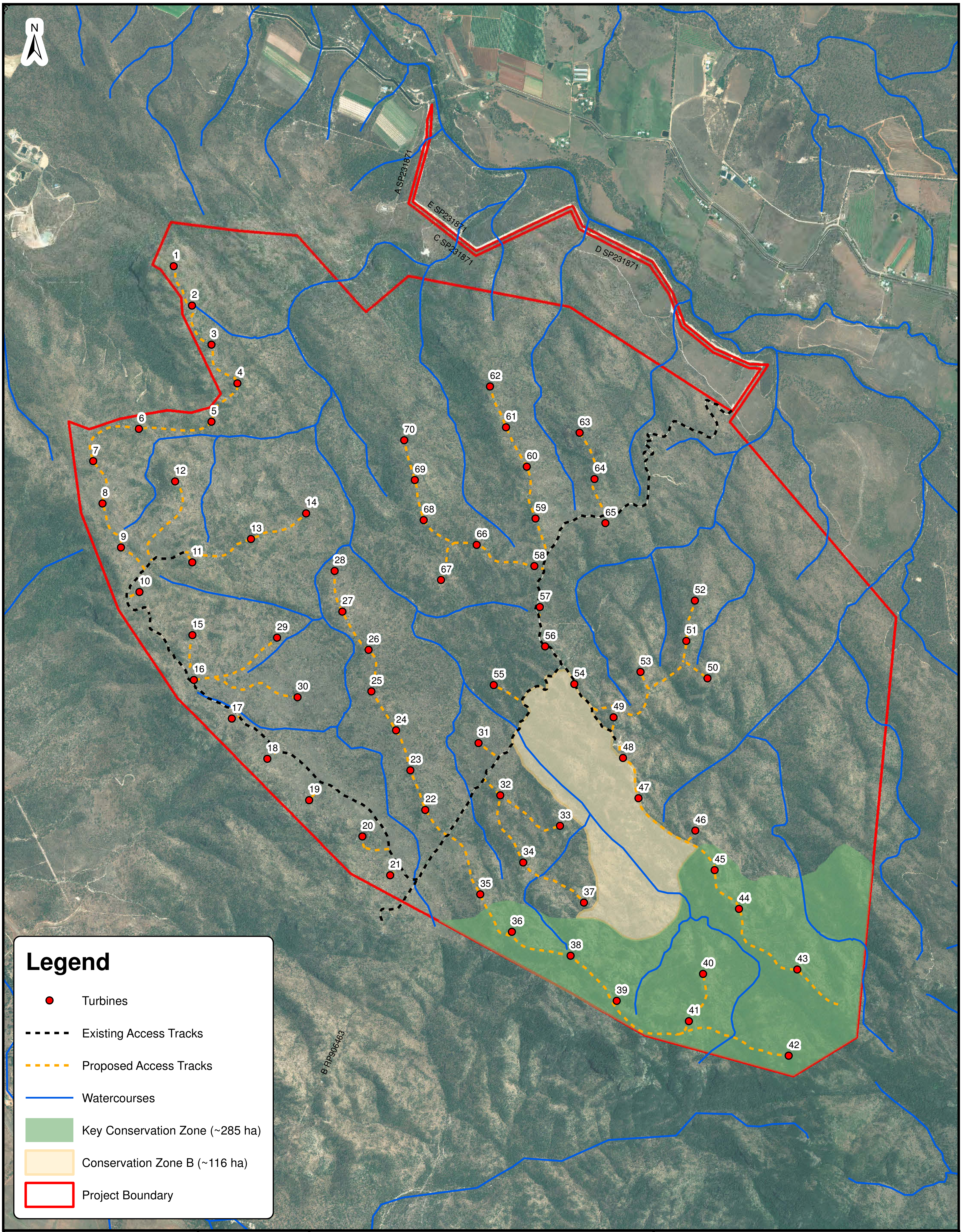
There is a charge of $1975.80 (18.5 hrs @ $106.80 per hr incl GST) for these identifications and a tax invoice and receipt are enclosed.

Yours sincerely

G.P.Guymer
Director

Appendix I

Environmental Constraints - Vegetation, Flora, Watercourses



DIGITAL CADASTRAL DATA BASE - BOUNDARY INFORMATION.
REGIONAL ECOSYSTEM VERSION 6 DATA
DERM AERIAL PHOTOGRAPHY.
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Compiled by	RMS
Map Projection	MGAz55
Map Datum	GDA94
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Appendix 17

Population Viability Analysis of Northern Quoll (*Dasyurus hallucatus*) populations in far north Queensland

Prepared by University of the Sunshine Coast

University of the Sunshine Coast

Population Viability Analysis of northern Quoll (*Dasyurus hallucatus)* populations in far north Queensland

October 2013

Report Compiled by

Yoko Shimizu (*Bsc. Hons*) and Dr Gabriel Conroy

Contents

Population Viability Analysis of northern Quoll (*Dasyurus hallucatus)* populations in far north Queensland

Executive Summary

- Population viability modelling of the quoll population occupying the Mt Emerald site was undertaken using RAMAS GIS V5. This exercise modelled the likelihood of extinction of the Mt Emerald quoll population under three scenarios, ranging from no change in mortality rate up to a 10% increase in mortality.
- PVA modelling reveals the high susceptibility of northern quoll populations to increased extinction risk with even modest increases in extrinsic mortality. The results suggest that an increase in local mortality as low as 2.5% results in a greater risk of extinction of the population and a 10% increase in local mortality may lead to localized extinction of the Mt. Emerald population within 20 years.
- Without knowing the nature and extent of impacts on quolls from the MEWF project it isn't possible to quantify the level of impact on population viability, however it is clear that any activity which results in any additional mortality of quolls will threaten the Mt Emerald population.
- The strength of the models run during this study is compromised by a lack of data on extent of dispersal into and out of the Mt Emerald population, and by the fact that various elements of the model input data are based on non-local, published data which are not necessarily indicative of far north Queensland population dynamics.
- Further, field derived data from the far north Queensland metapopulation is required

in order to examine *D. hallucatus* population viability at a range of spatial scales and to effectively model metapopulation dynamics.

Introduction

The northern quoll (*Dasyurus hallucatus)* is one of four quoll species) endemic to Australia (Braithwaite and Griffiths, 1994; Hill and Ward, 2010). *Dasyurus hallucatus* once occurred across northern Australia, however, much of their distribution range has contracted with substantial habitat fragmentation also occurring throughout the species range (Braithwaite and Griffiths, 1994; Pollock, 1999; Woinarski and Hill, 2012; Woinarski *et al*., 2008). Habitat destruction and urban development are considered one of the main threats for *D. hallucatus*, with habitat fragmentation also leading to a range of secondary threats including increased vehicle mortality and predation by introduced species (Hill and Ward, 2010). Several studies have also suggested that the species is declining at a rapid rate in association with the spread of the introduced Cane Toad *Rhinella marina* (Burnett, 2012; Woinarski *et al*., 2008). Although *D. hallucatus* is listed as Least Concern in Queensland under the Nature Conservation Act 1992 (Queensland Government, 1992), it is listed as nationally Endangered under the Environment and Biodiversity Conservation Act 1999 (Australian Government, 1999).

Due to the proposed development of Mt. Emerald Wind Farm (MEWF) in the northern Atherton Tablelands, Far North Queensland , the University of the Sunshine Coast (USC) has been commissioned to undertake simulation modeling and population viability analysis (PVA) of *D. hallucatus* in the region. Simulation modelling and population viability analysis (PVA) are extremely useful tools for the management of threatened species at the landscape scale (Akcakaya, 2000b; Baguette and Schtickzelle, 2003; Brook *et al*., 2000). PVA provides a systematic approach to evaluate short and long-term risks of decline or extinction associated with the effects of extrinsic ecological processes of a target species based on species-specific data (Akcakaya, 2000a; Conroy, 2012; Matsinos and Papadopoulou, 2004). Although simulation modelling has limitations in predicting absolute estimates of extinction risks due to uncertainties that arise during model formulation and data parameterization, they are considered to be useful to assess simple population dynamics and to compare the impacts of differing management options or risk factors upon these population dynamics (Conroy, 2012; Driscoll *et al*., 2010; Freckleton *et al*., 2008; Lindenmayer *et al*., 2003).

This report aims to undertake population viability modeling of *D. hallucatus* populations at several spatial scales in order to assess the potential impacts associated with the construction and operational phases of the proposed MEWF. Specifically, this report aims to investigate whether access and construction of the MEWF affects the survival probability of *D. hallucatus* populations in the Mt. Emerald quoll area. Due to lack of landscape level population and distribution data throughout far north Queensland and beyond, it is not possible to undertake PVA at scales beyond the Mt Emerald site scale.

Methods

Demographic data collection

Population viability models were developed using population and life history data for northern quolls. Some north Queensland specific data were obtained during this study, and other data were inferred or extrapolated from published data from other regions of Australia. Data specific to the quoll study population were collected via camera- and cage-trapping from Mt. Emerald and adjacent quoll sub-populations (Burnett, Shimizu and Middleton 2013), between July and September, 2012 (Figure 1). Data generated from this study included information pertaining to population abundance, gender and age breakdown, and population density in the study area. Some of the parameters required for the PVA model were not able to be collected in the field due to time and logistical constraints. Gender and age-specific survivorship and mortality, and reproductive information were therefore sourced from the published literature (e.g. Burnett 2012; Oakwood, 2000, 2002). In addition, the short duration of field work for this project meant that we could not construct spatially explicit models that incorporate metapopulation dynamics and dispersal. Reliable data for these aspects was also unavailable from published sources, and as such the PVA models utilized do not examine a range of spatial scales and focus purely on the Mt Emerald population.

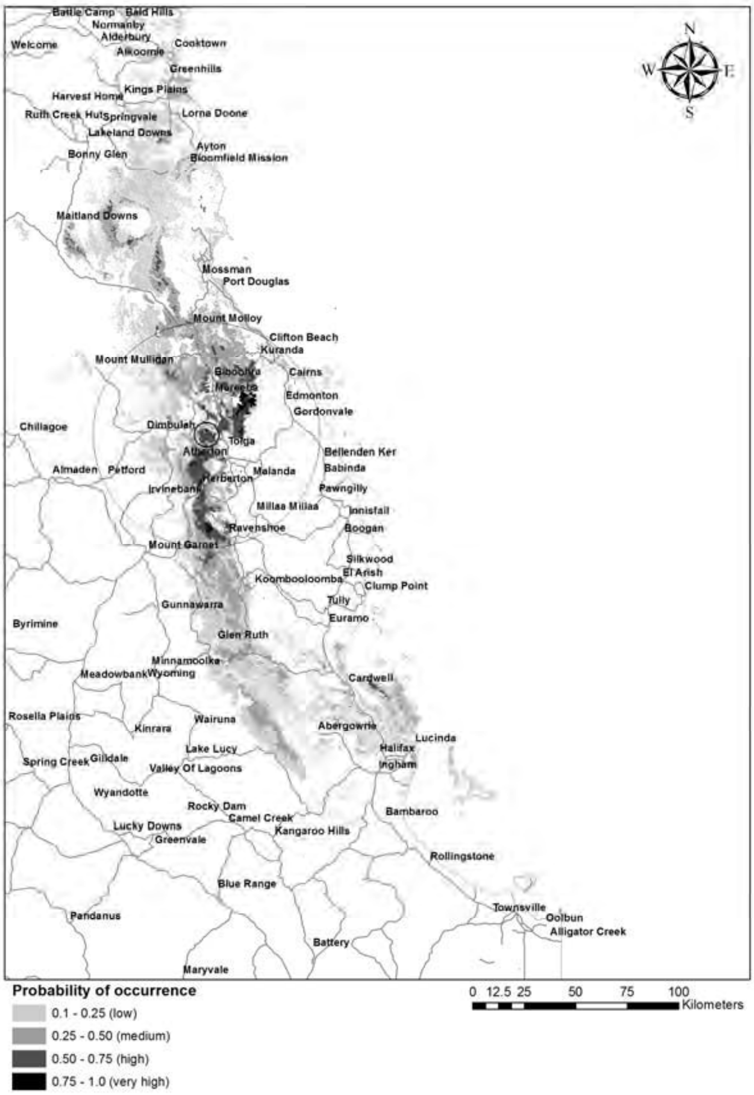


Figure 1: Map of the study region. The Mt Emerald area is indicated within the smaller circle, while the larger circle indicated areas within a 55km radius. The probability of D. *hallucatus* occurrence, based on Maxent habitat suitability modeling is indicated with shading (see legend)(see Burnett, Shimizu and Middleton 2013 for details of MaxEnt modelling).

Life history data, model parameterization and stochastic population modelling

The development of a PVA model requires the establishment of age specific life-history parameters for each sex. For females, twenty four life-history stages (at monthly time-steps) were tabulated, with 12 life-history stages identified for males, which typically die after one year of age (Appendix 1). Broad age classes used were pouch young for both sexes (first 2 steps/months), den young for both sexes (4 steps), adult male stages (6 steps comprising 4 distinct survival rates) and adult female stages (18 steps and 4 survival rates), respectively (Appendix 1); Burnett, 2012; Hill and Ward, 2010; Oakwood, 2000). Based on published data (Oakwood, 2000), the field data collected here, and the advice of experts (Martin Fingland, Geckoes Wildlife Presentations and Lynda Veyret Territory Wildlife Park), assumptions were made that (1) second year females do not contribute to reproduction in the wild, and (2) the number of females that live up to three years is negligible.

Survival rates and fecundity

Stage-transition survivorships for pouch young (S_p) and den young (S_i) were estimated using mortality data published in Oakwood (2000), as were the first-year adult female stage-transition survivorships (S_{f1}, S_{f2}, and S_{f3}; Table1). The adult female survival rate after second breeding (S_{f4}) was set to a negligible background rate to reflect the assumption that these females will not contribute reproductively in a third breeding season and will not survive beyond that year (Table1). As no field or published data was available for adult male survival rates between 7 to 9 months (S_{m1}), available pooled female survivorship data was also used for males between these time steps (Table 1).

Adult male mortality is known to be higher during both pre-mating and the mating period (10 to 11 months), due to higher incidence of fatalities by misadventure as males become muchmoreactive and mobile during this time. Oakwood (2000) states that mean home range of males can be expanded to as much as 1198ha from their normal mean range size of 99ha during this period. As no data has been published on adult male mortality during the 10 -11 month period (S_{m2} and S_{m3}), information on the number of monthly road-kill deaths for *D. hallucatus* was used to estimate stage-specific transition survivorship of S_{m2} and S_{m3} (Oakwood 2000, Table1). For adult male mortality at 12 months (S_{m4}), an assumption was made that the overall survival rate is 0.001 (negligible survival rate after one year, Table1). Unless specified, each monthly stage-transition survivorship was calculated using the following formula to convert longer (pooled) survivorship periods into monthly survivorships':

$$S_m = S_t^{1/m}$$

Where S_m is the monthly survival rate, S_t is the total survival rate over a specific period, and *m* is the number of months that the total survival was based on.

Fecundity values (number of males born to each first year female (F_{m1}) and number of females born to each first year female (F_{f1}) were calculated using the mean *D. hallucatus* litter sizes and offspring sex ratio from published data (Oakwood, 2000).

Model structure

In order to create a baseline PVA for the Mt Emerald population, the life-history table and parameters therein were used to construct a spatially explicit, stochastic, stage-based matrix model in RAMAS GIS version 5.0 (Akcakaya, 2005; Appendix 2). Density dependence (*DD*) was implemented to affect all vital rates using a scramble model. This ensures that simulated population densities remained within biologically realistic bounds. Environmental and demographic stochasticity were activated and set to lognormal with a within-population correlation on fecundities, survivorships and carrying capacity (*K*). Dispersal was set to nil due to lack of dispersal data. However, it should be noted that genetic analyses have shown substantial gene flow between populations of *D. hallucatus* within a 55km radius of the Mt. Emerald region (Conroy and Lamont, 2013). As such, the lack of dispersal data is a limitation of the model and its omission will most likely lead to an overestimation of extinction probabilities.

Population-specific parameter values

The spatial location and boundaries of the Mt. Emerald population were incorporated into the model structure (UTM; Datum: GDA1994 UTM Zone 55). Initial abundance of *D. hallucatus* in Mt. Emerald local area was estimated from field data (Burnett, Shimizu and Middleton 2013). The initial abundance value was then divided using the following gender breakdown ratio (proportion) based on field observations: 0.49 male (at 11months):0.49 female (at 11months):0.02 female (at 23months, Burnett *pers comm*. 2013). Carrying capacity (*K*) was estimated using the area of extent of Mt. Emerald and calculated population densities based on terrain information

Population viability analysis (PVA)

The potential impacts associated with the construction and operational phases of the proposed Mt. Emerald Wind Farm (MEWF) on the population viability of *D. hallucatus* in the Mt Emerald local area are unknown. As such, hypothesized impacts were examined in order to explore possible thresholds where population viability may be affected. To this end, customized PVA models were used to assess the potential impacts of increased mortality on population viability of *D. hallucatus* population in Mt. Emerald local area. Each model was run for 1000 replications with a 360-month time interval (30 years, 2013 – 2043) under the following simulation scenarios:

- Baseline – This simulation scenario used only the baseline matrix to examine population viability with no impacts occurring from the proposed development throughout the duration of the simulation period (30 years, 2013 – 2043).
- Simulation 1: Increased mortality (2.5%) – This simulation scenario examines the effect of a 2.5% increase in *D. hallucatus* mortality in all stages throughout the simulation period.
- Simulation 2: Increased mortality (5%) – This simulation scenario examines the effect of a 5% increase in *D. hallucatus* mortality in all stages throughout the simulation period.
- Simulation 3: Increased mortality (10%) – This simulation scenario examines the effect of a 10% increase in *D. hallucatus* mortality in all stages throughout the simulation period.

Carrying capacity (*K*) was set as default in all of the aforementioned simulation scenarios. This is justified because the areas expected to be cleared for the development of MEWF are only 0.4% (approximately 45ha) of the total Mt. Emerald local area. As such, given the current population abundance and estimated average population density, it is unlikely that the MEWF development would directly affect the carrying capacity of the site.

PVA data analysis and sensitivity analysis

Viability of the *D. hallucatus* population in the Mt. Emerald local area under each simulation model was assessed using expected minimum abundance (EMS) at the 30th year by averaging the abundance during the last 12 monthly time-steps of the simulation (McCarthy and Thompson, 2001). The proportional change in population size (Appendix 4) was calculated in order to examine any changes in population abundance within the PVA model duration. Expected minimum abundance of each simulation model was then compared using the non-parametric Kruskal-Wallis test to examine any differences in EMS between the models. The models were then compared against the baseline model using the non-parametric Mann-Whitney U test to examine any differences in EMS that may be ascribable to differences in the model-specific mortality rates. A probability of extinction curve was also presented for each simulation model to evaluate short and long-term risks of decline or extinction of the *D. hallucatus* population under the projected scenarios.

To validate model parameterization, a sensitivity analysis was performed on all baseline model parameters except for S_{m4} and S_{f4} stage. These parameters were excluded because they have negligible values (Table 1). Each parameter was modified to 10% above and 10% below their original baseline value, and the model was run for a 360-month simulation period with 1000 replicates. For each simulation, the resulting proportional change in final population abundance averaged over the last 12months period of simulation was calculated (Appendix 4).

Results and Discussion

All models predicted that the *D. hallucatus* population at the Mt. Emerald site will decline in abundance over the next 30 years regardless of the simulation scenario tested (level of increased mortality). On average, the population is predicted to decline by 47.17% under the baseline (no impact) scenario, 64.15% under simulation1, 98.11% with simulation 2, and 99.92% with simulation 3 by 2043 (Table 2). It is likely that these absolute values are in error, however the trend of significantly higher extinction risk as a result of elevated mortality rates are relevant to this discussion.

Table 2: Mean population size for the last 12 monthly time-steps of the *D. hallucatus* PVA model duration, and the proportional change in EMS (population size) relative to initial population size for all simulation models.

Scenario Mortality	Baseline Baseline		Simulation 1 2.5%+		Simulation 2 5%+		Simulation 3 10%+	
	EMS	*% Change*	*EMS*	*% Change*	*EMS*	*% Change*	*EMS*	*% Change*
D. hallucatus Mt. Emerald population (Initial *N*=53)	25	-47.17	19	-64.15	1	-98.11	0.04	-99.92

The expected minimum abundance (EMS) of the Mt Emerald population at the 30th year ranged from 25 to 0 (Table 2, Figure 2). Results of the non-parametric Kruskal-wallis test indicate a statistically significant difference in EMS when all scenarios were compared en masse (H=40.49, *p*<0.01), with a mean rank of 39.00 for the Baseline, 34.00 for simulation1, 18.50 for simulation2, and 6.50 for simulation 3. Further interrogation of the data with the Mann-Whitney U test revealed a statistically significant difference in EMS between the baseline and simulation 2 and 3 (Simulation 2, U<0.001, *p*<0.01; Simulation 3, U<0.001, *p*<0.01). The probability of extinction curves suggest that, under any simulation scenarios, the probabilities of quasi-extinction at the end of the PVA simulation duration are expected to be greater than 80% (Figure3). The figure also suggests that increased local mortality rate at 10% would severely affect the population viability and, the population is predicted to become extinct in approximately 20 years (Figure 3.1, 3.2).

Average final abundance of *D. hallucatus* in Mt. Emerald

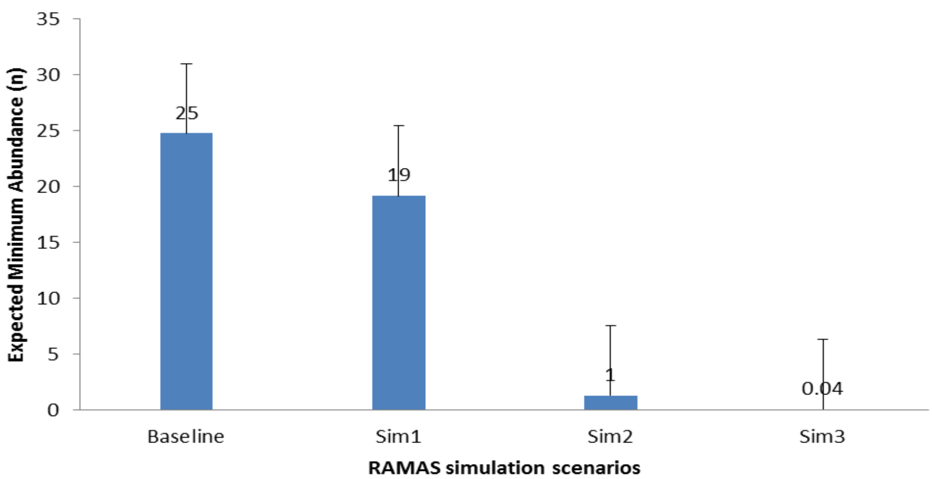
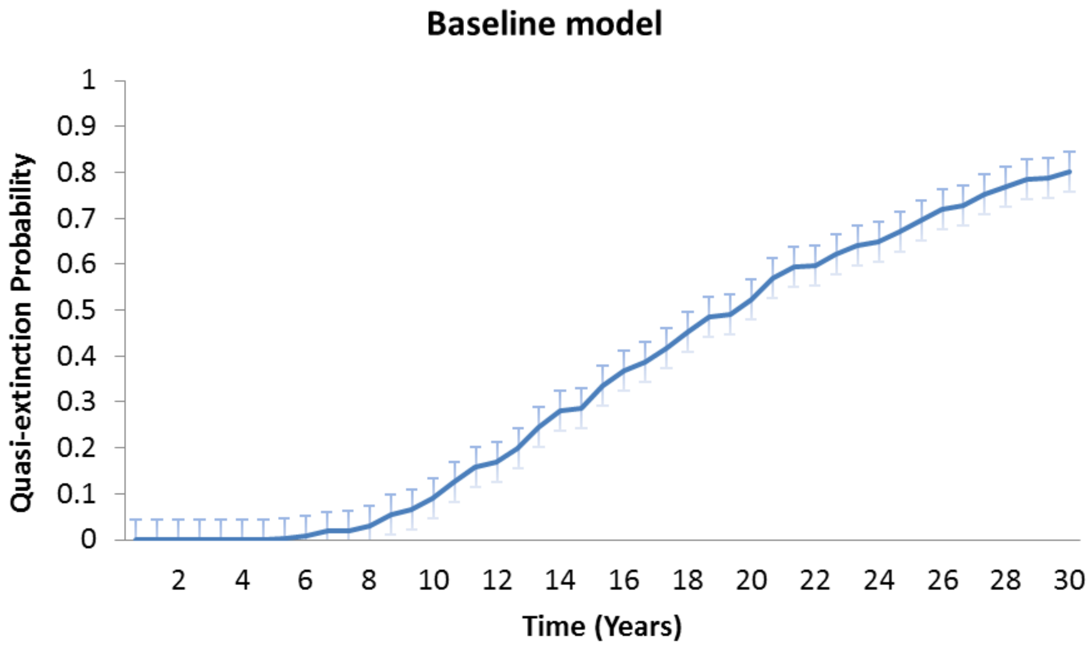


Figure2: Variation in expected minimum abundance for baseline and simulation scenarios (increased mortality). Error bars are 95% confidence intervals (CIs) averaged over 1000 replications. Sim1 was modelled with 2.5% increase in mortality, Sim2 with 5% increase in mortality, and Sim3 with 10% increase in mortality across all stages.



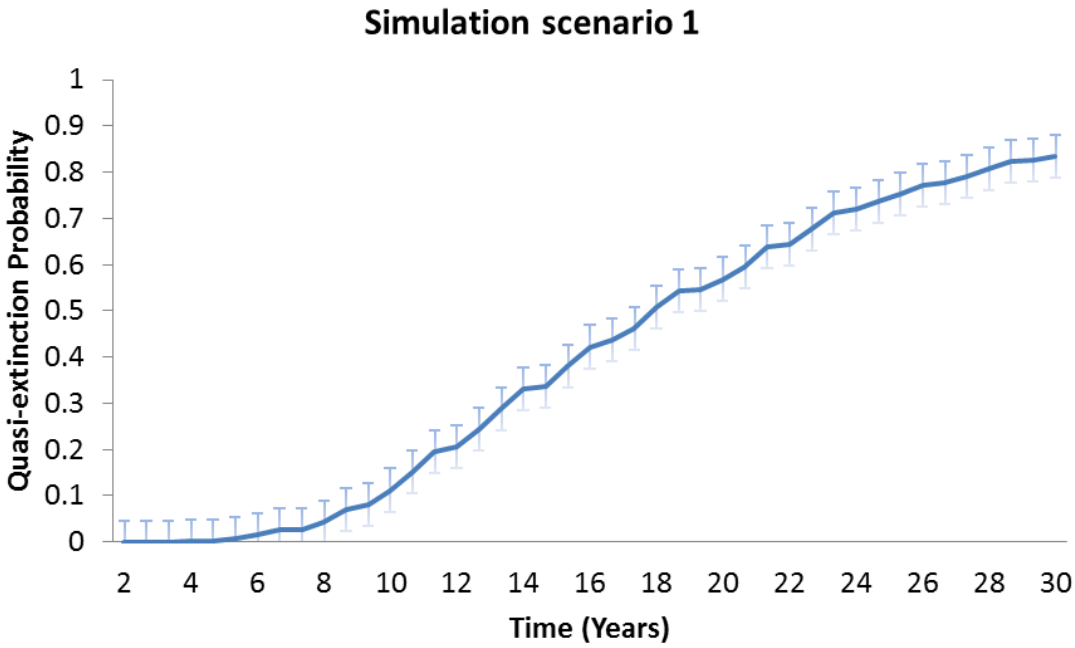
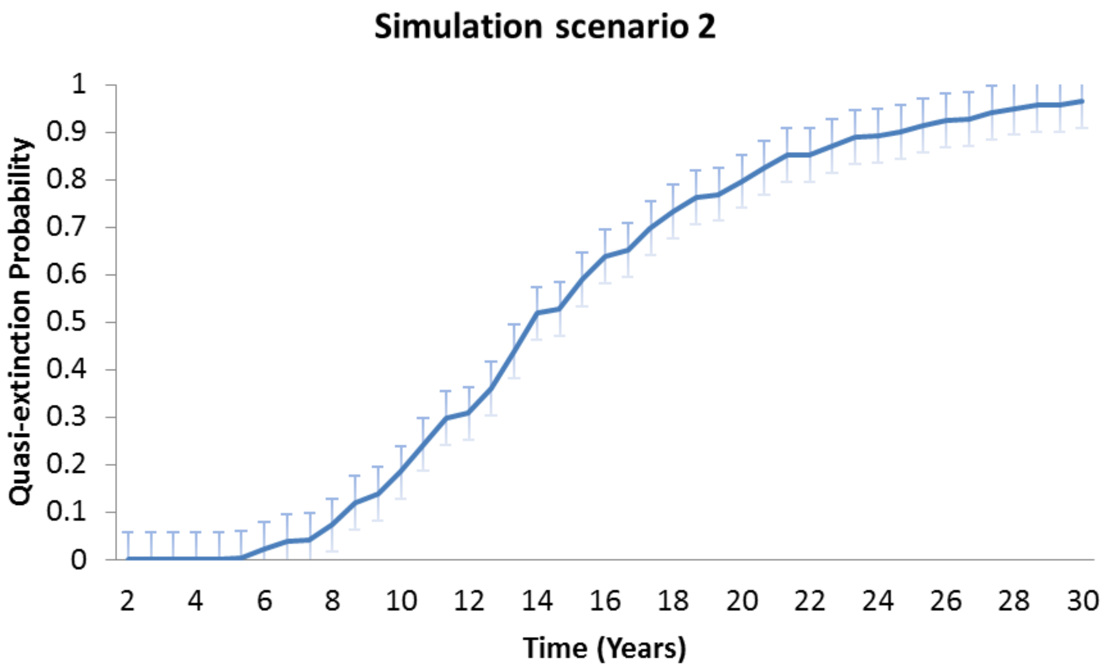


Figure3.1: Quasi-extinction probability curves for *D. hallucatus* population in Mt. Emerald throughout the 360 monthly-time step (30 year) period under the Baseline scenario and simulation scenario 1 (2.5% increase in mortality). Error bars are 95% confidence intervals (CIs) averaged over 1000 replications.



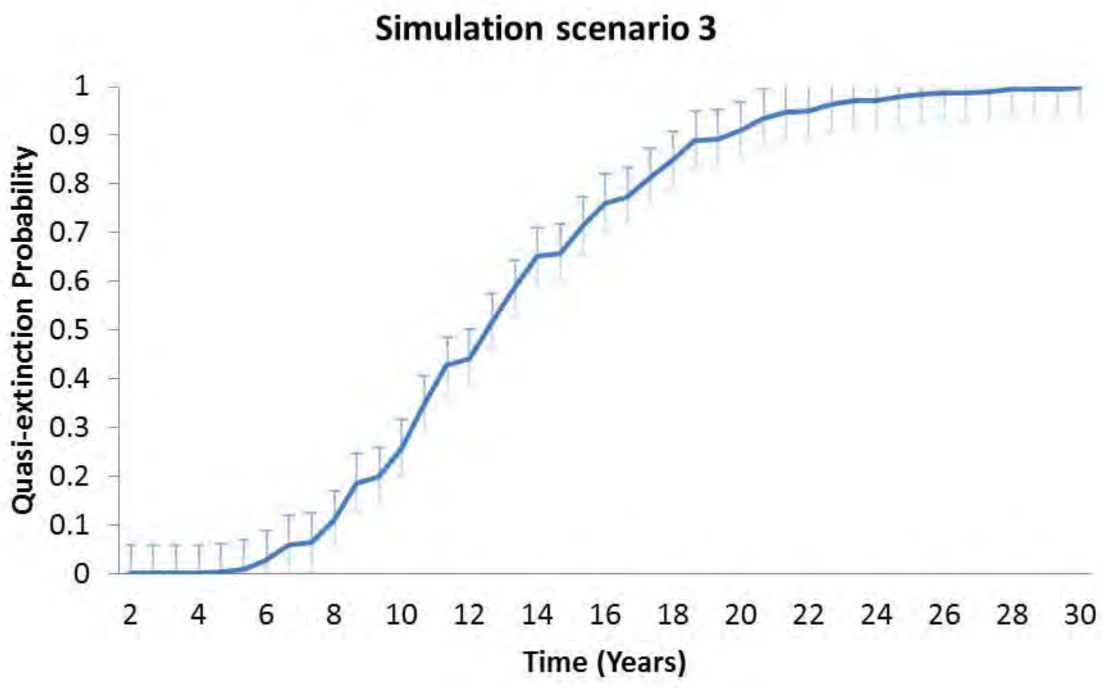


Figure 3.2: Quasi-extinction probability curves for *D. hallucatus* population in Mt. Emerald throughout the 360 monthly-time step (30 year) period under the simulation scenario 2 (5% increase in mortality) and simulation scenario 3 (10% increase in mortality). Error bars are 95% confidence intervals (CIs) averaged over 1000 replications.

Conclusions

Although the absolute values for extinction probability are likely to be exaggerated, the trends, towards significantly lower final population sizes and increased extinction risk from minor increases in mortality. This suggests that even relatively minor impacts resulting from the MEWF project could impact the viability of the Mt Emerald quoll population.

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Appendices

Appendix 1: Annual life history cycle of *D. hallucatus* used to generate PVA models; where S_p, survival rate of pouch young; S_j, survival rate of den young; S_{m1}, adult male survival between 7-9 months; S_{m2}, adult male survival in 10th month; S_{m3}, adult male survival in 11th month; S_{m4}, adult male mortality during 12th month; S_{f1} adult female survival rate between 7-11 months; S_{f2},adult female survival rates between 12-18 months; S_{f3}, adult female survival rates between 19-23 months; S_{f4}, adult female survival rate after 24 months; F_{m1}, number of males born to each first year female; F_{f1}, number of females born to each first year female.

Time step (month)	1 (13)	2 (14)	3 (15)	4 (16)	5 (17)	6 (18)	7 (19)	8 (20)	9 (21)	10 (22)	11 (23)	12 (24)
Stage classes	Pouch young	Pouch young	Den young	Den young	Den young	Den young	Adult	Adult	Adult	Adult	Adult (Mating)	Adult (Death)
Survivorship (shared)	S_p	S_p	S_j	S_j	S_j	S_j						
Male	-	-	-	-	-	-	S_{m1}	S_{m1}	S_{m1}	S_{m2}	S_{m3}	S_{m4}
Females 1st year	-	-	-	-	-	-	S_{f1}	S_{f1}	S_{f1}	S_{f1}	S_{f1}	$F_{m1}/F_{f1}/S_{f2}$
Females 2nd year	S_{f2}	S_{f2}	S_{f2}	S_{f2}	S_{f2}	S_{f2}	S_{f3}	S_{f3}	S_{f3}	S_{f3}	S_{f3}	S_{f4}

Appendix 2: Demographic information for *D. hallucatus* populations in the far north Queensland region derived from the results of this study.

Population-specific data	Unit	
Location	UTM	328802, 8101815
Initial Abundance	n	53
Gender breakdown:	n	
Male (11 month)		26
Female 1st year (11 month)		26
Female 2nd year (23 month)		1
Area of Extent	Ha	11486
Population density	Ha	1.66/100ha
Carrying Capacity (K)	n	190

Appendix 3: Values of each life history stage of *D. hallucatus* used to generate the baseline (natural survivorship levels) matrix model.

Time step (month)	1 (13)	2 (14)	3 (15)	4 (16)	5 (17)	6 (18)	7 (19)	8 (20)	9 (21)	10 (22)	11 (23)	12 (24)
Stage classes	Pouch young	Pouch young	Den young	Den young	Den young	Den young	Adult	Adult	Adult	Adult	Adult (Mating)	Adult (Births)
Survivorship (shared)	0.9912	0.9912	0.7224	0.7224	0.7224	0.7224						
Male	-	-	-	-	-	-	0.9691	0.9691	0.9691	0.864	0.729	0.00
Females 1st year	-	-	-	-	-	-	0.9813	0.9813	0.9813	0.9813	0.9813	4.35/3.05/0.9281
Females 2nd year	0.9281	0.9281	0.9281	0.9281	0.9281	0.9281	0.9222	0.9222	0.9222	0.9222	0.9222	0.001

Appendix 4. Average percentage change in population size resulting from baseline population viability model.

Parameters		Average % change from Baseline	
Pouch Young	S_p	10%+	1.4
		10%-	28.4
Den Young	S_j	10%+	2.6
		10%-	15.2
Adult male 7 - 9	S_{m1}	10%+	89.6
		10%-	24.6
Adult male 10	S_{m2}	10%+	125.6
		10%-	9.8
Adult male 11	S_{m3}	10%+	2.7
		10%-	18.4
Adult female 7 - 11	S_{f1}	10%+	80.1
		10%-	20.6
Adult female 12 - 18	S_{f2}	10%+	10.2
		10%-	7.5
Adult female 19 - 23	S_{f3}	10%+	15.5
		10%-	19.5
Fecundity (Male)	F_{m1}	10%+	115.6
		10%-	18.3
Fecundity (Female)	F_{f1}	10%+	88.7
		10%-	17.8

Appendix 18

Distribution and abundance of the Northern quoll (*Dasyurus hallucatus*) in far north Queensland

Prepared by University of the Sunshine Coast

Distribution and abundance of the Northern quoll (*Dasyurus hallucatus*) in far north Queensland

Report prepared by Scott Burnett, Yoko Shimizu and Jeff Middleton

for Ratch Australasia

November 2013

Table of Contents

Executive Summary

- This study used a combination of existing quoll presence records, capture-recapture data derived from camera trapping, and habitat modelling to enumerate the distribution and size of the far north Queensland quoll population within National, State and Local contexts.
- The Mt Emerald quoll population forms part of a far north Queensland quoll metapopulation which occurs from around Ravenshoe in the south to Cooktown in the north. This is one of 10 known quoll metapopulations that occur across Australia, and one of six metapopulations within Queensland.
- Based on extent of occurrence, current and anticipated threats, and the consistency of quoll records coming from the region, it is likely that the far north Queensland metapopulation is one of the most secure and important for the survival of *D. hallucatus* in Queensland and Australia.
- MaxEnt habitat modelling showed a robust discrimination of current and potentially suitable habitat areas of *D. hallucatus*. Habitat was categorised into one of five habitat suitability categories (low, medium, high and very high) across far north Queensland.
- This modelling reveals a band of high and very high quality habitat hugging the western edge of the Wet Tropics bioregion boundary and running from about Ingham north to Kuranda. A belt of high and very high quality habitat runs from Ravenshoe to Kuranda and includes Mt Emerald.
- More than 72% of predicted high and very highly suitable habitat in far north Queensland is found within a 55km radius of Mt. Emerald, suggesting the region including Mt. Emerald local area could be a significant reservoir of quolls for the region.
- This modelling reveals that Mt. Emerald is mostly composed of high and very high

quality quoll habitat.

- Quoll population density was estimated using individual recognition from camera trap photos to provide information on the number of quolls, and the ½ mean maximum distance statistic to calculate the sampling area from which those quolls were counted.
- This approach led to density estimates of 1.09 quolls/100ha in flat or near flat suitable habitat and of 2.25 quolls/100ha in moderately to extremely rugged, suitable habitat.
- The above density statistics, coupled with the extent of potential habitat—as as modelled by MaxEnt—s uggest that the far north Queensland quoll metapopulation numbers approximately 9466 individual quolls. This approach provides an estimate of 53 individual quolls on Mt Emerald. Closed population capture-recapture also provides an estimate of 53 individual quolls on Mt Emerald. This constitutes approximately 0.5% of all quolls estimated to occupy the far north Queensland metapopulation.
- This study is confounded by a lack of data in some areas. Future studies which ground truth the MaxEnt habitat model, and which aim to develop density estimations arising from camera trapping throughout the range of habitats within the far north Qld area, would significantly bolster the results of this study.
- The combination of high and very high quality quoll habitat on the Mt Emerald massif (Fig. 6) and its location adjacent to an area of discontinuous habitat suggests Mt Emerald may be critically important for maintaining connectivity and dispersal of *D. hallucatus* between the Walsh/ Herbert River catchment areas and the Barron/Mitchell catchment areas.
- Notwithstanding uncertainties in the data, this study suggests that the far north Queensland quoll population is highly significant at a State and National level.
- The Mt Emerald population of quolls—although not numerically significant within the overall far northern context—are present in an area that is critical for the far northern

metapopulation. Genetic analyses of *D. hallucatus* confirm the importance of Mt. Emerald for maintaining the genetic flow between northern and southern populations of far north Queensland quolls (Conroy and Lamont 2013).

- Although the extent of the impact of the MEWF project on quolls at Mt Emerald is unknown, the small contribution that this population makes to the far northern metapopulation indicate that it is unlikely that the development will negatively impact quolls at the state or regional scale in the short-term. It is unknown how the quoll population at the site will be affected over subsequent years as we lack any data or way of predicting changes to ecosystems carrying capacity that might occur as a result of construction and operation of the MEWF site.

Introduction

The northern quoll *Dasyurus hallucatus,* is a poorly known, endangered dasyurid marsupial. The species occurs in coastal and subcoastal habitats in tropical Australia (Van Dyck *et al.* 2013). Although a distinctive-looking and active predator, gaps exist in our knowledge of the distribution of this species at the regional and local scales. This is particularly true of Queensland populations of the species which have never been comprehensively surveyed or mapped. Likewise no published studies have attempted to calculate the numerical size of any naturally occurring northern quoll population. These data are essential in order to assess the potential impact on this species.

Therefore in this study we aim to investigate the distribution and numerical population size of northern quolls in far north Queensland in order to ascertain the significance of the Mt Emerald site within that spatial context. We achieve this using photo-based individual recognition, population density estimation and closed capture-recapture modeling to estimate the size of the Northern quoll (*Dasyurus hallucatus*) metapopulation in far North Queensland, and Mt Emerald.

Methods

The distribution of northern quolls

The distribution of northern quolls in far north Queensland was mapped using 274 species presence records obtained from a variety of sources including Wildlife Online, Quoll Seekers Network, unpublished data of wildlife scientists, and records obtained during this study (Appendix A).

Quoll distribution at the Queensland and National scales has been illustrated by Hill and Ward (2010) and Van Dyck *et al* (2013). This is used to contextualize the far north Queensland quoll metapopulation.

Extent of quoll habitat in far north Queensland

A species distribution model of *D. hallucatus* incorporating environmental predictor variables and species occurrence data was created using MaxEnt version 3.3.3k (Phillips et al., 2004).

Model settings

The MaxEnt Model was run at a spatial resolution of 80m with five-fold cross validation, and background predictions files were generated in each fold for additional model validation to be conducted. The remaining settings were left as default, with 500 iterations and the logistic output format, which represents the probability of occurrence of the target species within the range of 0 to 1 for each grid cell in the model (Phillips and Dudik, 2008). The final model output was masked using the vegetation layer to exclude unsuitable habitat types from the output (i.e. rainforest, non-remnant vegetation, urban and agricultural, and open water).

Model performance was evaluated by the area under the curve (AUC) in receiver operating characteristic analysis (ROC) of the cross validated model output. An AUC score of 1.0 indicate a statistically valid, perfect model fitting, while AUC value of <0.5 indicates a model performing poor and no better than random (Phillips et al., 2004). The true skill statistic (TSS) was also used in conjunction with AUC (Allouche et al., 2006). This measure is similar to the commonly used Cohen's Kappa index but correcting Kappa's dependency on species prevalence (Allouche et al., 2006; Jones, 2012; Lu et al., 2012). TSS score ranges from −1 to 1: A TSS values >0.6 indicate good predictions, 0.2 – 0.6 indicate fair, and values <0.2 indicate poor or no better than random predictions (Landis and Koch, 1977).

Model input data

Two-hundred and seventy-one presence records of *D. hallucatus* were obtained from a variety of sources including the Qld Museum, Queensland Government Wildlife Online Wildlife online, researchers, unpublished observations of researchers and those records obtained during this study (Appendix A). Only northern quoll presence records which could be located with a precision of 500m and which had originated since 1970 were used in the model.

Environmental data

We selected nine environmental variables as potential predictor variables of *D. hallucatus* distribution for this study, based on their biological and ecological relevance to species distributions. These included: elevation, aspect, slope, vegetation, geology, annual precipitation, precipitation seasonality, precipitation of wettest quarter, and precipitation of driest quarter. Climatic variables were especially considered to be highly biologically meaningful to define eco-physiological tolerances of a species within its distribution range (Kumar and Stohlgren, 2009).

The 80m Digital Elevation Model dataset of far north Queensland (Accad 1999) was used to generate slope and aspect parameters. The Queensland Government Regional ecosystem dataset provide vegetation parameters A geology dataset of Queensland contains mapped polygons classified by dominant substrate rock classes. Both vegetation and geology dataset were converted to a raster map layer for later analysis. For climatic data, BIOCLIM dataset, which consist of 19 statistically downscaled, high-resolution climatic variables representing current climatic conditions, were derived from the WorldClim database (Hijmans et al., 2005). A set of four BIOLCIM variable layers were selected for the model: bio12 = annual precipitation, bio15 = precipitation seasonality, bio16 = precipitation of wettest quarter, and bio17 = precipitation of driest quarter.

Model output

The default MaxEnt output is a continuous prediction of habitat suitability for a species. In this study, a classified, binary distribution map was created by applying thresholds to the default output. We defined habitat suitability as follows;

- probability of occurrence values <0.1; unsuitable habitat;
- probability of occurrence values 0.1 – 0.25; low habitat suitability
- probability of occurrence values 0.25 – 0.50; medium habitat suitability
- probability of occurrence values 0.50 – 0.75; high habitat suitability
- probability of occurrence values 0.75 – 1.0; very high habitat suitability.

The abundance of northern quolls in far north Queensland

The abundance of northern quolls was estimated by calculating the density of quolls in a subset of the study area and multiplying this by the amount of potential quoll habitat within the area (as per MaxEnt model output below). Density was calculated by tallying the number of quolls captured each of 379 survey points within a 55km radius of Mt Emerald. This was achieved using camera traps, which provided the photographic record of presence and movements of individual quolls required for these calculations (see below for details).

Camera trapping

Camera trapping entailed setting a Reconnyx 550V trail camera (www.reconyx.com) and a chicken lure, at each of up to 50 camera sites surveyed at any one time. Three-hundred and seventy-nine camera trap sites were spread across 11 districts, all within a 55km radius of the MEWF site (Fig. 1). These were operated between August and October 2012. Individual quolls were identified by their spot patterns. The usefulness of the photos for spot-pattern recognition was optimized by consistent placement of the cameras, 1m directly above the lure and facing down at right angles to the ground. We thereby obtained consistently oriented photos of the dorsum of each quoll which decreased ambiguity in individual identification. The lure consisted of three chicken necks, secured within a pegged down, 2” capped poly-pipe foot valve unit sold by irrigation suppliers.

Fig. 1. The location of 379 camera-trap sites (white squares) surveyed during this study.

Given the aim of estimating quoll density was to provide a basis for calculating quoll population size across the entire far north Queensland area, an effort was made to stratify camera trapping effort across a range of habitats within the study area. To do this, Broad Vegetation Group (BVG) and Terrain digital layers were dissolved to create a single layer of 63 BVG x Terrain habitat types. 1:2 000 000 scale BVG data (http://www.ehp.qld.gov.au/ecosystems/biodiversity/regional-ecosystems/bvg.html#12_million_descriptions) were used. The terrain data layer was created using the 80m DEM for the study area and applying Riley's Terrain Ruggedness Index (TRI) algorithm (Riley *et al.*, 1999) at a 360m spatial resolution. This spatial resolution was chosen as the nearest multiple of 80m (the base DEM resolution) to the putative home range radius of quolls (see below for details of 1/2MMDM calculations). The six ruggedness levels thus produced were further combined and reclassified into 3 levels;

- level and nearly level (Rileys TRI<116m),
- slightly to intermediately rugged (Rileys TRI 117 - 239m),
- moderately to extremely rugged (Rileys TRI<240-4367m).

Estimating the area sampled and the density of quolls at each camera trap array

Area sampled by each camera trap

The area sampled by the camera traps was estimated using the half maximum mean distance moved (1/2MMDM)(Wilson and Anderson 1985) statistic for each individual quoll. This statistic is used to estimate the mean sampling area for each camera trap, i.e. a circular area with a radius which equals the estimate of 1/2MMDM. Forty movement events made by 25 individual northern quolls were recorded during camera trapping resulting in a 1/2MMDM value of 334.6m. This translates to a circular sampling area of each camera trap of approximately 35ha.

Density of quolls at each camera trap site

Mark-recapture modelling

In addition to the density/area of habitat approach used to estimate quoll population size, a closed population mark-recapture model was also used to estimate the size of the MEWF site quoll population. This was achieved using Program Mark (White and Burnham 1999). The basic model (M0)(which assumes equal capture probability for all individuals on all days) proved the most parsimonious (AIC 24.6644).

Mark-recapture modelling of other camera-trapped populations was undertaken but models performed poorly, returning nonsensically large Confidence Intervals.

Estimating the size of the far north Queensland northern quoll metapopulation

The size of the northern quoll metapopulation was estimated by applying the average density of quolls discovered at 11 disparate districts to the extent of quoll habitat throughout far north Queensland. Camera trapping sampled 22 BVG x Terrain habitat polygons within that area, however due to the spatial ecology of northern quolls (which was revealed as this project progressed), it was decided in hindsight that it would be invalid to refer the density of quolls obtained from each camera site purely to the BVG x Terrain habitat in which the camera was sited, i.e. quolls could have been lured to the camera from any one of several BVG x Terrain habitats within the 35ha effective sampling area of each camera. We thus collapsed all BVG x Terrain habitat types into one of three Terrain levels (see above), without reference to BVG (but continuing to exclude vine-forest, agricultural and urban land). Even at this scale, it was necessary to further collapse the TRI levels 2 and 3 into a single level, due to the scale over which quolls potentially roam. Ultimately, two separate quoll density estimations were calculated; one for Flat habitats (TRI level 1 above), and another covering the slightly to highly rugged landscape (TRI levels 2 and 3 above).

These density estimates were applied to the extent of each of the above two habitat classes which overlapped with the MaxEnt habitat model.

Results and Discussion

Distribution

At the National scale, populations of the northern quoll are highly fragmented into 10 known metapopulations (Van Dyck *et al.* 2013, Hill and Ward 2010, Burnett unpublished data). Six of these metapopulations occur in Queensland, ranging from south-east Queensland in the south to Weipa in the north (Fig. 2).

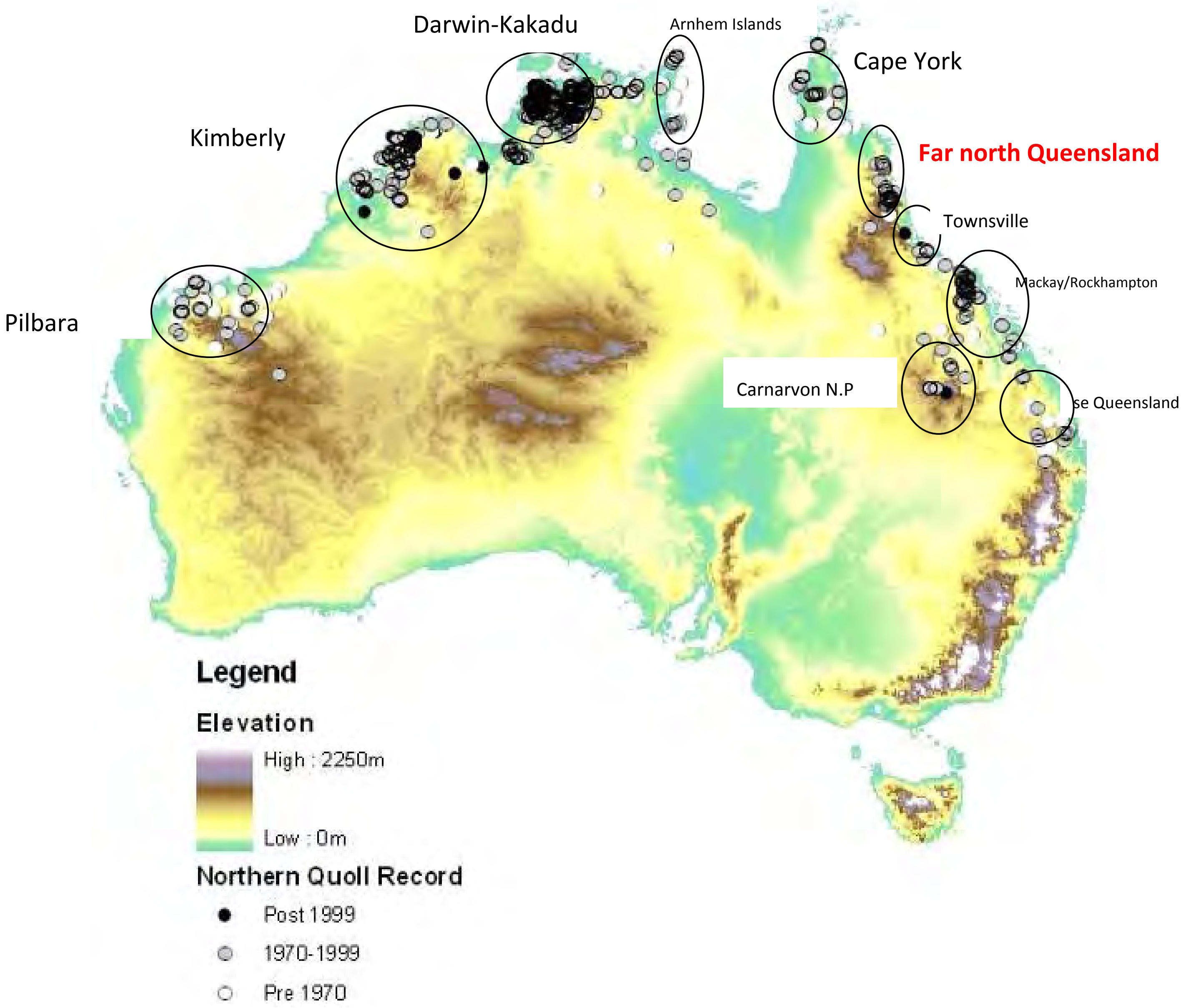

Fig. 2. Broad-scale distribution of the northern quoll across Australia (from Hill and Ward 2010). Putative metapopulation boundaries designated as part of the current study are labelled. Boundaries are indicative only.

Two-hundred and seventy-four presence records in combination with habitat modelling (as above), indicate that the Mt Emerald population of quolls forms part of a contiguous far north

Queensland quoll metapopulation which stretches from approximately Ravenshoe in the south to Cooktown in the north (Fig. 3).

The far north Queensland quoll metapopulation is significant at a state and national level. Within Queensland, it is one of only three metapopulations that are represented by more than 6 contemporary records (i.e.since 1999). The south-east Queensland, Carnarvon and Cape York metapopulations are known from either less than 6 contemporary records and/or from a spatial extent less than 25km^2. This suggests that quoll populations in these areas are not secure. On the other hand, and in common with the Mackay/Rockhampton and Townsville metapopulations, the far north Queensland metapopulation occurs over a reasonably large spatial extent and is represented by numerous records recorded over numerous years, suggesting that these are numerically robust and stable metapopulations. The status of all non-Queensland metapopulations is not secure. These metapopulations have either recently suffered massive declines as cane toads *Rhinella marina* (Hill and Ward 2010) invade their habitat, are restricted to off-shore islands where population sizes are limited by carrying capacity and which may be vulnerable to invasion by cane toads, or are in the path of the cane toad invasion front.

There is insufficient data to map the boundaries of these metapopulations with certainty. It is possible that those areas mapped as metapopulations really only represent a single cohesive population, multiple metapopulations or that additional unmapped metapopulations and populations also exist. Even in this far north Queensland metapopulation under study, we have only habitat modelling to confirm the metapopulation boundary, with limited field data to verify its accuracy.

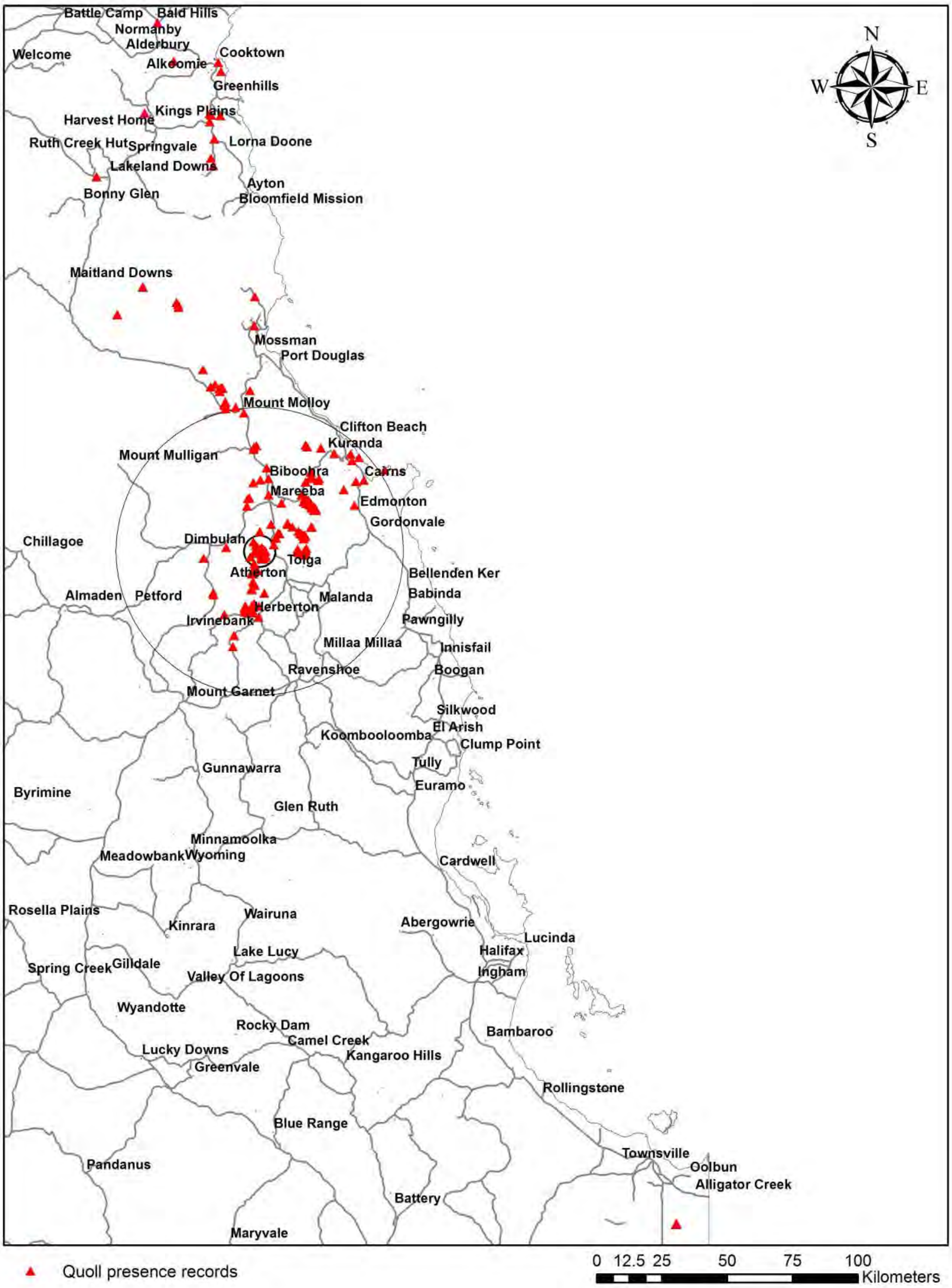

Fig. 3. The contemporary (since 1980) extent of occurrence of *D. hallucatus* in far north Queensland.

Extent of quoll habitat

The current distributions of *D. hallucatus* were modeled successfully. The results of AUC and TSS indicated that, on average, the MaxEnt model proved to be statistically valid (Mean AUC = 0.945, Mean TSS = 0.758) and have high discrimination ability (Table 1).

Table 1. Mean, minimum and maximum cross-validated AUC values and TSS values obtained for the *D. hallucatus* Maxent model. Mean value gives the average probability of AUC and TSS scores across cross-validated models.

	Value	**AUC**	**TSS**
Dasyurus hallucatus Maxent model	Mean	0.945	0.758
	Minimum	0.920	0.701
	Maximum	0.965	0.856

Relative contributions of each predictor variable

The MaxEnt model estimates the relative contribution of environmental variables (%) to model development. According to our model output results, climatic predictors made a greater contribution to the final model output than substrate related variables (Table 2). The most powerful predictors were precipitation of the driest quarter (bio17; 39.7%), followed by precipitation seasonality (bio15; 16.4%), and annual precipitation (bio_12; 11.5%). The contribution of the substrate related variables relatively low overall (<10.1%).

Table 2. Environmental predictor variables of *Dasyurus hallucatus* as grid layers across the study areas at a pixel resolution of 80m and mean percent contribution of the predictor variables to the final Maxent model. Mean % contribution of each predictor variable across cross-validated MaxEnt models.

Code	Description	Unit	Mean % contribution
bio17	BIOCLIM: Precipitation of driest quarter	Mm	39.70
bio15	BIOCLIM: Precipitation Seasonality	Mm	16.4
bio12	BIOCLIM: Annual precipitation	Mm	11.5
re55	Vegetation	RE classes	10.1
bio16	BIOCLIM: Precipitation of wettest quarter	Mm	9.7
elev55	Elevation	M	8.6
geo55	Geology	Rock classes	2.6
aspect55	Aspect	Degrees	0.8
slope55	Slope	Degrees	0.7

Predicted species distribution and area of extent

Habitat modelling revealed an almost continuous band of potential quoll habitat stretching from near Ingham in the south to Cooktown in the north (Fig. 4). This model suggests that the main discontinuity in quoll habitat occurs to the east and north of Mt Emerald (Fig. 5). The combination of high and very high quality quoll habitat on the Mt Emerald massif (Fig. 6) and the location of Mt Emerald adjacent to this discontinuity in habitat suggest that Mt Emerald may be of critical importance for maintaining connectivity and dispersal of *D. hallucatus* between the Walsh and Herbert River catchments to the Barron and Mitchell catchments to the north. Genetic analyses of *D. hallucatus* confirm the importance of Mt. Emerald for maintaining the genetic flow between northern and southern populations of far north Queensland quolls (Conroy and Lamont 2013).

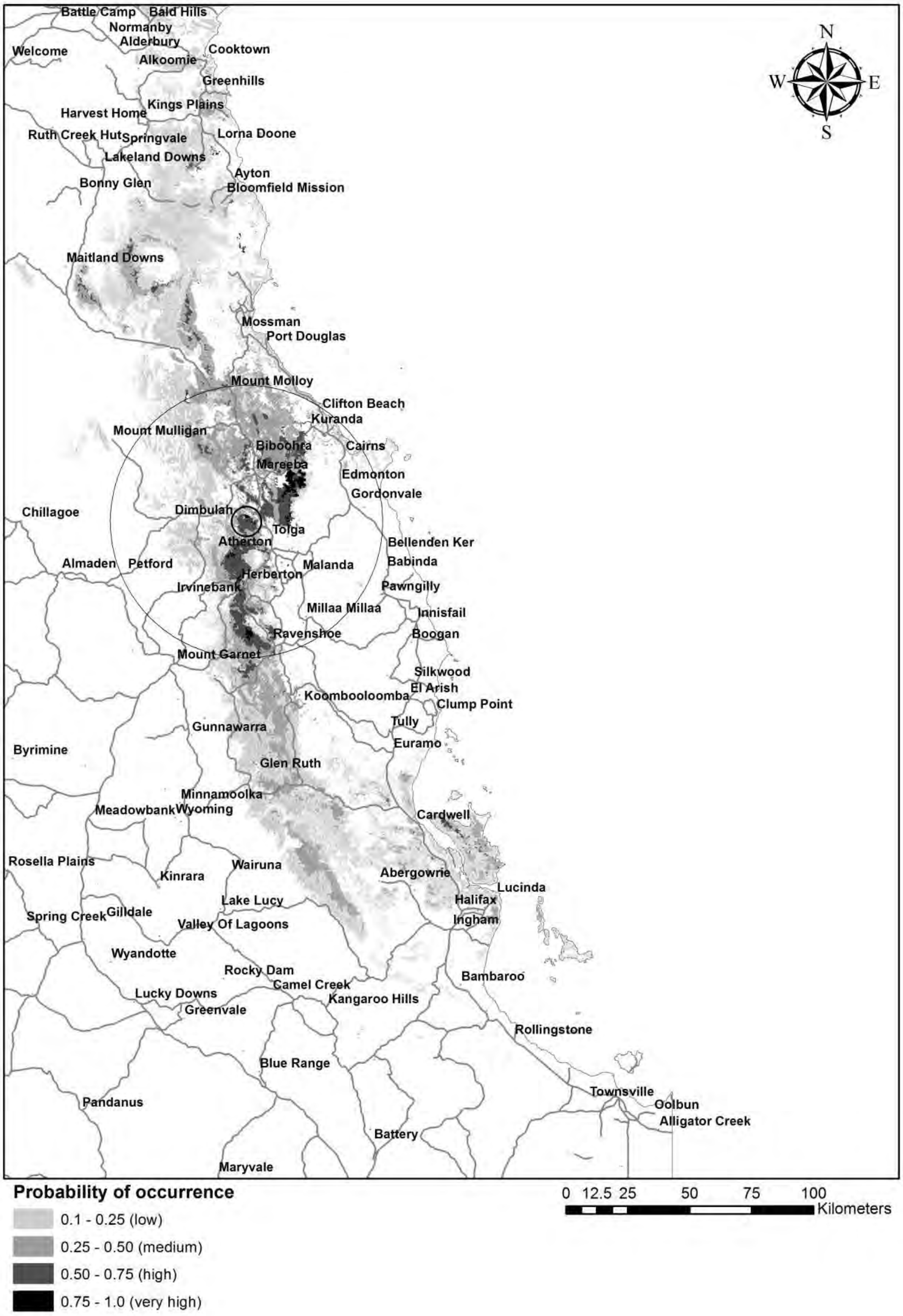

Fig. 4. Quoll habitat suitability within the far north Queensland region, modelled with MaxEnt.

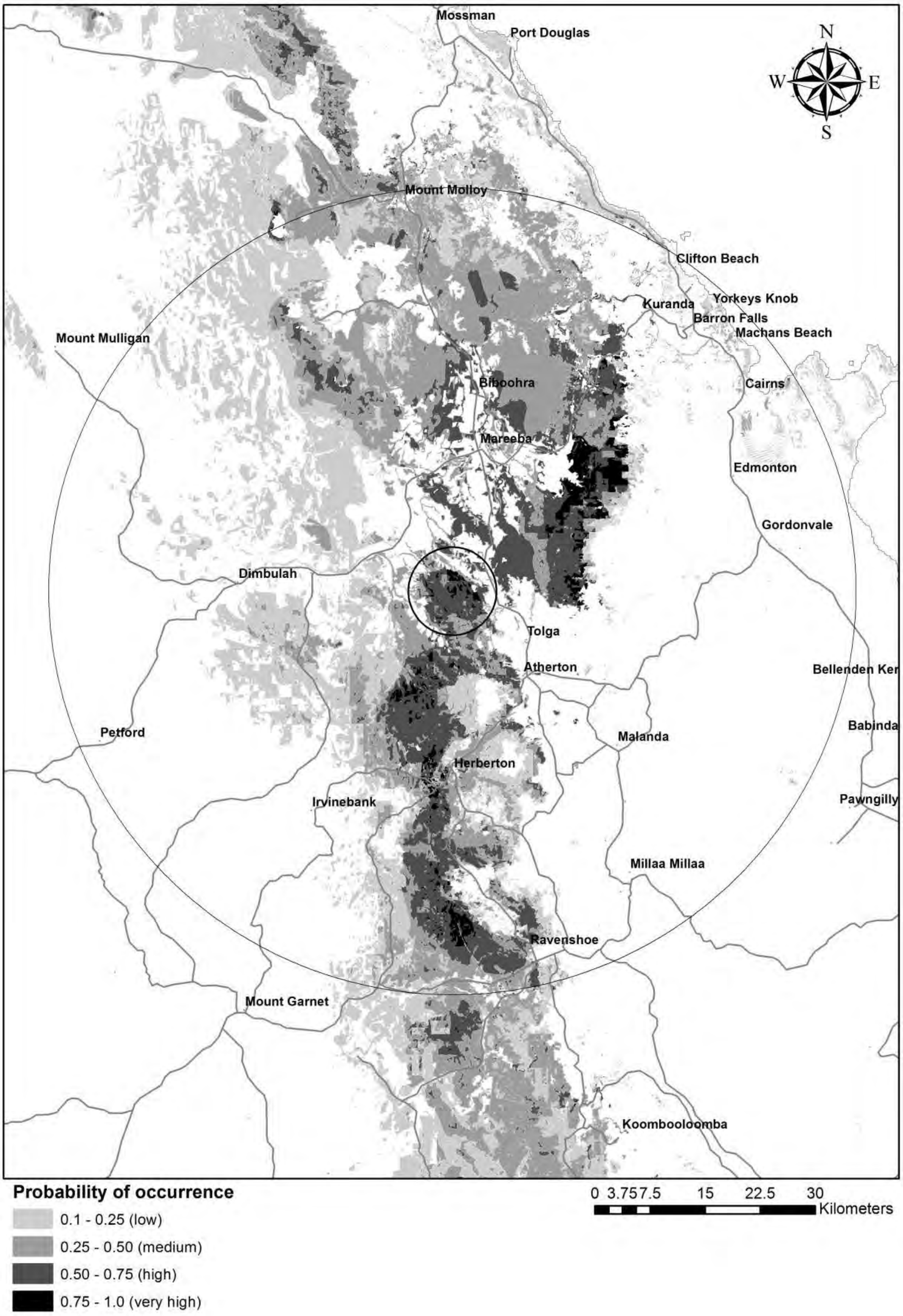

Fig. 5. Quoll habitat suitability within the northern Atherton Tablelands region, modelled with MaxEnt. Note that this is a magnified view of the above output (Fig. 4).

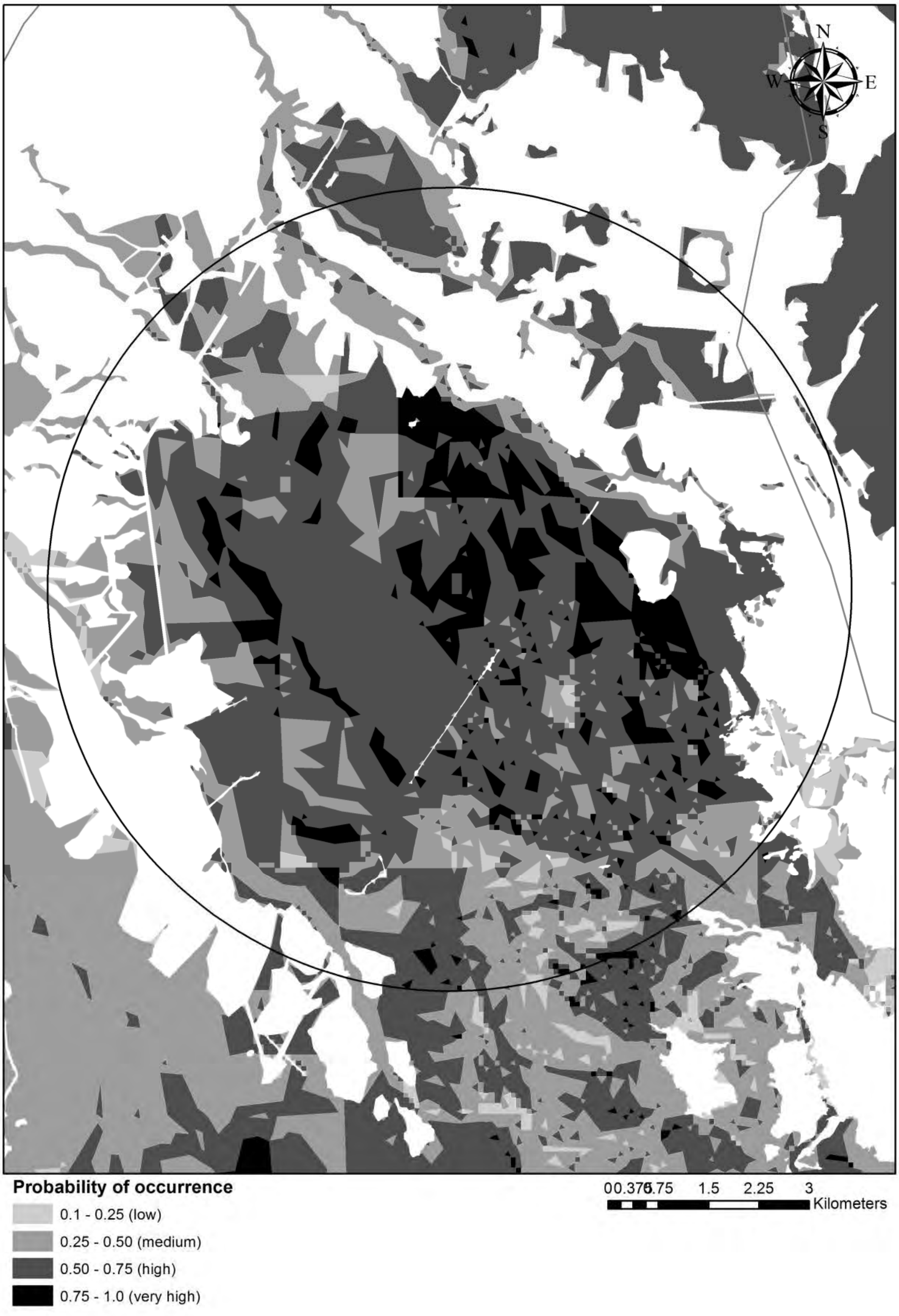

Fig. 6. Quoll habitat suitability within the Mt Emerald area, modelled with MaxEnt.

Note that this is a magnified view of the above output (Fig. 4).

Quality of quoll habitat in far north Queensland

MaxEnt modelling suggests that a band of high and very high quality quoll habitat makes up a core, stretching from Ravenshoe to Kuranda (Fig 3) implying that this central area of the far north Queensland region is particularly important to quolls. Mt Emerald sits within this area, forms part of this high quality habitat zone, and 72% of all predicted high and very high quality habitat occurs within a 55km radius of Mt Emerald (Table3, Fig 3, 4). Thus suggesting this central portion of the far north Queensland area is more important for quolls than other areas within the metapopulation. Mt Emerald itself consists largely of high and very high quality habitat, and makes up 4.5% of all such habitat in the far north Queensland. Mt. Emerald and the habitats contained within a 55km radius around Mt Emerald are very important for ensuring the persistence of *D. hallucatus* populations in far north Queensland (Table 3; Fig. 5).

This statistic has not been ground truthed and therefore should be interpreted with some caution. In particular it is noted the quoll presence samples used to build the MaxEnt model were not collected randomly and many of these records are anecdotal in origin—consequently the apparent density of quoll records in this area (which contributes to model output identifying this as high and very high quality habitat), could be biased by the fact this is also an area of high exposure and hence reporting rates. This uncertainty could be removed by ground-truthing the model output with randomly assigned survey locations across the far north Queensland range.

Density and abundance of quolls in far north Queensland

102 individual quolls were captured 130 times at 109 (28.8%) camera sites during this study. The overall camera trap success rate was approximately 29%. The density of quolls at each camera trap site ranged from 0 – 8.5 quolls/100ha (Mean 0.44 quolls/ha, SD 0.0124, n= 109).

The density of quolls differed between the two terrain classes into which all camera trap sites were categorized. The estimated density of quolls in flat and nearly flat terrain was approximately 1.09 quolls/100ha, compared to quoll density in moderately to extremely rugged terrain which averaged 2.25 quolls/100ha.

Table 3. Spatial extent of habitats of *D. hallucatus* within five suitability thresholds resulting from MaxEnt models.

Maxent Probability range	Habitat Category	Area within entire FNQ Area (Ha)	Area within 55km radius of Mt Emerald (Ha)	Area within Mt Emerald (Ha)	Proportion of each habitat class within FNQ area	Proportion of each habitat class within 55km radius of Mt Emerald	Proportion of each habitat class within Mt Emerald	Area of each habitat class within FNQ area as a proportion of total extent of that habitat class	Area of each habitat class within 55km radius of Mt Emerald as a proportion of total extent of that habitat class	Area of each habitat class within Mt Emerald as a proportion of total extent of that habitat class
<0.1	Unsuitable	6227420.9	650847.9	0.0	0.805	0.556	0.0	0.895	0.105	0.0
0.1 - 0.25	Low	885915.0	202458.1	932.3	0.115	0.173	0.061	0.77	0.229	0.001
0.25 - 0.5	Medium	484684.7	218178.1	8031.0	0.063	0.186	0.529	0.533	0.45	0.017
0.5 - 0.75	High	123251.8	87212.0	5283.2	0.016	0.074	0.348	0.25	0.708	0.043
0.75 - 1.0	Very high	14246.6	12254.1	931.1	0.002	0.01	0.061	0.075	0.86	0.065
TOTAL		7735519.12	1170950.13	15177.60						

Applying the density/unit area potential habitat approach, the entire far north Queensland quoll population is estimated at approximately 9466 individual northern quolls of which approximately 4299 quolls inhabit 394611.4ha of flat or near flat terrain and 5167 individuals inhabit 229264.18ha of moderately to extremely rugged terrain.

Application of the density method to estimate the size of the Mt Emerald quoll population suggests that 53 individual quolls potentially inhabit the site. Closed capture-recapture modelling using data from a 750-m camera trap grid which covered most of the site, also suggests a population size of 53 individuals (95%CI 34 – 109 individuals). This equates to between 0.35% and 1.2% of the entire estimated far northern quoll population.

Uncertainty in the estimate of quoll population size

This population estimate developed above must be viewed in the context of the data that were available for this. A number of factors suggest that this could be an overestimate of quoll abundance. Firstly, the estimate of extent of available habitat (MaxEnt modelling) is likely to overestimate the area of occupied quoll habitat. The model used a range of abiotic and biotic parameters to model the distribution of quoll habitat, but it cannot fully take into account other possible influences on quoll presence such as anthropogenic activities, ecological interactions, natural catastrophes or other threats, which may prevent *D. hallucatus* from fully occupying/accessing all potential habitat areas. It was not possible to ground-truth the model output during this project.

It is also possible that the habitat model is biased towards habitats in which human activity (and this encounters with quolls) is greatest, as mentioned above.

Further uncertainty arises from the density estimates which were applied to the modelled extent of quoll habitat to produce a total quoll population count. All camera trapping, from which density data were derived, was carried out within a 55km radius of Mt Emerald. The extrapolation of these density data to the entire far north Queensland quoll habitat area may therefore over- or underestimate the true size far northern quoll metapopulation.

The implications of these uncertainties are that the relative importance of the Mt Emerald site in the context of the far northern population could be underestimated if density data from Mt Emerald and surrounds are higher than elsewhere within the species range. This requires an extensive program of camera trapping throughout the far northern region in order to validate the density data.

Conclusions

The far north Queensland metapopulation of northern quolls is highly significant at the National and State scale. Unlike all mapped extant Northern Territory and Western Australian populations the far north Queensland metapopulation is not threatened by cane toads or in known decline, having endured and apparently recovered from that impact (Woinarski *et al.* 2008). Within a Queensland context, the far north Queensland population is significant in that it is a highly visible and persistent population. There are no data concerning the density or area of extant of northern quolls in any other metapopulation area so no conclusions can be drawn as to the relative abundance of quolls between the far north Queensland metapopulation and other metapopulations or populations.

Although the Mt Emerald quoll population represents only 0.5% of the overall northern quoll metapopulation—the importance of a population of any number in this location is unknown.

Given that a small total area is to be cleared (approx. 45ha) during the construction phase of this project, it is unlikely that many quoll fatalities will eventuate. Importantly, we don't know the medium- and long-term impacts of the development on carrying capacity of the site. Potential impacts on carrying capacity could arise from weed invasion associated with the movement of vehicles through the site, importation and expansion of weeds due to disturbance of the native ground covers and soil, and changes in fire regime.

Notwithstanding uncertainties in the data, this study suggests that the far north Queensland quoll population is highly significant at a State and National level. Genetic analyses of *D. hallucatus* confirm the importance of Mt. Emerald for maintaining the genetic flow between northern and southern populations of far north Queensland quolls (Conroy and Lamont 2013). The Mt Emerald population of quolls—although not numerically significant within the overall far northern context—are present in an area that is critical for the far northern metapopulation. Although the extent of the impact of the MEWF project on quolls at Mt Emerald is unknown, the small contribution that this population makes to the far northern metapopulation indicates that it is unlikely that the development will negatively impact quolls at the state or regional scale in the short-term. It is unknown how the quoll population at the site will be affected over subsequent years as we lack any data or way of predicting changes to the carrying capacity of the site that might occur as a result of construction and operation of the MEWF site.

Knowledge gaps and research needs

The following knowledge gaps impede a full and proper assessment of the significance of the far northern and Mt Emerald quoll populations, and of the impacts of the MEWF project.

1. Quoll population and metapopulation boundaries are poorly known, and represent estimates at best. There has been insufficient recent or historical survey for quolls to have high confidence that the species only occurs in mapped metapopulation areas.

2. It was not possible to ground-truth the MaxEnt model output during this project. This leads to uncertainty in the accuracy of habitat model output. An assessment of the accuracy of this output entails stratified sampling of quolls within the modelled extent in far north Queensland.

3. The applicability to the rest of the far northern metapopulation area of the quoll density estimates derived for the Mt Emerald and surrounds is untested. This requires an extensive program of camera trapping stratified by habitat-type and covering the entire far northern region in order to validate the density data.

4. There are no data concerning the density or area of extant of northern quolls in any other metapopulation area so no conclusions can be drawn as to the relative abundance of quolls between the far north Queensland metapopulation and other metapopulations or populations. This requires a program of quollpopulation survey and enumeration, using the same methods as those used in this study, in other metapopulation areas.

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Appendices

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Appendix A. Presence records used to map the contemporary extent of occurrence of *D. hallucatus* and to model habitat suitability in far north Queensland.

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
2	-17.49155	145.2824	Wildlife online	50	?	21/02/2012	21/02/2012	Dry River, 0.3 km SE of Rock Bar
3	-17.49155	145.2824	Wildlife online	50	?	12/05/2012	12/05/2012	Dry River, 0.3 km SE of Rock Bar
4	-17.45259	145.28733	Wildlife online	100	?	31/07/2010	31/07/2010	Silver Valley Road, between Lancelot battery & rockart rock
5	-17.4523	145.28795	Wildlife online	100	?	7/10/2009	7/10/2009	Silver Valley Road, Dry River "Rock Art site"
7	-17.371674	145.32822	Scott Burnett fauna records	10	WGS84	19/06/2000	19/06/2000	Upper Walsh River, upper Bussy Ck
8	-17.370898	145.349261	This study	15	GDA94	14/09/2012	18/09/2012	Upper Walsh
9	-17.37033	145.346925	This study	15	GDA94	14/09/2012	18/09/2012	Upper Walsh
10	-17.368571	145.348569	This study	15	GDA94	14/09/2012	18/09/2012	Upper Walsh
11	-17.36781	145.35292	Scott Burnett fauna records	100	WGS84	1/01/2003	30/05/2003	Watsonville Range, under powerline
12	-17.366915	145.350127	This study	15	GDA94	14/09/2012	18/09/2012	Upper Walsh

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
13	-17.366738	145.326863	Scott Burnett fauna records	10	WGS84	19/06/2000	19/06/2000	Upper Walsh River
14	-17.366682	145.326704	Scott Burnett fauna records	15	WGS84	19/06/2000	19/06/2000	Upper Walsh River
15	-17.366583	145.326799	Scott Burnett fauna records	15	WGS84	19/06/2000	19/06/2000	Upper Walsh River
16	-17.36518	145.351813	This study	15	GDA94	14/09/2012	18/09/2012	Upper Walsh
17	-17.359276	145.326543	Scott Burnett fauna records	15	WGS84	23/02/2003	23/02/2003	Picnic Rock, Watsonville
18	-17.359622	145.3279	Scott Burnett fauna records	50	WGS84	1/01/2000	31/12/2000	154 Walsh River Road, Watsonville QLD
19	-17.359309	145.326714	Scott Burnett fauna records	10	WGS84	19/06/2000	19/06/2000	Upper Walsh River
20	-17.354706	145.351284	This study	15	GDA94	13/09/2012	17/09/2012	Upper Walsh
21	-17.352441	145.351611	This study	15	GDA94	13/09/2012	17/09/2012	Upper Walsh
22	-17.352176	145.377335	This study	15	GDA94	14/09/2012	18/09/2012	Upper Walsh
23	-17.351458	145.35378	This study	15	GDA94	13/09/2012	17/09/2012	Upper Walsh
24	-17.350638	145.355919	This study	15	GDA94	13/09/2012	17/09/2012	Upper Walsh
25	-17.343214	145.359701	This study	15	GDA94	13/09/2012	17/09/2012	Upper Walsh
26	-17.3117	145.21423	This study	15	GDA94	13/09/2012	17/09/2012	Stannery Hills

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
27	-17.30692	145.39798	Wildlife online	400		17/12/1994	18/12/1994	Mt Baldy SF, Walsh River and adjacent slopes
28	-17.30513	145.21249	This study	15	GDA94	13/09/2012	17/09/2012	Stannery Hills
29	-17.2952	145.3529	Wildlife online	500		28/02/2001	28/02/2001	Mt Baldy - Lower I site
30	-17.29167	145.35306	Wildlife online	300		1/03/2001	1/03/2001	Mt Baldy - Lower I site
31	-17.2916	145.35214	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
32	-17.27979	145.36359	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
33	-17.2682	145.3578	Wildlife online	500		28/02/2001	28/02/2001	Mt Baldy - Upper I site
34	-17.26667	145.3575	Wildlife online	300		3/03/2001	3/03/2001	Mt Baldy - Upper I site
36	-17.24151	145.35629	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
37	-17.23948	145.35516	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
38	-17.23739	145.354	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
39	-17.23575	145.3602	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
40	-17.23494	145.35316	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
41	-17.23022	145.37395	Wildlife online	20		12/01/2012	12/01/2012	Oakey Creek, 11 km W of Tolga

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
42	-17.22904	145.36159	This study	15	GDA94	9/10/2012	15/10/2012	UPPER WALSH NORTH
43	-17.20651	145.36192	Wildlife online	50		5/01/2012	5/01/2012	Oakey Creek, Arriga, 8 km W of Walkamin
44	-17.20651	145.36192	Wildlife online	50		5/01/2012	5/01/2012	Oakey Creek, Arriga, 8 km W of Walkamin
45	-17.20651	145.36192	Wildlife online	50		18/01/2012	18/01/2012	Oakey Creek, Arriga, 8 km W of Walkamin
46	-17.20651	145.36192	Wildlife online	50		23/01/2012	23/01/2012	Oakey Creek, Arriga, 8 km W of Walkamin
47	-17.189778	145.395937	This study	15	GDA94	2012		Mt Emerald 750
48	-17.189708	145.388997	This study	15	GDA94	2012		Mt Emerald 750
49	-17.18465	145.18033	This study	15	GDA94	20/09/2012	24/09/2012	Mutchilba
50	-17.182983	145.403194	This study	15	GDA94	21/08/2012	27/08/2012	Mt Emerald 750
51	-17.182947	145.389078	This study	15	GDA94	2012		Mt Emerald 750
52	-17.18245	145.34784	This study	15	GDA94	24/10/2012	31/10/2012	Oakvale
53	-17.176207	145.403252	This study	15	GDA94	21/08/2012	27/08/2012	Mt Emerald 750
54	-17.176094	145.389152	This study	15	GDA94	21/08/2012	27/08/2012	Mt Emerald 750
55	-17.175785	145.396263	This study	15	GDA94	21/08/2012	27/08/2012	Mt Emerald 750

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
56	-17.169205	145.375112	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
57	-17.169191	145.368158	This study	15	GDA94	2012		Mt Emerald 750
58	-17.16819	145.52253	Wildlife online	300		1/09/1995	30/09/1995	Tinaroo Dam-G, 640m asl
59	-17.16554	145.54051	Wildlife online	300		1/09/1995	30/09/1995	Tinaroo Dam-D, 650m asl
60	-17.16496	145.51828	Wildlife online	300		1/09/1995	30/09/1995	Tinaroo Dam-H, 670m asl
61	-17.162859	145.39666	This study	15	GDA94	2012		Mt Emerald 750
62	-17.162653	145.403368	This study	15	GDA94	21/08/2012	27/08/2012	Mt Emerald 750
63	-17.162541	145.389269	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
64	-17.162484	145.38222	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
65	-17.162371	145.368122	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
66	-17.161711	145.545236	Quoll Seekers FNQ	100				Tinaroo Dam wall (200M EAST)
67	-17.15928	145.54718	Wildlife online	300		1/09/1995	30/09/1995	Tinaroo Dam-C, 670m asl
68	-17.15632	145.51902	Wildlife online	300		1/09/1995	30/09/1995	Tinaroo Dam-I, 690m asl
69	-17.155809	145.396464	This study	15	GDA94	2012		Mt Emerald 750

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
70	-17.155764	145.389328	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
71	-17.155708	145.382279	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
72	-17.155633	145.368205	This study	15	GDA94	2012		Mt Emerald 750
73	-17.1537	145.55073	Wildlife online	200		10/09/2000		1.4km northeast of Tinaroo Dam wall
74	-17.149091	145.389174	This study	15	GDA94	2012		Mt Emerald 750
75	-17.148894	145.262003	Quoll Seekers FNQ	50				1 Lemonside Road (off Dimbulah Road), Mareeba
76	-17.148874	145.375289	This study	15	GDA94	20/08/2012	24/08/2012	Mt Emerald 750
77	-17.142098	145.368162	This study	15	GDA94	2012		Mt Emerald 750
78	-17.12078	145.54162	Wildlife online	300		1/12/1995	31/12/1995	Tinaroo Creek retrapping-G
79	-17.11794	145.44048	This study	15	GDA94	27/09/2012	1/10/2012	HENRY HANNAM RD
80	-17.11501	145.44086	This study	15	GDA94	27/09/2012	1/10/2012	HENRY HANNAM RD
81	-17.109642	145.538949	This study	15	GDA94	2012		Lamb Range
82	-17.109064	145.541125	This study	15	GDA94	2012		Lamb Range

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
83	-17.108221	145.543591	This study	15	GDA94	2012		Lamb Range
84	-17.10386	145.53174	Wildlife online	300		1/04/1994	30/04/1994	Tinaroo Creek-H, 645m asl
85	-17.10065	145.44958	This study	15	GDA94	27/09/2012	1/10/2012	HENRY HANNAM RD
86	-17.09488	145.52143	Wildlife online	300		1/04/1994	30/04/1994	Tinaroo Creek-J, 640m asl
87	-17.094808	145.383019	Quoll Seekers FNQ	50		1/06/2010	1/06/2010	17░5'41.31"S 145░22'58.87"E Chewko Road QLD
88	-17.080996	145.570913	This study	15	GDA94	2012		Lamb Range
89	-17.080511	145.568052	This study	15	GDA94	2012		Lamb Range
90	-17.079859	145.500792	Quoll Seekers FNQ	50		29/12/2012	29/12/2012	S 17.079859 áEá145.500792á. 4)
91	-17.069806	145.483394	Quoll Seekers FNQ	50		29/12/2012	29/12/2012	S 17 04.113 E 145 29.022
92	-17.023062	145.585253	This study	15	GDA94	2012		Lamb Range
93	-17.022736	145.583454	This study	15	GDA94	2012		Lamb Range
94	-17.022061	145.578514	This study	15	GDA94	2012		Lamb Range
95	-17.01974	145.5842	Wildlife online	300		1/05/1994	31/05/1994	Davies Creek-S, 600m asl

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
96	-17.01973	145.58431	Wildlife online	100		9/08/2004		Davies Creek monitoring sites
97	-17.01873	145.5838	Wildlife online	100		5/12/2004	5/12/2004	Davies Creek monitoring sites
98	-17.01867	145.58532	Wildlife online	300		1/11/1995	30/11/1995	Davies Creek II-Q2, 650m asl
99	-17.01709	145.583933	This study	15	GDA94	2012		Lamb Range
100	-17.01704	145.58158	Wildlife online	100		16/07/2002	16/07/2002	Davies Creek monitoring sites
101	-17.01696	145.58498	Wildlife online	100		30/08/2005		Davies Creek monitoring sites
102	-17.01647	145.58344	Wildlife online	250		18/06/1990	18/06/1990	Davies Creek Rd, Lamb Range, 2.4 km NNE Mt Turtle
103	-17.015471	145.571727	This study	15	GDA94	2012		Lamb Range
104	-17.01486	145.58187	Wildlife online	100		12/09/2000		Davies Creek monitoring sites
105	-17.0148	145.57857	Wildlife online	100		2/12/2004	2/12/2004	Davies Creek monitoring sites
106	-17.01477	145.57767	Wildlife online	100		30/08/2005		Davies Creek monitoring sites
107	-17.01466	145.58103	Wildlife online	100		13/09/2000		Davies Creek monitoring sites
108	-17.01466	145.58103	Wildlife online	100		4/06/2003	4/06/2003	Davies Creek monitoring sites

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
109	-17.01466	145.58103	Wildlife online	100		5/06/2003	5/06/2003	Davies Creek monitoring sites
110	-17.01466	145.58251	Wildlife online	250		20/06/1990	20/06/1990	Davies Creek Rd, Lamb Range, 2.6 km NNE Mt Turtle
111	-17.01465	145.58157	Wildlife online	450		19/06/1990	19/06/1990	Davies Creek, Lamb Range, 2.5 km N Mt Turtle
112	-17.01431	145.58016	Wildlife online	100		31/08/2005		Davies Creek monitoring sites
113	-17.012826	145.571156	This study	15	GDA94	2012		Lamb Range
114	-17.01206	145.5789	Wildlife online	300		1/05/1994	31/05/1994	Davies Creek-T, 600m asl
115	-17.010795	145.57081	This study	15	GDA94	2012		Lamb Range
116	-17.00972	145.57806	Wildlife online	100		8/01/2012		Davies Creek NP nr Mareeba
117	-17.00825	145.57035	Wildlife online	250		20/06/1990	20/06/1990	Davies Creek Rd, Lamb Range, 3.4 km NNW Mt Turtle
118	-17.006497	145.338311	Quoll Seekers FNQ	50		20/01/2009	20/01/2009	94 Ivicevic Road, Paddys Green, Mareeba
119	-17.00371	145.56757	Wildlife online	250		16/06/1990	16/06/1990	Davies Creek Rd, Lamb Range, 3.8km NNW Mt Turtle
120	-17.002457	145.56202	This study	15	GDA94	2012		Lamb Range

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
121	-17.000208	145.563071	This study	15	GDA94	2012		Lamb Range
122	-16.99834	145.55104	This study	15	GDA94	28/09/2012	2/10/2012	Kay Rd
123	-16.998283	145.564188	This study	15	GDA94	2012		Lamb Range
124	-16.996766	145.56605	This study	15	GDA94	2012		Lamb Range
125	-16.993689	145.548716	This study	15	GDA94	2012		Lamb Range
126	-16.993409	145.545995	This study	15	GDA94	2012		Lamb Range
127	-16.993036	145.541565	This study	15	GDA94	2012		Lamb Range
128	-16.99167	145.55373	This study	15	GDA94	28/09/2012	2/10/2012	Kay Rd
129	-16.990752	145.5428	This study	15	GDA94	2012		Lamb Range
130	-16.989133	145.544627	This study	15	GDA94	2012		Lamb Range
131	-16.98694	145.55855	This study	15	GDA94	28/09/2012	2/10/2012	Kay Rd
132	-16.981539	145.550008	This study	15	GDA94	2012		Lamb Range
133	-16.98059	145.34102	This study	15	GDA94	27/09/2012	1/10/2012	Southedge Research Station
134	-16.980019	145.54553	This study	15	GDA94	2012		Lamb Range

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
135	-16.97761	145.34685	This study	15	GDA94	27/09/2012	1/10/2012	Southedge Research Station
136	-16.967502	145.415999	Quoll Seekers FNQ	50		1/01/2002	31/12/2012	-16.967502, 145.415999. 52 McGrath Road. Mareeba
137	-16.952069	145.686825	Quoll Seekers FNQ	50		11/05/2011	11/05/2011	16 57' 07.45"S 145 41' 12.57"E
140	-16.919165	145.594237	Scott Burnett fauna records	15	WGS84	18/06/2003	18/06/2003	Clohesy R Rd, 1000m e first ford
141	-16.916472	145.386922	Quoll Seekers FNQ	50				Pickford Rd, Biboohra QLD 4880
142	-16.913031	145.597453	Quoll Seekers FNQ	50		1/06/2008	30/06/2008	Cedar park Rd, Koah QLD
143	-16.912894	145.576731	Quoll Seekers FNQ	50				Clohesy River Road, Kuranda, QLD 4881
144	-16.890313	145.567816	Scott Burnett fauna records	15	WGS84	23/07/2001	23/07/2001	Cnr of Kennedy Highway and Palm Valley Rd, just north of Koah Roadhouse.
146	-16.829003	145.712022	Quoll Seekers FNQ	50		1/01/2005	31/12/2011	Dunne Rd at Yorkeys Knob
147	-16.809942	145.364043	Scott Burnett fauna records	15	WGS84	15/06/2000	15/06/2000	Big Mitchell Reserve
148	-16.807714	145.604567	Quoll Seekers FNQ	50				Myola Road, Kuranda QLD
150	-16.80292	145.55559	This study	15	GDA94	27/09/2012	1/10/2012	Private Property of Petra Lovey

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
151	-16.80248	145.36455	Wildlife online	200		12/03/2000	12/03/2000	100m north of Big Mitchell Creek, Peninsula Development Rd
152	-16.79782	145.373782	Scott Burnett fauna records	15	WGS84	14/06/2000	14/06/2000	Big Mitchell reserve
153	-16.797106	145.549978	Quoll Seekers FNQ	50				Armstrong Road, Kuranda.
158	-16.6068	145.35194	Wildlife online	200		10/05/2000	10/05/2000	Eulama Creek Rd, Julatten
159	-16.382919	145.36913	Quoll Seekers FNQ	50		23/07/2008	23/07/2008	Zone 55K (DATUM WGS 84) Easting 326229 Northing 8138625
160	-16.317182	145.09875	Scott Burnett fauna records	15	WGS84	28/05/2011	2/06/2011	Windsor Tableland
161	-16.307845	145.097047	Scott Burnett fauna records	15	WGS84	28/05/2011	2/06/2011	Windsor Tableland
162	-16.300264	145.090837	Scott Burnett fauna records	15	WGS84	28/05/2011	2/06/2011	Windsor Tableland
164	-16.246891	144.970892	Scott Burnett fauna records	15	WGS84	28/05/2011	2/06/2011	Windsor Tableland
165	-16.244297	144.971198	Scott Burnett fauna records	15	WGS84	28/05/2011	2/06/2011	Windsor Tableland
166	-15.86368	144.80962	Wildlife online	20		24/02/2009	24/02/2009	Lily Creek homestead, Lakeland Downs
167	-15.8027	145.219422	Quoll Seekers FNQ	50		27/09/2009	27/09/2009	S 15 48.972. E 145 13.992

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
176	-15.67711	145.21619	Wildlife online	450		28/07/1989	28/07/1989	Helenvale-Cooktown road junctio, 1.5 km WSW Black Mt
179	-15.656156	145.253889	Quoll Seekers FNQ	50		13/10/2011	13/10/2011	Mt Atmos Valley -15.39'22.16" 145.15'.14"
180	-15.65389	145.22167	Wildlife online	100		28/11/2004		Black Mountain N.P.
181	-15.65	145.216667	Quoll Seekers FNQ	50				Mount Simon,Rossville QLD 4895 (Black Mountian NP)
182	-15.64387	144.9839	Wildlife online	50		28/06/1996	29/06/1996	Northern limestone outcrop, above side tributary of East Normandy River, Kings Plains Station
183	-15.467167	145.089203	Quoll Seekers FNQ	50				Wilton access road 15 km north west of Cooktown
184	-15.332803	145.032889	Quoll Seekers FNQ	50		30/06/2009	31/12/2006	Endeavour Valley Rd, Cooktown QLD 4895
185	-16.920136	145.758744	Quoll Seekers FNQ	50				Parramatta Park, Severin St QLD
186	-16.885556	145.833889	Quoll Seekers FNQ	50				2240 Yarrabah Road, East Trinity
187	-16.34099	144.87802	Peter Buosi - Ecologist	50	GDA94	6/06/2006	6/06/2006	Palmer River

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
188	-16.34076	144.87968	Peter Buosi - Ecologist	50	GDA94	8/06/2006	8/06/2006	Palmer River
189	-16.34076	144.87968	Peter Buosi - Ecologist	50	GDA94	9/06/2006	9/06/2006	Palmer River
190	-17.39057	145.37621	Saeed De Ridder - Naturalist	100		24/03/2000	24/03/2000	Rifle Range, Herberton
191	-17.16972	145.54694	Andrew Dennis -Ecologist	100	AGD84	14/01/2000	14/01/2000	Pensini's Restaurant, Lake Tinaroo
197	-16.68445	145.32979	Scott Burnett fauna records	15	WGS84	2/12/1999	2/12/1999	on Mareeba Rd, 1km south of Mt Molloy
200	345428.6051	8101964.3	John Winter –Ecologist	15	WGS84	17/01/2007	17/01/2007	Tinaroo Falls
201	345434	8107800	John Winter –Ecologist	15	WGS84	11/03/2007	11/03/2007	Tinaroo Ck Rd, Emu Ck
202	338615.3609	8112512.9	John Winter –Ecologist	15	WGS84	12/03/2007	12/03/2007	Tinaroo Ck Rd, Douglas Ck
203	335616.8084	8108436.3	John Winter –Ecologist	15	WGS84	23/03/2007	23/03/2007	Tolga, Vollert's
204	310222.9681	8249120.4	John Winter –Ecologist	15	WGS84	2/06/2007	2/06/2007	Mt Poverty
205	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	25/05/2006	25/05/2006	Brookyn Sanctuary

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
206	-16.59740	145.25391	Australian Wildlife Conservancy	15	GDA94	25/05/2006	25/05/2006	Brookyn Sanctuary
207	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	15/11/2006	15/11/2006	Brookyn Sanctuary
208	-16.64881	145.26180	Australian Wildlife Conservancy	15	GDA94	15/11/2006	15/11/2006	Brookyn Sanctuary
209	-16.59740	145.25391	Australian Wildlife Conservancy	15	GDA94	15/11/2006	15/11/2006	Brookyn Sanctuary
210	-16.59942	145.24281	Australian Wildlife Conservancy	15	GDA94	15/11/2006	15/11/2006	Brookyn Sanctuary
211	-16.65802	145.26262	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
212	-16.59813	145.24796	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
213	-16.59813	145.24796	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
214	-16.59813	145.24796	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
215	-16.59813	145.24796	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
216	-16.59942	145.24281	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
217	-16.59942	145.24281	Australian Wildlife Conservancy	15	GDA94	18/04/2007	18/04/2007	Brookyn Sanctuary
218	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	10/11/2007	10/11/2007	Brookyn Sanctuary
219	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	10/11/2007	10/11/2007	Brookyn Sanctuary

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
220	-16.59740	145.25391	Australian Wildlife Conservancy	15	GDA94	10/11/2007	10/11/2007	Brookyn Sanctuary
221	-16.59730	145.25209	Australian Wildlife Conservancy	15	GDA94	10/11/2007	10/11/2007	Brookyn Sanctuary
222	-16.59813	145.24796	Australian Wildlife Conservancy	15	GDA94	10/11/2007	10/11/2007	Brookyn Sanctuary
223	-16.59942	145.24281	Australian Wildlife Conservancy	15	GDA94	10/11/2007	10/11/2007	Brookyn Sanctuary
224	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	6/10/2009	6/10/2009	Brookyn Sanctuary
225	-16.64881	145.26180	Australian Wildlife Conservancy	15	GDA94	6/10/2009	6/10/2009	Brookyn Sanctuary
226	-16.59348	145.21141	Australian Wildlife Conservancy	15	GDA94	19/04/2010	19/04/2010	Brookyn Sanctuary
227	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	7/11/2010	7/11/2010	Brookyn Sanctuary
228	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	7/11/2010	7/11/2010	Brookyn Sanctuary
229	-16.53234	145.18409	Australian Wildlife Conservancy	15	GDA94	26/09/2011	26/09/2011	Bottle tree
230	-16.53234	145.18409	Australian Wildlife Conservancy	15	GDA94	26/09/2011	26/09/2011	Bottle tree
231	-16.60963	145.24374	Australian Wildlife Conservancy	15	GDA94	26/09/2011	26/09/2011	Station Ck
232	-16.65503	145.25923	Australian Wildlife Conservancy	15	GDA94	26/09/2011	26/09/2011	Pom Pom track
233	-16.65174	145.26103	Australian Wildlife Conservancy	15	GDA94	26/09/2011	26/09/2011	Pom Pom track

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
234	-16.66896	145.26387	Australian Wildlife Conservancy	15	GDA94	15/03/2013	15/03/2013	Mulligan Highway
235	-16.64538	145.26272	Australian Wildlife Conservancy	15	GDA94	16/05/2013	16/05/2013	Brookyn Sanctuary
236	-16.65802	145.26262	Australian Wildlife Conservancy	15	GDA94	16/05/2013	16/05/2013	Brookyn Sanctuary
237	-16.58472	145.22794	Australian Wildlife Conservancy	15	GDA94	18/05/2013	18/05/2013	Brookyn Sanctuary
238	-16.66415	145.30062	Australian Wildlife Conservancy	15	GDA94	20/05/2013	20/05/2013	Mulligan Highway
239	-17.37556	145.3433	Scott Burnett fauna records	15	GDA94	19/05/2010	23/05/2010	Toy Creek, upper Walsh River
240	-17.37519	145.34869	Scott Burnett fauna records	15	GDA94	19/05/2010	23/05/2010	Toy Creek, upper Walsh River
241	-17.37512	145.34506	Scott Burnett fauna records	15	GDA94	19/05/2010	23/05/2010	Toy Creek, upper Walsh River
242	-17.37469	145.3521	Scott Burnett fauna records	15	GDA94	19/05/2010	23/05/2010	Toy Creek, upper Walsh River
243	-17.3743	145.34249	Scott Burnett fauna records	15	GDA94	19/05/2010	23/05/2010	Toy Creek, upper Walsh River
244	-17.37417	145.35023	Scott Burnett fauna records	15	GDA94	19/05/2010	23/05/2010	Toy Creek, upper Walsh River
245	-17.3673	145.35273	Scott Burnett fauna records	15	GDA94	20/05/2010	24/05/2010	Toy Creek, upper Walsh River
246	-17.36515	145.35244	Scott Burnett fauna records	15	GDA94	20/05/2010	24/05/2010	Toy Creek, upper Walsh River
247	-17.36366	145.35083	Scott Burnett fauna records	15	GDA94	20/05/2010	24/05/2010	Toy Creek, upper Walsh River

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
248	-17.36347	145.35288	Scott Burnett fauna records	15	GDA94	20/05/2010	24/05/2010	Toy Creek, upper Walsh River
249	-17.35598	145.35615	Scott Burnett fauna records	15	GDA94	20/05/2010	24/05/2010	Toy Creek, upper Walsh River
251	-17.17749	145.540223	Quoll Seekers FNQ	50		28/04/2012	28/04/2012	Main road into Tinaroo, not far from Tinaroo. Co-ordinates - 17.17749 145.540223
252	-17.14079062	145.433236	Quoll Seekers FNQ	50		21/04/2013	21/04/2013	Walkamin area Coordinates - 17.14079061783959;145.43323554345704
253	-17.113107	-17.113107	Quoll Seekers FNQ	50				-17.113107 145.363305. Walkamin near Mareeba (address of the prison is 729 Chettle Rd, Arriga
254	-17.11281667	145.544667	Quoll Seekers FNQ	50		28/12/2012	28/12/2012	Co-ordinates S 17 06.769 E 145 32.682 Alt 869m. Steep south facing rocky slope with open woodland and grassy understorey
255	-17.09480833	145.383019	Quoll Seekers FNQ	50		1/06/2010 13:20	1/06/2010 13:20	17° 5'41.31"S 145°22'58.87"E (Google it) base of Mount Uncle and Mount Aunt, Chewko Road.

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
256	-17.079859	145.500792	Quoll Seekers FNQ	50		29/12/2012	29/12/2012	Co-ordinates S 17.079859 E 145.500792 . 4)
257	-17.069339	145.423751	Quoll Seekers FNQ	50		Within a week of this date	matthewweinert@westnet.com.au	Near the Mareeba Airport - 17.069339,145.423751
258	-17.006209	145.724593	Quoll Seekers FNQ	50		1/5/11	30/11/2011	276 Robert Road, Bentley Park - 17.006209 145.724593
259	-16.907487	145.566101	Quoll Seekers FNQ	50		14/03/2012	14/03/2012	Kennedy Highway near the servo/davies ck bridge. - 16.907487, 145.566101
260	-16.87544444	145.410028	Quoll Seekers FNQ	50		8/06/2012 11.30pm	8/06/2012 11.30pm	Co-ordinates 16°52'31.6" S 145°24'36.1" E
261	-16.85134	145.716981	Quoll Seekers FNQ	50		10/04/2013	10/04/2013	Northern approach to Thomatis Creek Bridge on the Highway. Co-ords -- 16.851349,145.716981
262	-16.841214	145.741743	Quoll Seekers FNQ	50		6/05/2013	6/05/2013	Hibiscus Lane, Holloways Beach Co-ordinates -16.841214, 145.741743
264	-16.282283	145.372214	Quoll Seekers FNQ	50		1/01/2009	31/12/2009	Mossman-Daintree Road, adjacent to golf course

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
265	-16.282283	145.372214	Quoll Seekers FNQ	50		1/01/2010	31/12/2010	Mossman-Daintree Road, adjacent to golf course
266	-15.73675	145.231861	Quoll Seekers FNQ	50		3/06/2010 8AM	3/06/2010 8AM	Cooktown Road between Rossville and the Shiptons Flat Turn off, South of Cooktown. s 15 44' 12.3", e 145 13' 54.7" (Lat and Long) or 55L 0310553 8259389 (UTM UPS)
267	-15.5033	145.2574	Quoll Seekers FNQ	50		7/11/10	7/11/10	Just south of Cooktown, on the road to Quarantine Bay - about 15.5033S 145.2574E
268	-15.47186111	145.2482	Quoll Seekers FNQ	50		9/01/2012	9/01/2012	Charlotte Street, Cooktown 15°28'18.70"S 145°14'53.52"E
269	-14.25685278	144.461847	Quoll Seekers FNQ	50		25/09/11	25/09/11	Cape Melville - top of Camp Creek. 14°15'24.67"S 144°27'42.65"E
270	-17.1300	145.3600	Alex Kutt - Ecologist	50	WGS84	1/01/1992	31/12/1992	Walkamin
271	-17.11350	145.54415	Scott Burnett unpublished	15	WGS84	10/06/2004	10/06/2004	Tinaroo Creek Rd, Lamb Range

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
			records					
272	-17.11020	145.53684	Scott Burnett unpublished records	15	WGS84	10/06/2004	10/06/2004	Tinaroo Creek Rd, Lamb Range
273	-17.10388	145.53413	Burnett	15	WGS84	10/06/2004	10/06/2004	Tinaroo Creek Rd, Lamb Range
274	-17.10119	145.52767	Scott Burnett unpublished records	15	WGS84	10/06/2004	10/06/2004	Tinaroo Creek Rd, Lamb Range
275	-17.0187	145.5838	Far Northern Threatened Species	50	WGS84	2004		
276	-17.0170	145.5816	Far Northern Threatened Species	50	WGS84	2002		
277	-17.0170	145.5850	Far Northern Threatened Species	50	WGS84	2005		
278	-17.0149	145.5819	Far Northern Threatened Species	50	WGS84	2000		
279	-17.0148	145.5786	Far Northern Threatened Species	50	WGS84	2004		
280	-17.0148	145.5777	Far Northern Threatened	50	WGS84	2005		

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
			Species					
281	-17.0147	145.5810	Far Northern Threatened Species	50	WGS84	2000		
282	-17.0147	145.5810	Far Northern Threatened Species	50	WGS84	2003		
283	-17.0143	145.5802	Far Northern Threatened Species	50	WGS84	2005		
284	-16.924972	145.361497	Quoll Seekers FNQ	100	WGS84	30-Oct-08	30-Oct-08	ceiling of Jabiru Safari Lodge at Mareeba Wetlands
285	-16.924972	145.361497	Quoll Seekers FNQ	100	WGS84	6/07/2008	6/07/2008	Marreba wetlands
286	-16.826663	145.653584	Quoll Seekers FNQ	100	WGS84	7/08/2011	7/08/2011	By siide of Kennedy Highway, 400m east of Rainforestation .
287	233449	233449	Quoll Seekers FNQ	50	WGS84	6 July 2010	6 July 2010	**near Lakeland NP GPS 0233449 – 8389906**
288	55 336300 8120100		Lloyd Jones – QPWS	15	WGS84	6/06/2001	2000	South of Emerald Ck on Kennedy Highway.
289	55 343934		Mark Newton - QPWS	15	WGS84	29/09/2001	2000	Tichum Creek Bridge on Kennedy Highway

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
	8123320							7kms NW of Emerald Ck.
290	55 345461 8128183		Mark Newton- QPWS	15	WGS84	9/10/2001	2000	400m south of Kanervo Rd and Kennedy Highway, SW of Koah.
291	55 347452 8132025		Gary Wilson & Ian Fox- QPWS	15	WGS84	23/07/2001	2000	Cnr of Kennedy Highway and Palm Valley Rd, just north of Koah Roadhouse.
292	-16.923623	145.730832	Quoll Seekers FNQ	100	GDA94	1/01/2008	31/12/2008	Moody creek, Marino quarry forest
293	-16.912065	145.417056	Quoll Seekers FNQ	100	GDA94	1/02/2010	28/02/2010	Bibhoora, north of Mareeba on the Mulligan Highway.
294	-15.863476	144.809804	Quoll Seekers FNQ	100	GDA94	1/01/2007	31/12/2009	Lakeland
295	-17.359276	145.326543	Scott Burnett fauna records	50	GDA94	1/11/1998	30/11/1998	154 Walsh River Road, Watsonville QLD
297	-17.354384	145.326851	Scott Burnett fauna records	50	GDA94	1/05/2001	30/05/2001	Walsh R Rd/Toy Creek crossing
298	-17.356725	145.330933	Scott Burnett fauna records	50	GDA94	1/05/2011	30/05/2011	Toy Creek, upper Walsh River
299	-17.357352	145.329718	Scott Burnett fauna records	50	GDA94	1/02/1999	28/02/1999	The Castle, elliot trapped on track to Toy Creek, 2/3 of the way there
300	-17.35107	145.329506	Scott Burnett fauna records	50	GDA94	15/06/2001	15/06/2001	Totorooby, Walsh River

Record No.	LATITUDE	LONGITUDE	Project_source	PRECISION (m)	Datum	START_DATE	END_DATE	LOCALITY
301	-17.380269	145.252565	Scott Burnett fauna records	50	GDA94	1/01/2010	15/06/2013	Buckley residence, Bakerville
302	55k 487580	7844579	Townsville QSN project_Burnett	15	GDA94	30/05/2010	4/06/2010	211 Mt View Rd, Toonpan
303	55k 487412	7844337	Townsville QSN project_Burnett	15	GDA94	30/05/2010	4/06/2010	211 Mt View Rd, Toonpan
304	55k 487417	7844275	Townsville QSN project_Burnett	15	GDA94	30/05/2010	4/06/2010	211 Mt View Rd, Toonpan
305	55k 487431	7844384	Townsville QSN project_Burnett	15	GDA94	30/05/2010	4/06/2010	211 Mt View Rd, Toonpan
306	55k 487514	7844493	Townsville QSN project_Burnett	15	GDA94	30/05/2010	4/06/2010	211 Mt View Rd, Toonpan