COMPLIANCE REPORT

EPBC 2011/6228

Mount Emerald Wind Farm

April 2018

MEWF

RATCH-Australia Corporation

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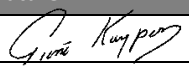
DOCUMENT STATUS

Version	Purpose of Document	Author	Review	Date
1	EPBC - Annual Compliance Report	T Johannesen	R Kuypers	12-4-2018

APPROVAL FOR ISSUE

Name	Signature	Date
Rene Kuypers		12-4-2018

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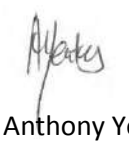
1. DECLARATION OF ACCURACY

In making this declaration, I am aware that sections 490 and 491 of the Environmental Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) make it an offence in certain circumstances to knowingly provide false or misleading information or documents. The offence is punishable on conviction by imprisonment or a fine, or both. I declare that all the information and documentation supporting this compliance report is true and correct in every particular. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:	
Full name (please print):	Anthony Yeates
Position (please print):	Director
Organisation (please print including ABN/ACN if applicable):	Mount Emerald Wind Farm Pty Ltd ACN – 149 050 322 ABN – 19 149 050 322
Date:	12 April 2018

2. PROJECT DESCRIPTION

The Mount Emerald wind farm site is a large rural allotment (Lot 7 SP235224) comprising some 2,422ha. It is located approximately 3.5km south-west of Walkamin, off Springmount Road at Arriga on the Atherton Tablelands. Topographically, the site is situated at the northern most end of the Herberton Range (part of the Great Dividing Range) with the north-western section of the site being dominated by Walsh's Bluff.

The site is characterised by rugged terrain with elevations of between 540m up to 1089m ASL (above sea level). The town centre of Mareeba is situated approximately 18km to the north of the site, with the town of Atherton approximately 12km south-east of the site.

Other features of the site include a series of ephemeral drainage lines, including the headwaters of Granite Creek. An established 275kV transmission line (Powerlink: Chalumbin-Woree) and its associated easement traverses the site in an east-west direction, broadly bisecting it.

3. PROJECT ACTIVITY STATUS

The project involves a range of activities needed to be conducted through the construction, commissioning and operation phases.

Mount Emerald wind farm is currently in the "Construction" phase of development.

The project commenced construction on the 7th February 2017. At the anniversary of this date (1 year) the construction effort is at its peak, with a wide range of activities being undertaken at various work fronts.

Key activities and their status as at the anniversary of this date are shown in the Table below.

Activity	Description	Start Date	Est. End Date	% Complete
PLQ Bench	Earthworks required to provide the cleared area needed to construct the Powerlink Substation for connection to the grid network	7-02-2017	17-08-2017	100%
PLQ Substation	Construction of the Powerlink Substation including all foundations, cabling and infrastructure necessary for connection to the grid network	18-03-2017	16-05-2018	13%
Access to Substation	Civil works necessary to construct the main access road from site entry to the substation sites	3-04-2017	4-07-2017	88%
Access Roads	Civil works necessary to construct the access roads from main access road to the various wind turbine locations	10-04-2017	7-11-2017	71%
Hardstands	Civil works necessary to construct the cleared work areas to allow installation, adjacent to each of the wind turbine locations	10-04-2017	7-11-2017	78%
Component Delivery	Delivery from Port to the wind farm site for the wind turbine components – tower sections, nacelle, blades, rotor, nose cone, transformer and controls	29-05-2017	6-08-2018	46%

Activity	Description	Start Date	Est. End Date	% Complete
WF Substation	Construction of the Wind Farm Substation including all foundations, cabling and infrastructure necessary for connection of the wind farm underground HV reticulation to the Powerlink Substation	1-06-2017	28-05-2018	30%
HV Reticulation	Installation of underground electrical cabling which connects each wind turbine to the WF Substation	8-06-2017	21-05-2018	31%
Foundations	Construction of wind turbine foundations including excavation, preparation, placement of reinforcing, placement of concrete and backfilling	6-07-2017	13-12-2017	82%
WTG Installation	Installation and erection of the wind turbines on the foundation	24-10-2017	23-08-2018	28%
WTG Commissioning	Preparation and testing of each completed wind turbine to ensure it is mechanically and electrically sound and in full operational order	9-06-2018	27-09-2018	0%

4. COMPLIANCE TABLE

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
General				
1	The action is limited to the construction of a maximum of 63 wind turbines and associated infrastructure on the wind farm site	Max. 63 WTG	COMPLIANT	For Construction layout comprises 53 WTG. As verified by TLDFP. (Attachment 1)
2	To minimise impacts to EPBC Act listed threatened species, the approval holder must not disturb more than 78 ha of habitat for EPBC Act listed threatened species on the wind farm site	Max. 78ha of disturbed area	COMPLIANT	ONGOING Refer to Ground Disturbance Tracking. (Attachment 2)
3	Prior to commencement of the action, the approval holder must submit a Turbine Location and Development Footprint Plan identifying the final position of all proposed turbines, access roads and associated operational and maintenance infrastructure, for the written approval of the Minister	Turbine Location and Development Footprint Plan (TLDFP)	COMPLIANT	Approval received 18/1/17. (Attachment 3) TLDFP sent to DOEE 13/01/2017 TLDFP (Attachment 1)
4	The Turbine Location and Development Footprint Plan must demonstrate how the approval holder has avoided and minimised disturbance to denning habitat for the Northern Quoll (Dasyurus hallucatus) and to *Grevillea glossadenia* and *Homoranthus porteri*.	Turbine Location and Development Footprint Plan (TLDFP)	COMPLIANT	Approval received 18/1/2017 (Attachment 3) Documents sent to DOEE 13/01/2017 TLDFP shows locations of plant species (Attachment 1) Refer to Design Justification Report (Attachment 4)
5	The approval holder must not commence the action until the Turbine Location and Development Footprint Plan has been approved by the Minister in writing.	Minister Sign-off	COMPLIANT	Approval of TLDFP received 18/1/2017. (Attachment 3) Date of Commencement 7/2/2017.
6	The Turbine Location and Development Footprint Plan must be implemented	Turbine Location and Development Footprint Plan (TLDFP)	COMPLIANT	Construction is occurring in-line with TLDFP

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
Northern Quoll Management				
7	For the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site.	Northern Quoll population ~50		Current estimate of population remains as per previous study.
8	The approval holder must prepare and submit an Outcomes Strategy for the Minister's written approval which describes a monitoring program to inform adaptive management and determine whether the outcome required under condition 7 is being or has been met. The Outcomes Strategy must: (a) be prepared by a suitably qualified expert; (b) identify and justify performance measures, which are capable of accurate and reliable measurement, and will be used to measure the outcome required under condition 7; (c) include a monitoring program, to detect changes in the performance measures. The monitoring must include baseline surveys, control sites and experimental design (to test the effectiveness of different management measures); and (d) describe how the baseline and monitoring data will be adequate to: inform adaptive management; enable an objective decision to be made on whether the outcome described in condition 7 has been met.	Northern Quoll Outcomes Strategy (NQOS)	COMPLIANT	Approval received 23/12/16. (Attachment 6) NQOS submitted 7/12/2016. (Attachment 5) Comments received from DOEE 28/11/2016. NQOS Draft sent to DOEE 27/9/2016.
9	The approval holder must not commence construction until the Minister has approved the Outcomes Strategy in writing.	Minister Sign-off	COMPLIANT	Approval received 23/12/2016 (Attachment 6)
10	The approved Outcomes Strategy must be implemented.		COMPLIANT	All Survey Results have been posted to Project WEBSITE. ***www.mtemeraldwindfarm.com.au/compliance/*** QOS Survey Results (Attachment 7)

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
11	If the Minister is not satisfied that either the outcomes required under condition 7 are likely to be achieved, or there is insufficient evidence that the outcomes required under condition 7 are being achieved, the Minister may (in writing) require the approval holder to submit a plan for the Minister's approval to reduce, mitigate, remediate, or offset impacts to matters protected under the controlling provisions of this approval within a designated timeframe. The Minister may require the plan be prepared or reviewed by a suitably qualified person or another person specified or agreed to by the Minister. If the Minister approves the plan then the approved plan must be implemented.	Northern Quoll Mitigation Plan	NOT APPLICABLE	Not required at this time.
Bare-rumped Sheathtail Bat and Spectacled Flying-fox Management				
12	Prior to commissioning, the approval holder must evaluate the effectiveness of suitable measures, including changed cut-in speed, avian radar system and SCADA system, to avoid and mitigate the impacts of turbine collision to Spectacled Flying-fox (*Pteropus conspicillatus*) and Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*) on the wind farm site.	Evaluation of Potential Measures to Reduce Turbine Collision	COMPLIANT	Email from DoEE confirming requirements met - 2/6/2017 (Attachment 9) Report provided to DoEE 5/5/2017. (Attachment 8)
13	Prior to commissioning, the approval holder must submit to the Minister for written approval, a Wind Farm Implementation Plan that is informed by the results of the evaluation required by condition 12. The Wind Farm Implementation Plan must include: (a) details of intended outcomes and measurable performance criteria for the Spectacled Flying-fox and Bare-rumped Sheathtail Bat which are based on information contained in relevant guidance material including;	Wind Farm Implementation Plan (WFIP)	In PROGRESS	PREPARING for SUBMISSION DoEE provided comment on DRAFT 16/1/2018. DRAFT WFIP provided to DoEE 18/12/2017.

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
	- Matters of National Environmental Significance: Significant Impact Guidelines 1.1 Environmental Protection and Biodiversity Conservation Act 1999 (2013); *- EPBC Act Policy Statement 2.3 Wind Farm Industry (2009); and* *- Draft Referral Guideline for 14 birds listed as migratory species under the EPBC Act (2015).* (aa) a program to implement a *Low Windspeed Curtailment Study*; (b) a program to monitor the effectiveness of progress against performance criteria; and (c) contingency measures and corrective actions that will be implemented if performance criteria are not being or are not likely to be met.			
14	The Wind Farm Implementation Plan must be reviewed by a suitably qualified expert prior to submission to the Minister for approval. The Wind Farm Implementation Plan must include the findings of the review undertaken by the suitably qualified expert and details of how any recommendations made by the suitably qualified expert have been addressed.	Wind Farm Implementation Plan Review (WFIP)	In PROGRESS	PREPARING for SUBMISSION Review and Confirmation Letter provided to DoEE 18/12/2017. Submitted with WFIP for Review.
15	The approval holder must not commission the wind farm until the Wind Farm Implementation Plan has been approved by the Minister in writing.	Minister Sign-off		
16	The approved Wind Farm Implementation Plan must be implemented.			

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
17	Upon the direction of the Minister, the approval holder must cease to operate any specified wind turbine generator/s if the Minister considers that, based on compliance reporting required by condition 26, they are having an impact on Bare-rumped Sheathtail Bat and Spectacled Flying-fox greater than the performance criteria required by condition 13(a) that cannot be mitigated or compensated.	Operational Strategy		
Offsets				
18	To compensate for residual significant impacts to EPBC Act listed threatened species, the approval holder must provide environmental offsets that comply with the principles of the EPBC Act Environmental Offsets Policy.	Offset Area Management Plan (OAMP)	COMPLIANT	Approval of OAMP provided 20/12/2016 (Attachment 11) Response and final OAMP submitted 16/12/2016. (Attachment 10) Comments received from DOEE 5/12/2016. Draft OAMP sent to DOEE 17/10/2016.

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
19	The approval holder must prepare and submit an Offset Management Plan to the Minister for approval in writing . The Offset Management Plan must include: (a) details of the minimum offset areas proposed to compensate for the loss of habitat for EPBC Act listed threatened species from the wind farm site, (b) information about how the offset area/s provide connectivity with other relevant habitats and biodiversity corridors, including a map depicting the offset areas in relation to other habitats and biodiversity corridors; (c) a description of the management measures that will be implemented on the offset site for the protection and management of habitat for EPBC Act listed threatened species, including a discussion of how measures proposed are consistent with the measures in conservation advice, recovery plans and relevant threat abatement plans; (d) performance and completion criteria for evaluating the management of the offset area/s, and criteria for triggering remedial action (if necessary); (e) a program, including timelines to monitor and report on the effectiveness of these measures, and progress against the performance and completion criteria; (f) a description of potential risks to the successful implementation of the plan, and a description of the contingency measures that would be implemented to mitigate against these risks; (g) the proposed legal mechanism and timelines for securing the offset/s; and (h) a textual description and map to clearly define the location and boundaries of the offset area. This must be accompanied with the offset attributes and a shapefile.	Offset Area Management Plan (OAMP)	COMPLIANT	Approval of OAMP provided 20/12/2016 (Attachment 11) Response and final OAMP submitted 16/12/2016. (Attachment 10) Comments received from DOEE 5/12/2016. Draft OAMP sent to DOEE 17/10/2016.

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
20	The approval holder must not commence construction until the Offset Management Plan has been approved by the Minister in writing.	Minister Sign-off	COMPLIANT	Approval of OAMP provided 20/12/2016 (Attachment 11)
21	The approved Offset Management Plan must be implemented			
Administrative Conditions				
22	To avoid duplication, the approval holder may provide the Minister with plans and strategies prepared for the State and/or an Authority provided the plans, and/or strategies meets the conditions specified in this approval. The plans and/or strategies must include a cross reference table that clearly identifies: (a) the condition specified in the approval for which the plan or strategy is being provided; and (b) the relevant folder, chapter, section number and page number in the plan or strategy where the condition has been addressed.		NOT APPLICABLE	Plans and Strategies have been provided to directly address conditions of this approval.
23	Within 10 business days after the commencement of the action, the approval holder must advise the Department in writing of the actual date of commencement.	Notification of Commencement of Construction	COMPLIANT	Date of Commencement 7 February 2017. Notice provided 13/2/2017 (Attachment 12) and acknowledged. (Attachment 13)

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
24	The approval holder must maintain a dedicated webpage on compliance with these conditions that is publically available on the approval holder's website for the life of the approval. The webpage must include: • a copy of the approval conditions (and any subsequent variations or other formal changes to the approval); • all monitoring results and • documentation required under these conditions and any other relevant information as directed by the Minister in writing. Unless otherwise agreed to in writing by the Minister, the approval holder must provide a copy of documents required to be published on the dedicated webpage to members of the public upon request, within a reasonable time of the request.	Website	COMPLIANT	EPBC Decision Notice and Conditions placed on website. **www.mtemeraldwindfarm.com.au/compliance/**
25	The approval holder must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement any plans and strategies required by this approval and measures taken to achieve the outcomes specified in conditions 7 and 13 and make them available upon request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	File management		

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
26	Within three months of every 12 month anniversary of the commencement of the action, the approval holder must publish a report on the webpage required in condition 24 addressing compliance with each of the conditions of this approval, including implementation of any plans and strategies as specified in these conditions and whether the outcome required by conditions 7 and 13 have been or are track to being met. The compliance report must consider the Department's Annual Compliance Report Guidelines. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the Department at the same time as the compliance report is published.	EIS Complaince Report	COMPLIANT	Date of Commencement 7 February 2017. Initial Compliance Report required by 7 May 2018.
27	The approval holder must report any contravention of the conditions of this approval to the Department within 2 business days of the approval holder becoming aware of the contravention.	Notification of Contravention	COMPLIANT	No contravention identified.
28	Upon the direction of the Minister, the approval holder must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The audit must not commence until the Minister has approved the independent auditor and audit criteria. The audit report must address the criteria to the satisfaction of the Minister.	Independent Audit	NOT APPLICABLE	No direction from Minister at this time.

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
29	The approval holder may choose to revise a plan or strategy approved by the Minister under conditions 3, 8, 13 and 19 without submitting it for approval under section 143A of the EPBC Act, if the taking of the action in accordance with the revised plan or strategy would not be likely to have a new or increased impact. If the approval holder makes this choice they must: (a) notify the Department in writing that the approved plan or strategy has been revised and provide the Department with an electronic copy of the revised plan or strategy; (b) implement the revised plan or strategy from the date that the plan or strategy is submitted to the Department; and (c) for the life of this approval, maintain a record of the reasons the approval holder considers that taking the action in accordance with the revised plan or strategy would not be likely to have a new or increased impact.	Revised Plans: #3 - Turbine Location and Development Footprint Plan #8 - Northern Quoll Outcomes Strategy #13 - Wind Farm Implementation Plan #19 - Offset Area Management Plan	NOT APPLICABLE	TLDFP submitted 13/1/2017; approved 18/1/2017 NQOS submitted 7/12/2016; approved 23/12/2016 WFIP submitted (to be advised) OAMP submitted 16/12/2016; approved 20/12/2016 No revisions made at this time.
30	The approval holder may revoke its choice under condition 29 at any time by notice to the Department. If the approval holder revokes the choice to implement a revised plan without approval under section 143A of the Act, the approval holder must implement the version of the plan most recently approved by the Minister.	Revised Plans	NOT APPLICABLE	No revisions made at this time.
31	Condition 29 does not apply if the revisions to the approved plan or strategy include changes to environmental offsets provided under the plan or strategy in relation to a matter protected by a controlling provision for the action, unless otherwise agreed in writing by the Minister. This does not otherwise limit the circumstances in which the taking of the action in accordance with a revised plan or strategy would, or would not, be likely to have new or increased impacts.	Revised Plans	NOT APPLICABLE	No revisions made at this time.

No.	CONDITION	DELIVERABLE	DESIGNATION	CURRENT STATUS
32	If the Minister gives a notice to the approval holder that the Minister is satisfied that the taking of the action in accordance with the revised plan would be likely to have a new or increased impact, then: (a) condition 29 does not apply, or ceases to apply, in relation to the revised plan; and (b) the approval holder must implement the version of the plan most recently approved by the Minister. To avoid any doubt, this condition does not affect any operation of conditions 29 and 30 in the period before the day after the notice is given.	Revised Plans	NOT APPLICABLE	No revisions made at this time.
33	At the time of giving a notice under condition 32, the Minister may also notify that for a specified period of time condition 29 does not apply for one or more specified plans required under the approval.	Revised Plans	NOT APPLICABLE	No revisions made at this time.
34	Conditions 29, 30, 31 and 32 are not intended to limit the operation of section 143A of the EPBC Act which allows the approval holder to submit a revised plan to the Minister for approval.	Revised Plans	NOT APPLICABLE	No revisions made at this time.
35	If, at any time after five years from the date of this approval, the approval holder has not substantially commenced the action, then the approval holder must not commence the action without the written agreement of the Minister.	Drop Dead Date - 26 November 2020	COMPLIANT	Refer to Condition 23.

A. TURBINE LOCATION AND DEVELOPMENT FOOTPRINT PLAN

B. DISTURBANCE AREA TRACKING

C. APPROVAL OF TURBINE LOCATION AND DEVELOPMENT FOOTPRINT PLAN

D. DESIGN JUSTIFICATION REPORT

E. NORTHERN QUOLL OUTCOMES STRATEGY

F. APPROVAL OF NORTHERN QUOLL OUTCOMES STRATEGY

G. NORTHERN QUOLL OUTCOMES STRATEGY – SURVEY RESULTS

H. WIND FARM IMPLEMENTATION PLAN – EFFECTIVENESS REPORT

I. APPROVAL OF WIND FARM IMPLEMENTATION PLAN – EFFECTIVENESS REPORT

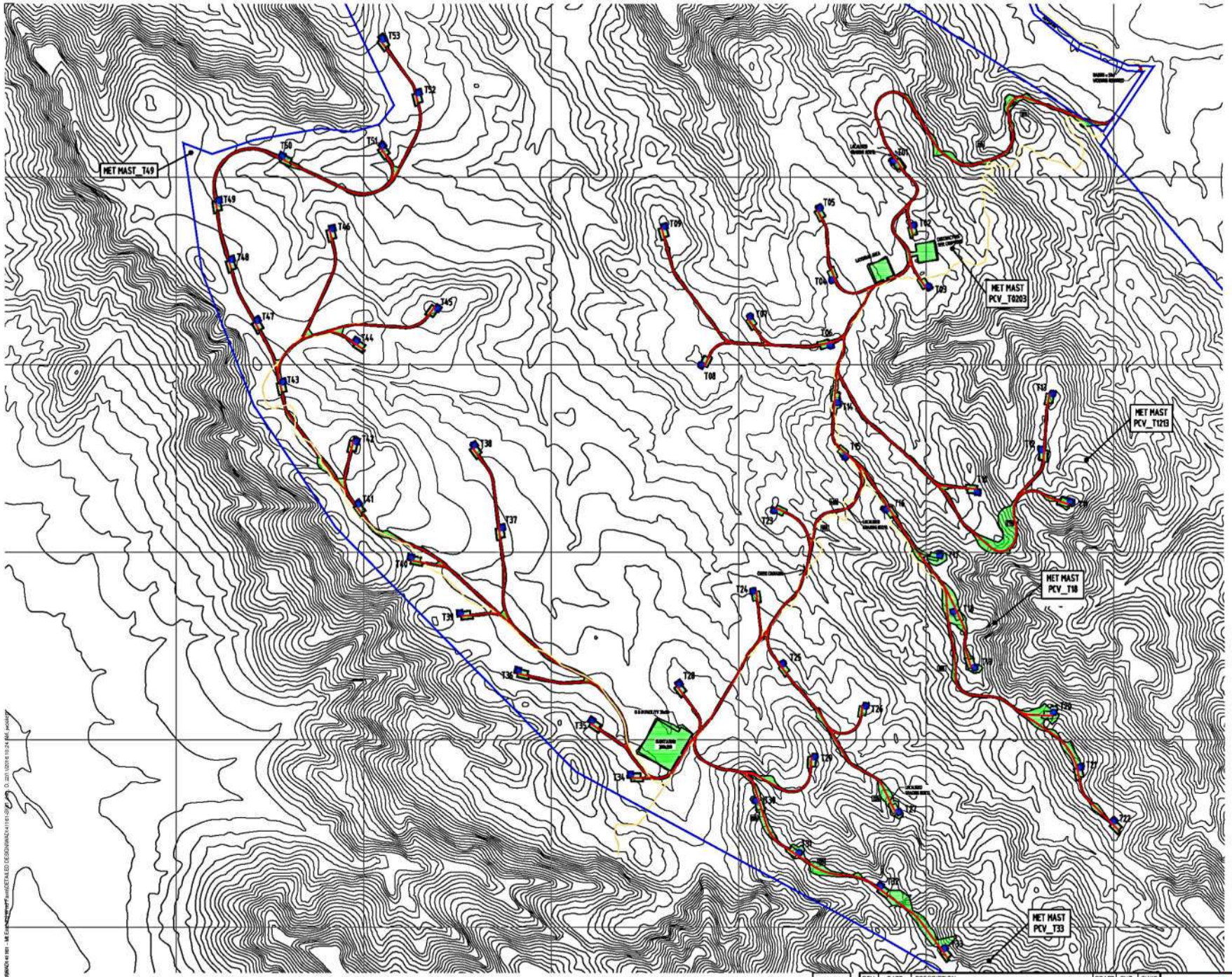
J. OFFSET AREA MANAGEMENT PLAN

K. APPROVAL OF OFFSET AREA MANAGEMENT PLAN

L. DATE OF COMMENCEMENT NOTIFICATION

M. ACKNOWLEDGEMENT OF DATE OF COMMENCEMENT

A. TURBINE LOCATION AND DEVELOPMENT FOOTPRINT PLAN



LEGEND

- T01 PROPOSED TURBINE LOCATION
- PROPOSED WIND FARM ROAD
- 10m CONTOUR
- EXISTING ROADS
- PROPOSED BATTER EXTENTS (1 IN 2 BATTERS)

NOTE:

CONCEPT LAYOUT BASED ON 10m CONTOUR DATA ONLY
AREA OF PROPOSED BATTER EXTENTS = 71.8 HECTARES

TURBINE COORDINATES

T01	E. 328792	N. 8102560
T02	E. 328903	N. 8102219
T03	E. 328983	N. 8101892
T04	E. 328466	N. 8101926
T05	E. 328402	N. 8102310
T06	E. 328458	N. 8101575
T07	E. 328031	N. 8101732
T08	E. 327768	N. 8101672
T09	E. 327574	N. 8102211
T10	E. 329242	N. 8100793
T11	E. 329738	N. 8100745
T12	E. 329581	N. 8101021
T13	E. 329644	N. 8101320
T14	E. 328498	N. 8101272
T15	E. 328537	N. 8100981
T16	E. 328753	N. 8100703
T17	E. 329043	N. 8100457
T18	E. 329113	N. 8100157
T19	E. 329228	N. 8099859
T20	E. 329448	N. 8099620
T21	E. 329790	N. 8099328
T22	E. 329970	N. 8099041
T23	E. 328157	N. 8100695
T24	E. 328045	N. 8100267
T25	E. 328206	N. 8099881
T26	E. 328648	N. 8099655
T27	E. 328824	N. 8099088
T28	E. 327652	N. 8099773
T29	E. 328376	N. 8099384
T30	E. 328058	N. 8099149
T31	E. 328292	N. 8098872
T32	E. 328726	N. 8098695
T33	E. 329067	N. 8098362
T34	E. 327392	N. 8099290
T35	E. 327187	N. 8099577
T36	E. 326793	N. 8099845
T37	E. 326708	N. 8100606
T38	E. 326556	N. 8101046
T39	E. 326484	N. 8100150
T40	E. 326222	N. 8100448
T41	E. 325941	N. 8100734
T42	E. 325931	N. 8101065
T43	E. 325539	N. 8101383
T44	E. 325930	N. 8101603
T45	E. 326364	N. 8101775
T46	E. 325803	N. 8102201
T47	E. 325402	N. 8101713
T48	E. 325266	N. 8102037
T49	E. 325197	N. 8102351
T50	E. 325535	N. 8102589
T51	E. 326071	N. 8102642
T52	E. 326263	N. 8102926
T53	E. 326071	N. 8103211

When sheet printed full size, the scale bar is 100mm.

0 50 100mm

200 100 0 200 400
SCALE 1:10000

INFORMATION ISSUE
NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION	DRAFT	ENG.	CHKD
A	06.10.16	CONCEPT INFORMATION ISSUE	BJH	RB	
B	17.11.16	TURBINES RENUMBERED	JM	RB	
C	21.11.16	REVISED TURBINE NUMBERING AND MET MAST LOCATIONS	JM	RB	
D	22.11.16	REVISED TURBINE NUMBERING	JM	RB	

W&G
WALLBRIDGE GILBERT
Consulting Engineers

MT EMERALD WIND FARM

TURBINE LOCATION AND DEVELOPMENT FOOTPRINT PLAN (TLDFP)

A1

DRAWING NUMBER
WAD141161 SK01D

Des'r BJH
Drn BJH

B. DISTURBANCE AREA TRACKING

Ground Disturbance As-con - Tracking Sheet - 22 MAR 2018

ROAD	DESIGN AREA (ha)	DESIGN AREA TO DATE (ha)	Total lenth	Cleared length	Additional areas (Ha)	AS-CON (ha)	CLEARING STATUS	LAST ACTIVITY DATE	THIS WEEK ACTIVITY	COMMENTS
KIPPEN DRIVE	0.24	0.24				0.32	completed	29-September-2017		Completed
ENTRY ROAD - Package 1A	3.77	3.36				3.45	completed	19-October-2017		Milsearch survey data utilized for calculation of batter and over spill
MAIN SITE ROAD	7.52	6.99				5.38	completed	12-December-2017		Including hardstand T14 and T15. Including roads and hardstand T23, T24 & T28. Includes MEWF access road.
SITE ROAD T01	1.57	1.57	652.51	652.51		1.07	ongoing	19-October-2017		remain area for Blade Pad WTG1
SITE ROAD T03	0.57	0.57	184.42	184.42		0.39	completed	09-September-2017		Including hardstand
SITE ROAD T05	1.32	1.32	682.80	682.80		1.05	completed	09-September-2017		Including hardstand T04
SITE ROAD T09	3.40	3.40	1823.00	1823.00		2.42	completed	09-September-2017		Including roads & hardstands T06, T07, T08 and T09 - completed
SITE ROAD T13	6.73	6.73	2895.55	2895.55		5.16	ongoing	21-February-2018	AR T13 additional area at "ski jump" for road widening	Including hardstand T10, T11, T12 & T13
SITE ROAD T22	7.35	7.35	3011.63	3011.63		5.42	ongoing	26-February-2018	Clear to drill and widen the road between WTG19 and WTG20	Including roads & hardstands T16, T17, T18, T21 and T22
SITE ROAD T33	5.86	5.86	2398.56	2398.56		3.71	ongoing	**22-March-2018**	**Road WTG32 to WTG33 + WTG33**	Including roads & hardstands T30, T31 & T32
SITE ROAD T27	5.76	5.76	2152.58	2152.58		3.01	ongoing	08-February-2018		Including roads & hardstands T25, 26 & 27
SITE ROAD T53	21.94	21.94	9974.78	9974.78		16.58	ongoing	07-March-2018	WTG46, 48,47 Hard stand - batter clearance	Including roads & hardstands T34 through T53 + CPP new cables corridor)
upper compound/spoil area A	1.13	1.13				0.95	completed	09-September-2017		no batter allowance or offset inlcuded
MEWF substation pad	1.85	1.85				1.65	ongoing	30-November-2017		includes O&M facility (no o&m batters)
PLQ substation pad	2.85	2.85				2.56	completed	09-September-2017		
upper compound B	0.64	1.10				0.88	completed	09-September-2017		80 X 80m pad (no batters or offsets included)
crushing area WTG28	1.00	1.00				1.00	completed	09-September-2017		
Lower compound										
PLQ						0.78	ongoing	11-November-2017		Including the laydown area in front of the MEWF bench
METmast Track WTG34 to Cross Roads						0.73	completed			As measured by Paul McDonald
CPP additional cables corridor					**0.00**					
WTG43 - WTG53	1.50				1.50	1.99	completed	20-December-2017		
WTG40 - WTG43	0.60				0.60	0.68	completed	21-November-2017		
MAR - WTG39	1.09				1.09	2.36	completed	12-December-2017		As measured by Paul McDonald
Along main access road						**0.42**	completed	24-January-2018		Additional cable alignment beside the main road
JB5/2 - Batching Plant	0.28	0.28				0.28	completed	31-January-2018		MEWF-CPP-003
Batching - WTG14	0.22	0.22				0.22	completed	31-January-2018		MEWF-CPP-003
WTG06 - WTG14	0.21	0.21				0.21	completed	31-January-2018		MEWF-CPP-003
WTG14	0.07	0.07				0.07	completed	31-January-2018		MEWF-CPP-003
WTG23-WTG25 Intersection	1.80	1.80				1.80	completed	31-January-2018		MEWF-CPP-003
WTG24-WTG28	1.26	1.26				1.26	completed	31-January-2018		MEWF-CPP-003
WTG28 Intersection - SUB	0.28	0.28				0.28	completed	31-January-2018		MEWF-CPP-003
Additional lay down areas						2.12	completed			
Met Mast						0.92	ongoing			
Existing PLQ track being built over (offset)	-1.16	-0.93				-0.93	completed	16-September-2017		4m width utilised for calculation
Running total	**79.64**	**76.20**				**68.15**				

C. APPROVAL OF TURBINE LOCATION AND DEVELOPMENT FOOTPRINT PLAN

Australian Government
Department of the Environment and Energy

Our reference: 2011/6228

Mr Terry Johannesen
Project Manager
RATCH-Australia Corporation Limited
Level 7, 111 Pacific Highway
PO BOX 1058
SYDNEY NSW 2059

Dear Mr Johannesen

EPBC 2011/6228: Mount Emerald Wind Farm Proposal, Queensland - Variation of condition 2 and approval of the Turbine Location and Development Footprint Plan

Thank you for your letter of 17 October 2016, on behalf of Mt Emerald Wind Farm Pty Ltd, seeking variation of condition 2 of EPBC approval decision 2011/6228 dated 26 November 2015, and your email of 4 January 2017, on behalf of Mt Emerald Wind Farm Pty Ltd, seeking approval of the Turbine Location and Development Footprint Plan submitted as required under condition 3 of EPBC approval decision 2011/6228 dated 26 November 2015.

Variation of Condition 2
Officers of this Department have reviewed your request for variation of Condition 2, to increase vegetation removal from 58 to 73 hectares. As a delegate of the Minister for Environment and Energy, I have agreed to vary condition 2 under section 143(1)(c) of the *Environment Protection and Biodiversity Conservation Act 1999* to enable the clearing, for turbine footprints and associated infrastructure, of 73 ha of habitat for EPBC Act listed threatened species. Condition 2 must now be undertaken in accordance with the varied condition specified in the variation notification, which has been attached for your information.

Approval of Turbine Location and Development Footprint Plan (Condition 3-6)
Officers of this Department have reviewed the *Turbine Location and Development Footprint Plan, January 2017*. As a delegate of the Minister, I have agreed to approve the *Turbine Location and Development Footprint Plan, January 2017* as meeting the requirements of conditions 3 and 4 of EPBC Approval 2011/6228.

EPBC 2011/6228 condition 29 allows you (under certain circumstances) to implement revised plans without seeking the Minister's approval. However, condition 31 precludes this option in relation to the Offset Area Management Plan. If you require any advice on whether or not to submit a revised plan for approval, please contact the officer below. When submitting any revised plan to the Minister under condition 29, please provide a 'tracked changes' version of the plan. I also attach a fact sheet providing guidance on 'new or increased impact' relating to changes to approved management plans under EPBC Act environmental approvals.

As you are aware, the Department has an active monitoring program which includes monitoring inspections, desk top document reviews and audits. Please ensure that you maintain accurate records of all activities associated with, or relevant to, the

conditions of approval so that they can be made available to the Department on request.

Should you require any further information please contact, Robin Nielsen, on 02 6274 1004 or by email: post.approvals@environment.gov.au.

Yours sincerely

Monica Collins
Assistant Secretary
Compliance & Enforcement Branch
Environment Standards Division

18 January 2017

Note: Under s 491 of the *Environment Protection and Biodiversity Conservation Act 1999* it is an offence to knowingly provide false and/or misleading information to a departmental officer.

D. DESIGN JUSTIFICATION REPORT

Mount Emerald Wind Farm

Design Justification

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REVISION STATUS

Rev	Date	Revision Details	Reviewed by	Signature	Approved by	Signature
A	4 May 17	First Draft	SD			
B	4 Aug 17	Second Draft	SD			
C	8 Dec	Third Darft	SD			
D	26 Mar 18	Fourth Draft	SD			

1 Introduction

The Mount Emerald Wind Farm design is required to follow several requirements and design approaches as set out in a number of plans including:

- Turbine Location and Development Footprint Plan
- Threatened Plant Management Plan
- Northern Quoll (Species) Management Plan
- Habitat Clearing and Management Plan
- Translocation Plan
- Rehabilitation Plan
- Offset Management Plan
- Construction Environment Management Plan (CEMP)

The design approach aims to limit impact of the project, in particular to balance impact to flora, fauna and cultural heritage items. The general approach is to avoid impact if possible. If impact is unavoidable the direct and indirect impacts are to be reduced as far as possible with preference for using already disturbed areas where available. Finally, Mitigation of impacts can be undertaken in accordance with the above plans including translocation/relocation, seed proposition, rehabilitation and securing biodiversity offsets. The following sections describe the design approach for each section of the wind farm design and how avoidance was prioritised over reduction and mitigation of impact options in balancing out the constraints on site.

At all possible locations, the following strategies were implemented to limit the impact of the project:

- Hardstands located at the end of a spur road were revised to include the drive through road inside the hardstand area which resulted in a saving of 220m^2 of ground disturbance for each applicable hardstand
- Shortening the blade laydown area allowing the blades to overhang the end of the laydown resulted in a saving of 180m^2 of ground disturbance for each applicable hardstand
- Increasing grades onto hardstands to a maximum of 20% in locations of steep terrain to reduce the amount of cut and in turn ground disturbance required to construct the road
- Increasing the maximum batter slope in cut to 2V:1H to reduce the disturbance footprint created by the batters
- Translocation of threatened species in line with the Translocation Plan
- Offset Management plan approved and to be implemented
- Implementation of the CEMP

2 Design justification

2.1.1 Basis of Oct 2016 Design – General all roads and hardstands

The original concept design was a simplistic design produced to estimate the probably extent of roadworks required for the project. The concept was based on 10m contour data and was therefore always subject to reasonable change due to the lack of accuracy of information available at the time. The road alignments were produced by triangulating the available survey and then producing slope bands to highlight steep areas of the site surrounding each turbine location. Preliminary road alignments were then 'draped' over the survey, and areas highlighted where road grades in excess of 15% were required to achieve those alignments.

Avoidance and minimisation of impacts

Limited information in terms of UXO, environmental or heritage constraints were available at this stage to evaluate in any detail.

2.2 Lower Compound and Main Access track (Lower compound to T3)

2.2.1 Basis of Jan 2017 Design

The January 2017 design required a number of changes to be made from the concept design due to the following:

- Availability of 0.5m contour data
- Vestas requirement to have a maximum of 14% (subsequently agreed to be 15%) maximum grade for access roads serving multiple turbines.
- Additional information available in regards to environmental and heritage constraints.

The Oct 2016 design highlighted areas where grades were required to be in excess of 15% to achieve that alignment, which under the current Contract is not permissible with the Vestas access road requirements. A number of alternative alignments were tested, which also needed to consider the need to minimise the road length, and cut or fill surfaces where possible, in order to also minimise or reduce any potential impact on the overall 'site disturbance' limit. The revised alignment achieves the maximum road grade requirements of 15%, and considers the constructability around building a road cutting across steep batters slopes and the need to construct this in cut.

Avoidance and minimisation of impacts

The design was optimised to:

- Provide for a compliant maximum road grade of 15% (original concept shows grades of 17% - 20%)
- Provide suitable horizontal and vertical curvature for turbine supply to site
    - More significant cuts, fills and in turn ground disturbance was required to maintain adequate horizontal and vertical curvature on the original alignment. The new alignment works with the existing terrain to produce less significant cuts resulting in less overall disturbance
- Minimise overall road length
- Avoid environmental and heritage areas where possible
- Avoidance of mortar firing positions (European Heritage)

Residual impacts managed by:

- Translocation of 2 x small populations of Plectranthus amoenus in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus
- Implementation of the CEMP

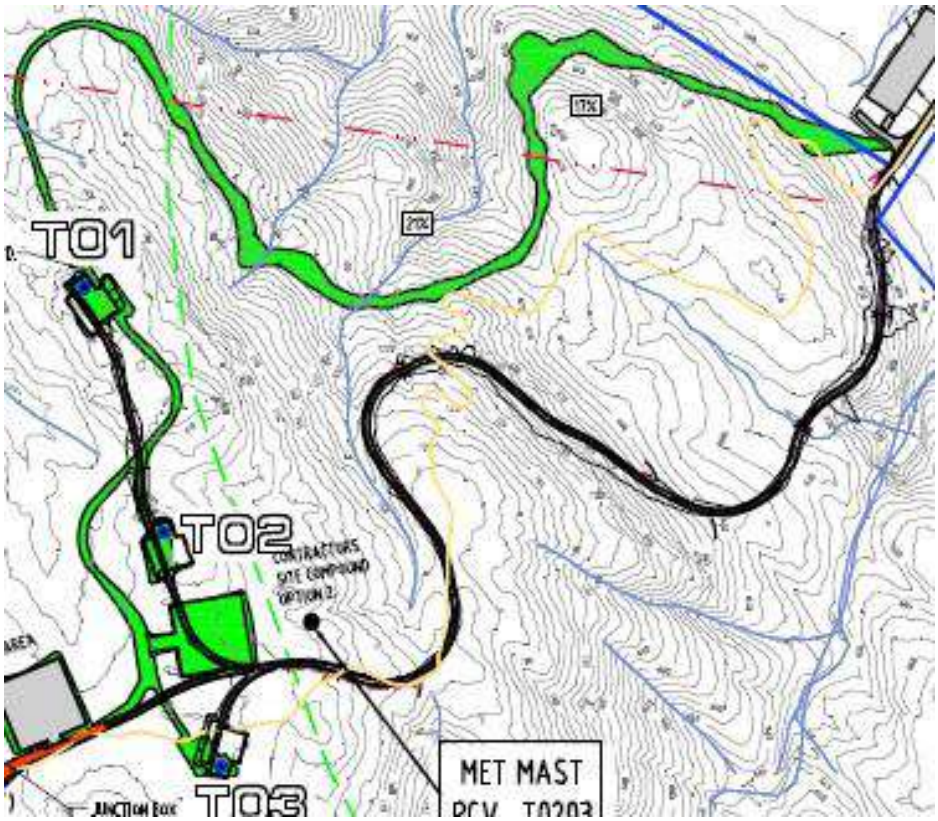


Figure 1: Final alignments to T01 to T03

2.2.2 Basis of Final Design

With the exception of a minor realignment on the main access road between chainages 1344-1482 to reduce significant cut volumes, the final design has not altered significantly from the 70% design.

2.3 Turbine 1 – 3

2.3.1 Basis of Jan 2017 Design

The road alignment to turbines 1, 2 and 3 has changed due to redesign of the main access road from Kippin Drive up the escarpment. Due to the approach direction of the revised access road, the horizontal turning radii and swept path requirements have led to more direct road leading into the hardstand areas. In addition to this, the hardstands located at the end of a spur road were revised to include the drive through road inside the hardstand area which resulted in a saving of 220m^2 of ground disturbance for 2 hardstands. The road layout has typically been aligned to follow the ridge line where possible to minimise the need for drainage which has also helped minimise ground disturbance.

2.3.2 Basis of Final Design

The final design has not altered significantly from the 70% design.

Residual impacts managed by:

- Translocation of Plectranthus amoenus in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus
- Implementation of the CEMP

2.4 Turbine 4 - 5

2.4.1 Basis of Jan 2017 Design

The road and hardstand layout for turbines 4 to 5 were originally revised from the Oct 2016 design based on the more detailed contour data with the aim to minimise cut, fill and site disturbance.

2.4.2 Basis of Final Design

To align with pre-construction surveys already completed on site, the final design has been altered so that the alignment matches the concept design as far as practical. The hardstands located at the end of a spur road were revised to include the drive through road inside the hardstand area which resulted in a saving of 220m^2 of ground disturbance for one hardstand.

2.5 Turbine 6 – 9

2.5.1 Basis of Jan 2017 Design

The road and hardstand layout for turbines 6 to 9 were originally revised from the Oct 2016 design based on the more detailed contour data with the aim to minimise cut, fill and site disturbance.

2.5.2 Basis of Final Design

To align with pre-construction surveys already completed on site, the final design has been altered so that the alignment matches the concept design as far as practical. The hardstands located at the end of a spur road were revised to include the drive through road inside the hardstand area which resulted in a saving of 220m^2 of ground disturbance for 3 hardstands.

Residual impacts at WTG 07 site managed by:

- Translocation of Homoranthus porter in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus
- Implementation of CEMP

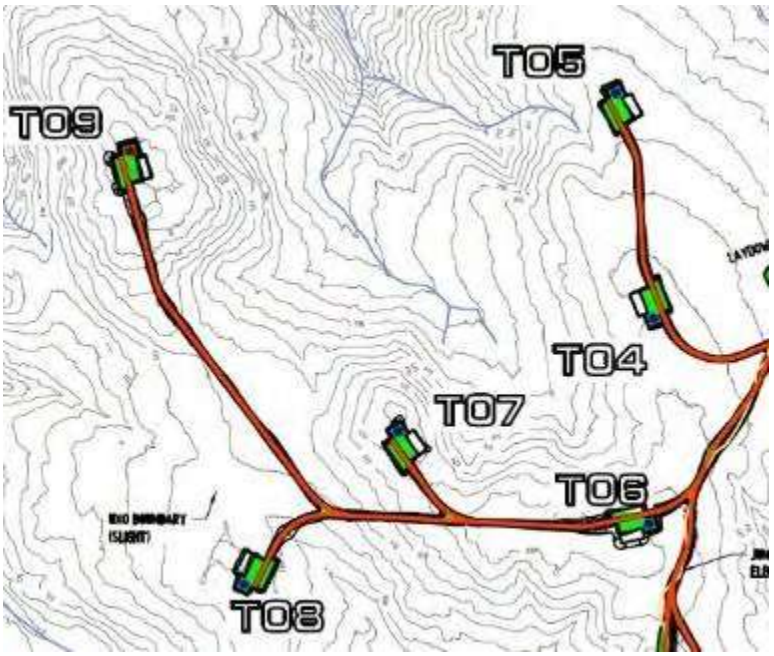


Figure 2: Final alignments to T04 to T09

2.6 Turbine 10-13

2.6.1 Basis of Jan 2017 Design

The road and hardstand layout for turbine numbers 10 -13 was based on the original concept design which was produced with limited survey and constraint data. The concept did show extensive areas of disturbance.

2.6.2 Basis of Final Design

The final design has been based on the advice from CATCON through Vestas, that where necessary, the grades of the roads can be increased to 18%, particularly at single turbine end spurs, or locally on a main line if absolutely necessary. This section of the wind farm has some particular challenges, such as the location of Turbine 11 and a significant steep sided gully that needs to be crossed to get from Turbine 10 across to Turbine 11 and 12. With the availability of more detailed survey information the road alignment needed to be adjusted significantly to get across to Turbines 11 and 12 with a maximum grade of 15%. Access to Turbine 11 is also difficult as it is on the top of a steep sided hill. Access to Turbine 11 could only be reasonably achieved by adopting an approach gradient of 18% to the hardstand. There were some areas of significant vegetation that also needed to be avoided, which the design has aimed to do where possible, noting it is impossible to do this as the turbine and hardstand locations as turbines are fixed and the space required for the hardstands requiring significant cuts to be made at these locations. The new design also avoids a heritage exclusion zone that was previously impacted (Cycads) and avoids a known population of Prostanthera clotterniana.

Residual impacts at WTG 12 and 13 site managed by:

- Translocation of 2 x populations of Grevillea glossadenia in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus
- Implementation of CEMP

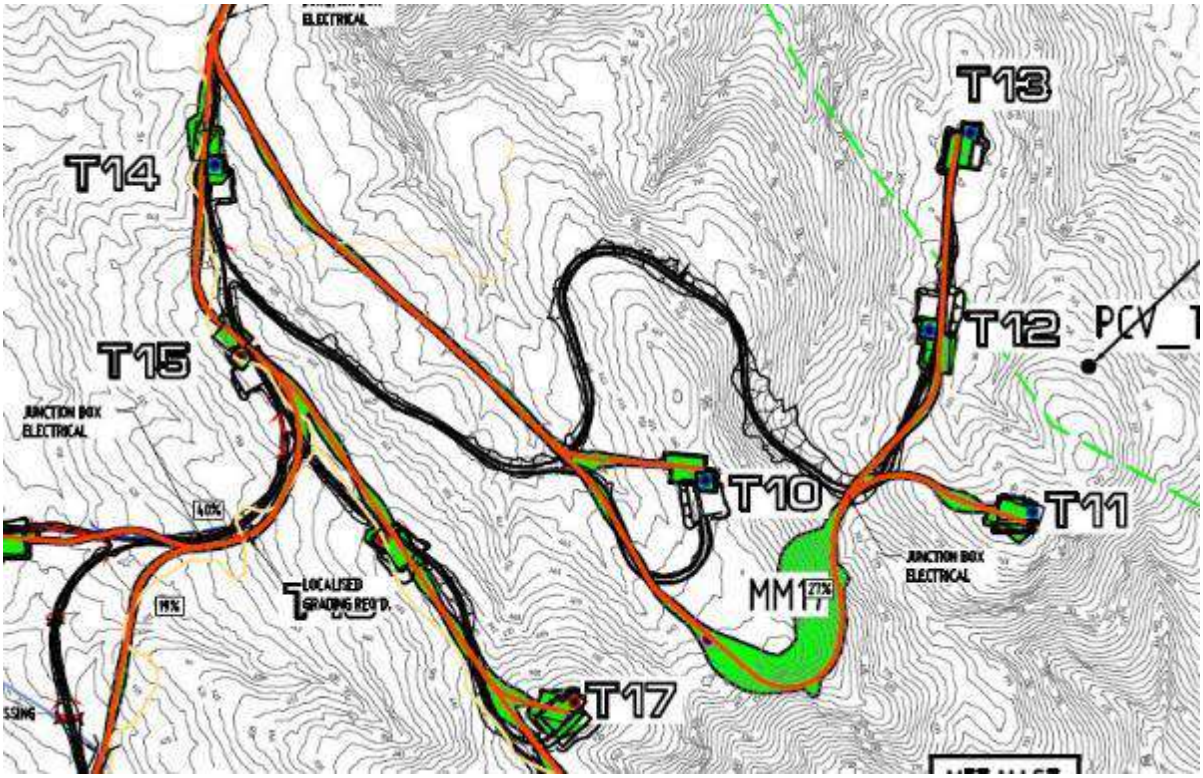


Figure 3: Final alignments to T10 to T13

2.7 Turbine 14 - 15

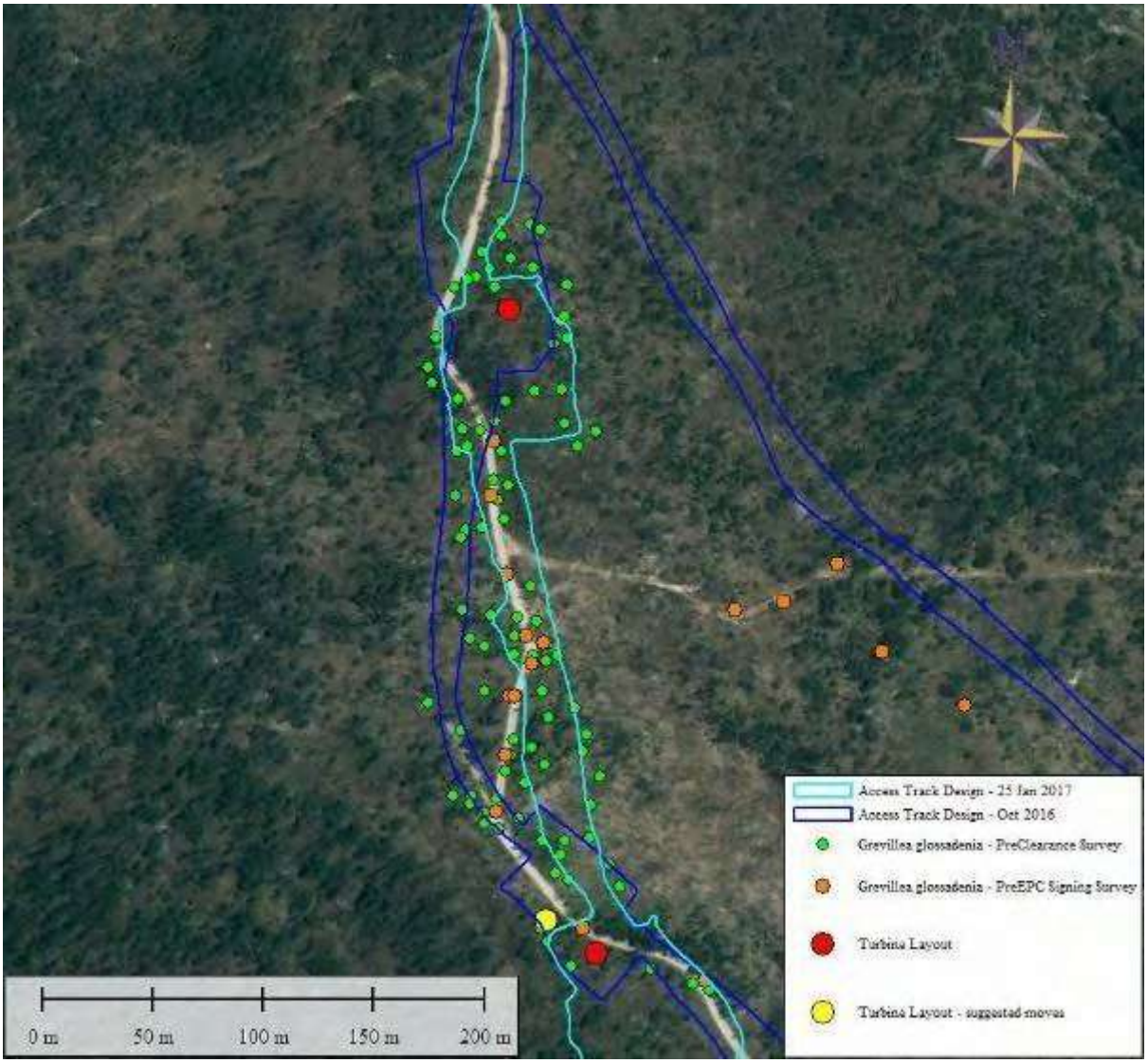


Figure 4: Design iterations with constraints for T14 and T15 (including hardstand and access track)

2.7.1 Basis of October 2016

Turbines locations are as per the approval. Design of interconnecting tracks and hardstands are in accordance with Vestas Transport requirements to allow over weight and over length turbine components to be delivered to site. The necessitates road to reasonably directly link up turbine locations generally in accordance with the approved plans and considering available information about the site including terrain data (to determine constructability) and other constraints that exist in the relevant area of the site such as Protected Plant locations.

Avoidance and minimisation of impacts

- Design carried out to avoid GG as best possible (orange locations).
- Hardstands oriented to minimise cut and hence disturbance as a higher responsibility that protection of GG.
- Consideration given to reducing overall clearance areas as best possible to preserve Quoll habitat as required under approvals.

- Other detailed site surveys in addition to that included in the Development Application from heritage, UXO, geotech etc. yet to be undertaken.

2.7.2 Basis of Jan 2017 design

Turbine locations and transport requirements remain unchanged. New and more accurate terrain information and geotechnical data has been used to refine this design.

- Design of access track realigned to follow existing track to a greater extent. This concentrates impacts to a single corridor that is already disturbed and limits the overall clearance area of Quoll habitat.
- More accurate terrain data has been used to better locate the road to reduce earthworks required to build the road such that road extent can be minimised and road slope maintain within (and at the limit of 15%) of the Vestas Transport Manual.
- Hardstand for T15 reoriented to avoid GG locations (orange locations).
- T14 hardstand reoriented to better use the existing road (to avoid additional clearing area relevant to minimising impact to Quoll habitat).

2.7.3 Basis of March 2017 design (final design)

Transport requirements and terrain data information remain unchanged from the previous design. T15 has been moved ~15m northwest to avoid potential impact on Powerlink easement corridor (as required by Powerlink). Interconnecting road and hardstand has therefore been realigned to take account for the new location.

Avoidance and minimisation of impacts

- Road design has been refined to follow the existing road alignment for a longer distance. This allows impacted area to remain along the existing corridor and to reduce the overall clearing area and therefore impact to Quoll habitat.
- Targeted protected plant survey results based on Jan 2017 design indicate that GG is prevalent in the area (many more specimens than previously thought). Relocation of road to avoid all impact is not possible as there are a larger number of the species either side of the existing track and within areas that could reasonably be expected to locate a road diversion.
- UXO and cultural heritage items not located in this region and therefore do not impact the design.
- Terrain is steep in this area and consideration has been given in relocating the road to the maximum road slope of 15% in the Vestas Transport Manual.
- Offset Management Plan also includes management actions to preserve Quoll habitat.

Residual impacts managed by:

- Translocation of Grevillea glossadenia in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus
- Implementation of CEMP

2.8 Turbine 16 – 22

2.8.1 Basis of Jan 2017 Design

The road and hardstand layout for turbine numbers 16-22 was based on the original concept design which was produced with limited survey and constraint data and based on a maximum road grade of 15%. The concept did show extensive areas of disturbance and significant cuts and fills. The concept design was generating up to 200,000m3 of cut alone through these 7 turbines.

2.8.2 Basis of Final Design

The final design has adopted a similar alignment to the Jan 2017 design but been based on the advice from CATCON through Vestas, that where necessary, the grades of the roads can be increased to 18%, particularly at single turbine end spurs, or locally on a main line if absolutely necessary. When branching off the main access track to WTG 16 the road had to be re-aligned to avoid a PLQ transmission tower. Through consultation with Vestas a non-standard hardstand configuration was adopted at T17. This configuration resulted in a less significant cut on the eastern side of the hardstand/blade laydown area and avoided a known population of GG.

There is a short section where 18% has been adopted on a main line road, following a ridge line, and all spurs have adopted an 18% approach grade where necessary. Revising the maximum allowable grade approaching the hardstands has resulted in significantly reduced cut, fills and ultimately ground disturbance required through this challenging section of terrain. To further reduce ground disturbance, the width of the road has been incorporated into the hardstand at dead end spur locations. The revised design also avoids a known population of Melaleuca uxorum.

2.9 Turbine 23, 24, 28 and Substation

2.9.1 Basis of Jan 2017 Design

The January 2017 design was based on the concept design prepared with limited survey and constraint data.

2.9.2 Basis of Final Design

The alignments of the hardstands and approach roads to these short spurs have been altered on the basis of ensuring the approach geometry from the main access road is able to accommodate the turn path radii for heavy vehicle movements. The approaches to these 3 turbines are flatter than other areas of the site and can be achieved without the use of high approach grades and avoids some known Grevillea glossadenia.

At request of PLQ, WTG 24 was moved so that it is adequately spaced from future powerline conductors. In some areas the access track had to be realigned around existing and future PLQ infrastructure and where possible, the alignment of the current PLQ access track was utilised to reduce unnecessary ground disturbance.

In addition to these changes the PLQ Bench was moved from the West to the East side of the road to minimise the impact to a natural watercourse which was originally running through the middle of the proposed Bench.

Residual impacts managed by:

- Translocation of isolated individual Grevillea glossadenia in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus

- Implementation of CEMP

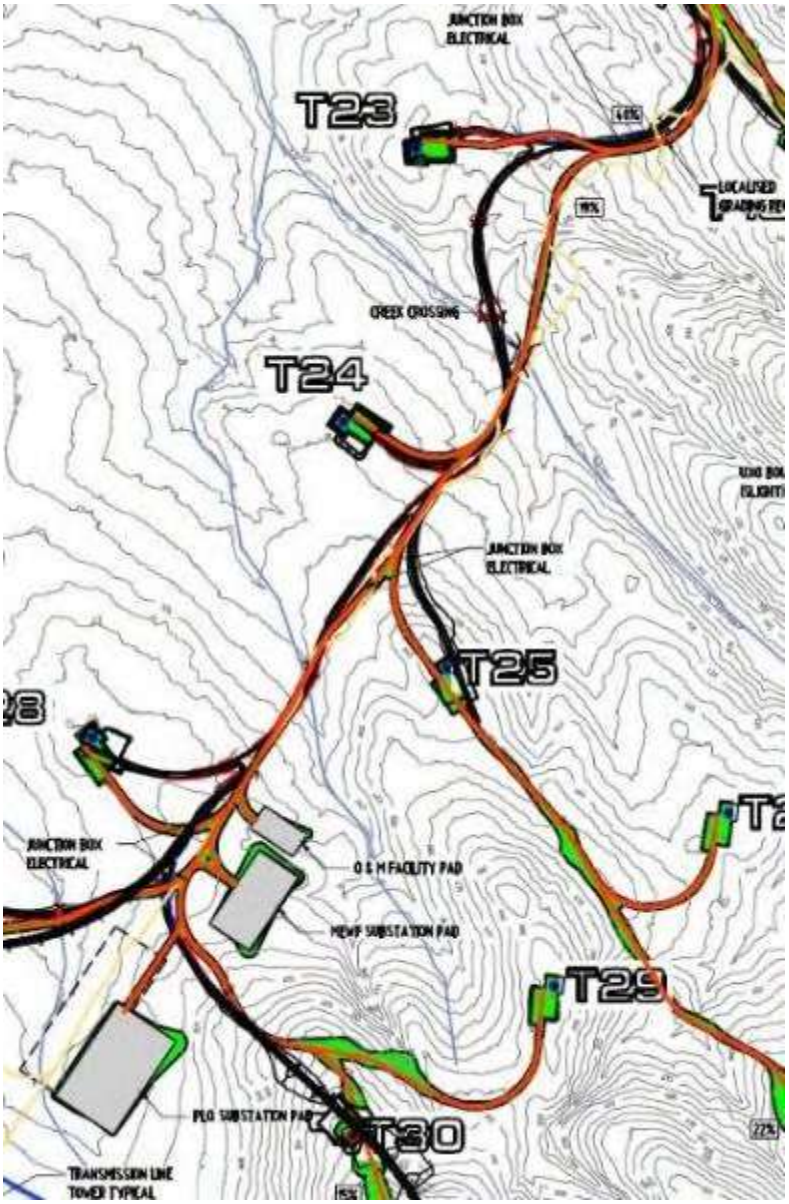


Figure 5: Final alignments to T23, T24 and T28

2.10 Turbine 25, 26, 27, 29

2.10.1 Basis of Jan 2017 Design

The January 2017 design was based on the concept design prepared with limited survey and constraint data.

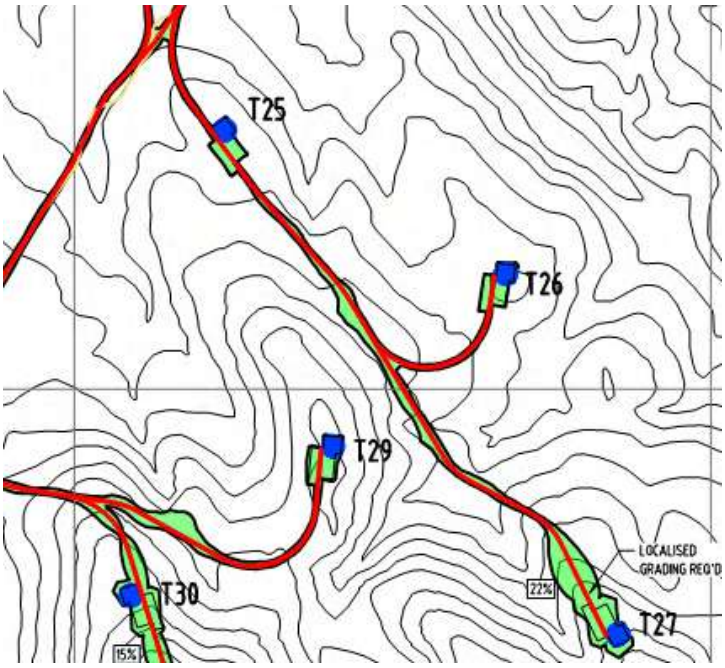


Figure 6: Original alignments to T25, T26, T27 and T29

2.10.2 Basis of Final Design

The final design has seen a number of changes in this area due to the more detailed survey revealing that the proposed connection from T30 to T29 cannot be achieved due to the steepness of the gully separating these turbines. This section of the wind farm is also particularly steep.

Through consultation with Vestas, it was determined that the final approach grades to these turbine locations could be steepened to 18-20%. Steepening the maximum allowable grade in these challenging sections has resulted in less cut, fill and in turn reduced ground disturbance.

In order to provide access to this area, the following changes were required to the design and design basis.

- T29 was accessed from T25, with access provided by following the ridge line. As a result this spur approach grade was steepened to 17-18%.
- The approach to T27 needed to be steepened to 20% to maintain Vestas vertical curve access requirements

The revised alignment removes the cable run from WTG 27- WTG 32 and WTG 29 to WTG 30 and also avoids some known Grevillea glossadenia.

Residual impacts managed by:

- Translocation of isolated individuals of Grevillea glossadenia in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus

- Implementation of CEMP

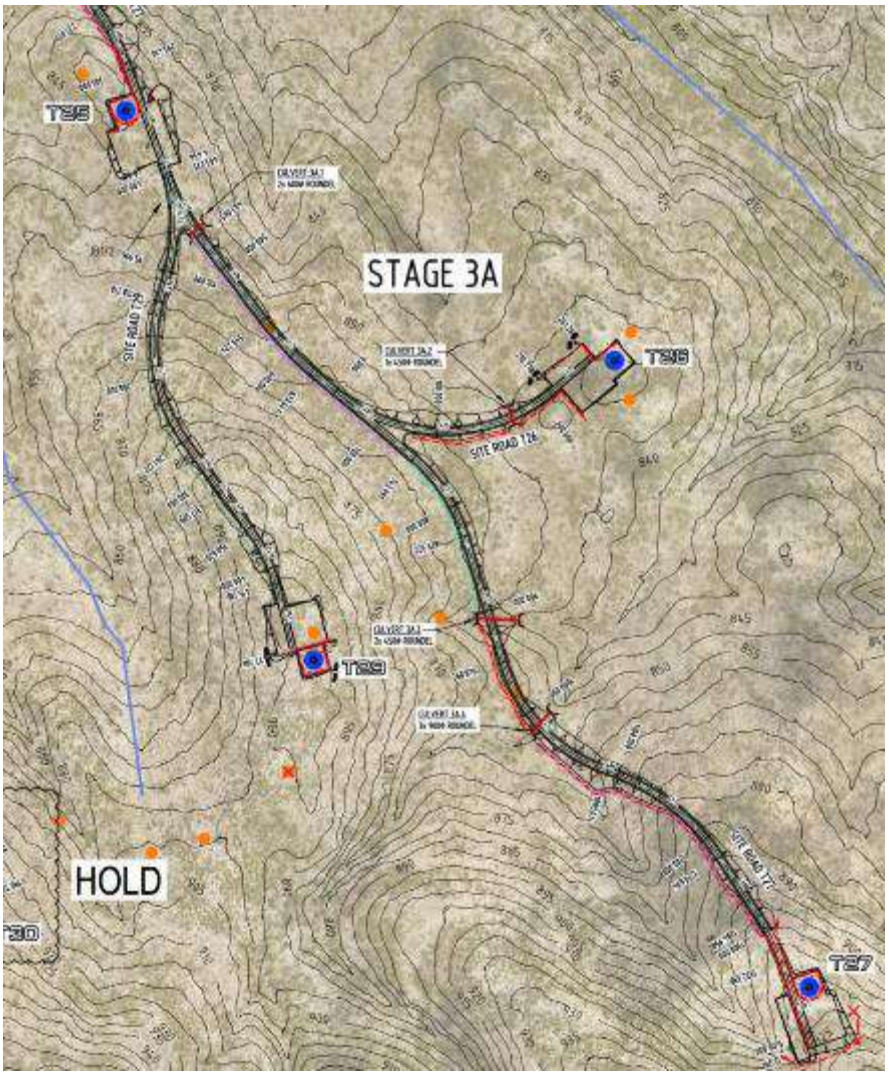


Figure 7: Final alignments to T25, T26, T27 and T29

2.11 Turbine 30 – 33

2.11.1 Basis of Jan 2017 Design

The January 2017 design was based on the concept design prepared with limited survey and constraint data. The concept design shows some significant areas of disturbance and grades in excess of 20%

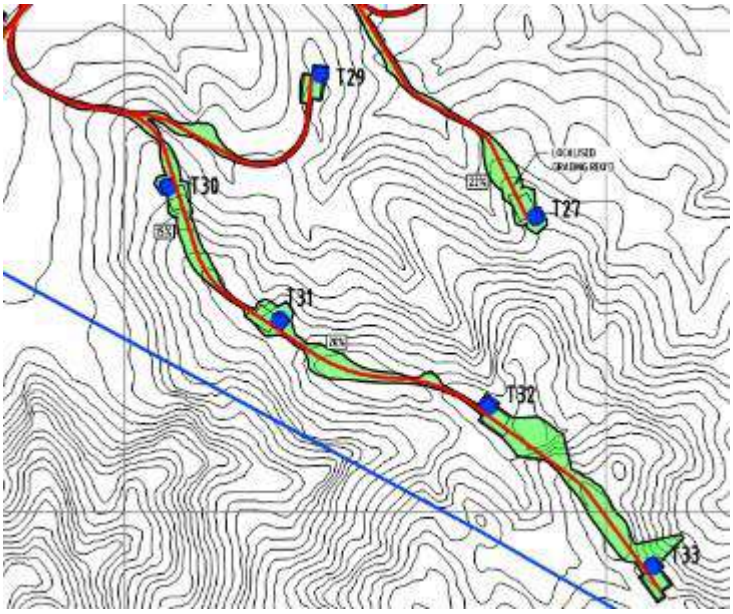


Figure 8: Original alignments of T30-T33

2.11.2 Basis of Final Design

This section of the wind farm is the most challenging with extremely steep natural grades and a very narrow ridge line. In order to achieve access and minimise disturbance, the road design has had to follow the ridge line as you cannot flatten the road by approaching slopes transversely as there is insufficient length to reach the crest. Through consultation with Vestas, the road has had to be steepened to 20% in a number of locations in order to follow the ridge line and have a constructible road solution. Increasing the road grade has resulted in less cut, fill and in turn ground disturbance created when constructing the road.

The revised alignment from T30-T31 avoids a large population of Grevillea glossadenia and Homoranthus porter and minimises the impact to a known population Grevillea glossadenia on the T32-T33 route.

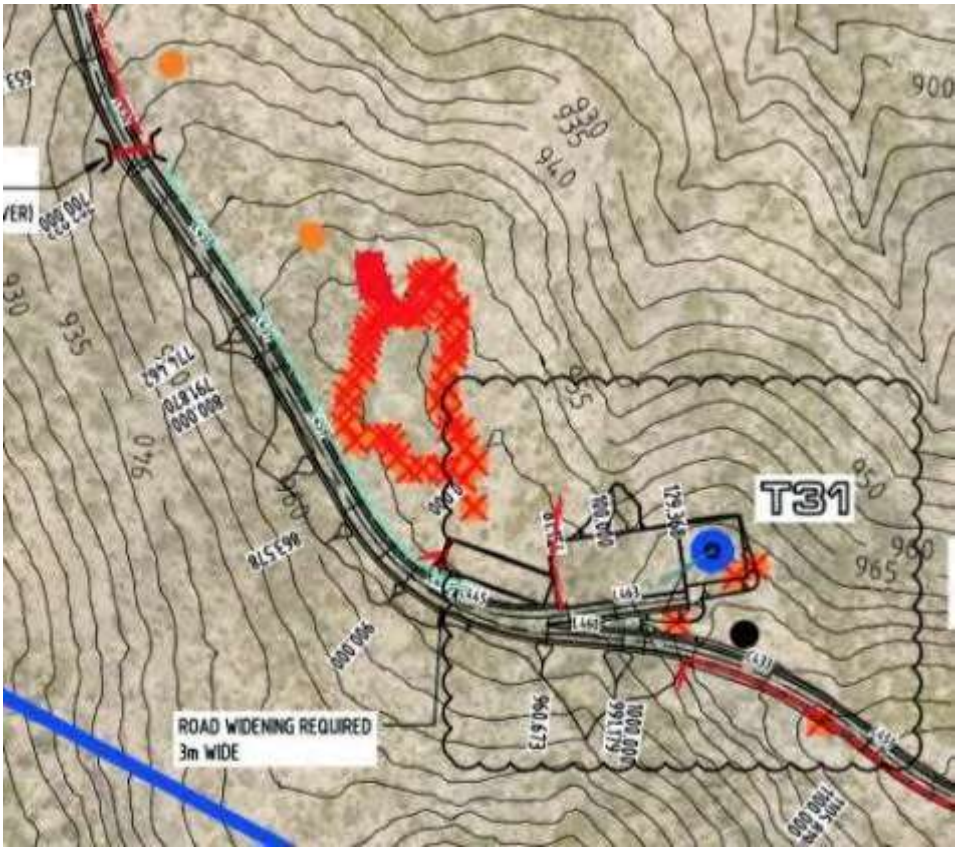
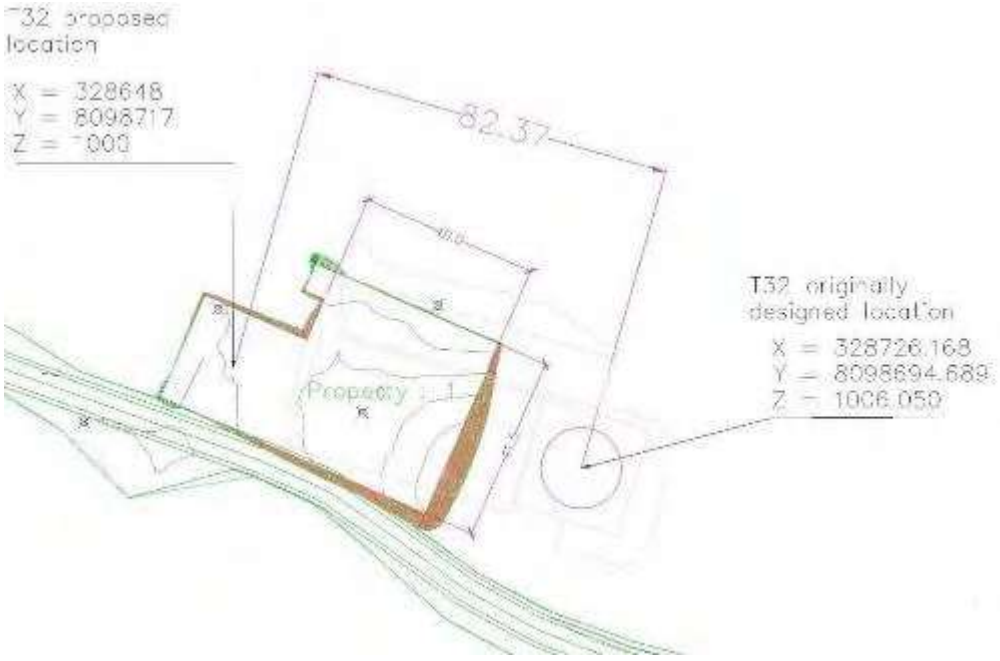


Figure 9: Revised alignment of T30-T31 access route

The original location of T32 showed a significant cut on the turbine foundation area and a large fill to construct the associated blade laydown area. After consultation with Vestas, the approach to the T32 hardstand was flipped and the final turbine location was microsited 82 metres. This enabled the foundation area to be in less cut and remove the large fill area to construct the blade laydown area which will result in less cut, fill and in turn overall ground disturbance



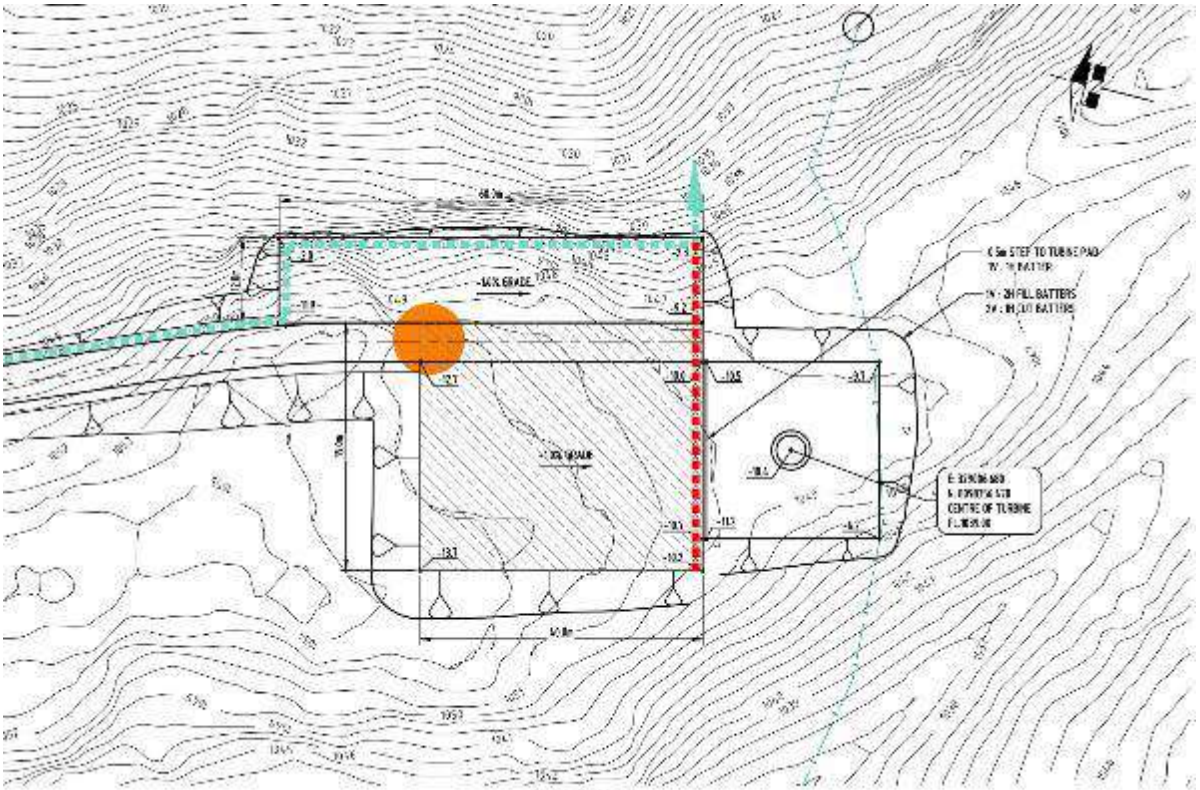
F*igure 10: Final location of T32*

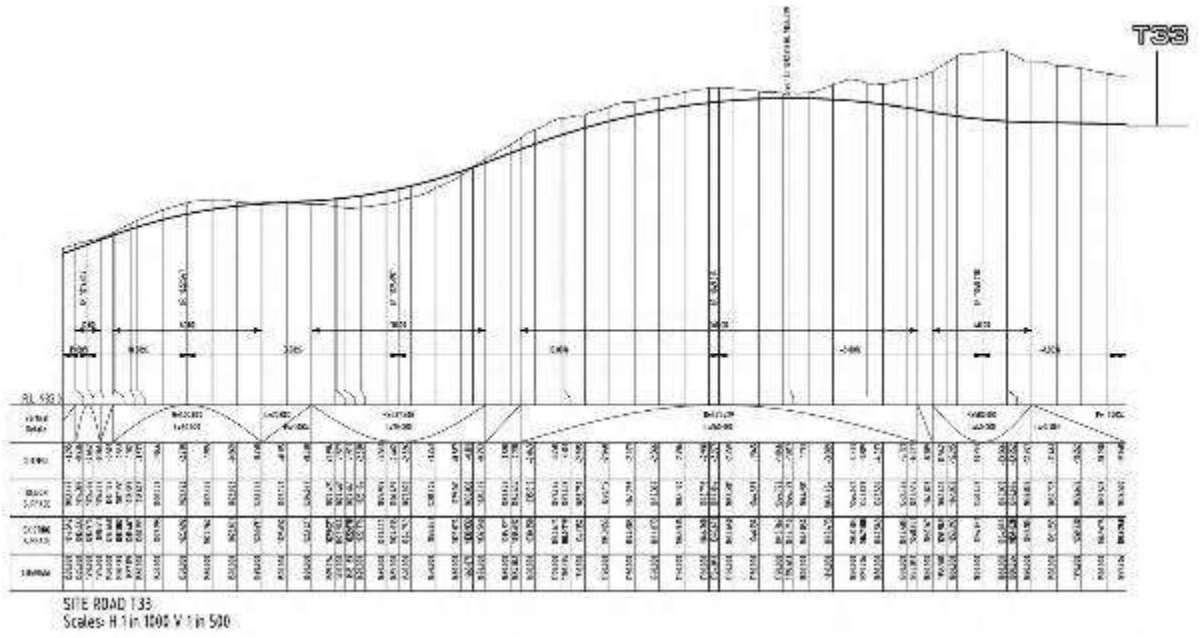
The location of turbine 33 is particularly problematic as it is located on the opposite side of the ridge from the approach road, and its elevation is significantly lower than the crest. The solution requires the entire ridge crest to be removed to a depth of up to 22m. Based on the current geotechnical test results across the site and with consultation from geotechnical engineers the batters were steepened to 2V:1H in significant cuts in rock. This has significantly reduced the ground disturbance required to construct the road and hardstand in this area.

The T33 site is currently governed by the maximum allowable AHD tip height of the turbine blades as set out in the project development approval. Efforts are currently underway to both microsite and change the proposed V117 site at T33 to a V112. This will enable the hardstand to be raised an additional 8.5m which will result in less cut, fill and in turn overall ground disturbance.

Residual impacts managed by:

- Translocation of isolated individuals of Grevillea glossadenia in line with the Translocation Plan
- Offset Management plan approved and to be implemented which includes Plectranthus amoenus
- Implementation of CEMP





F*igure 11: Final proposed location and long section to T33*

2.12 Turbine 35 - 53

2.12.1 Basis of Jan 2017 Design

The January 2017 design was based on the concept design prepared with limited survey and constraint data.

2.12.2 Basis of Final Design

The final design has been optimised a number of times due to some challenges in terrain. The road alignment from the Powerlink substation through to Turbines 35 to 41 has realigned to follow a direct route passing through these turbine sites, as opposed to an offset road with spur roads in. This has assisted in reducing the potential disturbance area through here, and also avoided the need to construct a section of the main access road, through relatively soft alluvial soils in the flatter areas. This revision has saved around 1km of site road (approximately 9,500m2 of ground disturbance).

Hardstand orientations have been 'reversed' at some locations, such as Turbines, 35, 36, 43, 47, 48, 49 and 50 when the approach roads are on a downslope, to minimise the extent of cut, fill and ground disturbance.

There is no significant vegetation within these extensive areas that needed consideration with the exception of the road alignment from Turbine 35 to 36 which has been adjusted to avoid the localised Plectranthus Amoenus.

Figure 12: Final location of T34-T48

The original location of turbine 50 required a significant cut to build the access road onto the hardstand area. Through consultation with Vestas it was determined that access onto T50 could be achieved directly off the main access track by reorientating the blade laydown and altering the standard component delivery method. This has reduced the ground disturbance required to construct the road onto the hardstand in this area.

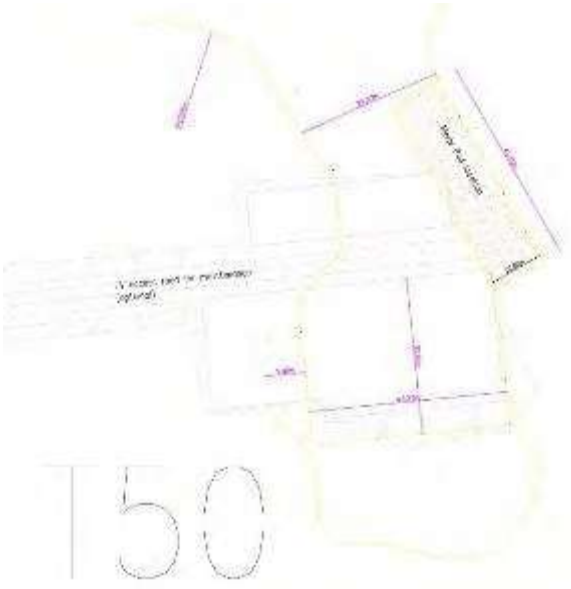


Figure 13: Realignment of T50 access road and hardstand

Through consultation with the pre-construction survey teams on site, the new revision has avoided numerous areas of significance such as:

- heritage exclusion zones (quartz outcrop on the approach to WTG 37 and large heritage exclusion zone on the access road from T39-T40)
- construction met mast on access road from T41-T43
- watercourse on the approach to T38
- watercourse on the T49 hardstand

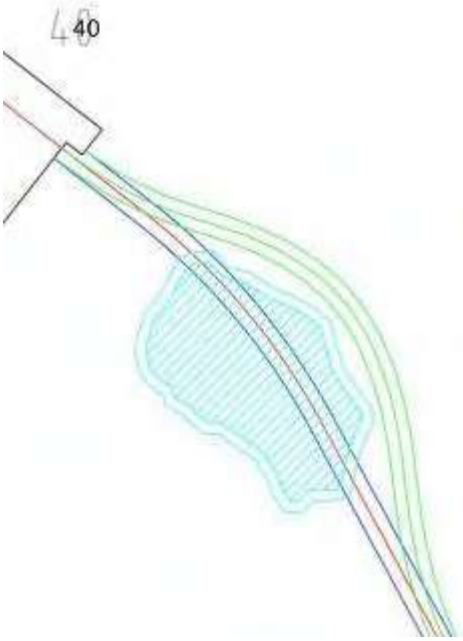


Figure 14: Realignment to avoid large heritage exclusion zone on the access road from T39-T40

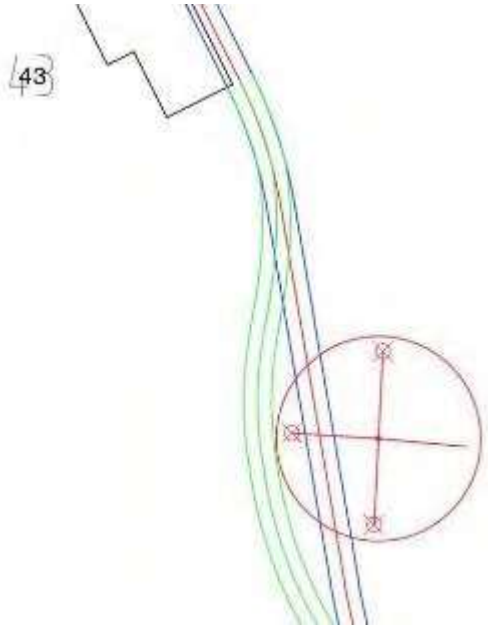


Figure 15: Realignment to avoid construction met mast

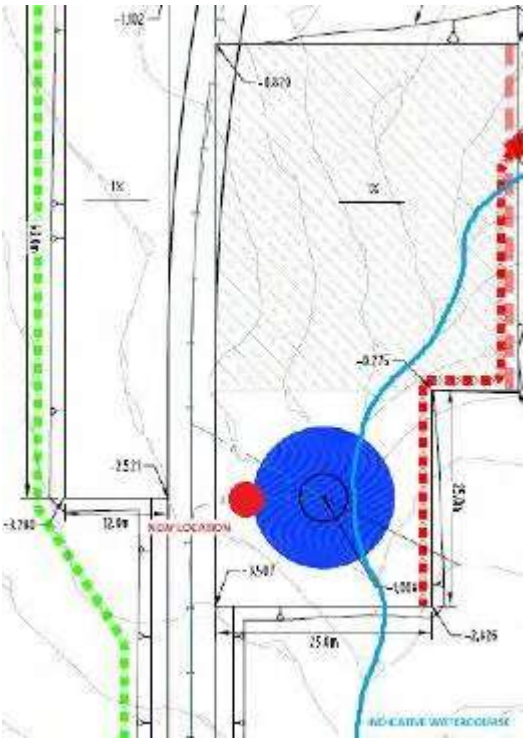


Figure 16: Realignment to avoid watercourse on the approach to T38

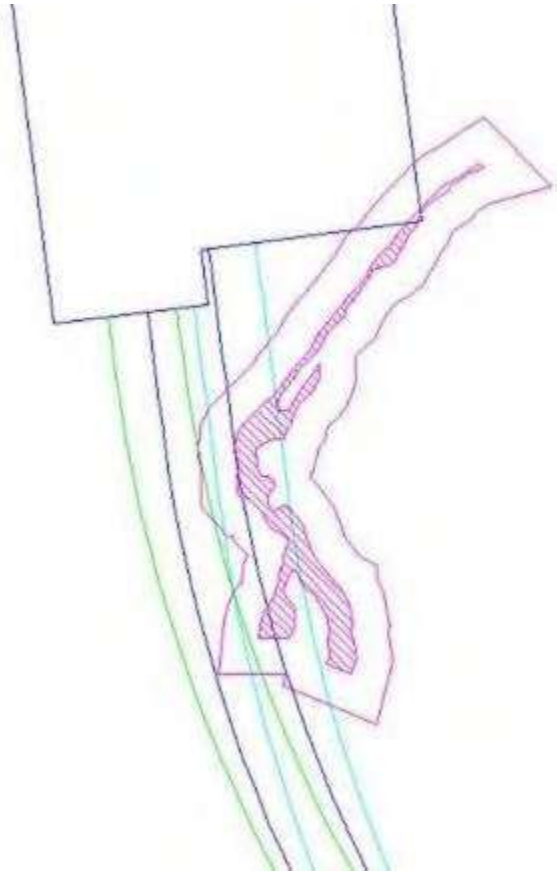


Figure 17: Realignment to avoid watercourse on the T49 Hardstand

2.13 Cabling

2.13.1 Basis of Jan 2017 Design

The January 2017 design was based on the concept design prepared with limited survey and constraint data.

2.13.2 Basis of Final Design

The final design has been optimised a number of times due to some challenges in road building. The cable installation was re aligned in some area to remove cabling from main access road to reduce project risk due to traffic interaction and the ability to progress the project in challenging terrain. Figure 16 below shows the areas where cabling has been removed from roads.

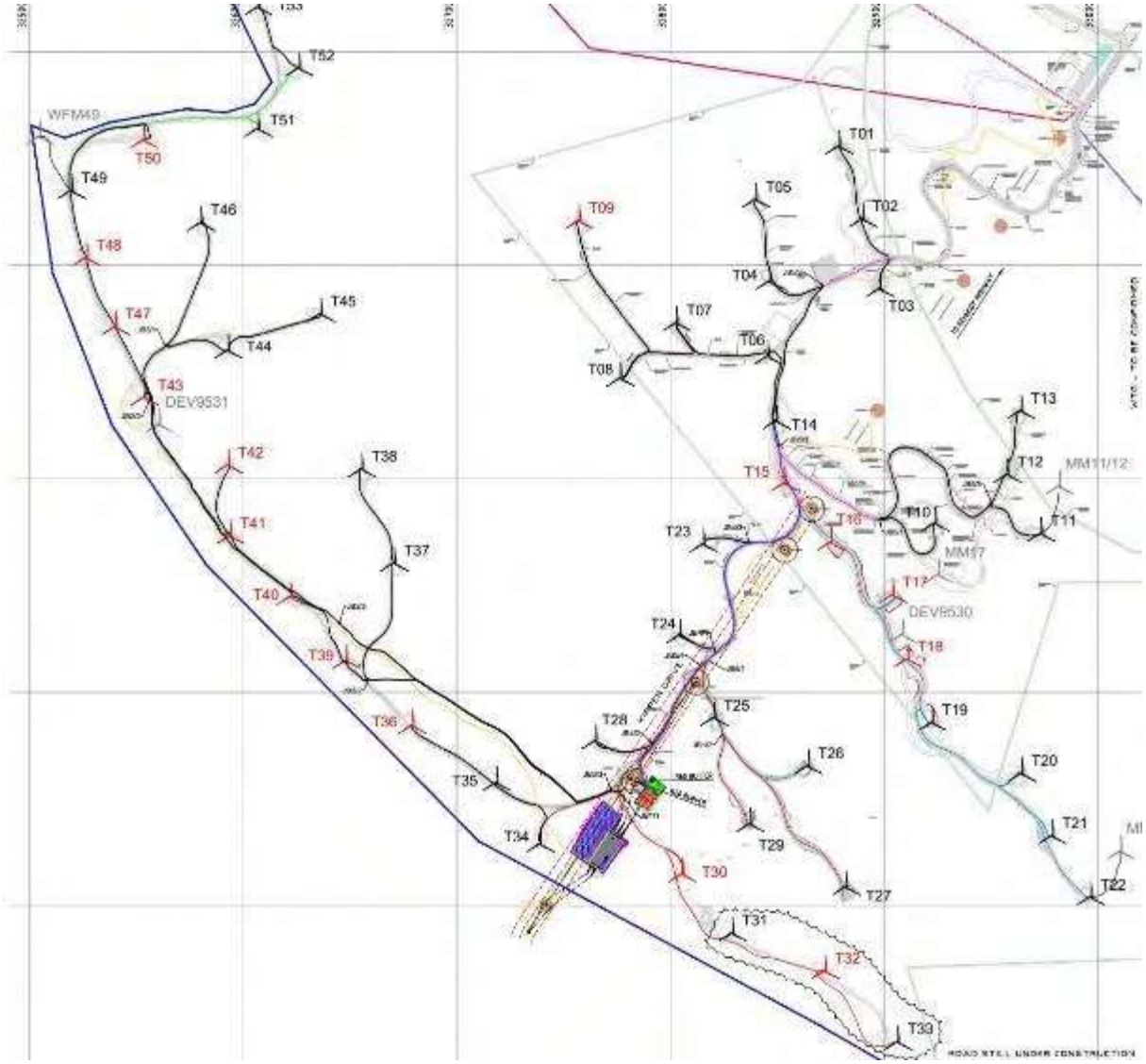


Figure 18: MEWF Cable installation overview

3 Quantification of impact

Based on the IFC designs presented, the as constructed disturbance is 68.15Ha.

Ground Disturbance As-con - Tracking Sheet - 22 MAR 2018

ROAD	DESIGN AREA (ha)	DESIGN AREA TO DATE (ha)	Total lenth	Cleared length	Additional areas (Ha)	AS-CON (ha)	CLEARING STATUS	LAST ACTIVITY DATE	THIS WEEK ACTIVITY	COMMENTS
KIFFEN DRIVE	0.74	0.74				0.47	completed	24 September 2017		Completed
ENTRY ROAD - Package 1A	4.77	4.96				4.45	completed	19 October 2017		Mibearch survey data utilised for calculation of batter and over spill
MAIN SITE ROAD	7.57	6.99				5.48	completed	12 December 2017		Including hardstand T14 and T15. Including roads and hardstand T25, T24 & T28. Includes MEWF access road.
SITE ROAD T01	1.57	1.57	652.51	652.51		1.07	ongoing	15-October-2017		remain area for Stack Pad WTG1
SITE ROAD T03	0.57	0.57	184.42	184.42		0.39	completed	03-September-2017		Including hardstand
SITE ROAD T05	1.42	1.42	182.80	182.80		1.05	completed	09 September 2017		Including hardstand T04
SITE ROAD T09	3.40	3.40	1823.00	1823.00		3.42	completed	03-September-2017		Including roads & hardstands T06, T07, T08 and T09 - completed
SITE ROAD T13	6.73	6.73	2835.55	2835.55		5.16	ongoing	21-February-2018	All T13 additional area at "ski jump" for road widening	Including hardstand T10, T11, T12 & T13
SITE ROAD T22	7.35	7.35	3011.65	3011.65		5.42	ongoing	26 February 2018	Clear to drill and widen the road between WTG19 and WTG20	Including roads & hardstands T16, T17, T18, T21 and T22
SITE ROAD T33	5.86	5.86	2398.56	2398.56		5.71	ongoing	22-March-2018	**Road WTG32 to WTG33 + WTG33**	Including roads & hardstands T30, T31 & T32
SITE ROAD T27	5.76	5.76	2152.58	2152.58		3.01	ongoing	08 February 2018		Including roads & hardstands T25, 26 & 27
SITE ROAD T53	21.94	21.94	9924.78	9924.78		16.58	ongoing	07-March-2018	WTG46, 48, 47 Hard stand - batter clearance	Including roads & hardstands T34 through T53 - CPP new cables corridor)
upper compound/spoil area A	1.13	1.13				0.95	completed	03-September-2017		no batter allowance or offset included
MEWF substation pad	1.85	1.85				1.65	ongoing	30-November-2017		Includes O&M facility (no o&m batters)
PLQ substation pad	2.85	2.85				2.56	completed	09 September 2017		
upper compound B	0.64	1.10				0.88	completed	09 September 2017		80 x 80m pad (no batters or offsets included)
crushing area WTG26	1.00	1.00				1.00	completed	03-September-2017		
Lower compound										
PLQ						0.78	ongoing	11 November 2017		Including the laydown area in front of the MEWF bench
MET mast Track WTG44 to Cross Roads						0.73	completed			As measured by Paul McDonald
CPP additional cables corridor					0.00					
WTG48 - WTG53	1.50				1.50	1.99	completed	20 December 2017		
WTG40 - WTG43	0.60				0.60	0.68	completed	21 November 2017		
MAR - WTG39	1.09				1.09	2.36	completed	12 December 2017		As measured by Paul McDonald
Along main access road						0.42	completed	24-January-2018		Additional cable alignment beside the main road
J05/2 - Batching Plant	0.28	0.28				0.28	completed	31-January-2018		MEWF-CPP-003
Batching - WTG14	0.22	0.22				0.22	completed	31-January-2018		MEWF-CPP-003
WTG06 - WTG14	0.21	0.21				0.21	completed	31-January-2018		MEWF-CPP-003
WTG14	0.07	0.07				0.07	completed	31-January-2018		MEWF-CPP-003
WTG25 WTG25 intersection	1.80	1.80				1.80	completed	31 January 2018		MEWF-CPP-003
WTG26-WTG28	1.26	1.26				1.26	completed	31-January-2018		MEWF-CPP-003
WTG28 intersection - SUB	0.28	0.28				0.28	completed	31 January 2018		MEWF-CPP-003
Additional lay down areas						3.12	completed			
Met Mast						0.92	ongoing			
Existing PLQ track being built over (offset)	-1.16	-0.93				-0.93	completed	16-September-2017		4m width utilised for calculation
Running total	**79.84**	**76.20**				**68.15**				

E. NORTHERN QUOLL OUTCOMES STRATEGY

Mount Emerald Wind Farm

Northern Quoll Outcomes Strategy

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft	Outcomes Strategy	Scott Burnett	MJ / TJ	21/09/2016
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Final	Outcomes Strategy	Scott Burnett	MJ / TJ	14/12/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		14/12/2016

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Appendix D Habitat Clearing Management Plan
Appendix E Weed Management Plan
Appendix F Pest Management Plan
Appendix G Bushfire Management and Emergency Evacuation Plan

1.0 Introduction

The Northern Quoll *Dasyurus hallucatus* is the smallest species of the quolls, a group of predominantly carnivorous marsupials found only in Australia and New Guinea (Van Dyck and Strahan, 2008).

The species is regarded as Endangered under the EPBC Act (1999), and is the subject of a recovery plan - National Recovery Plan for the Northern Quoll *Dasyurus hallucatus* (Hill and Ward 2010). The main aim of the recovery plan is to;

> *"minimise the rate of decline of the Northern Quoll in Australia, and ensure that viable populations remain in each of the major regions of distribution into the future. The recovery actions proposed here emphasise protecting key populations from colonization by cane toads and cats (especially through quarantine of offshore islands); fostering recovery of populations that have collapsed following cane toad arrival; managing secure populations (including captive and translocated); identifying and managing the threats to the Northern Quoll in the absence of cane toads; raising public awareness and native (sic) support of Northern Quoll in the absence of cane toads; raising public awareness and active support of northern quolls; and enhancement of cane toad management, including quarantine."*

Key listed threats include:

- Cane toads;
- Feral predators;
- Inappropriate fire regimes;
- Habitat degradation;
- Habitat destruction;
- Weeds;
- Disease;
- Hunting; and
- Population isolation.

The disparity between historical records and the known contemporary distribution of *D. hallucatus* suggests that their populations underwent a catastrophic collapse during the 20th century, resulting in the disjointed range of the species in Australia and Queensland today (Braithwaite and Griffiths 1994, Oakwood 2008). Northern quolls in Queensland are known from only six disjunct populations:

(1) Weipa;

(2) Eastern Einasleigh uplands/western and northern Wet Tropics boundary from Ravenshoe – Cooktown;

(3) Townsville – Bowen;

(4) Mackay/Whitsunday region and hinterland;

(5) Rockhampton region and hinterland; and

(6) Carnarvon Range (Burnett unpublished data).

It is possible that further survey effort in the southern and central Queensland regions will locate more populations.

The Mt Emerald quoll population forms part of the eastern Einasleigh upland/western wet tropics quoll population and like all remnant Queensland quoll populations, has survived there in sympatry with cane

toads, and during more than 100 years of European occupation with slight modification of their habitat (e.g. Woinarski *et al.* (2008), S. Burnett, University of the Sunshine Coast, unpublished data).

Studies by Burnett *et al.* (2013) suggest that the western and northern Atherton Tablelands, extending north to Cooktown, is a hot spot for Northern Quolls in Queensland and the area within a 55km radius of Mt Emerald contains 72% of the remaining Northern Quolls in the Einasleigh Uplands/Wet Tropics region. Conroy and Lamont (2013) further identify that the Mt Emerald quoll population experiences gene flow to and from adjacent populations in the upper Walsh River about 20km to the south-west, and the Lamb Range (Tinaroo and Davies Creeks) about 20km to the east and that Mt Emerald is likely a route through which gene flow from the Lamb Range through to the Herberton Range occurs.

An attempt was made to model the population viability (PVA) of the Mt Emerald quoll population using a suite of parameters derived by direct observation of this and nearby quoll populations, and parameters inferred from quoll populations across the species range (Shimizu and Conroy 2013). This PVA was hampered by a lack of detailed data on critical aspects of quoll population ecology and dispersal patterns, and the major recommendation of that report was to undertake studies to collect more of this data.

Further research has built on these studies and have been particularly focussed on establishing the best methods of detecting and enumerating quoll populations. Hemmings (2015) compared the efficiency of cage trapping versus camera trapping for detecting and enumerating the size of Northern Quoll populations at six sites between Townsville and Mareeba, revealing that camera trapping is at least as efficient as cage trapping. Given the much lower effort required to conduct a camera-trap versus a cage-trapping survey he recommends the use of trail cameras to locate and count quolls.

Current research (N. Foster, University of the Sunshine Coast, unpublished data) is exploring the most effective camera trap deployment for detection and population estimation of Northern Quolls. Foster (unpublished) has tested a variety of camera trap spacings on each of nine, 1-km-long transects between Mackay and Mareeba on the Atherton Tablelands. While these analyses are ongoing, the preliminary results suggest that even at 100-m-spacings, insufficient recaptures are had to permit strong mark-recapture derived population estimates to be obtained on these single transect-lines of camera traps.

The methods proposed below to effectively monitor Northern Quoll populations are derived from the above studies and suggest that for effective population estimation of Northern Quolls, a grid-based approach, at which cameras are spaced no more than 350-m-apart, and in which cameras are left in-situ for a minimum of 14 days are required to maximise the number of individuals detected, the number of recaptures, and hence to maximise the accuracy of spatially-explicit mark-recapture estimation of population size. **Figure 1** identifies the locations of the Mt Emerald Wind Farm and associated grid locations in the regional landscape.

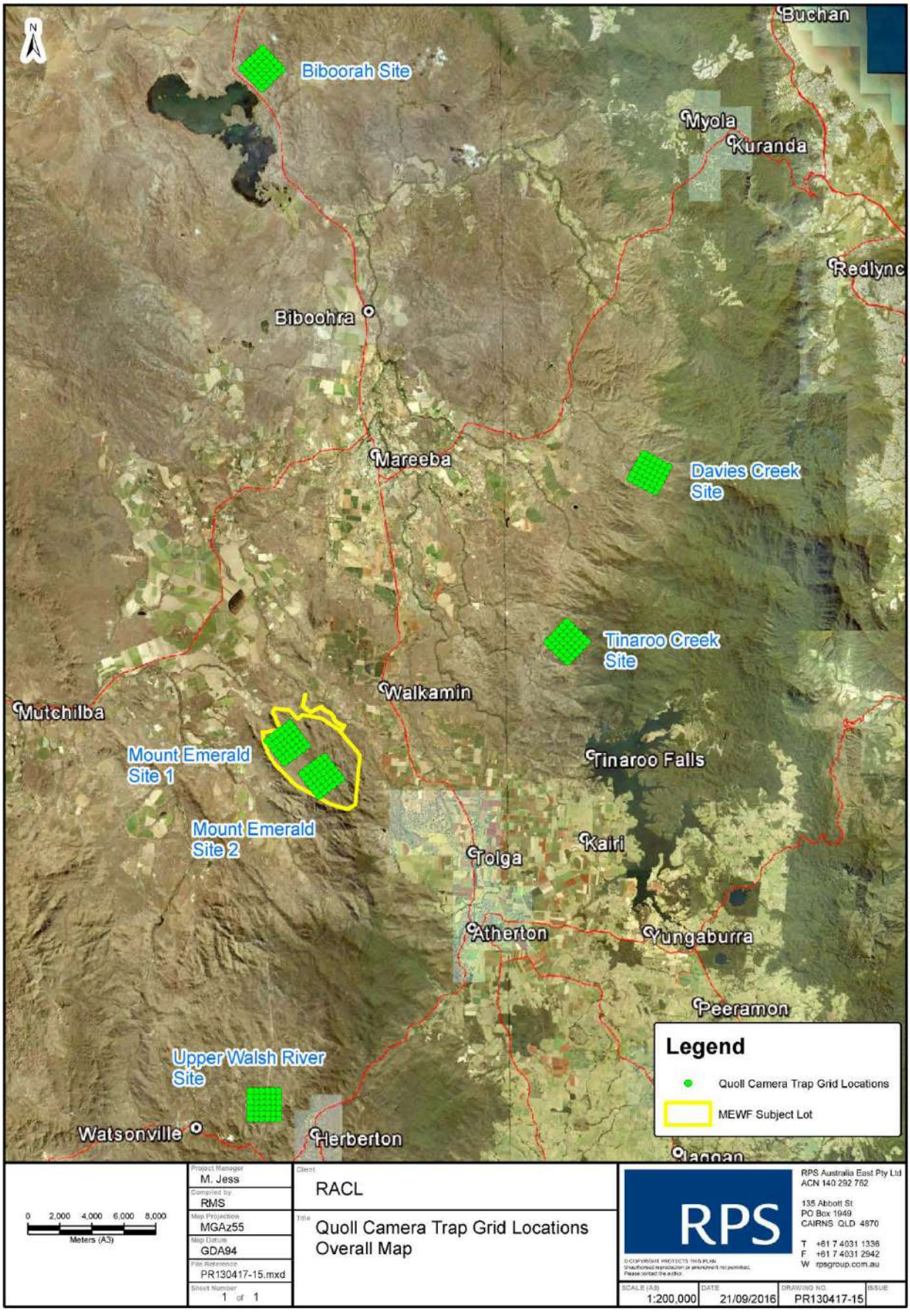

Figure 1 Quoll Camera Trap Grid Locations

1.2 Regulatory Requirements

This Northern Quoll Outcomes Strategy has been prepared to address Decision Notice Conditions (26 November 2015) for the approval EPBC 2011/6228 as issued by the federal Department of Environment and Energy

Conditions relevant to the preparation and implementation of the Northern Quoll Outcomes Strategy are detailed in **Table 1** below.

Table 1 Conditions of EPBC Referral Approval

EPBC Condition	Location in Report
7. For the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site.	**Section 2**
8. The approval holder must prepare and submit an Outcomes Strategy for the Minister's written approval which describes a monitoring program to inform adaptive management and determine whether the outcome required under condition 7 is being or has been met. The Outcomes Strategy must:	
a) be prepared by a suitably qualified expert;	**Appendix A**
b) identify and justify performance measures, which are capable of accurate and reliable measurement, and will be used to measure the outcome required under condition 7;	**Section 2** and **Section 4**
c) include a monitoring program, to detect changes in the performance measures. The monitoring must include baseline surveys, control sites and experimental design (to test the effectiveness of different management measures); and	**Section 1** and **Section 3**
d) describe how the baseline and monitoring data will be adequate to: inform adaptive management; enable an objective decision to be made on whether the outcome described in condition 7 has been met.	**Section 6**

2.0 Statement of Outcomes

The Condition 7 of the approval issued by the Department of Environment and Energy under the EPBC Act for the Mount Emerald wind farm states "for the protection of the Northern Quoll, the approval holder must maintain a viable population of Northern Quoll on the wind farm site."

The nature of the approval condition is in-line with the broader objectives of the National Recovery Plan for the Northern Quoll (Hill and Ward, 2010), particularly:

- Specific Objective 2 - Foster the recovery of Northern Quoll sub-populations in areas with cane toad; and
- Specific Objective 5 - Maintain secure populations and source animals for future reintroductions / introductions, if they become appropriate.

It is unknown what population size reflects a viable population, however the viability of the population can be inferred if changes in the size and distribution of the windfarm population remains within the range of values recorded at references sites outside of the project area. Therefore, the key outcomes for the work outlined in this strategy are to identify any statistically significant changes in:

(1) Quoll population size between windfarm and reference sites between each monitoring occasion; and

(2) Site occupancy by quolls on the windfarm site compared to the reference sites.

Such changes will be determined by statistical comparison of the proportional change in population size and/or site occupancy between the windfarm and reference sites during each triannual monitoring occasion during construction, during each biannual monitoring event in each of three years following the construction phase, and at a single monitoring event in each of 5 and 10 years following completion of construction.

Numerical size of each quoll population will be defined through mark-recapture modelling (White and Burnham 1999), or where insufficient captures and recaptures are reasonably achievable, through the minimum number known to be alive method (Krebs 1966). Site occupancy will be estimated using occupancy modelling (McKenzie *et al* 2003).

2.1 Spatially Explicit Mark -Recapture Program (SECR)

> *Like other statistical methods for estimating animal abundance, SECR combines a state model and an observation model to generate animal density estimates with confidence intervals. These density models are then applied to a model generated habitat mask or buffer, to provide a population size estimate. The state model describes the distribution of animal home ranges in the landscape, and the observation model (a spatial detection model) relates the probability of detecting an individual at a particular detector to the distance of the detector from a central point in each animal's home range. The distances are not observed directly (usually range centres are unknown), so conventional distance sampling methods do not apply. The distribution of range centres in the population (the state model) will usually be treated as a homogeneous Poisson point process. Density (= intensity) is the sole parameter of a homogeneous Poisson process. An inhomogeneous Poisson distribution may also be fitted; this provides a means to evaluate the effects of habitat variables on density. (Efford, 2016)*

The probability of detecting an individual (the observation model) is modelled by either the half normal detection function defined by $g(d) = g0 \exp(-d\ 2/\ 2\sigma 2)$ or the exponential detection function by $g(d) = g0 \exp(-d/\sigma)$.

The model of best fit will be determined (and therefore the most likely correct population estimate) during the analyses by exploring consequences of modelled time trends, learned responses, transient responses, differences between monitoring sessions and interactions of the above. Models are fitted by numerically

maximizing the likelihood. The likelihood involves integration over the unknown locations of the animals' range centres. This is achieved in practice by summation over points in the habitat mask. The default maximization algorithm is Newton-Raphson. By default, all reported variances, covariance's, standard errors and confidence limits are asymptotic and based on a numerical estimate of the information matrix.

It isn't possible to state at the outset which parameters and variables, nor model settings will be used to derive the optimum model. These can only be determined by trial and error during the modelling process.

Should data generated from the monitoring plots be insufficient for SECR modelling (i.e. insufficient spatial recaptures) and Mark-Recapture modelling, which again uses an iterative modelling procedure to arrive at population estimates. A single-season closed population model will be used in this instance. Initial inspection of the data suggests that SECR will be suitable. (Efford, 2016)

3.0 Milestones

(a) In the 12 months prior to construction, baseline data on quoll population size, site occupancy, population vital statistics and habitat condition is collected from two sampling sites on Mt Emerald and in four regional reference sites within a 50km radius of Mt Emerald.

(b) In the first 12 months of the project, two funded PhD studies commence; Study 1: The distribution and population ecology of the Northern Quoll; Study 2: Spatial ecology and habitat selection by the Northern Quoll.

(c) In each year of construction, triannual monitoring of quoll populations and their habitat at the project site and at least four reference sites will be monitored using the methods established at Milestone A.

(d) In each year for three years post construction, triannual monitoring of quoll populations and their habitat at the project site and at all reference sites (identified above) will be undertaken using the methods of Milestone A.

(e) In the fifth year post-construction, annual monitoring of quoll populations and their habitat will be undertaken at the project site and at the four regional sites using the methods of Milestone A.

(f) In the tenth year post construction, annual quoll population and habitat monitoring will be undertaken at the project site and the four regional sites using the methods of Milestone A.

4.0 Performance Criteria

The following Performance Criteria are proposed for assessing the relevant performance of the Northern Quoll Management and associated environmental management in regards to the Mount Emerald wind farm.

PC 1 During the preconstruction stage a monitoring program is established and baseline quoll population size, occupancy and population vital statistics and habitat data are collected for at least four regional reference sites and two Mt Emerald monitoring sites.

PC 2 During and for three years after the construction phase, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.

PC 3 In the 5th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.

PC 4 In the 10th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.

5.0 Monitoring

Monitoring of Northern Quolls and their habitats will occur on six permanent study grids (**Appendix B**). Each study grid will consist of 36 equidistant quoll and habitat monitoring points arranged on a 6 x 6 grid, with points 350m-apart (total grid dimensions 1750m x 1750m = 306.25ha). This approach to quoll monitoring is based on the findings of Hemmings (2015) and Foster (in prep).

Quoll monitoring will utilise a single incandescent flash, Reconyx™ 550 Hyperfire trail camera (or equivalent) simultaneously at each of the 36 points of each monitoring grid. Deployment, timing and programming of cameras must be consistent between each monitoring grid and each time, to ensure comparability of monitoring data. Trail cameras will be mounted 1.5m above ground level on a 90° bracket fixed to a vertical tree trunk with hex-head timber screws resulting in a vertical orientation (i.e. pointing directly down onto the target area). The target area will consist of an approximately 75-cm-square area cleared of grass and other obstructions, in the centre of which (i.e. immediately below the camera) is a 10-cm-length of 50mm PVC pipe with a cap at one end and a mesh cowling at the other, containing as many chicken necks as will fit (usually between 3 and 5). The container is preferably spray-painted black to minimise the risk of over-exposed photos caused by the camera's flash on a white object, and pegged to the ground so it can't be removed by scavengers.

Each camera will be programmed to take three images per trigger event, at medium/high sensitivity with no delay between trigger, and deployed for a minimum 14 days, without refreshing/replacing the bait.

Monitoring of quoll habitat will utilise the method outlined in the Queensland BioCondition Reference Site and Assessment Guideline (Eyre *et al.* 2011; Eyre *et al.* 2015) and will occur at half of the camera trap points on each grid, each time that quoll monitoring is undertaken.

The grids will be located on Mt Emerald (2 monitoring grids within the impact area), and at four reference grids within known Northern Quoll populations within 45km of Mt Emerald and within the same general climatic zone and broad vegetation community (**Table 2**).

Table 2 Indicative location of each 1750 x 1750m monitoring grid used to monitor quoll populations, quoll occupancy, feral carnivore occupancy and habitat attributes

Site	Type	Indicative grid centre point
Mt Emerald 1	Impact site	-17.181362, 145.38741
Mt Emerald 2	Impact site	-17.157438, 145.366421
Davies Creek	Reference site	-17.009332, 145.583918
Tinaroo Creek	Reference site	-17.101861, 145.534146
Upper Walsh River	Reference site	-17.366243, 145.354304
Biboorah	Reference site	-16.778739, 145.357973

6.0 Adaptive Management

This section outlines the adaptive management strategies that will be implemented to ensure that outcomes based conditions can be met more effectively. The following approach will be followed:

- General mitigation measures including management actions, significant species management plans and threatened species inductions developed for clearing, construction and operation of the MEWF;
- Northern Quoll Management Plan (**Appendix C**) and Habitat Clearing (**Appendix D**) and Management Plan for protection of fauna species during MEWF Activities;
- Pest Management Plan (**Appendix E**) and Weed Management Plan (**Appendix F**);
- A Bushfire Management Plan and Emergency Evacuation Plan (**Appendix G**) promoting a regime of mosaic burns;
- Collection of Northern Quoll monitoring data which will be systematically evaluated and compared to baseline and reference site data on a regular basis (triannually up to 5 years) in a process of adaptive management to verify whether there are any responses to the immediate and long-term impact of construction; and
- A regular review of external factors.

Table 3 below provides Adaptive Management Actions that will be implemented when key performance targets are not being met.

Table 3 Adaptive Management Actions

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
1	During the preconstruction stage a monitoring program is established and baseline quoll population size, occupancy and population vital statistics and habitat data are collected for at least four regional reference sites and two Mt Emerald monitoring sites.	Monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Bio-condition Index) at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	One round of monitoring not completed prior to construction.	Prioritise monitoring so that all monitoring on Mt Emerald is completed prior to any construction (roads, wind turbines or other infrastructure). Monitoring at regional reference sites can happen immediately after Mt Emerald monitoring is completed.	▪ Monitoring Report; ▪ Database of Northern Quoll detections created; ▪ Quoll locations resulting from monitoring recorded in GIS database.
2	During and for three years after the construction phase, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.	Triannually monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Biocondition Index), at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a proportionally greater decrease in population size than the mean proportional population decrease on the four regional reference sites, over the same time interval. At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a greater decrease in site occupancy than on the four regional reference sites, over the same time interval. Northern Quoll not detected on the Mt Emerald sites.	Repeat monitoring at all sites immediately, to rule out sampling errors. If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause. Modify predator control and establish additional effective controls in consultation with DEE Where impacts to breeding are suspected or observed, implement management strategies including revised night time construction hours, directional lighting and use of low noise machinery in affected areas to minimise further disturbance. Review fauna corridor areas –	▪ Monitoring Report ▪ Identify relevant corrective actions with 28 days of monitoring event and notify DEE. ▪ Database of Northern Quoll detections created ▪ Quoll locations resulting from monitoring recorded in GIS database ▪ Input into Annual Environmental reports each year. ▪ Update website each year

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
				set up trapping lines to determine impacts, observe edge effects and determine factors for decline. Review Bushfire management strategies to improve habitat condition where required to prevent premature burn for example. Where insufficient habitat considers decreasing fire intervals to increase areas of variable fuel load to prevent wild fire and maintain a mosaic distribution. Refer to MEWF Bushfire Management Plan for further advice. Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage, traffic calming devices and penalties. Consult with DEE and DEHP and update Outcomes Strategy where required. Assess the potential cause of reduction in habitat and Implement quarantine protocols, as detailed in the Northern Quoll Recovery Plan (2007) to prevent the spread of weed species into the MEWF project area (refer to MEWF Weed Management Plan. Notify DEE. Review revegetation works around culverts, dry access areas and revegetation areas (for fauna underpass areas),	

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
				and identify cause for slow regeneration. Reinstate replace landscaping plants if suitable, or substitute with recommended species. Refer MEWF Revegetation Plan.	
3	In the 5th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.	Biannually monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Biocondition Index) at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a proportionally greater decrease in population size than the mean proportional population decrease on the four regional reference sites, over the same time interval. At any of the Mt Emerald monitoring sites, monitoring indicates that the quoll population has undergone a greater decrease in site occupancy than on the four regional reference sites, over the same time interval. Northern Quoll not detected on the Mt Emerald sites.	Repeat monitoring at all sites immediately, to rule out sampling errors. If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause. Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline. Review Bushfire management strategies to improve habitat condition where required to prevent premature burn for example. Where insufficient habitat considers decreasing fire intervals to increase areas of variable fuel load to prevent wild fire and maintain a mosaic distribution. Refer to MEWF Bushfire Management Plan for further advice. Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of signage and penalties. Consult with DEE and DEHP and update Outcomes Strategy	Identify relevant corrective actions with 28 days of monitoring event and notify DEE. Data base of Northern Quoll Encounters Locations and habitat recorded in GIS data base Biannual Monitoring report Website Update

Number	KPI	Monitoring	Trigger for Adaptive Management	Management Actions	Reporting
				where required. Assess the potential cause of reduction in habitat and identify relevant corrective actions with 28 days of monitoring event. Implement quarantine protocols, as detailed in the Northern Quoll Recovery Plan (2007) to prevent the spread of weed species into the MEWF project area (refer to MEWF Weed Management Plan. Notify DEE.	
4	In the 10th year after completion of construction, any detected proportional decreases in the size of the quoll population, decreases in site occupancy, or changes in population vital statistics on the two Mt Emerald monitoring sites are not statistically significantly greater than at the four regional sites over the same period.	Biannually monitor quoll populations (using trail cameras and using mark recapture modelling methods) and site occupancy (using occupancy modelling), and quoll habitat condition (using Biocondition Index) at two sites at Mt Emerald, and at least four regional reference sites (Tinaroo Creek, Davies Creek, upper Walsh River, and Biboorah).	Trap success (i.e. capture rate) and estimated population X % of baseline data collected on Burnett et al (2013). Northern Quoll only recorded in regional sites. No signs of breeding (pouch young or sub adult). No evidence of individuals moving between sub populations. Northern Quoll struck by road vehicle. Evidence of increase in predation from exotic predators	Repeat monitoring at all sites immediately, to rule out sampling errors. If after repeating the monitoring (above) adaptive management is still triggered, review the habitat monitoring data to attempt to identify a possible cause. Review fauna corridor areas – set up trapping lines to determine impacts, observe edge effects and determine factors for decline. Review Bushfire Management Strategies to improve habitat condition if required. Reduce and enforce speed limits in the vicinity of Quoll habitat through the implementation of further signage and penalties. Consult with DEE and DEHP and update Outcomes Strategy where required.	Identify relevant corrective actions with 28 days of monitoring event and notify DEE. Monitoring Reports Data base of Northern Quoll Encounters Locations and habitat recorded in GIS data base Biannual Environmental report Website update

7.0 Record Keeping

The approval holder will provide a summary of findings arising from the monitoring data, and any corrective actions implemented annually to DEE.

The approval holder will establish a dedicated webpage that is publicly available for the lifetime of the project. The webpage must include a copy of the raw monitoring data and a descriptive of any corrective action undertaken.

All wildlife spatial data collected during monitoring will be provided to the Queensland Government Wildlife Online database and to the Commonwealth Atlas of Living Australia.

Data arising from research funded by the approval holder will be published in peer reviewed journals during the lifetime of the project.

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Appendix A

CV – Scott Burnett Nov 2016

Curriculum Vitae

Name:	Scott Edward Burnett
Address	5 Cherry St, Maleny
	PO Box 1219 Maleny, 4552
Email	sburnett@usc.edu.au
Contact telephone	0408 963350
Date of birth:	6 June 1968.

Academic record:

Date	***Qualification***	***Institution***
1988	BSc: Zoology.	James Cook University.
1989	BSc. (Hons) 1st Class: Mammal ecology.	James Cook University.
2001	PhD: Ecology and conservation status of Spotted tailed Quoll, *Dasyurus maculatus*.	James Cook University.

Professional Experience:

Date	***Role and duties***	***Employer***
Jan 2008 - present	**Lecturer**. Lecture in ecology and conservation. Supervision of Honours and post-graduate student projects.	University of the Sunshine Coast
Jun 05 – Dec 07	**Wildlife Projects Manager**. Managed the Quoll Seekers Network, PlatypusWatch and Gliders in the Spotlight community science programs. Included grant writing, implementation of programs, development of promotional materials, coordination of events and public speaking and research.	Wildlife Preservation Society of Queensland
Jan 01 to Jan 05	**Project Officer**. Distribution mapping and monitoring endangered fauna including Northern Bettong, Yellow-bellied glider, Cassowary	Threatened species unit, QPWS.
Jan to Dec 03.	**Project officer**. Owl project, promoting project and delivering milestones – increased awareness, owl boxes out on farms, spotlighting tours	Barron River Integrated Catchment Management Association.
Nov 1990 to present	**Fauna Consultant**. Working on various general and species specific vertebrate fauna inventory and impact mitigation projects throughout Qld. Projects include focal surveys for amphibians, reptiles, birds and mammals, and general vertebrate fauna inventory.	Private sector, Local, State and Commonwealth Govt.

Other Qualifications:

Drivers Licence: Class C.

Computers: MS DOS, Windows and Mac OS software including word processing, spreadsheets and graphics packages, ArcGIS.

Queensland Ambulance Service First Aid Certificate.

Advanced 4WD techniques certificate

4WD Sand driving certificate

Memberships:

Date	***Organisation***
2009 to now	Bird Conservation Nepal
90 to now	Royal Zoological Society of New South Wales.
86 to now	Australian Mammal Society.

Refereed Publications:

Date	***Title***
2014	M. Jones, S. Burnett, A. Claridge, B. Fancourt, G. Körtner, K. Morris, D. Peacock, S. Troy and J. Woinarski. Australia's surviving marsupial carnivores: threats and conservation, C.h 9 in Carnivores of Australia, CSIRO Publishing
2013	McDonald, K.P., Burnett, SE. and Robinson, W.R. Utility of owl pellets for monitoring threatened mammal communities: An Australian case study. Wildlife Research, 40 (8), pp. 685-697.
2012	Burnett, S. Northern quoll *D. hallucatus* pp 340-341 in Curtis LK, Dennis AJ, McDonald KR, Kyne PM and Debus SJS (editors). Queensland's Threatened Animals. CSIRO Publishing, Melbourne.
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2008	Moore, L. and Burnett S. Fawn-footed melomys *Melomys cervinipes*. Pp 671 – 673 in Van Dyck, S.M. and Strahan, R. (eds) Mammals of Australia. Reed New Holland, Sydney.
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1995 Kutt A., Burnett S. & Skull S. Significant vertebrate records from the Lamb Range, Wet Tropics World Heritage Area. *Mem. Qld Mus*. 38(2): 436.

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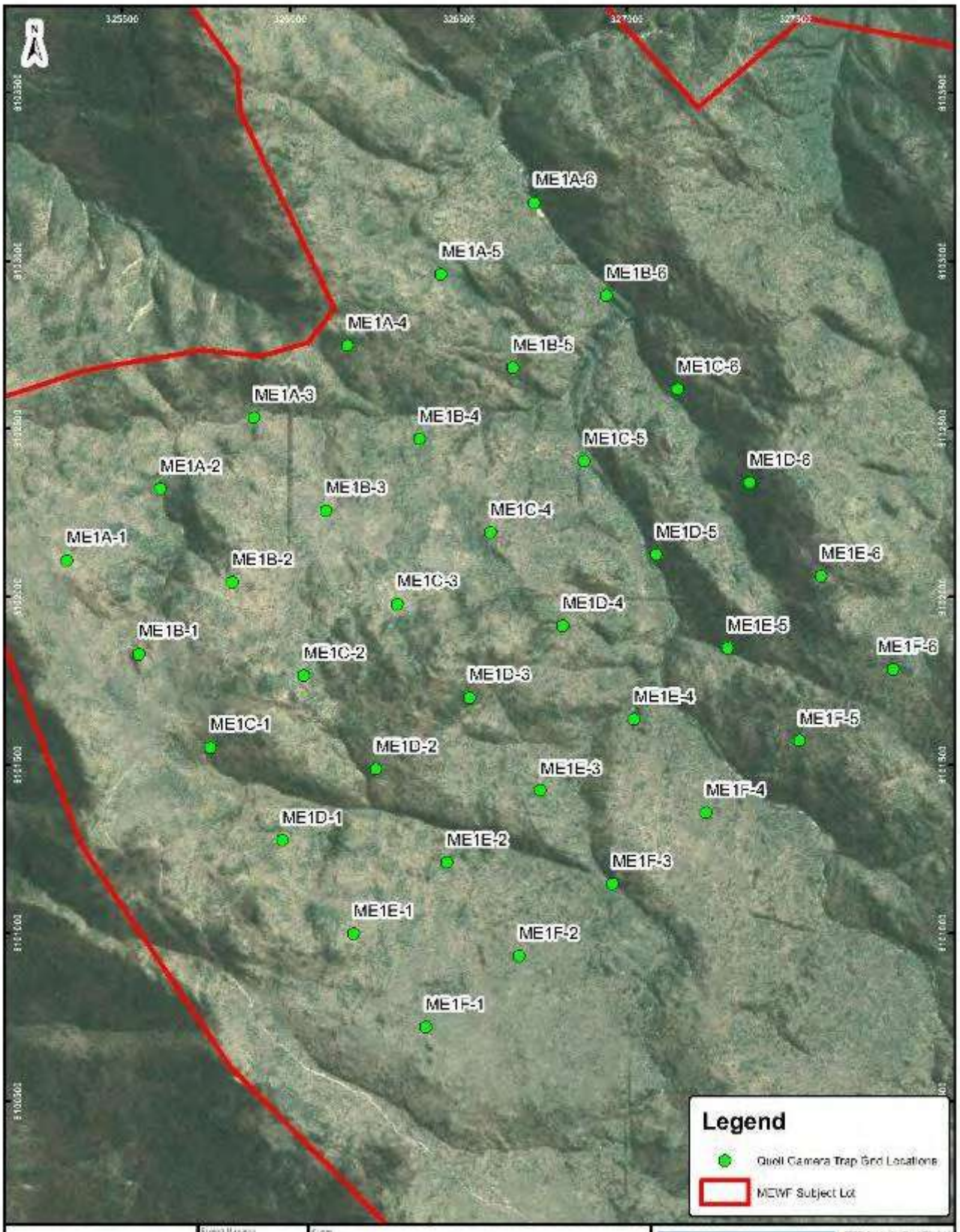
Referees:

Dr Steve Van Dyck
Curator of Vertebrates,
Queensland Museum, tel 07 38407706

Dr John Winter,
John Winter Ecologist,
tel 07 40970048

Appendix B

Quoll Camera Trap Grid Locations



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File Reference	PR130417-16.mxd
Sheet Number	1 of 1

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Mount Emerald Site 1

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RPS Australia East Pty Ltd
ACN 140 292 782
135 Abbott St
PO Box 1949
CAIRNS QLD 4870
T +61 7 4031 1336
F +61 7 4031 2942
W rpsgroup.com.au

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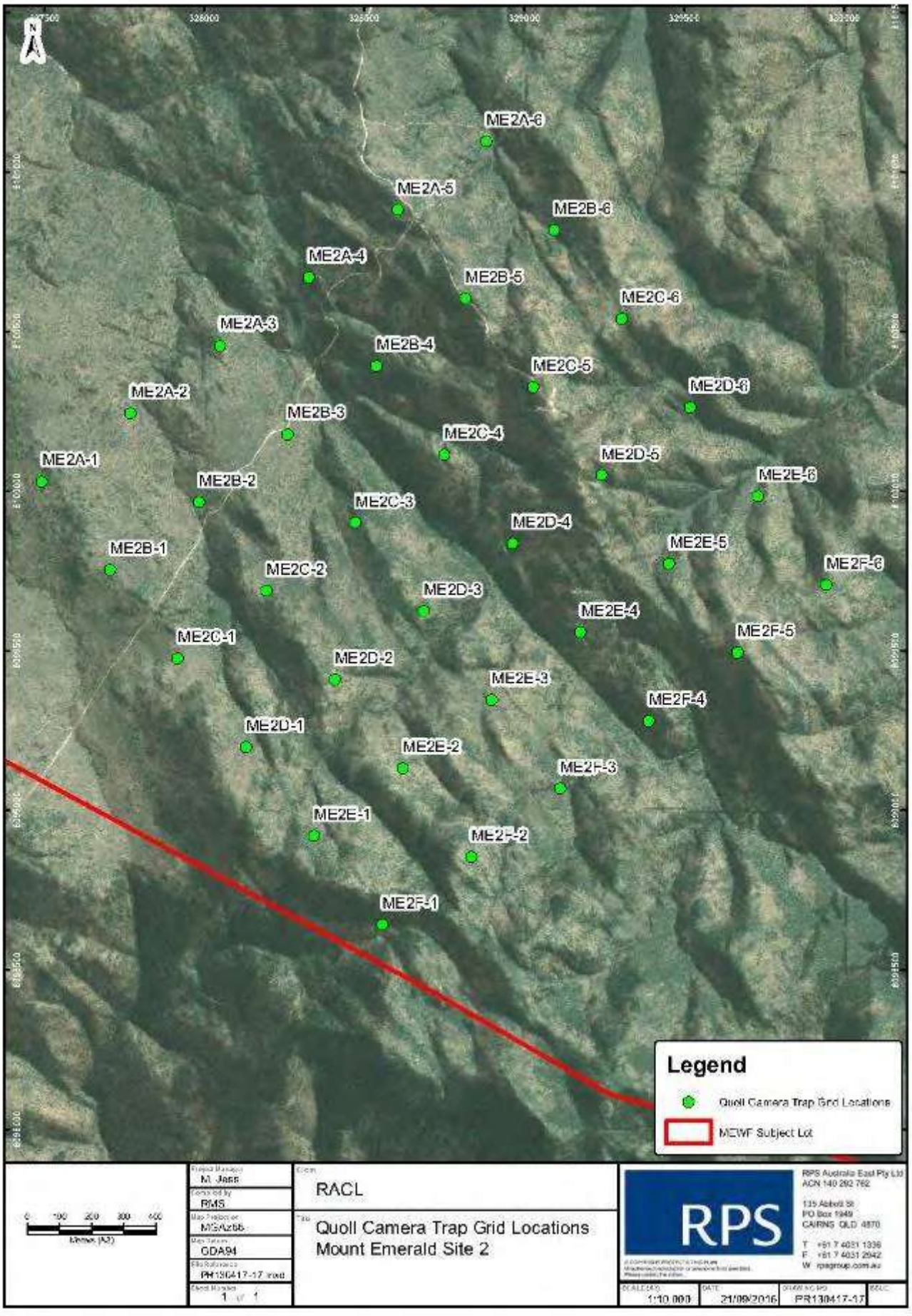
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M. Jess
Compiled by
RMS
Map Projection
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Sheet Number
1 of 1
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RACL
Title
Quoll Camera Trap Grid Locations
Mount Emerald Site 2
RPS
RPS Australia 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
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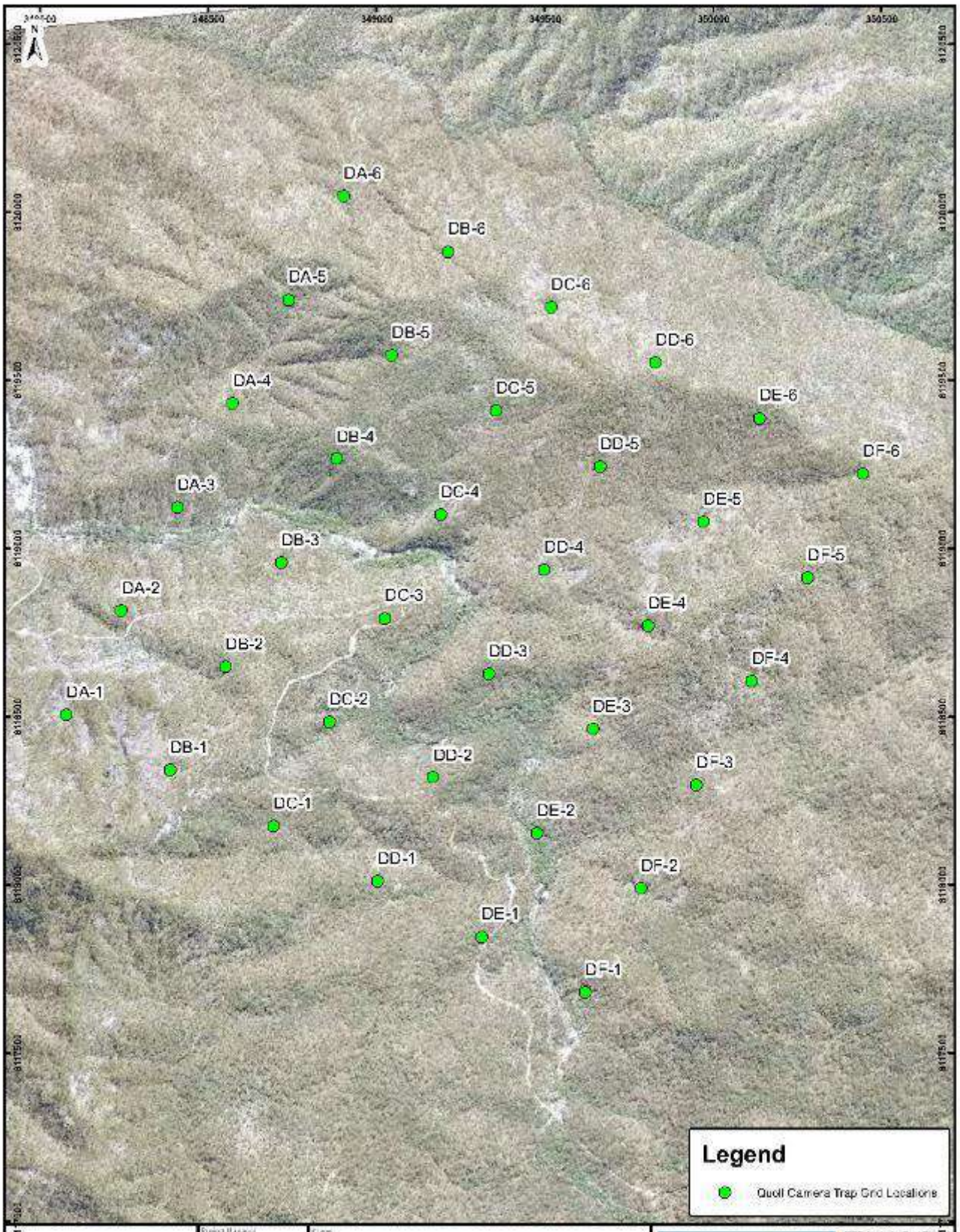

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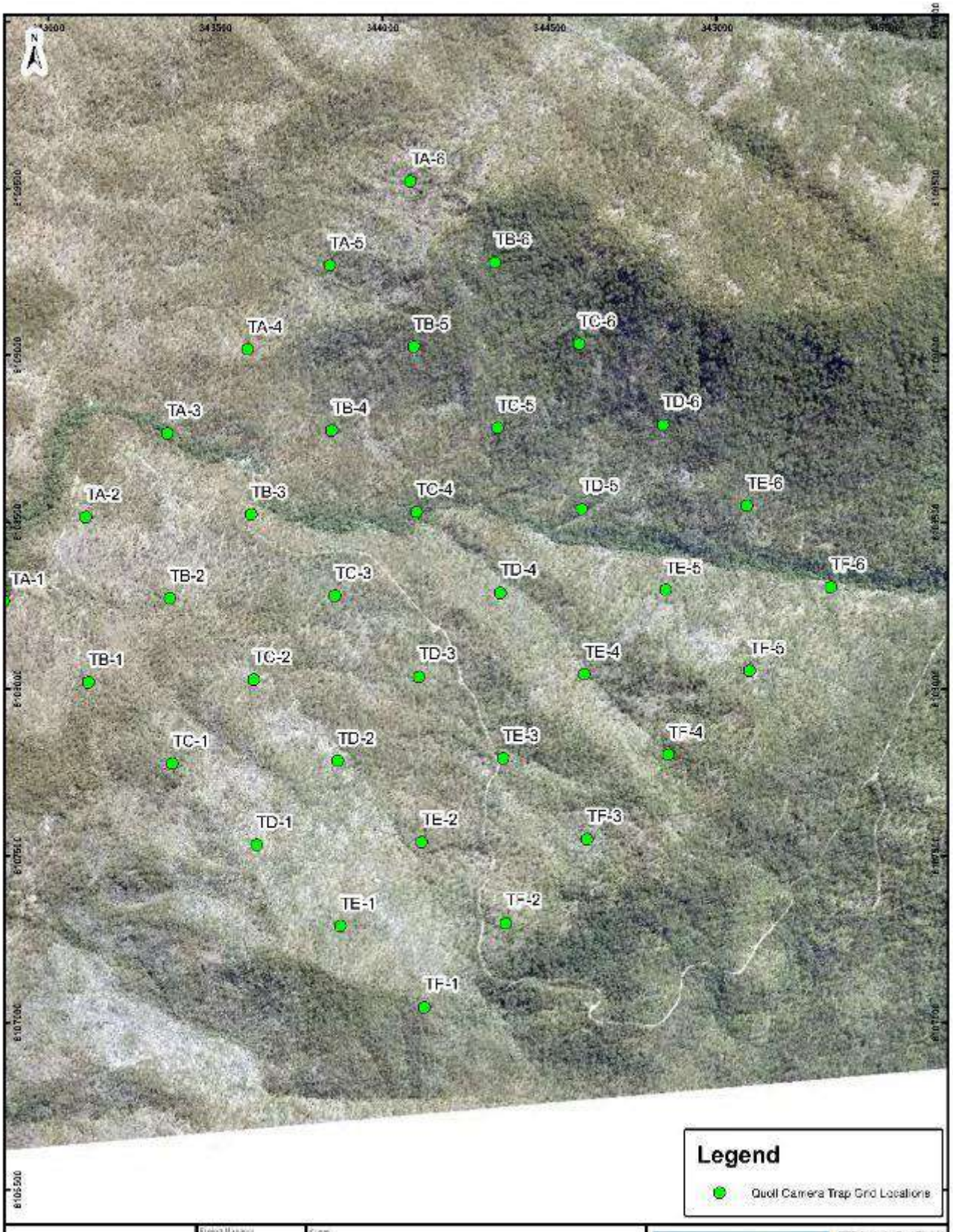

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Compiled by: RMS
Map Projection: MGA/z56
Map Datum: GDA94
File Reference: PR130417-19.mxd
Sheet Number: 1 of 1

Client: RACL

Title: Quoll Camera Trap Grid Locations
Tinaroo Creek Site

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): 1:10,000
DATE: 21/09/2016
DRAWING NO: PR130417-19
REV: C

Project Manager: M. Jess
Compiled by: RMS
Map Projection: MGA/z56
Map Datum: GDA94
File Reference: PR130417-20.mxd
Sheet Number: 1 of 1

Client: RACL

Title: Quoll Camera Trap Grid Locations
Upper Walsh River Site

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): 1:10,000
DATE: 21/09/2016
DRAWING NO: PR130417-20
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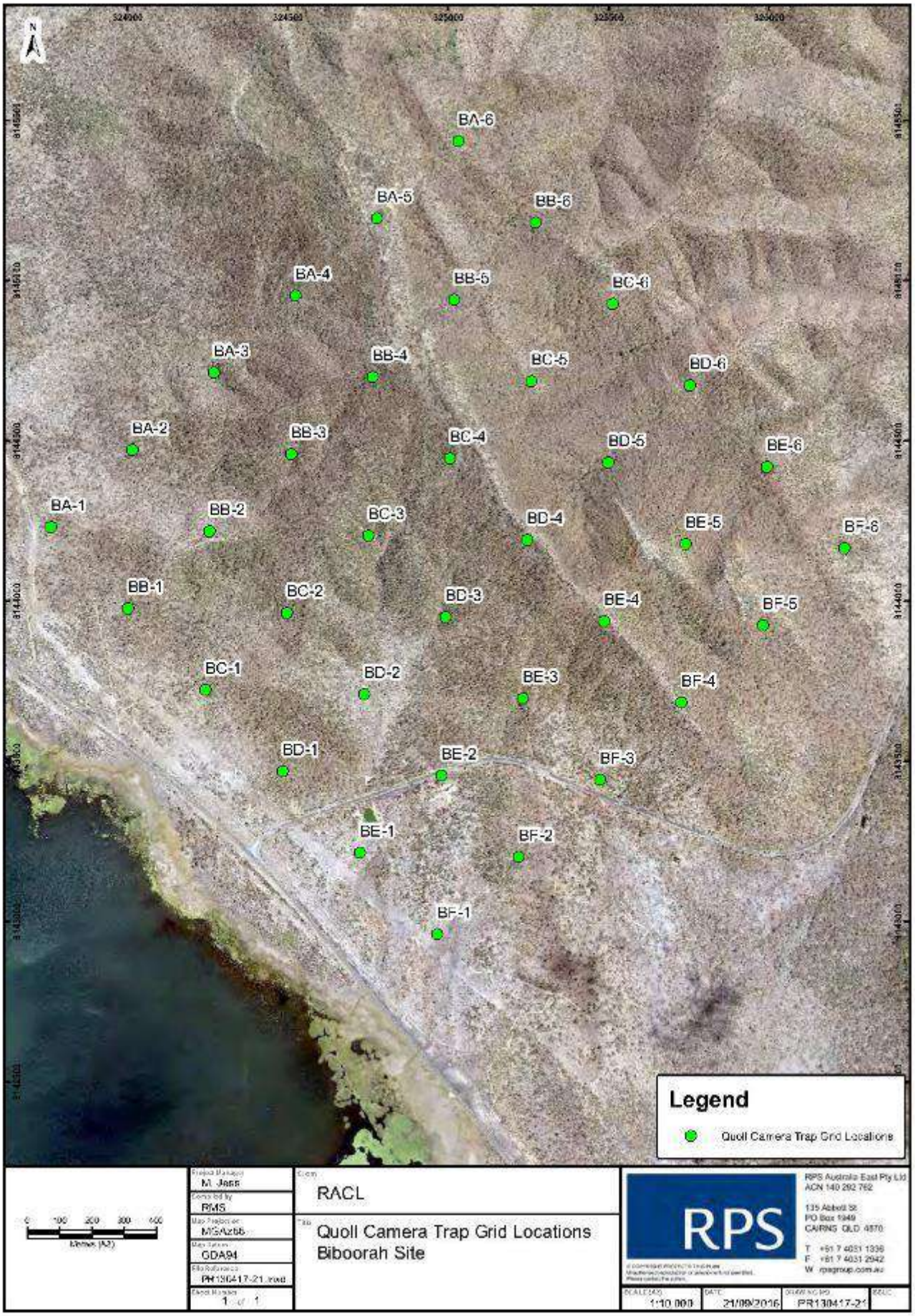
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Legend
Quoll Camera Trap Grid Locations
RACL
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F. APPROVAL OF NORTHERN QUOLL OUTCOMES STRATEGY

Australian Government
Department of the Environment and Energy

Our reference: 2011/6228

Mr Terry Johannesen
Project Manager
RATCH-Australia Corporation Limited
Level 4, 231 George Street
BRISBANE 4000

Dear Mr Johannesen

EPBC 2011/6228 Mount Emerald Wind Farm Proposal, Queensland

Thank you for your letter dated 14 December 2016 to the Department, for and on behalf of Mount Emerald Wind Farm Pty Ltd, requesting approval of the *Mount Emerald Wind Farm, Northern Quoll Outcomes Strategy, December 2016, Document R76073/PR130417-2*.

Officers of the Department have reviewed and advised me on the *Mount Emerald Wind Farm, Northern Quoll Outcomes Strategy, December 2016, R76073/PR130417-2*. On this basis, and as a delegate of the Minister for the Environment and Energy, I have decided to approve the *Mount Emerald Wind Farm, Northern Quoll Outcomes Strategy, December 2016, R76073/PR130417-2*. This plan must now be implemented.

EPBC 2011/6228 condition 29 allows you (under certain circumstances) to implement revised plans without seeking the Minister's approval. If you require any advice on whether or not to submit a revised plan for approval, please contact the officer below. When submitting any revised plan to the Minister under condition 29, please provide a 'tracked changes' version of the plan. I also attach a fact sheet providing guidance on 'new or increased impact' relating to changes to approved management plans under EPBC Act environmental approvals.

Should you require any further information please contact Robin Nielsen, on 02 6274 1004 or by email: post.approvals@environment.gov.au

Yours sincerely

Monica Collins
Assistant Secretary
Compliance & Enforcement Branch
Environment Standards Division
23 Dec 2016

Enc.

G. NORTHERN QUOLL OUTCOMES STRATEGY – SURVEY RESULTS

MOUNT EMERALD WIND FARM – NORTHERN QUOLL MONITORING PROGRAM

SUMMARY OF RESULTS

MONITORING PERIOD: Late 2016 (September/October/November)

Monitoring Grid (refer to Fig. 1)	No. survey points monitored	Survey Period	No. individual quolls detected	Quoll population estimate*	Quoll occupancy#	Quoll detection probability[1]
Mt Emerald Site 1	36	Sept - Oct 2016	10	20	0.52	0.04
Mt Emerald Site 2	36	Sept - Oct 2016	13	25	0.79	0.05
Davies Ck Site, Davies Ck NP	36	Oct 2016	11	18	0.79	0.1
Tinaroo Ck Site, Dinden NP	36	Oct 2016	12	20	0.95	0.04
Upper Walsh River Site	36	Oct - Nov 2016	8	18	0.77	0.05
Biboorah Site	36	Sept - Oct 2016	2	NA	NA	NA

NOTES

*population estimated using spatially explicit capture-recapture modelling.

Occupancy is the proportion of sites (in this case the 36 trail camera monitoring points within each monitoring grid), at which quolls are estimated to occur, given the modelled uncertainty in detecting quolls when they occur at a point. Modelled using Presence software.

[1] Detection probability is the modelled probability of detecting a quoll on each detection opportunity when it is present at a site. Modelled using Presence software.

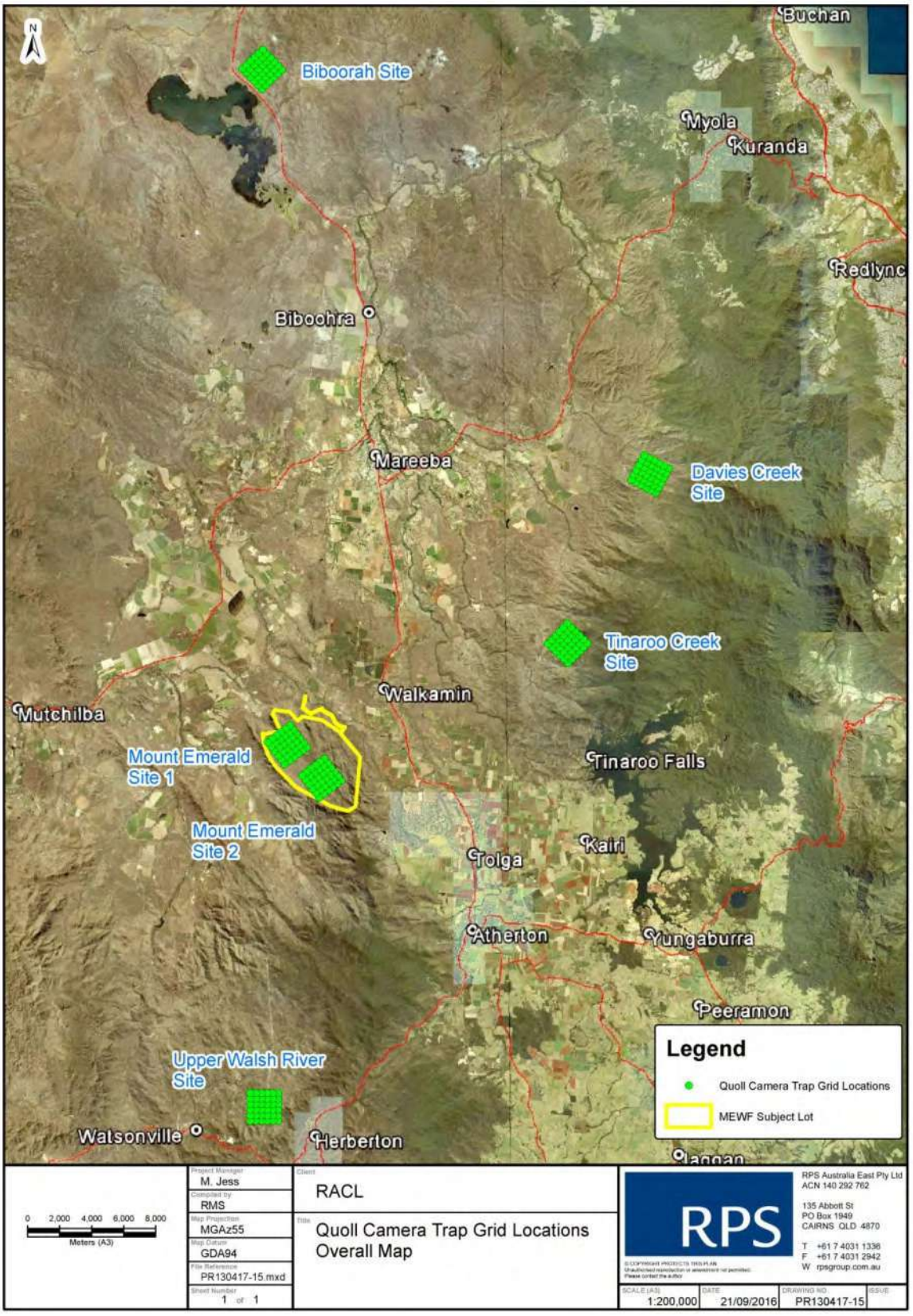

Figure 1 - Indicative locations of the six monitoring grids used to monitor Northern Quoll populations in the northern Atherton Tablelands

NORTHERN QUOLL MONITORING PROGRAM

SUMMARY OF RESULTS

Program Summary

A condition of the Mt Emerald Windfarm approval is that the impacts of the project on populations of the northern quoll *Dasyurus hallucatus* are documented and managed. To this end, a quoll population and habitat monitoring program was established in late 2016.

This monitoring program consists of six camera trapping grids (Fig. 1) located across the northern Atherton Tablelands in North Queensland.

Each monitoring grid consists of a 6 x 6 grid with an approximate spacing of 350m, for a total area of 306ha. This provides a total of 36 trail camera survey points which are monitored continuously for 14 days and nights during each monitoring period.

Quoll habitat monitoring (using the Qld Government's BioCondition Assessment method) is undertaken at a subset of the 36 points on each monitoring grid.

Quoll Identification

Quolls are well suited to population monitoring using trail cameras because every quoll has its own unique spot pattern. By orientating cameras vertically, we always get the same image of each quoll which makes identification of individuals from spots that much easier.

See the photos below for an example of some of the individuals detected during the late 2016 quoll monitoring.

MOUNT EMERALD WIND FARM – NORTHERN QUOLL MONITORING PROGRAM

SUMMARY OF RESULTS: JULY 2017

Monitoring Grid (refer to Fig. 1)	No. survey points	Survey Occasion	No. individual quolls detected	Quoll population estimate (se)[1]	Quoll occupancy (se)[2]	Quoll detection probability (se)[3]
Mt Emerald Site 1	35	July 2017	9	32.6 (17.9)	0.7319 (0.2628)	0.0523 (0.0215)
Mt Emerald Site 2	36	July 2017	8	Insufficient spatial recapture data	0.4841 (0.1591)	0.0739 (0.0269)
Davies Ck Site, Davies Ck NP	36	July 2017	22	Insufficient spatial recapture data	0.8164 (0.2212)	0.0619 (0.0199)
Tinaroo Ck Site, Dinden NP	36	July 2017	26	62 (18.06)	0.6295 (0.0992)	0.1418 (0.0235)
Upper Walsh River Site	36	July 2017	1	Insufficient spatial recapture data	Naïve occupancy 0.02* Insufficient detections for modelling	Insufficient detections for modelling
Brooklyn Sanctuary[4]	36	July 2017	17	60.5 (25.02)	0.4625 (0.1304)	0.0903 (0.0278)

Table 1. Three metrics of quoll abundance and detection probability values for six quoll monitoring sites monitored during July 2017.

NOTES

[1]population estimated using spatially explicit capture-recapture modelling (Efford 2016);

[2] Occupancy is the proportion of sites (in this case the 36 trail camera monitoring points within each monitoring grid), at which quolls are estimated to occur, given the modelled uncertainty in detecting quolls when they occur at a point. Modelled using Presence software (Hines 2006);

[3] Detection probability is the modelled probability of detecting a quoll on each detection opportunity when it is present at a site. Modelled using Presence software (Hines 2006);

[4] The Brooklyn site replaced the Biboorah site from July 2017 onwards;

[*] Naïve occupancy used in this case as insufficient detections were made.

NORTHERN QUOLL MONITORING PROGRAM

SUMMARY OF RESULTS: JULY 2017

Trail cameras were used to collect capture-recapture and site occupancy data on six populations of northern quoll *Dasyurus hallucatus* (Map 1) during July 2017. Eighty-three individual quolls were detected (Table 1) during approximately 3000 camera trap days. Population estimates were able to be generated at half of the sites due to low numbers of spatial recaptures from the other half of sites. Occupancy estimates were able to be generated at all but one site.

Figure 1 - Indicative locations of the six monitoring grids (red diamonds) used to monitor Northern Quoll populations in the northern Atherton Tablelands from July 2017 onwards. Monitoring site names in white text. Local place names in black text. *Basemap: GoogleEarth Pro 9 December 2017*.

The number of quoll individuals detected on each of our 3km^2 sites ranged from 1 to 26. The numbers from the Mt Emerald sites are at the lower end of this range (Table 1). Of the three sites for which population sized could be estimated, the Mt Emerald 1 site had the lowest population size. The occupancy of the Mt Emerald sites is within the range of values at the three control sites for which occupancy could be modelled (Table 1).

References

Efford, M. G. (2016) secr: Spatially explicit capture-recapture models. R package version 2.10.4. http://CRAN.R-project.org/package=secr.

Hines, J. E. (2006). PRESENCE- Software to estimate patch occupancy and related parameters. USGS-PWRC. <http://www.mbr-pwrc.usgs.gov/software/presence.html>.

MOUNT EMERALD WIND FARM – NORTHERN QUOLL MONITORING PROGRAM

SUMMARY OF RESULTS: OCTOBER 2017

Monitoring Grid (refer to Fig. 1)	No. individual quolls detected (naïve occupancy)[1]		Quoll population estimate (se)[2]		Quoll occupancy (se)[3]		Quoll detection probability (se)[4]		Overall trend in Quoll population between sampling occasions
	Oct 2016	Oct 2017	Oct 2016	Oct 2017	Oct 2016	Oct 2017	Oct 2016	Oct 2017	
Mt Emerald Site 1	10 (0.3889)	6 (0.1944)	20 (6.96)	12.64 (6.56)	0.52 (0.11)	0.4474 (0.271)	0.047 (0.02)	0.039 (0.0265)	All abundance metrics downwards
Mt Emerald Site 2	13 (0.5278)	8 (0.25)	25 (7.57)	Insufficient recaptures	0.79 (0.16)	Insufficient data	0.052 (0.018)	0.0179 (0.0059)	All abundance metrics downwards
Davies Ck Site, Davies Ck NP	11 (0.72)	13 (0.42)	17.44 (5.71)	24.3 (7.217)	0.79 (0.08)	0.5144 (0.1125)	0.102 (0.023)	0.11 (0.026)	Abundance upwards, occupancy downwards
Tinaroo Ck Site, Dinden NP	12 (0.6667)	19 (0.6389)	19.16 (5.72)	39.06 (9.79)	0.95 (0.08)	0.98 (0.1867)	0.044 (0.014)	0.073 (0.018)	All abundance metrics upwards or stable
Upper Walsh River Site	8 (0.4848)	0 (0.00)	17.99 (10.57)	No quoll captures	0.77 (0.16)	Insufficient data	0.046 (0.015)	Insufficient data	All abundance metrics downwards
Brooklyn Sanctuary[5]	NA	8 (0.25)	NA	22.93 (10.96)	NA	0.434 (0.1798)	NA	0.059 (0.027)	NA

Table 1. Four metrics of quoll abundance and detection probability values for six quoll monitoring sites, on two comparable occasions, Oct 2016 and Oct 2017.

NOTES

[1] Naïve occupancy is the proportion of sites at which quolls were detected

[2] Population estimated using spatially explicit capture-recapture modelling (Efford 2016);

[3] Occupancy is the proportion of sites (in this case the 36 trail camera monitoring points within each monitoring grid), at which quolls are estimated to occur, given the modelled uncertainty in detecting quolls when they occur at a point. Modelled using Presence software (Hines 2006);

[4] Detection probability is the modelled probability of detecting a quoll on each detection opportunity when it is present at a site. Modelled using Presence software (Hines 2006);

[5] The Brooklyn site replaced the Biboorah site from July 2017 onwards;

MOUNT EMERALD WIND FARM – NORTHERN QUOLL MONITORING PROGRAM

SUMMARY OF RESULTS: OCTOBER 2017

Trail cameras were used to collect capture-recapture and site occupancy data on six populations of northern quoll *Dasyurus hallucatus* (Map 1) during October-November 2017. Fifty-four individual quolls were detected (Table 1) during approximately 3000 camera trap days. Population estimates were able to be generated at two thirds (4/6) of the sites due to low numbers of spatial recaptures at 2 two of the sites. Occupancy estimates were also only able to be generated at two thirds of the sites due to very low detection rates there.

Figure 1 - Indicative locations of the six monitoring grids (red diamonds) used to monitor Northern Quoll populations in the northern Atherton Tablelands from July 2017 onwards. Monitoring site names in white text. Local place names in black text. *Basemap: GoogleEarth Pro 9 December 2017*.

The number of quoll individuals detected on each of our 3km^2 sites ranged from 1 to 19. The numbers from the Mt Emerald sites are at the lower end of this range (Table 1). Of the four sites for which population sized could be estimated, the Mt Emerald 1 site had the lowest population size of any site that could be modelled. Occupancy could only be calculated for one of the Mt Emerald sites (Mt Emerald 1) and was at the lower end of occupancy ranges of any of the six sites (Table 1).

Changes in populations between October 2016 and October 2017

The October 2017 monitoring session marks the first time during this project we have repeat monitoring data from the same season in different years. This is important as quoll abundance, activity and detection probability are likely to vary with seasonal life history stages. Comparative data reveal all indices of northern quoll abundance (no. individuals, proportion of sites detected, modelled population size, and occupancy) have decreased on the two Mt Emerald sites between October 2016 and October 2017 (Table 1, Fig 2).

Interpretation of this with respect to the role of construction activity on quoll populations is ambiguous, as one of the control sites (Walsh) has demonstrated an even more extreme decline in

quoll abundance during the same period (Table 1), effectively disappearing from this site despite no obvious changes in land management there. Metrics of quoll abundance at the other two control sites for which we have comparable data have increased or remained stable during the same period (Table 1).

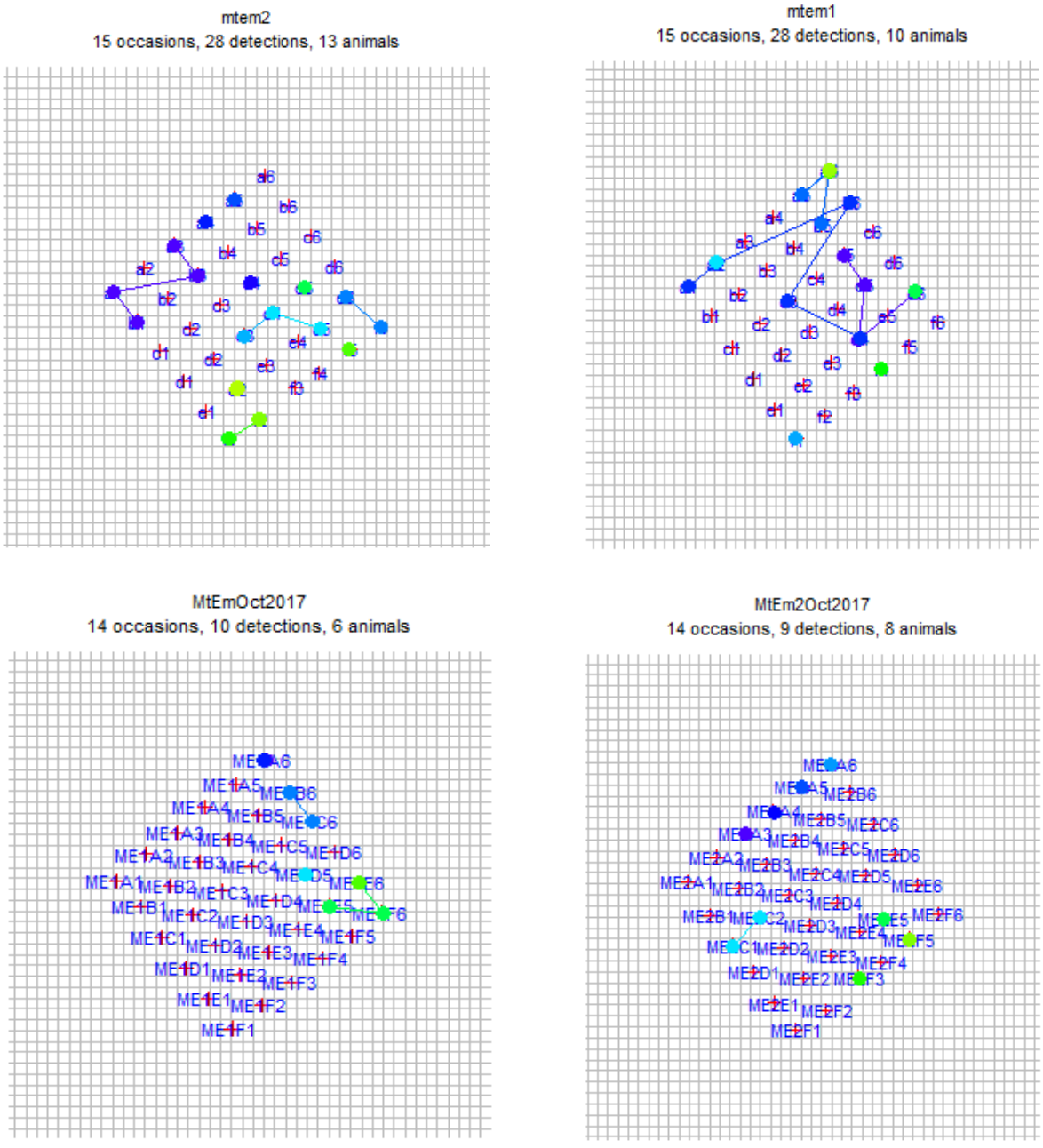

Fig 2. Comparison of detections of northern quolls at Mt Emerald 1 site between October 2016 (top left) and October 2017 (top right), and at Mt Emerald 2 site between October 2016 (bottom left) and October 2017 (bottom right). Labelled red crosses indicate camera trap locations, coloured dots are quoll detections, and coloured lines show movements by individuals between detectors.

References

Efford, M. G. (2016) secr: Spatially explicit capture-recapture models. R package version 2.10.4. http://CRAN.R-project.org/package=secr.

Hines, J. E. (2006). PRESENCE- Software to estimate patch occupancy and related parameters. USGS-PWRC. <http://www.mbr-pwrc.usgs.gov/software/presence.html>.

H. WIND FARM IMPLEMENTATION PLAN – EFFECTIVENESS REPORT

Evaluation of potential mechanisms to reduce turbine collision risk for two species of bats at Mount Emerald Wind Farm, Queensland

Prepared for Ratch Australia

12 April 2017

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Document information

Report to: Ratch Australia

Prepared by: Ian Smales

Biosis project no.: 24523

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Version	Internal reviewer	Date issued
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- Terry Johannsen, Hugh Sangster: Ratch Australia
- Mark Collier: Bureau Waardenburg, Holland

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Executive Summary

This report provides an initial evaluation of the effectiveness of potential measures to reduce the risk for Spectacled Flying-fox and Bare-rumped Sheathtail Bat of colliding with turbines at Mount Emerald Wind Farm in north Queensland.

The assessment provides an initial step in response to a condition of approval for Mount Emerald Wind Farm under provisions of the EPBC Act.

The evaluation takes the form of a desktop review of potential measures that might be applicable to reduction of collision risk for the two species. The review presented here is intended specifically to assess the applicability of potential methods for the two species at the Mount Emerald site so that further consideration of this issue is better informed about methods that may be suitable.

The evaluation reviews low wind speed cut-in of turbines and two possible methods to deter the target species from approaching turbines and eight systems designed to monitor flying vertebrates within close proximity of turbines. Some of the latter systems are intended to reduce potential for collisions by short-term shut-down and re-start of turbines.

The review documents information about the two species and uncertainties about them that are of relevance to consideration of methods to reduce collisions.

The review found that:

- Use of low wind speed turbine curtailment may be applicable although at present no information is available about response to wind speed by the two species of concern. An adaptive management approach to use of this method is recommended. It would use initial controlled experiments in which a subset, or subsets, of turbines are programmed to cut-in at different defined wind speeds and the incidence of collisions by both species is documented to ascertain whether the incidence of collisions differs according to cut-in wind speed. On that basis a determination can then be made about whether low wind speed turbine curtailment would be of value to reducing collisions and if so, what wind speeds should be applied to turbine cut-in.
- Some methods intended to deter bats for approaching wind turbines have been tried overseas. Due to the entirely experimental nature of these possible deterrent techniques, they are not considered to be applicable for the two species of concern at Mount Emerald.
- Current information suggests that systems for turbine shut-down and re-start triggered by radar are not applicable to the specific and individual requirements for reduction of collision risk for the two bat species of concern at Mount Emerald.
- Systems for turbine shut-down and re-start triggered by ultrasonic bat calls are not applicable to Spectacled Flying-fox because the species does not use ultrasonic calls. Current limitations due to inability to obtain consistent, accurate identification of Bare-rumped Sheathtail Bat; call-detection distance relative to size of turbines; and time taken for turbine shut-down, indicate that such systems do not have capacity to achieve meaningful reduction of collision risk for the species.
- Systems using thermal imaging and acoustic sensors do not offer the capacity for automated shut-down and re-start of turbines and are not applicable to reduction of turbine collision risk.

1 Introduction

1.1 Background

Biosis Pty Ltd was commissioned by Ratch Australia to undertake a review and evaluation of mechanisms that might assist in reduction of turbine collision risk for two species of bats at the proposed Mount Emerald Wind Farm in north Queensland.

Mount Emerald Wind Farm was approved under provisions of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) in 2011. Condition 12 of the approval (EPBC 2011/6228) is as follows:

> Prior to commissioning, the approval holder must evaluate the effectiveness of suitable measures, including changed cut-in speed, avian radar system and SCADA system, to avoid and mitigate the impacts of turbine collision to Spectacled Flying-fox *Pteropus conspicillatus* and Bare-rumped Sheathtail Bat *Saccolaimus saccolaimus nudicluniatus* on the wind farm site.

Condition 13 of the approval stipulates that results of the evaluation are to be used to inform a Wind Farm Implementation Plan that is required to be prepared.

Both Spectacled Flying-fox and Bare-rumped Sheathtail Bat were recorded at the site of Mount Emerald Wind Farm during pre-approval investigations (RPS 2013a, b).

The approach adopted by Ratch Australia is to commence the required evaluation with a desktop review of potential measures that might be applicable to reduction of collision risk for the two species. That is provided by this report. The review presented here may be used to determine subsequent steps to be taken in meeting the EPBC Act conditions of approval.

It should be noted that there is no empirical experience with how either Spectacled Flying-foxes or Bare-rumped Sheathtail Bats interact with wind turbines. Overseas experience, and to a limited degree experience elsewhere in Australia, indicates that some species of bats are at some risk of colliding with wind turbines. However, that experience does not include either of the two species in question, nor even other species within the genera *Pteropus* and *Saccolaimus*.

The two species belong to different suborders of bats and differ from each other in many respects.

The Spectacled Flying-fox is a fruit and blossom feeder with a wingspan of about one metre and weight of more than 500 grams. These bats roost in trees in or close to rainforests during daylight in camps of hundreds to thousands of individuals. They fly out nightly to forage and return to the camp and may travel many kilometres in doing so.

The Bare-rumped Sheathtail Bat weights approximately 50 grams. It roosts during daylight, individually or in very small groups, in hollow trees. These bats feed on flying insects and are believed to forage principally above the tree canopy, however little is known of the species biology as it is rarely trapped or recorded during bat surveys.

Both species were recorded at the site of Mount Emerald Wind Farm. Bare-rumped Sheathtail Bat was documented from a relatively small number of species-specific ultrasonic calls recorded there between 2010 and 2013 (RPS 2013a). Spectacled Flying-foxes were also positively identified at the site during both late dry season and late wet season between 2010 and 2013. However the majority of observations made during surveys for that species using night-vision goggles and thermal imaging were not able to consistently or

reliably distinguish Spectacled Flying-fox from Little Red Flying-fox, although one or other, or both of those two species were documented from a broad range of locations across the site.

1.1.1 Detection of bats

Bats are primarily active during the hours of darkness and human observers generally simply cannot see them, particularly within treed environments like the Mount Emerald site. Various technological approaches are therefore necessary to detect their presence. These either use detection of bat calls or some method, such as radar scanning, thermal imaging or night-vision equipment that allows bats to be 'seen'.

Some of these technologies, in particular ultrasonic bat call recorders, have been developed into automated systems that can be deployed to collect data for subsequent analysis to determine whether particular taxa occur at a site. However, call detectors are applicable only to species that emit ultrasonic calls and because they record calls, they do not provide information about how many individuals of any species were present. They are generally limited by the capacity of microphones to distances of about 20 – 30 metres. Radar is not able to differentiate between similar-sized flying objects and does not have capacity to distinguish different species of similar-sized bats from each other or from similar-sized birds. Thermal imaging and night-vision gear are both significantly limited by distance, obstacles like trees, and the need for human observers to be present. They also do not generally allow an observer to distinguish between species that are similar in size and behaviour.

1.2 Objective of the current review & evaluation

The objective of this report is to provide a desktop review of available information about potential methods to reduce turbine collision risk, principally by techniques that curtail the operation of turbines when flying fauna enters a zone close to the turbine(s). The review has evaluated existing information about methods and systems specifically in light of knowledge about the Spectacled Flying-fox and Bare-rumped Sheathtail Bat and the Mount Emerald Wind Farm site.

1.3 Information sources and limitations

The review and evaluation here have been informed by literature information about Spectacled Flying-foxes and Bare-rumped Sheathtail Bats and specifically reports prepared for the Mount Emerald Wind Farm (RPS 2013a, b). It has also taken account of understanding of the Mount Emerald site gleaned from first-hand visits by Biosis zoologists, Ian Smales and Daniel Gilmore in 2012. Nonetheless, knowledge of the biology of the two species, particularly the Bare-rumped Sheathtail Bat, and of the potential turbine collision risk for both species is limited and this review necessarily entails a degree of informed professional judgement.

None of the techniques aimed at reducing potential collision risk that are considered here have been employed at wind energy facilities in Australia. As a consequence, the review has collated information from a variety of sources, all of which are overseas. Most of the information about technical systems intended to reduce collision risk has been sourced from specifications provided in publications or websites of developers/manufacturers. Biosis does not have first-hand experience with any of the techniques and the review is thus reliant on the veracity of the information obtained.

Valuable independent and comparative evaluations of a number of systems for reducing collision risk for birds and bats have been made by Collier et al. (2011, 2012) and Birdlife International (2015). Those reviews were focussed on birds and the Collier et al. investigation was specifically related to offshore wind farms. Nevertheless, much of the information they contain about the technical aspects of different systems is informative for the present review which has been tailored to consider bats at the Mount Emerald site.

2 Consideration of potential collision risk & risk reduction for Spectacled Flying-fox & Bare-rumped Sheathtail Bat

As outlined above there is no empirical information from operating wind farms about turbine collision risk for either Spectacled Flying-fox or Bare-rumped Sheathtail Bat. As a consequence, while both species have been recorded at the site of Mount Emerald Wind Farm, the actual risk that turbines there may pose to either species is not known and there are numerous uncertainties entailed in consideration of this risk. It is also the case that the two species of concern are very different in numerous respects and the evaluation of possible means to reduce collision risk requires a good comprehension of how such differences might influence a choice, or choices of suitable methods.

Uncertainties are not only due to the lack of experience with the two species at existing wind farms. They also are the result of very limited general understanding of behaviour and biology, especially in the case of the Bare-rumped Sheathtail Bat. Despite substantial survey effort for the two species at the site (RPS 2013a, b), there is still very little information about how either species uses the site.

The uncertainties associated with the two species of concern must be taken into account when evaluating possible means to minimise collision risk for them. The evaluation presented in this report is substantially informed by information about other species of bats at wind farms and all of this is from the northern hemisphere. That information is almost entirely confined to small insectivorous bats and there is no known experience or experimental data about turbine collisions for any species of flying-fox. It is also notable that in North America significant mortality of small bats is associated with species that make long-distance annual migrations. In common with Australian bats generally, neither of the two species of concern at Mount Emerald are long-distance migrants.

We consider that the following, drawn from general knowledge of the two species, may be relevant to consideration of collision risk and of methods to reduce that risk for them at Mount Emerald Wind Farm.

2.1.1 Spectacled Flying-fox

The Spectacled Flying-fox is a fruit and blossom feeder with a wingspan exceeding one metre and weight of more than 500 grams. These bats roost in trees in or close to rainforests during daylight in camps of hundreds to thousands of individuals. They fly out nightly to forage and return to the camp and may travel many kilometres in doing so.

Spectacled Flying-foxes were positively identified at the site during both late dry season and late wet seasons between 2010 and 2013. However the majority of observation made during surveys for the species using night-vision goggles and thermal imaging were not able to consistently or reliably distinguish Spectacled Flying-fox from Little Red Flying-fox *Pteropus scapulatus* (RPS 2013b). As a result, although one or other of these flying-fox species was documented from a broad range of locations across the site, the actual utilisation of the site by Spectacled Flying-foxes is poorly understood. It is possible that Black Flying–fox *Pteropus alecto* may also occur at the site.

Spectacled Flying-foxes frequently make flights during daylight in the immediate area in which they roost, however there is no suitable habitat for daytime roost camps of the species on the site so collision risk for it will be essentially confined to the overnight period from dusk until dawn.

Crepuscular and nocturnal flights by Spectacled Flying-foxes may cover several tens of kilometres but they are principally for the purpose of moving to and from sources of food. A Spectacled Flying-fox was recorded by

RPS (2013b) feeding at blossom on the site and it is expected that the species makes flights associated with foraging within the site when appropriate tree species are in flower.

If, or when no foraging opportunities are present on the site, Spectacled Flying-foxes may fly through or over the site to reach food sources beyond it. It is possible that such commuting flights may be concentrated on particular periods of the night (possibly close to dusk and prior to dawn), but that has not been determined.

The heights at which Spectacled Flying-foxes routinely fly are not known and attempts to determine them using night vision equipment and thermal imaging at the site were not successful (RPS 2013b). Flights above or below turbine rotor-swept height do not represent a collision risk. The risk of collision will be substantially influenced by the heights of the species flights at the site.

Similarly, it is not known how flight activity of Spectacled Flying-foxes is correlated with wind speed, but they are large, powerful flyers and are not likely to be affected by relatively small changes in wind speed to the extent that some species of small bats are.

Flying-foxes use their excellent colour vision as their primary means for navigation in flight. They do not echolocate using ultrasonic calls. Consequently, it is likely that their capacity to actively avoid collisions with turbines may be similar to that of crepuscular and nocturnally-flying birds and less like that of insectivorous bats that primarily use echolocation to navigate.

2.1.2 Bare-rumped Sheathtail Bat

The Bare-rumped Sheathtail Bat weights approximately 50 grams. It roosts during daylight, individually or in very small groups, in hollow trees. These bats feed on flying insects, however little is known of the species biology as it is rarely trapped or recorded during bat surveys.

Bare-rumped Sheathtail Bat was recorded at the Mount Emerald Wind Farm site from a relatively small number of species-specific ultrasonic calls recorded there between 2010 and 2013. A small number of additional calls detected may have been from this or one of three other species (RPS 2013a). Bare-rumped Sheathtail Bat was one of 17 microchiropteran bat species documented with a high degree of confidence at the site and a further three to six species were possibly recorded there (RPS 2013a).

Small groups of Bare-rumped Sheathtail Bats roost in hollows in large eucalypts during daylight hours. They are believed to forage principally above the tree canopy. *Saccolaimus* bats are thought to have capacity to travel substantial distances from roost locations to forage but it appears that the Mount Emerald site offers habitat suitable for all the requirements of the species and it is likely to be resident there. It is thus possible that the species may fly widely within the site on almost any night when weather conditions are suitable.

Distinguishing sonograms of recorded calls of Bare-rumped Sheathtail Bat from other species of *Saccolaimus* and of Beccari's Freetail Bat *Mormopterus beccarii* has proven difficult and many calls cannot be ascribed to a particular species with complete certainty. Use of full spectrum detectors has somewhat improved this because they have capacity to provide more information on call harmonics that are useful in discriminating the species, than could generally be obtained from zero crossed based systems. However capture of calls that have sufficient definition for this purpose is substantially reliant on the bat flying close enough to the detector microphone for the relevant parts of the call signal to be recorded.

Other methods to survey for the species include mist-netting using nets set high within or above the tree canopy and targeted searches for roost sites in trees with large hollows (Commonwealth of Australia 2010). Both would present challenges at the Mount Emerald Wind Farm site and, while such surveys might provide further information about presence of the species there, neither would be likely to offer additional information about the risk of Bare-rumped Sheathtail Bat collisions with turbines.

Due to the high number of other small species of bats that are known to use the site the capacity to distinguish the Bare-rumped Sheathtail Bat from other species is almost certainly limited to detection of bat-calls. Methods such as use of thermal imaging do not offer the capacity to discriminate between the various species present.

The heights at which Bare-rumped Sheathtail Bats routinely fly are not known although they are believed to forage for aerial insects mainly above tree canopy height (Churchill 2009). Flights above or below turbine rotor-swept height do not represent a collision risk. The risk of collision will be substantially influenced by the species flight-height at the site.

Some small species of bats have been shown to reduce their flight activity in response to relatively minor changes in wind speed and to have a preference for still nights or those with quite low wind speed. This aspect is not known for the Bare-rumped Sheathtail Bat.

Bare-rumped Sheathtail Bats echolocate using ultrasonic calls as their primary means for navigation in flight.

Calls of Bare-rumped Sheathtail Bats were not common when compared with those of some other small bat species encountered during surveys at the site (RPS 2013a). This agrees with a general low encounter rate despite the distribution of the species in Australia which extends along much of the coastal zone of northern Queensland.

3 Pre-emptive methods to reduce risk

A number of methods have the potential to reduce the incidence of bats colliding with turbines by acting pre-emptively to reduce the exposure of flying bats to the turning rotors of operational wind turbines. These include:

- Setting the minimum wind-speed at which turbines begin to operate (turbine 'cut-in' wind-speed) at a level above the range of wind-speeds during which the species of concern spends most time in flight.
- Using methods that may actively dissuade bats from approaching turbines.

3.1 Turbine cut-in wind-speed

A number of investigations overseas have demonstrated that small species of bats prefer to fly when wind speeds are relatively low. As a consequence, some studies have investigated whether a reduction in bat fatalities due to turbine collision can be achieved by the relatively simple measure of programming night-time operation of turbines so that they cut-in only after a wind speed is reached that is above the speed at which the species of concern spends most time in flight. This is generally termed 'low wind speed turbine curtailment'.

Low wind speed curtailment has been demonstrated to be an effective operational measure to reduce fatalities of migratory, tree roosting bat species, including the Hoary Bat *Lasiurus cinereus*, at wind farms in the mainland U.S.A. and in Canada (Arnett et al. 2009, 2010; Baerwald et al. 2009; Good et al. 2012; Young et al. 2011). In some jurisdictions of the USA and Canada turbine cut-in speed has been mandated with a view to reducing collisions of migratory bats.

The cited studies have compared numbers of bat collision fatalities found under turbines with and without low wind speed curtailment. By way of example, Arnett et al (2009) found that the estimated total bat fatalities per turbine (i.e. all carcasses found and corrected for field bias) were 1.23–4.68 times greater (mean = 2.34) at non-curtailed turbines relative to turbines where cut-in wind speeds were 5.0 metres/second (m/s) or 6.5 m/s. They quantified the loss of power output resulting from the experiment as amounting to approximately 2% of total project output during the 76-day study period (corresponding to the season of greatest local activity for the species of concern) for the 12 turbines. Hypothetically, if the experimental changes in cut-in speed had been applied to all 23 turbines at the site for the study period (0.5 hour before sunset to 0.5 hour after sunrise for the 76 days studied), the 5.0 m/s curtailment used would have resulted in lost output equalling 3% of output during the study period and only 0.3 % of total annual output. If the 6.5 m/s curtailment were applied to all 23 turbines during the study period, the lost output would have amounted to 11% of total output for the period and 1% of total annual output.

More recently, Forcey et al. (2016) conducted a 2-year study at Raleigh Wind Energy Center in southwestern Ontario to compare bat mortality at wind turbines curtailed at 3.5 m/s vs 4.5 m/s (2014) and 4.0 m/s vs 4.5 m/s (2015). In 2014, bat mortality at turbines with a 3.5 m/s cut-in speed were significantly higher than turbines curtailed at 4.5 m/s across all species ($P = 0.001$). During 2015, bat mortality at turbines curtailed at 4.0 m/s was similar to mortality at turbines curtailed at 4.5 m/s ($P > 0.10$). As the 2015 study did not show significant differences in estimated bat mortality between 4.5 m/s and 4.0 m/s cut-in speeds, they suggest that implementing the 4.0 m/s cut-in speed compared to a 4.5 m/s cut-in speed would not increase estimated bat mortality, but would increase the electricity generated at the project through increased operational time, while keeping the mortality below a prescribed threshold.

At two wind farms in Hawaii, Snetsinger et al. (2016) found that low wind speed turbine curtailment did not always coincide with reduced mortality of Hoary Bats, but that it did in some seasons and they recommended the application of curtailment.

Additionally, some recent investigations have considered refinements to the simple blanket measure of a low wind speed turbine curtailment at a particular wind speed.

For example, Sutter et al (2016) conducted a study to determine if using real-time measures of bat activity at Blue Sky Green Field wind facility near Fond du lac, Wisconsin could be used in combination with weather conditions as an appropriate trigger for curtailment to reduce bat fatalities and increase operational time during the fall migratory season of relevant species. The model operated turbines showed an 83% reduction in overall bat fatalities and a 90% reduction in fatalities of *Myotis* species as compared to the normally operating turbines. The number of curtailed hours was slightly less (9%) under the model scenario than a 5.5 m/s cut-in speed scenario but was substantially less (35%) than if a 6.9m/s cut-in speed had been employed. The results of the survey also showed a strong correlation between bat activity and mortality, validating the use of activity data to inform mitigation.

Huso and Maurer (2016) outline a study they have commenced to assess whether other factors that reduce bat flight activity, such as high precipitation, low temperatures, high humidity, dropping barometric pressure, could also be taken into account to reduce loss of revenue without compromising the reduction in bat mortality.

Potential applicability of low wind speed turbine curtailment at Mount Emerald Wind Farm	
Spectacled Flying-fox	• Preferred wind speed for the species flight activity has not been determined but could likely be ascertained through observational study on or off the site. • Given the size and powerful flight capacity of the species, it is unlikely that it is substantially limited by the general range of local ambient wind speeds and it is not known whether low wind speed turbine curtailment would be particularly effective in reducing risk of collisions by the species.
Bare-rumped Sheathtail Bat	• Given the relatively small size of the species it is likely that it does preferentially fly during periods of low wind speed. • Preferred wind speed for the species flight activity has not been determined and because the species is infrequently encountered it is unlikely that any correlation could be readily documented. • In the absence of an understanding of actual relevant wind speeds suitable for the species, specifying any particular turbine cut-in speed would be arbitrary and there would be no guarantees of its efficacy for reducing collision risk for the species. • If low wind speed turbine curtailment was to be considered as a purely precautionary measure for Bare-rumped Sheathtail Bat it would be important for Ratch Australia to first model the effects on electricity production of various cut-in speeds, based on existing wind data from the site. This should then be assessed against the possibility of significant impacts on the species (as defined for the purposes of the EPBC Act).

General comments	• The possible value of low wind speed turbine curtailment has not been tested in Australia. Neither of the two species of concern at Mount Emerald are migratory species and that behaviour appears to have been particularly relevant to other bat species collision risk in the northern hemisphere. • Low wind speed turbine curtailment is not applicable during daylight hours. • It does not seem likely that the technique would substantially affect the incidence of collisions by Spectacled Flying-foxes.
RECOMMENDATIONS	**Under prevailing uncertainties, we recommend adoption of an adaptive management approach in which any incidence of collisions by either species during operation of the wind farm are assessed to determine whether they correspond with wind speed. It would use initial controlled experiments in which a subset, or subsets, of turbines are programmed to cut-in at different defined wind speeds and the incidence of collisions by both species is documented to ascertain whether the incidence of collisions differs according to cut-in wind speed. On the basis of the results of that experimental exercise a determination can then be made about whether low wind speed turbine curtailment would be of value to reducing collisions. If it is, it should be implemented with a clearly defined cut-in speed and a set of other circumstances when that cut-in speed is not applicable.**

3.2 Deterrence from proximity of turbines

3.2.1 Ultrasound noise

Arnett et al. (2013) undertook experiments at an operational wind farm to evaluate the effectiveness broadcasting ultrasound noise with the intent of deterring bats that rely on their own emission of ultrasound for navigation and foraging. They found a general, but variable reduction in fatalities of Hoary Bats and Silver-haired Bats *Lasionycteris noctivagans* at treatment turbines when compared with control turbines. They also found that effectiveness of ultrasonic deterrents was limited by distance and area covered by broadcast ultrasound and that this was, in part due to rapid attenuation in humid conditions. They caution that an operational deterrent device was not yet available and further modifications and experimentation were needed. They recommended that further assessment was required to determine cost effectiveness of deterrents in relation to curtailment strategies.

3.2.2 Ultraviolet lighting

Gorresen et al (2015) carried out a trial in which they illuminated trees with dim flickering ultraviolet light in areas frequented by Hawaiian Hoary Bats *Lasiurus cinereus semotus*, an endangered subspecies affected by wind turbines, to ascertain whether this would reduce their flights in proximity to the illuminated trees. They used a repeated-measures design to quantify bat activity near trees with acoustic detectors and thermal video cameras in the presence and absence of ultraviolet illumination, while concurrently monitoring insect numbers. Results indicated that dim UV did reduce bat activity despite an increase in insect numbers. However, the experimental treatment did not completely inhibit bat activity. This method is not known to have been tried on operational wind turbines and for the present this method can be considered to be purely experimental.

Potential applicability of deterrence from proximity of turbines at Mount Emerald Wind Farm	
Spectacled Flying-fox	• The species does not use ultrasonic echolocation and broadcast of ultrasound is not likely to act as a deterrent for the species. • The capacity for the species to see or respond to ultraviolet light is not known and it would require significant responses to test the value of this as a deterrent.
Bare-rumped Sheathtail Bat	• The species uses ultrasonic echolocation but because the species is infrequently encountered it is unlikely that its response to broadcast of ultrasound can be tested. • The capacity for the species to see or respond to ultraviolat light is not known and it would require significant responses to test the value of this as a deterrent.
General comments	• These techniques are the subject of experiments only and are entirely untested for the two species of concern at Mount Emerald.
RECOMMENDATIONS	**Due to the entirely experimental nature of these possible deterrent techniques, they are not considered to be applicable for the two species of concern at Mount Emerald. It is recommended that they be reconsidered only if controlled experiments overseas prove their efficacy in the context of operational commercial scale wind energy facilities.**

4 Automated systems to reduce collision risk

This section of the report provides a review of various automated systems that have been developed to monitor the presence of birds and bats in proximity to wind turbines and where a collision risk is considered likely.

Condition 12 of the EPBC Act approval for Mount Emerald Wind Farm requires assessment of methods to avoid and/or mitigate the impacts of turbine collisions on the two species of bats. The majority of systems reviewed here are designed to do that by using some type of monitoring that is linked to an automated mechanism for shut-down and re-start of turbine(s). All turbines have existing SCADA (supervisory control and data acquisition), or similar control mechanisms for shut-down and re-start in response to wind conditions. In the course of the review, it was apparent that some systems have been designed for the more simple purpose of recording and documenting collisions but they have been included for completeness of the review.

This section covers systems that use radar, recording of ultrasonic bat calls, infrared imaging and others, some of which are a combination of different systems. The substance of the review comparing these systems is contained in tables 1 – 3. The tables set out information collated from the review for multiple aspects that are considered relevant in evaluating the applicability of each system to reduction of potential turbine collisions by the two species of bats at Mount Emerald Wind Farm.

Condition 12 of the EPBC Act approval for Mount Emerald Wind Farm specifically requires consideration of whether SCADA is a part of the turbine curtailment system. SCADA refers to software application programs for process control and the gathering of data in real time from remote locations in order to control equipment. Automated turbine curtailment systems require a mechanism to detect a bat that may be at risk (usually because it has entered a prescribed distance from the turbine) and use the detection as a trigger to shut down the turbine, or turbines, until the bat is no longer within the danger zone. SCADA, or equivalent, would be integral to functioning of the system by eliminating the need for monitoring or response intervention by human controllers. In practice it is most likely that a control system for response to the presence of the target species of bats at Mount Emerald would be integrated into the existing SCADA system that controls turbines in response to weather.

Information from the manufacturers of two systems (DeTect Merlin Radar and ID Stat) was included with EIS documentation for Mount Emerald Wind Farm.

4.1 Radar

Radar uses radio waves to scan a given radius to detect objects within the airspace. Simultaneous use of horizontal and vertical surveillance radars allows scanning in three dimensions. Where the surrounding terrestrial landscape has a complex topography or multiple obstacles such as trees or buildings, this 'clutter' renders radar ineffective for detecting targets that are close to the ground or amongst those obstacles.

Radar has a substantial history of use for detection of flying birds and bats and is widely used at airports to reduce aircraft bird- and bat-strikes. Radar can, and has been used at wind farms to obtain good information about the overall use of the local airspace by birds and bats, but its application to reduction of collision risk requires a substantial additional system. Three commercially available radar systems specifically supplied for use at wind farms are considered in table 1.

Radar does not have intrinsic capacity to distinguish particular species and does not readily distinguish large objects (like a single large animal) from a tight cluster of smaller objects (like a small flock of birds or insects), but with local experience it is possible to categorise flying animals into basic size classes. Radar has now been in use at various wind farms, primarily in the northern hemisphere, for the purpose of reducing collision risk. Available information about use of radar for this purpose suggests that its primary applications are where the species of concern are large birds or flocks of birds that are approaching a wind farm from outside its boundaries. It has been of value in detecting the approach of migrating flocks of birds or of individuals of large species like eagles, vultures or cranes. This type of application is of particular relevance where such events may occur seasonally or infrequently and a turbine shut-down can be used to reduce collision risk while the animals pass through the wind farm.

As radar can detect flying animals more comprehensively and at a greater distance than can human observers, it certainly has value in alerting to their presence, location and flight speed. However, confirmation of the identity of species will usually require the simultaneous use of a complementary method, such as human observers, or another automated detection system. The Robin 3D Flex Bird Radar system has complementary Frequency Modulation Continuous Wave (FMCW) radar which is designed to measure the wingbeat pattern and frequency of a single target. However, for the system to be able to use these to identify a species of concern its signature wingbeat pattern must be known and it must be different from that of other local species.

In order for radar to be of use as a trigger for an automated turbine shut-down to reduce collisions by Spectacled Flying-foxes or Bare-rumped Sheathtail Bats at Mount Emerald Wind Farm, it would either need to be able to distinguish them from other similar species in close proximity to a turbine or it would be necessary to adopt an approach in which shut-down would be acceptable when any similar species was detected. Neither of these scenarios appears to be workable.

Potential applicability of radar systems to reduce collision risk for target bats at Mt Emerald Wind Farm	
Spectacled Flying-fox	• Relative to most other nocturnal flying animals at the site, Spectacled Flying-foxes are large and would be likely to be detected by a radar system. However, it is unlikely that the species could be distinguished from other species of flying-fox or some birds, like owls. Surveys at the site that used more discriminating technologies were not able to distinguish between two species of flying-fox, so it is almost certain that radar would also not be able to do so. • It may be possible to identify an approaching group as Spectacled Flying-foxes if it was feasible to co-ordinate observation of them leaving a nearby roost camp, but this would have limited value if more than one species was subsequently using the site during the night, as was found to be the case during bat surveys at the site (RPS 2013b). • A precautionary approach in which turbine shut-down would be triggered by radar detection of any species of equivalent size to a Spectacled Flying-fox, would seem unlikely to be workable because the one or two other local flying-fox species appear to be prevalent at the site and it is thus likely that such a protocol would trigger many unnecessary shut-downs.
Bare-rumped Sheathtail Bat	• The species is one of at least 17 species of small insectivorous bat species known to use the site. It is certain that standard radar would not be able to discriminate Bare-rumped Sheathtail Bats from all of them, or possibly from any of them. • It is possible that radar designed to measure the wing-beat pattern and

	frequency of Bare-rumped Sheathtail Bats might have the ability to distinguish it from other bats at the site, although it is unlikely that it would distinguish it from other *Saccolaimus* species that use the site. Before that method could be implemented a significant and complex study would first be required to determine the wing-beat pattern of all small bats using the site. In light of the fact that the species of concern is rarely encountered during bat surveys, such a study would likely take years and would have no guarantee of success. • A precautionary approach in which turbine shut-down would be triggered by radar detection of any species of equivalent size to a Bare-rumped Sheathtail Bat would be unworkable because of the multiple other similar species that would trigger frequent unnecessary shut-downs.
General comments	• Radar does not appear likely to offer a workable mechanism as a trigger for turbine-shut down for the two bats species of concern at Mount Emerald Wind Farm due to its lack of capacity to distinguish the species of concern and the many other similar species known from the site. • The necessity of using a complementary system with radar, such as imaging or bat-call detection to identify species, indicates that radar itself would be superfluous.
RECOMMENDATIONS	**Current information suggests that radar systems are not applicable to the specific and individual requirements for reduction of collision risk for the two bat species of concern at Mount Emerald.** **Further information could be sought from suppliers of radar systems to ascertain whether any recent refinements can demonstrably overcome to difficulties outlined above for the specific application to both species of bats at Mount Emerald.**

Table 1 Summary review of radar systems

SYSTEM	DeTect MERLIN Avian Radar System	Robin 3D Flex Bird Radar	STRIX Birdtrack
System owner/supplier	DeTect International, 5801 Lee Highway Arlington, Virginia 22207 USA.	Robin Radar systems, Mercuriusweg 1-A, 2516AW, The Hague, The Netherlands.	STRIX Rua Roberto Ivens, 1314 1º sala 15 4450 – 251 Matosinhos, Portugal.
Information currency	2017	2017	2017
Overview	Simultaneous horizontal & vertical radar providing data on flight heights & horizontal distance from unit. Linked to an automated individual turbine shutdown & restart under site-specific protocol.	Simultaneous horizontal & vertical radar providing data on flight heights & horizontal distance from unit. Linked to an automated individual turbine shutdown & restart under site-specific protocol.	Simultaneous horizontal & vertical radar providing data on flight heights & horizontal distance from unit. Linked to an automated individual turbine shutdown & restart under site-specific protocol.
System incorporates automated turbine curtailment and re-start	Yes	Yes	Yes
Monitoring system	Simultaneous horizontal & vertical radar.	Simultaneous horizontal & vertical radar.	Simultaneous horizontal & vertical radar.
Basic purpose			
Detect & record collision	No	No	No
Detect & record presence in danger zone (within a prescribed distance of rotor)	Yes	Yes	Yes
Development status			
Fully field tested & operational, commercially available	Yes	Yes	Yes
Fully developed & field tested, not yet commercially available			
In development, not yet fully tested			
Coverage (relevant to target bat species)			
Capacity to cover entire wind farm turbine array	1 - 2 units	1 - 2 units (?)	1 - 2 units (?)
Individual turbines (requires deployment on every turbine to achieve coverage of entire array)	No	No	
Management system	SCADA	Can be controlled remotely. System not specified.	Can be controlled remotely. System not specified.
Detection capacity/coverage			

SYSTEM	DeTect MERLIN Avian Radar System	Robin 3D Flex Bird Radar	STRIX Birdtrack
Entire turbine	Yes	Yes	Yes
Entire rotor			
Portion(s) of turbine/rotor only			
Diurnal/nocturnal/weather detection			
Diurnal detection	Yes	Yes	Yes
Nocturnal detection	Yes	Yes	Yes
Affected by rain/fog	Potentially	Potentially	Potentially
Species discrimination capacity			
Potential to discriminate to species level	No	Possibly if FMCW system is functional (see below)	No (?)
Potential to discriminate weight/size class	Limited		Limited
Likely general limitations for application at Mt Emerald site	Complex topography of site & tree cover may 'clutter' or obscure some turbines from full radar coverage. This would need to be ascertained from full field trials and micro-siting of units. It is likely that at least 2 units (& possibly more) would be required for coverage of all turbines.	Complex topography of site & tree cover may 'clutter' or obscure some turbines from full radar coverage. This would need to be ascertained from full field trials and micro-siting of units. It is likely that at least 2 units (& possibly more) would be required for coverage of all turbines.	Complex topography of site & tree cover may 'clutter' or obscure some turbines from full radar coverage. This would need to be ascertained from full field trials and micro-siting of units. It is likely that at least 2 units (& possibly more) would be required for coverage of all turbines.

SYSTEM	DeTect MERLIN Avian Radar System	Robin 3D Flex Bird Radar	STRIX Birdtrack
Potential limitations for two species of bats at Mt Emerald	The system cannot discriminate taxa. The system is not likely to be able to discriminate the Spectacled Flying-fox from other flying-fox species nor the Bare-rumped Sheathtail Bat from numerous other more abundant small bats at the site. For both target species, recognition capacity may improve with accumulated experience if the system is used in combination with methods such as simultaneous and complementary use of thermal imaging, acoustic detection. However, those systems can operate without radar and radar itself would thus seem to be unnecessary	The system has complementary Frequency Modulation Continuous Wave (FMCW) radar which can be used to measure the wingbeat pattern and frequency of a single target. Combined with other variables like reflection size and flight behaviour (may require simultaneous complementary studies), this provides some capacity for distinction between species. It is not currently known whether the Spectacled Flying-fox or Bare-rumped Sheathtail Bat have 'signature' wingbeat frequencies that would permit them to be discriminated from other bats at the Mt Emerald site. Given the large number of other species there, a major, long-term investigation would be required to obtain the required information and it would have no guarantee of success.	The system cannot discriminate taxa. The system is not likely to be able to discriminate the Spectacled Flying-fox from other flying-fox species nor the Bare-rumped Sheathtail Bat from numerous other more abundant small bats at the site. For both target species, recognition capacity may improve with accumulated experience if the system is used in combination with methods such as simultaneous and complementary use of thermal imaging, acoustic detection. However, those systems can operate without radar and radar itself would thus seem to be unnecessary

4.2 Ultrasonic bat-call detection

Recording of ultrasonic bat calls is undertaken routinely in surveys for bats and was used as the primary means of survey for small bats at the Mount Emerald Wind Farm site (RPS 2013a). The use of detected bat-calls to trigger turbine shut-down to reduce collision risk requires a substantial additional system. Two commercially available systems using ultrasonic bat-call detection specifically designed for use at wind farms are considered in table 2.

Spectacled Flying-foxes do not make ultrasonic calls and this method is not applicable to that species.

The calls of most microchiropteran bats are characteristic for individual species and sonograms of ultrasonic calls can be used to identify species. However, the calls of some closely related species in Australia are difficult to distinguish. Bat-call detectors function by recording the calls of bats flying within proximity of the detector microphone. Detector technology has seen on-going improvement over recent years and can be expected to continue to be refined and improved, nonetheless at present the capacity to detect a call and the quality of the recorded call are strongly influenced by the distance between the bat and the microphone.

The capacity to curtail turbines on the basis of detecting ultrasonic calls for a particular species of concern is dependent on an automated positive and instantaneous identification of the species from its characteristic calls. In the case of the Bare-rumped Sheathtail Bat, a degree of uncertainty in discriminating its calls from those of some other taxa that occur at the Mount Emerald site currently exists. Along with quality of calls detected, this uncertainty was problematic in positive identification of Bare-rumped Sheathtail Bat from bat surveys at the site even with expert analysis and scrutiny (RPS 2013a). We understand that some further research into this species has been undertaken in northern Australia, including Cape York, since the time of the RPS surveys at Mount Emerald (T. Reardon pers. comm.) and some improved understanding of specifics of the species calls may be available as a result.

However, even if the issue of species identification could be fully resolved in the immediate future, the capacity for an automated system to shut-down turbines based on detection of ultrasonic calls of Bare-rumped Sheathtail Bats would be limited by the distance at which calls can be detected and the response time of the turbines. Current model bat-call detectors generally have a maximum detection distance of approximately 30 metres under optimal conditions and, in normal operation the turbines to be installed at Mount Emerald Wind Farm are expected to take at least 30 seconds for rotors to come to a complete standstill. The wind farm will use a mix of two models of turbines (Vestas V112 (112m rotor) on 84m hub and Vestas V117 (117m rotor) on 90m hub). Thus a detector mounted on the nacelle of the smaller of the two turbines would have potential, even under optimal conditions, of detecting the species from less than 30% of the rotor-swept area and the portion would be smaller still for the larger turbine. Flight speed for Bare-rumped Sheathtail Bat is not known but *Saccolaimus* bats are recognized to be fast-flying species and turbine shut-down is thus not expected to substantially reduce risk for a bat within a distance of 30 metres or less.

Potential applicability of bat-call detection to reduce collision risk for target bats at Mt Emerald Wind Farm	
Spectacled Flying-fox	• The species does not use ultrasonic echolocation and systems using bat call detection are not applicable to reduction of collision risk for this species.
Bare-rumped Sheathtail Bat	• The species uses ultrasonic echolocation and, in due course a dedicated system might have potential to be implemented to reduce collisions by this species, but, for the present, the following issues would appear to prevent this technology from application to reduction of collision risk for Bare-rumped

	Sheathtail Bat at Mount Emerald Wind Farm. • Rapid identification of the species calls from a small number of other species is not able to be achieved consistently and instantaneous discrimination by a wholly automated system is not a realistic prospect. • The maximum call detection distance of current model bat detectors means that detectors would have capacity to monitor only a small portion of the rotor-swept zone of turbines at Mount Emerald Wind Farm and this would significantly limit the value of such a system even if calls can be accurately identified. • The combination of flight-speed of Bare-rumped Sheathtail Bat and time required for turbines to come to standstill indicate that systems using echolocation calls are not realistically likely to function to reduce collision risk for this species.
General comments	• Systems using bat call detection are not applicable to reduction of collision risk for Spectacled Flying-fox. • Systems using detection of bat-calls do not appear likely to offer a workable mechanism as a trigger for turbine-shut down for Bare-rumped Sheathtail Bat at Mount Emerald Wind Farm.
RECOMMENDATIONS	**Current information suggests that systems using detection of bat-calls are not applicable to the specific and individual requirements for reduction of collision risk for the two bat species of concern at Mount Emerald.**

Table 2 Summary review of systems using ultrasonic bat-calls

SYSTEM	DTBat	TIMR (Turbine Integrated Mortality Reduction)
System owner/supplier	Liquen/DT Bird, C/ Mauricio Legendre no 16 Of. 2711, 28046 Madrid, Spain.	Normandeau Environmental Consulting, USA.
Information currency	2016	2017
Overview	Ultrasonic bat-call detection linked to automated trigger of turbine shut-down & restart.	Monitors & records ultrasonic bat-calls (using ReBAT system) linked with weather data in real time. TIMR provides controlled automated individual turbine shutdown & restart.
System incorporates automated turbine curtailment and re-start	Yes	Yes
Monitoring system	Ultrasonic bat-call detectors.	Ultrasonic bat-call records.
Basic purpose		
Detect & record collision	Yes	No
Detect & record presence in danger zone (within a prescribed distance of rotor)	Yes	Yes
Development status		
Fully field tested & operational, commercially available	Yes	Yes (?)
Fully developed & field tested, not yet commercially available		
In development, not yet fully tested		
Coverage (relevant to target bat species)		
Capacity to cover entire wind farm turbine array	Unit(s) on every turbine	As described, routinely uses bat detectors installed on a small subset of turbines, but appears it can be installed on every turbine
Individual turbines (requires deployment on every turbine to achieve coverage of entire array)	Yes	Yes
Management system	Can be controlled remotely.	Integrated into existing turbine

SYSTEM	DTBat	TIMR (Turbine Integrated Mortality Reduction)
	System not specified.	SCADA
Detection capacity/coverage		
Entire turbine		
Entire rotor	Yes	Yes
Portion(s) of turbine/rotor only	Expected to be limited by microphone detection distance	Expected to be limited by microphone detection distance
Diurnal/nocturnal/weather detection		
Diurnal detection	N/A	N/A
Nocturnal detection	Yes	Yes
Affected by rain/fog	?	?
Species discrimination capacity		
Potential to discriminate to species level	Yes, but see below	Yes, but see below
Potential to discriminate weight/size class		
Likely general limitations for application at Mt Emerald site	None known	None known
Potential utility for two target species of bats at Mt Emerald	Spectacled Flying-fox does not make ultrasonic calls so system is not applicable to that species. Current limitations due to inability to obtain consistent, accurate identification of Bare-rumped Sheathtail Bat; call-detection distance relative to size of turbines; & time taken for turbine shut-down, indicate this system does not have capacity to achieve meaningful reduction of collision risk for the species.	Spectacled Flying-fox does not make ultrasonic calls so system is not applicable to that species. Current limitations due to inability to obtain consistent, accurate identification of Bare-rumped Sheathtail Bat; call-detection distance relative to size of turbines; & time taken for turbine shut-down, indicate this system does not have capacity to achieve meaningful reduction of collision risk for the species.

4.3 Thermal imaging

Thermographic cameras detect radiation in the long-infrared range of the electromagnetic spectrum. Effectively this allows an image to be made from the variable temperatures of items in the absence of visible light. Thermal imaging cameras have now been used widely to detect and 'see' nocturnal wildlife. One system has been developed using thermal imaging to trigger monitoring of the proximity of a turbine (Thermal Animal Detection System (TADS)). Available information indicates that it is not integrated into a system to trigger turbine shut-down and re-start and that it has capacity to monitor a portion of a given turbine but not the entire machine or entire rotor.

Thermal imaging was used effectively to detect flying foxes at the Mount Emerald site (RPS 2013b). However, the similarity in size and thermal properties of all flying-fox species meant that the thermal images alone did not permit Spectacled Flying-foxes to be distinguished from Little Red Flying-foxes and it is unlikely that they would allow any flying-fox species to be discriminated from another.

The Bare-rumped Sheathtail Bat is one of at least 17 species of small insectivorous bat species known to use the site and it is very unlikely that thermal imaging would permit it to be confidently and routinely identified from any of the other species.

As the review found no available thermal imaging system that controls turbine shut-down and re-start, this technology does not, at present have capacity to provide the requirements for collision reduction for the target species of bats at Mount Emerald. No further assessment of this technology is warranted for the present.

4.4 Other systems

The WT-Bird system uses a combination of acoustic sensors installed within rotor blades and on the turbine tower to detect a collision and trigger active infrared video cameras to record the event. This system is designed to record collisions but is not a system that controls turbine shut-down and re-start.

The ID Stat system uses microphones mounted within rotor blades linked to a filter and recording system to detect physical collisions by flying animals.

As these two systems are designed to record collisions but are not systems that control turbine shut-down and re-start, they do not have capacity to provide the requirements for collision reduction for the target species of bats at Mount Emerald. No further assessment of them is warranted for the present.

Table 3 Summary review of systems using thermal imaging and other techniques

SYSTEM	TADS (Thermal Animal Detection System)	WT-Bird	ID Stat
System owner/supplier	National Environmental Research Institute, Denmark.	Energy Research Centre of the Netherlands, Westerduinweg 3, 1755 LE Petten, The Netherlands.	Bertrand Delprat, Calidris, 14 rue Picard, 44 620 La Montagne, France.
Information currency	2012	2012	2012
Overview	Combination of thermal imaging with software to trigger recording when animal is within a defined proximity of turbine (determined from minimum number of pixels occupied by image).	Combination of acoustic sensors installed within rotor blades & on turbine tower to detect collision and trigger recording by active infrared video to record event.	Microphones mounted within rotor blades linked to filter & recording to detect physical collisions by flying vertebrates.
System incorporates automated turbine curtailment and re-start	No	No	No
Monitoring system	Thermal imaging cameras	Acoustic (e.g. audible bird calls) sensors trigger active infrared cameras	Microphones detect physical collisions
Basic purpose			
Detect & record collision	Yes	Yes	Yes
Detect & record presence in danger zone (within a prescribed distance of rotor)	Yes	Yes	No
Development status			
Fully field tested & operational, commercially available	No	No	
Fully developed & field tested, not yet commercially available	No	No	Yes
In development, not yet fully tested	Yes	Yes	
Coverage (relevant to target bat species)			
Capacity to cover entire wind farm turbine array	Unit(s) on every turbine	Unit(s) on every turbine	Unit(s) on every turbine
Individual turbines (requires deployment on every turbine to achieve coverage of entire array)	Yes	Yes	Yes

SYSTEM	TADS (Thermal Animal Detection System)	WT-Bird	ID Stat
Management system			
SCADA	?	Yes	No
Other with capacity for remote management	?		Potential notification by email
Detection mechanism			
Turbine contact/collision		Yes	Yes
Audible acoustic call records (audible bird & bat calls)			
Ultrasonic acoustic call records (ultrasonic bat calls)			
Thermal image records	Yes		
Active infrared image records		Yes	
Detection capacity/coverage			
Entire turbine			
Entire rotor		Yes	Yes
Portion(s) of turbine/rotor only	Yes		
Diurnal/nocturnal/weather detection			
Diurnal detection	Yes	Yes	Yes
Nocturnal detection	Yes	In development?	Yes
Affected by rain/fog	?	Yes	No
Species discrimination capacity			
Potential to discriminate to species level	?	No	No
Potential to discriminate weight/size class	?	Yes	Yes

SYSTEM	TADS (Thermal Animal Detection System)	WT-Bird	ID Stat
Likely general limitations for application at Mt Emerald site	Described system has capacity to monitor small portion only of rotor swept area of a given turbine, hence could only monitor subset of potential zones of risk even if installed on all turbines. As at 2012, data required human interpretation & no automated system to trigger turbine curtailment.	As reported, had significant level of false triggers. Will require calibration to specifics of turbine and site conditions.	Detection of collisions only.
Potential utility for two target species of bats at Mt Emerald	Limited resolution of thermal images. Reported high false-positive detection rates. Described system requires human interpretation, but see below re experimental automation potential.[Matzner et al (2015) & Cullinan et al (2015) describe a software & algorithms experimentally developed to automatically ascribe two-dimensional flight tracks from thermal images and classify them to taxa using a library of flight characters. They suggest this may be applicable to data obtained using the TADS system.]	As at 2012 infra-red image quality was considered insufficient to permit species identification in darkness.	No capacity to distinguish target species of bats from any other species of birds or bats unless combined with another system.

5 Conclusion

This report provides an initial evaluation of the effectiveness of potential measures to reduce the risk for Spectacled Flying-fox and Bare-rumped Sheathtail Bat of colliding with turbines at Mount Emerald Wind Farm in north Queensland.

We consider that the most promising means to reduce collision risk for the two species will be modifying turbine cut-in according to wind-speed. On the basis of overseas experience it is likely that Bare-rumped Sheathtail Bats fly less as wind speed increases. It is less likely that Spectacled Flying-foxes are affected by wind speed. An adaptive management approach to use of this method is recommended. It would use initial controlled experiments in which a subset, or subsets, of turbines are programmed to cut-in at different defined wind speeds and the incidence of collisions by both species is documented to ascertain whether they correspond with wind speed. On that basis a determination can then be made about whether low wind speed turbine curtailment would be of value to reducing collisions and if so, what wind speeds should be applied to turbine cut-in.

Some methods intended to deter bats from approaching wind turbines that have been tried overseas are entirely experimental. They are not recommended due to uncertainties about their efficacy and applicability for the two species of concern at Mount Emerald Wind Farm.

The evaluation reviewed three automated methods that have been used overseas to detect a species of concern when it approaches a turbine and that initiate short-term shut-down of turbines until the species is no longer present. A number of systems respectively use radar, thermal imaging or detection of ultrasonic bat-calls for this purpose.

The review provides details of six systems using various of these technologies. While all of them have had some application at northern hemisphere wind farms, none of them appears to be applicable to reduction of collision risk for the two species at Mount Emerald. The primary reasons for this relate to their inability to distinguish the species of concern from other species using the site; their limited spatial coverage; and, limitations imposed by the current state of knowledge about the two species and the capacity to obtain improved information about them.

The limitations of each of these types of systems suggest that none of them are likely to provide a useful reduction in collision risk for the two species at Mount Emerald Wind Farm.

Systems included in the review that simply record animal collisions with turbines are not applicable to reduction of turbine collision risk.

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I. APPROVAL OF WIND FARM IMPLEMENTATION PLAN – EFFECTIVENESS REPORT

Terry Johannesen

From: Kerin, Christopher <Christopher.Kerin2@environment.gov.au>
Sent: Friday, 2 June 2017 1:56 PM
To: Terry Johannesen
Cc: Blackwell, Peter
Subject: RE: EPBC 2011/6228 - Condition 12 & 13 - BRSB and SFF Management [SEC=UNCLASSIFIED]

Hi Terry,

Thank you for the additional information, and my apologies for the delay. As discussed over the phone on Wednesday (24/05/2017) document 1 (*Evaluation of Potential Mechanisms to Reduce Turbine Collision Risk for Two Species of Bats at Mount Emerald Wind Farm*) meets the requirements of condition 12. The "conceptual study" proposed in document 2 (*Further advice RE EPBC – listed Bats for Mount Emerald Wind Farm*) is also acceptable, providing that testing of the cut in speeds is undertaken by commencing testing at the higher cut in speeds and then reducing the cut in speeds until impacts are detected.

It is the Department's opinion that the approach to defining the performance measures should remain as conditioned, by using 'population viability analysis' and 'numerical collision risk modelling'.

Kind regards

Christopher Kerin
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Subject: RE: EPBC 2011/6228 - Condition 12 & 13 - BRSB and SFF Management [SEC=UNCLASSIFIED]

Chris

Attached are the reports from the EIS which deal with avian species;

- Appendix 13 - Fauna Survey Summary and Ecological Assessment Report
- Appendix 23 - Mt Emerald Wind Farm Turbine collision risk assessment
- Appendix 24 - Mount Emerald Wind Farm - Microchiropteran Bat Ultrasonic Call Assessment
- Appendix 25 - An Assessment of Utilisation Patterns of SFF

Regards

Terry Johannesen

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Subject: RE: EPBC 2011/6228 - Condition 12 & 13 - BRSB and SFF Management [SEC=UNCLASSIFIED]

Good afternoon Terry,

Thank you for submitting the below documentation in relation to the Implementation plan for the Bare-rumped Sheathtail bat and the Spectacled Flying-fox.

I have a few questions and on the study and would like some further clarification. Would you be available for a chat sometime soon?

Kind regards

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Cc: Hugh Sangster <Hugh.Sangster@ratchaustralia.com>
Subject: EPBC 2011/6228 - Condition 12 & 13 - BRSB and SFF Management

Robin/Peter/Panna

I enclose for your consideration the following documents in regard to the Mount Emerald Wind Farm;

1. *Evaluation of Potential Mechanisms to Reduce Turbine Collision Risk for Two Species of Bats at Mount Emerald Wind Farm, Queensland*

   This document has been prepared in reference to **Condition 12** of the EPBC Approval, and provides an assessment of the potential measures available to reduce the risk for Spectacled Flying-fox (SFF) and Bare-rumped Sheathtail Bat (BRSB). It is intended to inform the next steps in the process for management of the noted species.

2. *Further Advice RE EPBC-listed Bats for Mount Emerald Wind Farm*

   This document has been prepared as a first step in the process of addressing the requirements for **Condition 13** of the EPBC Approval. It contains advice on the suitability of aspects of **Condition 13** along with a proposed approach to determining the performance criteria required. It also provides a conceptual outline for a low wind speed curtailment study as referenced in the above document, which we feel should also be included in the eventual Wind Farm Implementation Plan.

At this time we are seeking advice from the department on the acceptability of;

- Document 1 meeting the requirements of condition 12.

- The proposed “alternative approach to defining performance measures” as outlined in document 2.
- The “conceptual design for low wind speed curtailment study” as outlined in document 2.

Please feel free to contact me regarding any clarifications, questions or further information.

If you think it is necessary, I would be willing to arrange for a meeting (including our engaged experts) to discuss these points in further detail.

Regards

Terry Johannesen

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J. OFFSET AREA MANAGEMENT PLAN

Offsets Area Management Plan

Mt Emerald Wind Farm, Herberton Range, North Queensland

Prepared by:

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
1	Draft Offset Area Management Plan	M Jess	L Liessmann	28/09/2016
2	Offset Area Management Plan	M Jess	L Liessmann	04/10/2016
3	Offset Area Management Plan	M Jess	L Liessmann	21/11/2016
4	Offset Area Management Plan	M Jess	T Johannesen	13/12/2016

Approval for Issue

Name	Signature	Date
Mellissa Jess		13/12/2016

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Appendix K Pest Management Plan

1.0 Introduction

RATCH-Australia Corporation Limited (RACL) proposed to develop the Mount Emerald Wind Farm (MEWF) project located southeast of Walkamin in north Queensland (**Figure 1**). The MEWF (Lot 7 SP235244) is approximately 2,422 ha in size and will include 53 wind turbines, associated access tracks and electrical infrastructure, feeding into the main electricity grid (Chalumbin-Woree transmission line).

The purpose of this Mt Emerald Offset Area Management Plan (OAMP) is to identify the management objectives and outcomes, and the actions necessary to fulfil a statutory requirement for the provision of an offset under an approval (EPBC 2011/6228) granted under the *Environment Protection and Biodiversity Conservation Act 1999* (Clth) (EPBC Act) to Mount Emerald Wind Farm Pty Ltd (MEWFPL). This Plan has been developed to meet both the EPBC Act and NCA Act requirements and also the requirements to secure the land under a voluntary agreement within relevant state legislation.

This Offset Area Management Plan replaces the MEWF Management Plan produced by CO_2 Australia (2013) for the MEWF Offset Area.

The purpose of this Offsets Area Management Plan (OAMP) is to provide:

- A map of the offset area, including GPS points;
- The type and location of values to be offset;
- The offset area management objectives and outcomes;
- Activities that will be undertaken to achieve the management objectives and outcomes and analysis of the risks to achieving the management objectives and outcomes;
- A monitoring and reporting program;
- Estimated time until the offset management objectives and outcomes will be achieved; and
- Identification of all registered interests including mortgages, leases, subleases, covenants, profit-a-prendre.

1.1 Regulatory Requirements

Conditions relevant to the preparation and implementation of the offset Area Management Plan are detailed in **Table 1** below.

Table 1 Location of specific EPBC Condition information within this document

EPBC Condition		Location
18.	To compensate for residual significant impacts to EPBC Act listed threatened species, the approval holder must provide environmental offsets that comply with the principles of the EPBC Act Environmental Offsets Policy.	Section 4
19.	The approval holder must prepare and submit an Offset Management Plan to the Minister for approval in writing. The Offset Management Plan must include:	
	a) details of the minimum offset areas proposed to compensate for the loss of habitat for EPBC Act listed threatened species from the wind farm site,	Section 4.6
	b) information about how the offset area/s provide connectivity with other relevant habitats and biodiversity corridors, including a map depicting the offset areas in relation to other habitats and biodiversity corridors;	Section 4.4
	c) a description of the management measures that will be implemented on the offset site for the protection and management of habitat for EPBC Act listed threatened species, including a discussion of how measures proposed are consistent with the measures in conservation advice, recovery plans and relevant threat abatement plans;	Section 4.4 and Table 12
	d) performance and completion criteria for evaluating the management of the offset area/s, and criteria for triggering remedial action (if necessary);	Table 12
	e) a program, including timelines to monitor and report on the effectiveness of these measures, and progress against the performance and completion criteria;	Table 12 Appendix I Appendix K
	f) a description of potential risks to the successful implementation of the plan, and a description of the contingency measures that would be implemented to mitigate against these risks;	Section 8 Table 11
	g) the proposed legal mechanism and timelines for securing the offset/s; and	Section 5
	h) a textual description and map to clearly define the location and boundaries of the offset area. This must be accompanied with the offset attributes and a shapefile.	Appendix A

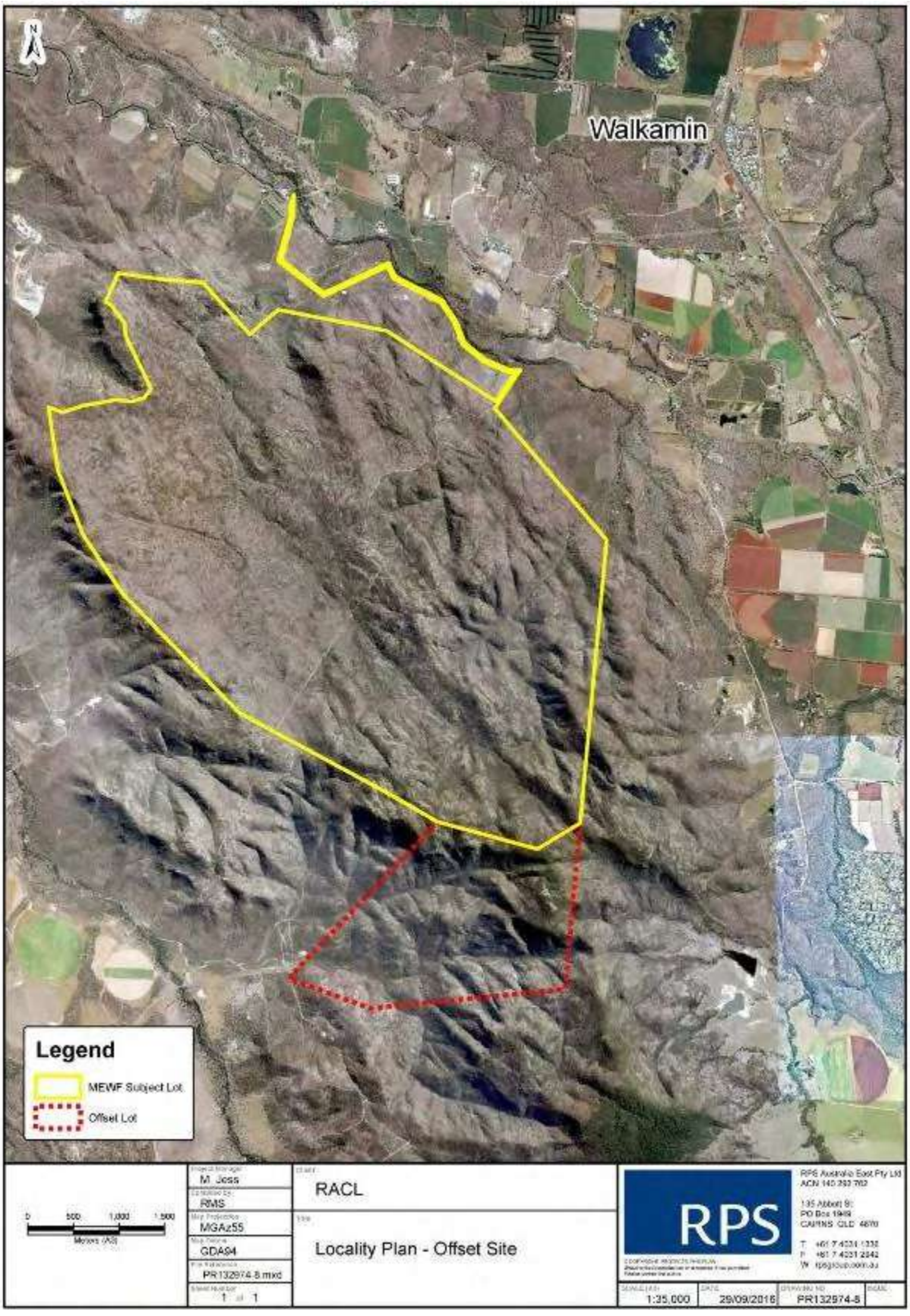


Figure 1 Locality Plan Offset Site

2.0 Summary Information

2.1 Departmental Reference Details

As a requirement of the EPBC Act approval 2011/6228, Mount Emerald Wind Farm Pty Ltd (MEWFPL) is required to finalise an offset to compensate for the clearing of habitat on the Mount Emerald Wind Farm (MEWF) Project Site. The departmental reference and assessment details for the offset area are outlined in **Table 2**.

Table 2 Referral Triggers, Reference and Assessment Details

EPBC Act Referral Trigger	Values Impacted/Requiring Offset
EPBC Act Approval 2011/6228	☒ Listed Threatened Species
Reference and Assessment Details Requiring Offset	
Departmental Ref. Number: EPBC 2011/6228	
Property Address: Lot 7 Springmount Road Arriga, Atherton Tablelands	
Real property description (Primary Lot on Plan/s): Lot 7 SP235224, Easements A, C & E in Lots 1, 2 & 3 on SP231871 and part of Lot 905	
Primary Local Government Area: Mareeba Shire Council	
Tenure: Freehold	
Offset ID: Lot 22 SP 210202	

2.2 Property and Ownership Details

The offset area is located at Lot 22 SP 210202 near Mutchilba within the Mareeba Shire Council Area. The lot tenure is freehold and the primary land use is vacant. The area fringes the Baldy Mountain Forest Reserve and the Herberton Range National Park via the Herberton Range (Queensland Government 2016). The town centre of Mareeba is situated approximately 18km to the north of the site, with the town of Atherton approximately 11.5km south-east of the site. Property Ownership and landholder details are outlined in **Table 3** and **Table 4** below.

Table 3 Offset Landholder details

Offset Landholder details	
Name of Registered Owner(s)/ Licensee(s) or Trustee(s)	**Peter and Carolyn Hinchcliffe**
Postal Address	**Po Box 190 Port Douglas QLD 4877**
Phone	**0409 985 214**
Facsimile	
Email Address	
Real Property Description	**Lot 22 SP210202**
Property Name	
Area of Property	**434.9 ha**
Local Government Area	**Mareeba Shire**
Tenure Type	**Freehold**

Table 4 Registered Interests

Parcel (Lot and Plan)	Type of Registered Interest	Registered Interest holder's name and contact details
Lot 22 SP210202	Purchase Option Agreement	**Contact details: Mount Emerald Wind Farm Pty Ltd** **Phone number:** 02 8913 9400 **Fax number:** 02 8913 9423

3.0 Threatened Flora Species

Four EPBC listed threatened plant species have now been confirmed to be present within the MEWF project footprint and could be impacted during construction, maintenance and decommissioning of the wind farm.

Grevillea glossadenia and *Homoranthus porteri* have previously been identified; however two new species have been added to the threatened species list:

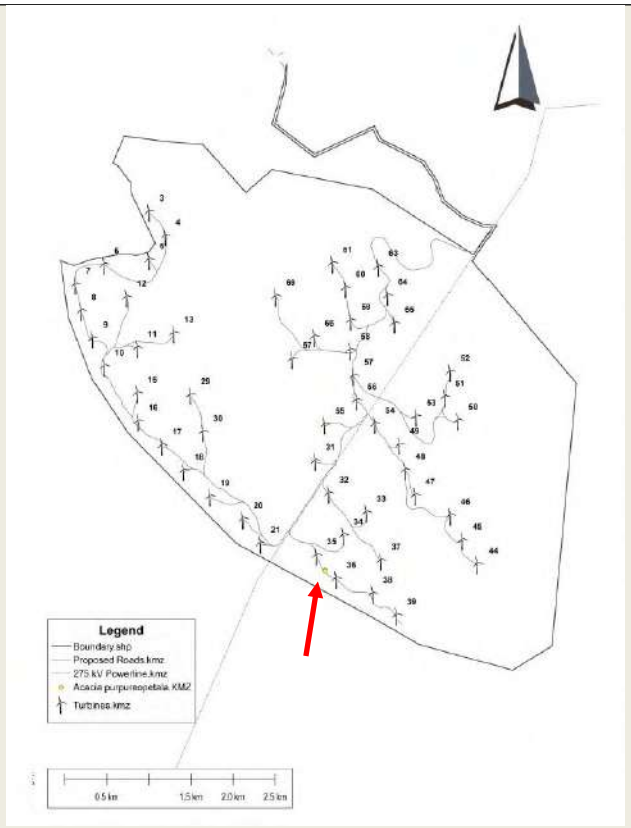
- ***Acacia purpureopetala*** (Purple-flowering Wattle) – Critically Endangered/Endangered (EPBC Act / NC Act); and
- ***Prostanthera clotteniana*** (Mint Bush) – Critically Endangered/Endangered (EPBC Act / NC Act).

These species have been assessed against the EPBC Act Offsets Assessment Guide and have also been field verified on the offsets site.

3.1 *Acacia purpureopetala*

The Purple-flowering Wattle *Acacia purpureopetala* is a prostrate shrub with a spreading habitat growing to approximately 50 cm high. Most plants are lower and usually attain a height of 20-35 cm. Older plants have a distinctive "rosette" pattern to the branches, where they tend to radiate outwards in a circular fashion and arch downwards. Mature plants may spread to a diameter of one metre or more.

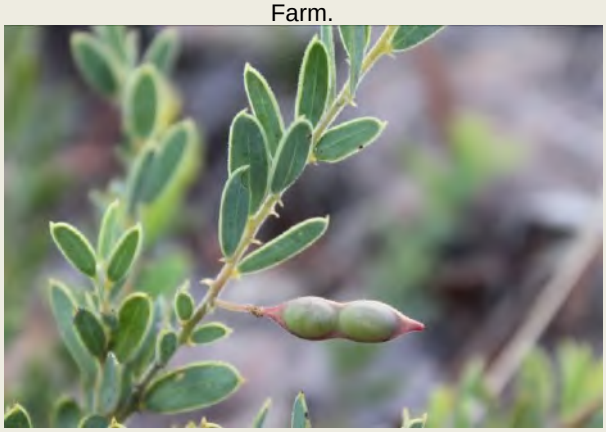
Acacia purpureopetala is endemic to northern Queensland and has a restricted distribution with populations between Herberton and Irvinebank, Stannary Hills, and Silver Valley. The Mt Emerald Wind Farm site populations represent the most north-eastern distribution of the species, where it is found at only a single location between WTG's 35 and 36 (**Figure 2**).



Location of *Acacia purpureopetala* - Mt Emerald Wind Farm.

Acacia purpureopetala foliage and flowers. Photo SG

Acacia purpureopetala growth habit. Photo TDR



Acacia purpureopetala fruit pod. Photo SG

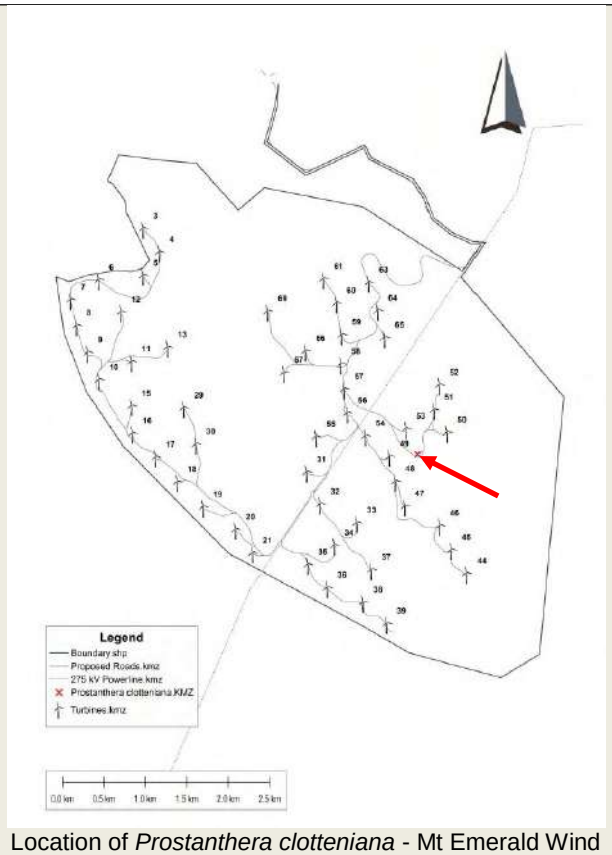
Acacia purpureopetala seedling. Photo SG

Figure 2 *Acacia purpureopetala* Location on MEWF

3.2 *Prostanthera clotteniana*

Prostanthera clotteniana grows in exposed rocky areas which are protected from hot fires. The species prefers the tops of steep rocky drop-offs with a southeast aspect. Associated species include *Pseudanthus ligulatus*, *Grevillea glossadenia*, *Eucalyptus lockyeri* and *Xanthorrhoea johnsonii*. There can be woodland of *Eucalyptus reducta* in gullies and on slopes in adjacent areas. Grasses include *Cleistochloa subjuncea*, *Cymbopogon obtectus* and *Themeda triandra*.

Prostanthera clotteniana is endemic to northern Queensland and is highly restricted. Populations are found near Ravenshoe, the Dinden State Forest to the north-east, and the single population of the Mt Emerald Wind Farm site. It has also been recorded from the Baal Gammon mine area near Watsonville, and at lower elevation around Oaky Creek. All populations are small. It is found in one location of few specimens on the eastern edge of the broad ridge south of WTG 53 (**Figure 3**).



Location of *Prostanthera clotteniana* - Mt Emerald Wind Farm.

Prostanthera clotteniana foliage and flowers. Photo SG

Prostanthera clotteniana growth habit. Photo SG

Prostanthera clotteniana flower and branches. Photo SG

Prostanthera clotteniana habitat. Photo SG

Figure 3 *Prostanthera clotteniana* Location on MEWF

3.3 Threatened Plants Management

Major threats to the survival of the conservation significant species include altered fire regimes, weed invasion, and physical clearing and modification of critical habitats.

MEWF Threatened Plants Management Plan (Gleed, 2016) details the distribution, habitat, ecology, conservation status, threats and management actions relating to threatened plant species occurring on the MEWF site. The Plan's overarching intent is to provide guidance to avoid or minimise adverse impacts to threatened plant species and their respective habitats listed under the *Queensland NC Act* and the *Commonwealth EPBC Act* and provides details where there are no recovery plans available for these restricted species.

4.0 Description of the Offset Management Area

4.1 Site Description

The Offset area is located within land described as Lot 22 SP210202, comprising approximately 434.9 ha (**Figure 4**). It is located immediately to the south west of the MEWF site. The site was considered in the original offsets assessment (CO2 Australia, 2013) which was inclusive of six segmented allotments however, MEWF have concluded after consultation with DEE and landowners, that a (whole) single lot offset under the ownership of MEWF was a more viable option.

The site is located within Mutchilba within the Mareeba Shire Council Area. The lot tenure is freehold and the primary land use is vacant. The area fringes the Baldy Mountain Forest Reserve and the Herberton Range National Park, via the Herberton Range (Queensland Government, 2016) (**Plate 1**).

Plate 1 Offset Site

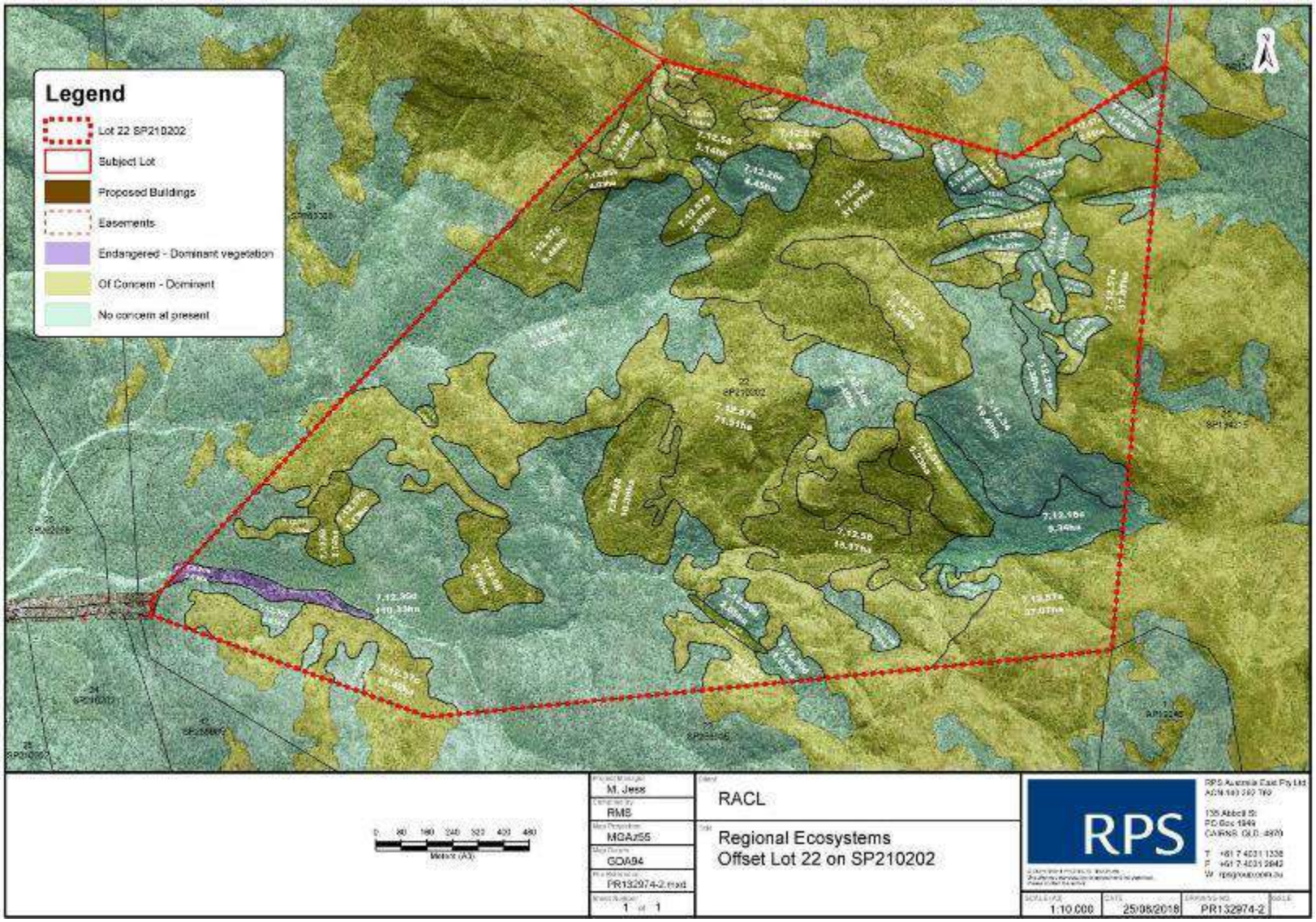


Figure 4 Regional Ecosystems on Offset Site

4.2 Environmental Values of the Offset Area

The offsets site is broadly within the wet tropics bioregion and is markedly rugged and steeply dissected; rendering the highest points as a series of narrow ridges and rocky knolls with steep drop-offs on adjacent slope faces.

The site is composed of nearly entirely remnant vegetation with approximately 192.89 ha consisting of Least Concern vegetation and the remaining 242 ha listed as Of Concern vegetation. An assessment of the common trees of the woodlands include Lemon-scented Gum (*Corymbia citriodora*), Yellow Stringybark Range Bloodwood (*C. abergiana*), Ironbark (*E. crebra*), Dead Finish (*E. cloeziana*), Cypress Pine (*Callitris intratropica*), Silver-leaf Ironbark (*E. shirleyi*), Orange Jacket (*C. leichhardtii*) which are all found on the gentler slopes.

Shrublands are characterised by many species, but typically include Sheoak (*Allocasuarina littoralis*), (*Xanthorrhoea johnsonii*), *Eucalyptus lockyeri*, Wattle (*Acacia aulacocarpa*), *Homoranthus porteri*, *Grevillea glossadenia*, and stunted forms of Range Bloodwood (*Corymbia abergiana*). Shrublands are generally found in relation to the ridge environment where thin rocky soils prevail. A feature of the montane heathland and shrublands at high elevation is the presence of rock pavements and areas of poorly vegetated rock outcrops. This particular habitat supports few large plant species because of the near-absence of soil or growth medium on their surfaces.

The steep rocky slopes, outcrops, cliffs, caves, and fallen logs and thick grasses offer plentiful habitat and refuge for both terrestrial and arboreal fauna species throughout the site.

4.3 Values to be Offset

The offset site is comprised of approximately 434.9 ha of high quality remnant habitat which sits adjacent to the MEWF project site. The offset requirements have been identified and are presented in **Table 5**.

Three threatened fauna species require offset and four threatened flora species.

Detailed offset area map/s identifying values, vegetation types (Regional Ecosystems) and GPS points are included in **Appendix A**.

Table 5 Environmental Values on Offset Site

Environmental Value	EBPC Act Status	NC Act Status
Fauna		
Northern Quoll (*Dasyurus hallucatus*)	E	E
Spectacled Flying-fox (*Pteropus conspicillatus*)	V	C
Bare-rumped Sheathtail Bat (*Saccolaimus Saccolaimus nudicluniatus*)	CE	CE
Flora		
Grevillea glossadenia	V	V
Homoranthus porteri	V	V
Acacia purpureopetala	CE	V
Prostanthera clotteniana	CE	E
Melaleuca uxorum	-	V
Plectranthus amoenus	-	V

4.3.1 *Nature Conservation Act* Listed Flora

An offset is not required for *Melaleuca uxorum* and *Plectranthus amoenus* (**Table 6**) as all reasonable avoidance and mitigation measures have been met for each of these species and there will be no 'significant residual impact' on these matters of State environmental significance.

Table 6 NCA Environmental Values on Offset Site

Environmental Value	EBPC Act Status	NC Act Status
Flora		
Melaleuca uxorum	-	V
Plectranthus amoenus	-	V

4.3.1.2 Avoidance

Complete avoidance of impacts to populations of highly threatened plants is considered as a priority. In terms of rarity on the wind farm site, *Melaleuca uxorum* and *Plectranthus amoenus* are rare species and are represented in the vicinity of proposed construction works by very small populations in isolated locations.

Sensible positioning of tracks which maintain an undisturbed, natural buffer from the populations of these species is recommended in the Threatened Plants Management Plan (Gleed, 2016), and Rehabilitation Plan (Gleed 2016) prepared for the wind farm.

4.3.1.3 Translocation

The requirement for re-establishing threatened plants assumes direct impacts to the species cannot be avoided, therefore this mitigation measure is required. A number of individuals of *Plectranthus amoenus* will be cleared during construction; whereby a selection of the cleared plants are candidates for translocation. This species is known to respond well to translocation (**Appendix B)**.

4.3.2 Regional Ecosystems

The offset site is mapped almost entirely as remnant vegetation (Regional Ecosystems - RE's), with a small area of non-remnant shown near the south-west corner at the end of Lemon Tree Drive.

The RE's mapped for the offset site are described in **Table 7** and shown on the mapping in **Figure 4**.

Table 7 Regional ecosystem present within the proposed offset site

RE	RE Description	VMA[1]	Bio.[2]	Area[3]
7.3.26a	*Casuarina cunninghamiana* (river oak) woodland to open forest on alluvium fringing streams. Occurs on channel benches, levees and terraces on deep loamy sands or sandy clay loams (often with loose surface gravel). (BVG1M: 16a). Vegetation communities in this regional ecosystem include: 7.3.26a: Riverine wetland or fringing riverine wetland. *Casuarina cunninghamiana*, *Eucalyptus tereticornis*, *Lophostemon suaveolens*, *Melaleuca leucadendra*, *M. fluviatilis*, *Buckinghamia celsissima*, *Mallotus philippensis* woodland and forest with an understorey of *Melaleuca viminalis* and *Bursaria tenuifolia*. Fringing forests of larger streams. (BVG1M: 16a)□.	OC	E	2.63
7.12.7c	Simple to complex microphyll to notophyll vine forest, often with *Agathis robusta* (kauri pine) or *A. microstachya* (bull kauri). Granites and rhyolites of foothills and uplands, of the moist rainfall zone. (BVG1M: 5c). Vegetation communities in this regional ecosystem include: □7.12.7c: Simple notophyll semi-evergreen vine forest. Uplands of the dry rainfall zone. Rhyolite. (BVG1M: 5c)□.	LC	NCP	1.24

RE	RE Description	VMA[1]	Bio.[2]	Area[3]
7.12.9	*Acacia celsa* (brown salwood) open forest to closed forest. Foothills, uplands and highlands on granites and rhyolites, of the very wet and wet rainfall zone. (BVG1M: 5d).	OC	OC	1.16
7.12.16a	Simple to complex notophyll vine forest, including small areas of *Araucaria bidwillii* (Bunya pine). Uplands and highlands on granites and rhyolites, of the cloudy wet to moist rainfall zones. (BVG1M: 6b). Vegetation communities in this regional ecosystem include: □7.12.16a: Simple notophyll vine forest (often with *Agathis microstachya*). Uplands of the cloudy wet to moist rainfall zones. Granite and rhyolite. (BVG1M: 6b)□.	LC	NCP	9.34
7.12.26a	*Syncarpia glomulifera* (turpentine) +/- *Corymbia intermedia* (pink bloodwood) +/- *Allocasuarina* spp. (sheoaks) closed-forest to woodland, or *Lophostemon suaveolens* (swamp mahogany), *Allocasuarina littoralis* (black sheoak), *C. intermedia* shrubland, (or vine forest with these species as emergents). Exposed ridgelines or steep rocky slopes, on granite and rhyolite.□ 7.12.26a: *Syncarpia glomulifera*, *Allocasuarina torulosa* and/or *A. littoralis* open-forest and woodland. Uplands and highlands, often on steep slopes, of the wet rainfall zone. Granite and rhyolite. (BVG1M: 28e)□.	LC	NCP	4.41
7.12.26e	*Syncarpia glomulifera* (turpentine) +/- *Corymbia intermedia* (pink bloodwood) +/- *Allocasuarina* spp. (sheoaks) closed forest to woodland, or *Lophostemon suaveolens* (swamp mahogany), *Allocasuarina littoralis (bl*ack sheoak), *C. intermedia* shrubland, (or vine forest with these species as emergents). Exposed ridgelines or steep rocky slopes, on granite and rhyolite. (BVG1M: 9d).□Vegetation communities in this regional ecosystem include: □7.12.26e: *Syncarpia glomulifera* low open forest and low woodland. Uplands on steep rocky slopes, of the moist and dry rainfall zone. Granite and rhyolite. (BVG1M: 28e)□.	LC	NCP	8.99
7.12.29a	*Corymbia intermedia* (pink bloodwood) and/or *Lophostemon suaveolens* (swamp mahogany) open forest to woodland +/- areas of *Allocasuarina littoralis* (black sheoak) and *A. torulosa* (forest sheoak). Uplands, on granite and rhyolite. (BVG1M: 9c). Vegetation communities in this regional ecosystem include: □7.12.29a: *Corymbia intermedia*, *Eucalyptus tereticornis*, *E. drepanophylla* open forest to low open forest and woodland with *Allocasuarina torulosa*, *A. littoralis*, *Lophostemon suaveolens*, *Acacia cincinnata*, *A. flavescens*, *Banksia aquilonia* and *Xanthorrhoea johnsonii*. Uplands, on granite and rhyolite. (BVG1M: 9c)□.	LC	NCP	4.60
7.12.30d	*Corymbia citriodora* (lemon-scented gum) +/- *Eucalyptus portuensis* (white mahogany) woodland to open forest. Granite and rhyolite (often coarse-grained red earths and lithosols with much surface rock). (BVG1M: 10b). Vegetation communities in this regional ecosystem include: 7.12.30d: 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*. Rocky slopes on granite and rhyolite.(BVG1M: 9d).	LC	NCP	133.42
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. (BVG1M: 9d).	LC	NCP	23.76

RE	RE Description	VMA[1]	Bio.[2]	Area[3]
7.12.57a	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. (BVG1M: 9d). Vegetation communities in this regional ecosystem include: 7.12.57a: Shrubland and low woodland mosaic with *Syncarpia glomulifera*, *Corymbia abergiana*, *Eucalyptus portuensis*, *Allocasuarina littoralis* and *Xanthorrhoea johnsonii*. Uplands and highlands on granite and rhyolite, of the moist and dry rainfall zones. (BVG1M: 9d).	OC	OC	58.60
7.12.57c	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. (BVG1M: 9d). Vegetation communities in this regional ecosystem include: 7.12.57c: Shrubland/low woodland (1.5-9 m 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*, *Coelospermum reticulatum*, *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 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. Rocky slopes on granite and rhyolite. (BVG1M: 9d).	OC	OC	107.32
7.12.58	*Eucalyptus reducta* woodland to open forest (6-18m tall). Common associated species include *E. granitica*, *Corymbia dimorpha*, *C. citriodora*, *E. cloeziana* and occasionally *C. intermedia*. There is often a sparse secondary tree layer of *C. abergiana* and/or *E. lockyeri*. There may be a very sparse tall shrub layer of species such as *Acacia flavescens*, *Persoonia falcata*, *Allocasuarina littoralis* and *Acacia simsii*, and a very sparse to dense lower shrub layer of *Acacia calyculata*, *Pultenaea millarii*, *Jacksonia thesioides*, *Grevillea glossadenia*, *Grevillea dryandri* subsp. *dryandri*, *Homoranthus porteri* and *Dodonaea lanceolata* var. *subsessilifolia*. The ground layer is often dominated by species such as *Themeda triandra*, *Eriachne* spp., *Cleistochloa subjuncea*, *Lomandra longifolia*, *Mnesithea rottboellioides*, *Xanthorrhoea johnsonii*, *Heteropogon triticeus* and *Coronidium newcastlianum*. Granite and rhyolite. (BVG1M: 9d).	OC	OC	72.45

RE	RE Description	VMA[1]	Bio.[2]	Area[3]
7.12.65k	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. (wattles) and/or *Lophostemon suaveolens* (swamp mahogany) and/or *Allocasuarina littoralis* (black sheoak) and/or *Eucalyptus lockyeri* subsp. *exuta*. (BVG1M: 28e). 7.12.65k: Granite and rhyolite rock outcrop, of dry western areas, associated with shrublands to closed forests of *Acacia* spp. and/or *Lophostemon* spp. and/or *Allocasuarina* spp. In the Mount Emerald area, shrubs may include *Acacia umbellata*, *Melaleuca borealis*, *Homoranthus porteri*, *Leptospermum neglectum*, *Melaleuca recurva*, *Melaleuca uxorum*, *Grevillea glossadenia*, *Corymbia abergiana*, *Eucalyptus lockyeri*, *Sannantha angusta*, *Pseudanthus ligulatus* subsp. *ligulatus*, *Acacia aulacocarpa*, *Leptospermum amboinense*, *Xanthorrhoea johnsonii* and *Jacksonia thesioides*. Ground-cover species may include *Borya septentrionalis*, *Lepidosperma laterale*, *Eriachne* spp., *Cleistochloa subjuncea*, *Boronia occidentalis*, *Cheilanthes* spp., *Coronidium newcastlianum*, *Schizachyrium* spp., *Tripogon loliiformis*, *Gonocarpus acanthocarpus* and *Eragrostis* spp. Dry western areas. Granite and rhyolite. (BVG1M: 29b).	LC	OC	7.03
9.5.8	Woodland to open-woodland of *Eucalyptus cullenii* (Cullen's ironbark) and/or *E. leptophleba* (Molloy red box) +/- *Corymbia erythrophloia* (red bloodwood) +/- *Erythrophleum chlorostachys* (Cooktown ironwood). *Eucalyptus tardecidens* (box) may also occur as a subdominant in northern extent of this regional ecosystem. A sparse shrub layer includes *Petalostigma* spp., *Melaleuca* spp., *Grevillea* spp., *Alphitonia pomaderroides* and *Maytenus cunninghamii* (yellowberry bush). The sparse to dense ground layer is dominated by *Heteropogon contortus* (black speargrass) and *Sarga plumosum* (plume sorghum). Occurs on undulating plains in valleys in ranges on Tertiary/Quaternary soils overlying granite and metamorphic geologies. (BVG1M: 13a)	LC	NCP	0.01
9.5.9a	Woodland to open-woodland of *Corymbia clarksoniana* (Clarkson's bloodwood) and/or *Eucalyptus leptophleba* (Molloy red box) and/or *E. platyphylla*. A sparse to mid-dense shrub layer including *Melaleuca* spp., *Grevillea* spp., and *Planchonia careya* (cocky apple) can occur. The ground layer is dominated by *Themeda triandra* (kangaroo grass) and *Heteropogon* spp. Occurs on plains, undulating plains and outwash deposits and Tertiary to Quaternary locally consolidated high-level alluvium and colluvium. Major vegetation communities include: 9.5.9a: Woodland to open-woodland of *Corymbia clarksoniana* (Clarkson's bloodwood) +/- *Eucalyptus platyphylla* (poplar gum) +/- *E. leptophleba* (Molloy red box) +/- *C. tessellaris* (Moreton Bay ash) with a distinct to sparse sub-canopy layer often including *Melaleuca viridiflora* (broad-leaved paperbark), *Grevillea glauca* (bushman's clothes peg), *Petalostigma pubescens* (quinine) and *Alphitonia pomaderroides* (soapbush). An open to sparse shrub layer includes *Melaleuca* spp., *Persoonia falcata*, *Grevillea* spp. and *Petalostigma pubescens (*quinine). The sparse to mid-dense ground layer is dominated by *Themeda triandra* (kangaroo grass), *Aristida* spp., *Heteropogon contortus* (black speargrass), *H. triticeus* (giant speargrass), and *Sarga plumosum* (plume sorghum). Occurs on undulating plains. (BVG1M: 9e)□.	LC	NCP	

RE	RE Description	VMA[1]	Bio.[2]	Area[3]
9.12.7a	Woodland to low open-woodland of Eucalyptus cullenii (Cullen's ironbark) +/- Erythrophleum chlorostachys (Cooktown ironwood) +/- C. leichhardtii (yellowjacket) +/- Corymbia erythrophloia (red bloodwood). The mid-layer is generally absent but a subcanopy and/or shrub layer can occur. The ground layer is sparse to dense and dominated by Heteropogon contortus (black speargrass) and Themeda triandra (kangaroo grass). Occurs on predominantly felsic volcanic rocks, on rolling to steep hills. Major vegetation communities include: 9.12.7a: Woodland to open-woodland of *Eucalyptus cullenii* (Cullen's ironbark) +/- *Corymbia erythrophloia* (red bloodwood) +/- *Erythrophleum chlorostachys* (Cooktown ironwood) +/- *C. dallachiana* (Dallachy's gum). An open to mid-dense subcanopy can occur and includes a variety of species. The shrub layer is absent to open and dominated by *Maytenus cunninghamii* (yellowberry bush), *Alphitonia pomaderroides* (soapbush), *Petalostigma* spp., and *Acacia* spp. The ground layer is sparse to dense and dominated by *Heteropogon contortus* (black speargrass), *H. triticeus* (giant speargrass), *Themeda triandra* (kangaroo grass) and *Sarga plumosum* (plume sorghum) with a *Xanthorrhoea* sp. (grasstree) occurring in some areas. Occurs on rhyolite hills. (BVG1M: 13a)□.	LC	NCP	0.01
9.12.40	Low open-woodland to low woodland of *Melaleuca citrolens* (scrub teatree) +/- *Terminalia platyptera* (yellow-wood) +/- *Corymbia dallachiana* (Dallachy's gum) +/- *Erythrophleum chlorostachys* (Cooktown ironwood). The sparse shrub layer consists of *Petalostigma banksii* (smooth-leaved quinine), *M. citrolens* and *Gardenia vilhelmii* (breadfruit). The ground layer is frequently bare, with patches of short grasses including *Eriachne* spp., *Aristida* spp. and *Schizachyrium* spp. (firegrass). This community also occurs as short open-tussock grassland wooded with low trees and shrubs of *Melaleuca citrolens* +/- *Terminalia* spp. Occurs on gentle slopes, footslopes, rolling hills and colluvial low slopes. (BVG1M: 21b).	LC	NCP	
Non-rem	Non-remnant: modified land, roads, clearings and tracks.			0.08

[1] Status under Vegetation Management Act 1999: OC - Of Concern; LC - Least Concern.

[2] Biodiversity management status: E - Endangered; OC - Of Concern, NCP - No Concern at Present.

[3] Area - total area in hectares of RE type within offset site.

Conservation status of EVNT species: *Acacia purpureopetala* (CE - EPBC Act, V - NCA); *Grevillea glossadenia* (V- EPBC Act, V - NCA); *Homoranthus porteri* (V - EPBC Act, V - NCA); *Melaleuca uxorum* (E - NCA); *Plectranthus amoenus* (V - NCA); *Prostanthera albohirta* (CE - EBC Act, E - NCA); *Prostanthera clotteniana* (CE - EBC Act, E - NCA).

4.4 Habitat Connectivity

Regionally, the MEWF site forms the northern extent of the Herberton Range. The Wet Tropics bioregion section is contiguous with the Mount Emerald mountain range. The Wet Tropics section and the western ridge of the Einesleigh Uplands section are in near pristine condition. They hold very high values in terms of floristic diversity, landscape connectivity and undisturbed ecological function. The site forms important refuge areas for numerous species of flora and fauna, many of which are restricted to montane environments. The MEWF site joins to the Offsets site leading to the south to the Herberton Range State Forest (**Figure 1**). There, contiguous native vegetation exists to the south. This native vegetation is unbroken with the exception of occasional minor access tracks, providing habitat linkages throughout surrounding areas.

The project site is located in a landscape fragmented by farmland. However, both the project and offset sites' vegetation is widely untouched and well connected to surrounding habitat. This corridor extends into the Herberton State Forest providing both a wide corridor and protected habitat of high ecological value to matters of national significance.

The removal of habitat on the project site as a result of the MEWF project will remove some remnant vegetation, but will not create further fragmentation of the habitat at a wider landscape level. The project

is unlikely to isolate the site and habitat to the remaining vegetation community. Arboreal mammals, terrestrial mammals, reptiles and amphibians will still be able to move across the landscape, within similar remnant communities. Connectivity, identified in **Figure 5** to the offset area and State Forest adjacent to the site, will be maintained.

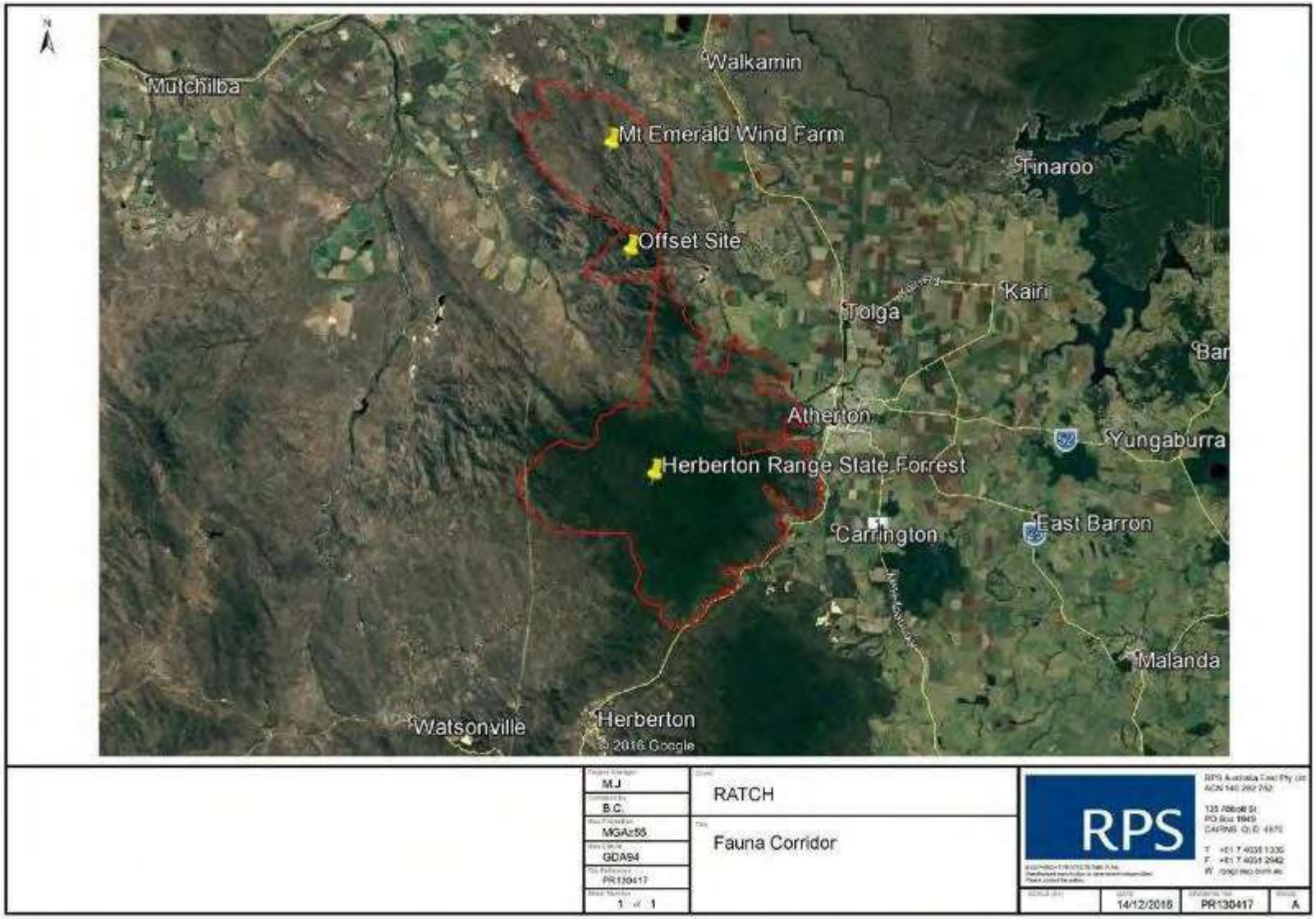


Figure 5 MEWF and Offset Site Biodiversity Corridor

4.4.1 Northern Quoll

Habitat modelling conducted by University of Sunshine Coast researchers for the project (Burnett et al, 2013) indicate that 72% of the predicted high and very highly suitable Northern Quoll habitat in FNQ is found within a 55 km buffer of the project site boundary. Rocky areas may provide refugia from fire and predation by feral cats and due to their water retaining attributes, they may support high floristic diversity and productivity and thus higher prey abundances than areas without rocky outcrops (Burnett, 1997; Hill & Ward, 2010).

Individuals of the Northern Quoll are known to utilise the entire MEWF and Offset site due the species ability to utilise a large variety of habitat structures for nesting and denning and to forage over several kilometres in a single night.

As an endangered species at the federal level there are guidelines for recovery, mitigation and conservation:

- National Recovery Plan for the Northern Quoll *Dasyurus hallucatus*;
- Threat abatement plan for predation by feral cats;
- Threat Abatement Plan for Predation by the European Red Fox.

The MEWF Pest Management Plan includes strategies to prevent undisturbed habitat throughout the project and offset site from being impacted by feral animals. An extensive corridor system will ensure habitat functionality and faunal movement is maintained to external boundaries and not confine individuals within or external to the site. The projects mitigation measures are consistent with the National Recovery Plan for the species.

4.4.2 Bare-rumped Sheathtail Bat

The Bare-rumped Sheathtail Bat *(Saccolaimus saccolaimus nudicluniatus)* has been recorded in a range of habitats including tropical woodland and tall open forests where it roosts in long, wide hollows in various eucalypts (*Eucalyptus platyphylla* and *Eucalyptus tetrodonta*) and in *Melaleuca leucadendra*. Consistent with the National Recovery Plan for Bare-rumped Sheathtail Bat the offset area ensures sufficient foraging area would be maintained, and connectivity will be maintained between riparian areas and external to the site. Therefore the project is not expected to interfere with the recovery of the species.

4.4.3 Spectacled Flying Fox

Essential roosting, breeding and mating habitat for Spectacled Flying-foxes includes rainforest, gallery forest, Melaleuca swamps, mangroves and eucalypt forest (DERM, 2010; Curtis and Dennis, 2012). Most camp sites are located within 6.5 km of rainforest (Richards, 1990); however at least one colony located at Mareeba is approximately 16 km from the nearest rainforest (Shilton *et al*., 2008). Ongoing satellite-telemetry tracking of Spectacled Flying-foxes by CSIRO researchers is assisting with the discovery of new roost sites (James Hammond, DotE, pers. comm., 16/10/13).

Potential roosting habitat is within areas that will be buffered from the impacts of the project development and as the species is very selective in camp preference for mangrove, vine forest, riparian gallery forest which occurs within the Tolga scrub and across the Wet Tropics. The proposed project will not interfere with the recovery of the species as it has no impact on foraging or roosting activities. Effective pest and weed management measures incorporated into the offset site are consistent with National recovery measures for the Spectacled Flying Fox in particular the species foraging distribution across the local and regional landscape.

4.4.4 Threatened Plants

The four species of threatened plants listed under the EPBC Act and found on the wind farm site: *Acacia purpureopetala, Grevillea glossadenia, Homoranthus porteri and Prostanthera clotteniana*, were positively identified in the field in the offset site. All were represented in healthy populations growing under remnant vegetation in original ecological condition to the type (see RE descriptions). Additionally, one of the two NCA listed species *Plectranthus amoanus* was also found in a healthy population on the offsets site.

With the exception of *G. glossadenia*, these species have specific habitat requirements, which explains their rareness in the wild. *G. glossadenia* tends to favour disturbance events, which can include mortality by fire that triggers mass germination of seeds, or substrate disturbance, where seed germination is in response to an altered edaphic condition. Hence, *G. glossadenia* is more widespread and can tolerate a range of habitat attributes and characteristics, which vary from wind-swept ridges to less exposed (but dry) woodlands along broader ridges.

Predicting suitable habitats for the listed threatened plants within the offset site poses a number of uncertainties and inconsistencies when measured against and compared to the supporting habitats on the wind farm site. Simply matching Regional Ecosystem types is inadequate and does not sufficiently detail the idiosyncrasies of threatened plant habitat. This is because obligate habitats are part of mosaic or complex of habitats nested amongst wider mapping units (RE's). The offset site nevertheless, is in pristine ecological condition with few incidences of notable human impact and influence. The absence of modification, isolation from human influence and rugged topography similar to that found on the wind farm are in many ways major determinants of "habitat suitability" for threatened plants, which should be able to persist in the landscape for several generations in the absence of gross disturbance and modification.

As with the predicted genetic dispersal between the population of Northern Quolls between the offset site and the wind farm, a similar ecological scenario is expected for threatened plants because of the functional, contiguous landscape connectivity and very low probability of future disturbance.

4.5 Field Verification

Targeted fauna surveys were conducted in the offsets site between 29 August – 13 September 2016.

4.5.1 Northern Quoll (*Dasyurus hallucatus*)

4.5.1.1 Methods

The most suitable method for determining the presence of Northern Quoll is by undertaking a Camera Trapping Survey.

The survey site spacing was based on research on optimal camera trap spacing for the Northern Quoll conducted by RPS at the Mt Emerald Wind Farm site, (RPS, 2014). A total of 18 camera traps (Reconyx visible flash units) were used for the camera trapping survey. At each survey site (**Appendix C**) a single camera trap was attached horizontally to the trunk of a tree with a ‘dbh’ (diameter at breast height) of at least 15 cm with a metal angle bracket, at ~1 m above the ground so the camera faced the ground. Directly beneath the camera, a bait holder, consisting of a Rain Harvesting™ PVC toilet vent pipe cap with a 50 mm PVC pipe insert, baited with two chicken necks, was affixed to the ground with a 30 cm, 5mm diameter tent peg.

Each camera was set at the medium-level trigger sensitivity. All loose vegetation (e.g. grass stalks, forbs and shrub branches) within the field of view of each camera were removed to minimize false triggers. Camera traps were active for a period of 14 days. Habitat assessments were conducted at each site.

4.5.1.2 Results

A total of 252 camera trap nights were conducted on the offsets site and all of the units captured images. Thirteen Northern Quolls were recorded during the camera trapping survey. In addition, 8 other fauna species were able to be positively identified from the images (2 reptiles, 6 mammals) with none of these species listed as threatened under the EPBC Act or Queensland NC Act.

Habitat was observed to be of high quality with large refugial areas of rocky outcrops and deep ravines and gullies suitable for denning with quality foraging and dispersal habitat available across the site in the form of rocky outcrops, hollows and fallen logs. Quoll scats were also located within creek beds and gullies in both low and high altitude aspects of the site.

4.5.2 Spectacled Flying Fox (*Pteropus conspicillatus*)

4.5.2.1 Methods

Diurnal searches for roosts and feeding signs were undertaken over a large proportion of the project site during the course of setting out camera traps for the targeted Northern Quoll survey over the 14 day period including the patches of evergreen to semi-evergreen notophyll vine forest on the project site.

The total number of spot-lighting transects as recommended by DotE (2014b) were unachievable given the harsh terrain (i.e. 5 hours per 50 ha/night = a total of 365 hrs of spotlighting) and location. Observers conducted a total of 30 hours spotlighting.

A botanical assessment of the presence of feed trees and the percentage currently flowering (during this survey) across the site was undertaken by a qualified botanist.

4.5.2.2 Results

No Spectacled Flying-foxes (SFF) were recorded during the survey. Foraging trees were located across the site however fewer than 5% were flowering during each site visit in August and September. Foraging habitat is available across the offset site and is considered in moderate to high quality.

The majority of the site was found to be suitable foraging habitat for the SFF, due to the high availability of pollen and blossom food sources including *Eucalyptus reducta, E. portuensis, E. tereticornis, E. crebra, E. shirleyi, E. cloeziana*, *Corymbia leichhardtii, C. clarksoniana, C. abergiana*, *Lophostemon grandiflorus, Melaleuca viridiflora* and *M. monantha.* These RE's included *7.12.57a. 7.12.34, 7,12.30d* (**Appendix D**).

In addition, the riparian habitats present in the deeply dissected rocky creek lines throughout the centre of the project site contain tree species that possess fruits known to be eaten by SFF, *e.g. Pleiogynium timorense* (Burdekin Plum).

4.5.3 Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus nudicluniatus*)

4.5.3.1 Methods

Four ultrasonic bat call detectors (Wildlife Acoustics SM2+BAT fitted with a SM-UX microphone) were placed across the site (**Appendix E**), to determine presence and species composition of bats within the Offset areas. The bat call detectors were programmed to turn on automatically at 6 pm each evening and record for a 12 hour period.

All call analysis was conducted by Kelly Matthews from Green Tape Solutions, Brisbane. Kelly is a recognised expert on bat call analysis and has an extensive library of reference calls from the FNQ

Bioregion. Survey limitations identified bat detectors failures preventing recording across the full site during the full fortnight duration. Functioning bat detectors identified large numbers of bat calls.

4.5.3.2 Results

A total of 56 detector nights of microchiropteran bat call surveys were conducted within the project site between August and September 2016 (**Appendix E**).

From the data set, 2244 bat calls were selected for call identification, with 2192 of these calls also analysed in full spectrum format to determine the presence of Saccolaimus species. Six microbat species were identified on site with an additional five species listed as potentially recorded on site. The Bare-rumped Sheathtail Bat (*Saccolaimus saccolaimus*) was most likely recorded on site (**Appendix E**) however the species could not be clearly identified due to the poor condition of the call, the similarity in call with sympatric species and overlap in their distribution (**Appendix F**). The presence of the species confirmed within 500m of the site and the available habitat being within exception ecological condition with high levels of natural integrity, it is highly likely the species would utilise the offset site for roosting and foraging activities.

Table 8 summarises the Call Analysis.

Table 8 Summary of Call Analysis

Species Scientific Name	EPBC	NC Act	Occurrence
Miniopterus australis	Least Concern	Least Concern	Definite
Miniopterus orianae oceanensis	Least Concern	Least Concern	Definite
Mormopterus eleryi	Least Concern	Least Concern	Definite
Myotis macropus	Least Concern	Least Concern	Probable
Nyctophilus sp ▪ *N. geoffroyi*, ▪ *N. gouldi* ▪ *N. bifax*	 Least Concern Least Concern Least Concern	 Least Concern Least Concern Least Concern	
Rhinolophus megaphyllus	Least Concern	Least Concern	Definite
Saccolaimus flaviventris	Least Concern	Least Concern	Probable
Saccolaimus saccolaimus	Critically Endangered	Endangered	Possible
Taphozous troughtoni	Least Concern	Least Concern	Possible
Vespadelus troughtoni	Least Concern	Least Concern	Definite
Vespadelus pumilus	Least Concern	Least Concern	Definite

4.5.4 *Grevillea glossadenia*

4.5.4.1 Methods

Survey methods conformed to the 'Flora survey guidelines – Protected Plants' for species listed under the *Nature Conservation Act 1992* (DEHP 2014), using the 'systematic transect search method'. This includes the presence of threatened flora identified under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) within suitable habitat areas.

When an Endangered, Vulnerable or Near Threatened (EVNT) plant species has been recorded during the transect search, the population extent and density was determined in order to quantify the potential impact.

Additionally, Vegetation communities discernible in the field were surveyed using Queensland CORVEG Database methods and the outline for recording quaternary type information as defined by the 'Methodology

for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland' (Nelder *et al*. 2012).

Any conservation significant species not previously recorded will form a voucher collection of plant specimens with specimens submitted to the Queensland Herbarium for formal identification where required.

4.5.4.2 Results

Grevillea glossadenia was positively identified in the field in the offset site. It was widespread mostly across the southern section of the property around Oaky Creek and mostly in woodland on lower hills. The species was represented in healthy populations growing under remnant vegetation in original ecological condition to the type (see RE 7.12.30d).

Grevillea glossadenia grows in rocky soils or on ridges in exposed conditions or on the edges of woodlands. It rarely grows under woodland cover. Associated plants included: *Eucalyptus lockyeri, E. mediocris, Corymbia abergiana, C. citriodora, Xanthorrhoea johnsonii* and the grasses *Themeda triandra* and *Cleistochloa subjuncea* along the dissected ridgetops to the eastern sections of the offsets site (**Appendix G**). The habitat and surrounding vegetation was of exceptionally high quality ecological condition.

4.5.5 Homoranthus porteri

4.5.5.1 Methods

As per **Section 4.5.4.1**.

4.5.5.2 Results

Homoranthus porteri was positively identified in the field in the offset site and primarily concentrated around the rocky, fire-protected zone of Oaky Creek and on rock shelves and platforms above gorges. The species was represented in healthy populations growing under remnant vegetation in original ecological condition to the type (see RE 7.12.30d). This species is found in habitats ranging from the fireproof niche environment of the rocky upper banks and slopes of Oaky Creek and its tributaries. The offset site nevertheless, is in pristine ecological condition with few incidences of notable human impact and influence. **Appendix G** provides a map of the species known distribution.

4.5.6 Acacia purpureopetala

4.5.6.1 Methods

As per **Section 4.5.4.1**.

4.5.6.2 Results

A healthy population of *Acacia purpureopetala* was located on the offset site near the southern boundary, however the species does remain rare across its distribution. *Acacia purpureopetala* is another enigmatic threatened plant, whose habitat cannot be prescriptively defined based on suitable habitat. In the offset site, the only possible determinant of habitat is the presence of Pumpkin Gum (*E. pachycalyx*). Even within a broader area of woodland dominated by *E. pachycalyx*, the population of *A. purpureopetala* occupies an area not much larger than 30 m x 15 m, and is not found elsewhere under the same woodland composition. The offset site nevertheless, is in pristine ecological condition with few incidences of notable human impact and influence. **Appendix G** provides a map of the species known distribution.

4.5.7 *Prostanthera clotteniana*

4.5.7.1 Methods

As per **Section 4.5.4.1**.

4.5.7.2 Results

Prostanthera clotteniana, was positively identified in the field in the offset site. Three populations were found in the vicinity of the southern side of Oaky Creek. Two of these are under *E. pachycalyx - C. intratropica* woodland, and the third on the top bank of Oaky Creek under *C. intratropica* with *H. porteri* and *G. glossadenia - E. pachycalyx* is absent at this site. The species represented in a healthy populations growing under remnant vegetation in original ecological condition to the type (RE 7.12.30d). *Prostanthera clotteniana* appear to be obligated to strict habitat conditions as with *Homoranthus porteri*, where protection from fire, or at least the intensity of fire, is afforded by the predominance of rock cover down slope or around the species' populations. These species are therefore found in habitats ranging from the fireproof niche environment of the rocky upper banks and slopes of Oaky Creek and its tributaries. *P. clotteniana* is difficult to predict a certain habitat preference, other than protection from fire. The species is constrained to small populations on the less dissected hills south of Oaky Creek. Despite extensive searches in apparently "suitable habitat" elsewhere, *P. clotteniana* remains cryptic and poorly represented. In comparison to the MEWF site, the species was better represented on the offset site.

4.6 Offset Availability against Offset Assessment Guide

The method used to measure and compare values between the impact area and the offset area has been identified in Section 3 of *CO2* Australia's *MEWF Offsets Assessments Guide* (2013) and has been used here to:

(1) Update the offset site; and

(2) Include a further two threatened flora species for offset assessment.

Table 9 provides the outcomes of the Offsets Assessments Guide results for seven threatened species. These results were developed in consultation with the CO2 Australia report *MEWF Offsets Assessment Guide* (2013) which considered the individual characteristics of each threatened species on the impact site and is therefore not detailed further here.

The values generated from the offsets assessment guide indicate the proposed offset is suitable to acquit the offset requirements of the project and the percentage of impact offset is over 100% for all values. **Sections 4.6.1 - 4.6.7** provide further information for each threatened species.

Table 9 Offsets Assessment Guide Results

Offset Assessment Guide Parameters	Northern Quoll	Spectacled Flying Fox	Bare-rumped Sheathtailed Bat	*Grevillea glossadenia*	*Homoranthus porteri*	*Acacia purpureopetala*	*Prostanthera clotteniana*
Size of impact area:	73 ha	73 ha	73 ha	0.399 ha	0.2 ha	0.0021 ha	0.01ha
Current Offset Area	434.9 ha	355.58 ha	404.04 ha	5 ha	1 ha	0.04 ha	0.045 ha
Quality of impact area:	8	3	7	7	7	7	7
Start quality of offset area:	9	4	9	10	10	10	10
Future quality with offset:	9	4	9	10	10	10	10
Future quality without offset:	7	3	7	7	7	7	7
Confidence in results:	80%	80%	80%	80%	80%	80%	80%
Risk of loss with offset:	3%	3%	3%	3%	3%	3%	3%
Risk of loss without offset:	5%	5%	5%	5%	5%	5%	5%
Confidence in results:	80%	80%	80%	80%	80%	80%	80%
Time over which loss is averted:	20 years	20 years	20 years	20 years	20 years	20 years	20 years
Time until ecological benefit:	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate	Immediate
Minimum % of impact offset:	100%	100%	100%	100%	100%	100%	100%
Maximum % of impact offset:	121.64%	131.58%	129.15%	430.73%	171.86%	696.40%	156.70%

4.6.1 Northern Quoll

The proposed offset area has the potential to provide a conservation gain that maintains the populations of the regional Northern Quoll population. The proposed offset area is mapped as containing 434.9ha of potential foraging, denning and dispersal habitat (**Appendix H**) which was supported by evidence of Northern Quolls at camera traps at almost all identified locations across the site and evidence of scats within creeks and gullies at low and high altitude locations. The offset site has a strong connectivity to the project site, and provides a pathway link to the Baldy Mountain Forest Reserve, which facilitates dispersal between populations. Using the available habitat, further field verification and the new offset area against the offset

assessment guide RPS has been able to determine the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.6.2 Spectacled Flying Fox

The proposed offset area is mapped as containing 355.58 ha of available SFF foraging habitat (**Appendix D**). This habitat was field verified as moderate quality, some of which of higher quality than the project site due to the larger number of myrtaceous species. While SFF were not sighted during the field surveys there are records of the species utilising this site. Using the available habitat, further field verification and the new offset area against the offset assessment guide RPS has been able to determine the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.6.3 Bare-rumped Sheathtail Bat

Field Surveys verified approximately 404.04h of the proposed offset area contains suitable habitat for the potential roosting of the Bare-rumped Sheathtail (**Appendix F**). There is also strong connectivity between the offset site and the project site which facilitates dispersal between populations. Using the available habitat, further field verification and the new offset area against the offset assessment guide RPS has been able to determine the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.6.4 Grevillea glossadenia

The MEWF project is expected to impact on 0.399ha of *Grevillea glossadenia* or removal of up to 500 individuals (Gleed, *2016*). Field verification identified approximately 5 hectares of *G. glossadenia* present (**Appendix G**) on the offset site. The amount of suitable habitat capable of sustaining this species is much higher. Calculations against the Offset assessment guide determined the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.6.5 Homoranthus porteri

The MEWF project is expected to impact on approximately 0.20 ha of *Homoranthus porteri*. Field verification identified approximately 1 hectare of *H. porteri* present on the offset site. The amount of suitable habitat capable of sustaining this species is likely to be higher, although the (**Appendix G**) species is quite restricted and can be cryptic. Calculations against the Offset Assessment Guide determined the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.6.6 Acacia purpureopetala

The Mt Emerald Wind Farm site population of *Acacia purpureopetala* represent the most north-eastern distribution of the species, where it is found at only a single location and represents an area of .0021ha. Field verification identified an area of approximately 0.04ha on the offsets site. This does not eliminate the possibility or additional suitable habitat capable of sustaining this species. The distribution on the offsets site and available habitat area was determined to be of high quality (**Appendix G**). Calculations against the Offset Assessment Guide determined the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.6.7 *Prostanthera clotteniana*

Small populations of *Prostanthera clotteniana* were found in habitats ranging from the fireproof niche environment of the rocky upper banks and slopes of Oaky Creek and its tributaries on the offset site. In comparison the species was found in one location on the MEWF within an impact area of 0.010ha. Field verification identified an area of approximately 0.045ha on the offset site. This does not eliminate the possibility or additional suitable habitat capable of sustaining this species (**Appendix G**). Calculations against the Offset Assessment Guide determined the offset site will fulfil its offsets compliance requirement. In addition the site is of high quality and therefore an immediate ecological benefit can occur.

4.7 Summary of Field Verification

In summary the suitability of the MEWF Offset Site Lot 22 SP210202 has been assessed against the seven EPBC threatened species listed namely:

- Northern Quoll (*Dasyurus hallucatus*);
- Spectacled Flying-fox (*Pteropus conspicillatus*);
- Bare-rumped Sheathtail Bat (*Saccolamimus saccolaimus nudicluniatus*);
- *Grevillea glossadenia;*
- *Homoranthus porteri;*
- *Acacia purpureopetala; and*
- *Prostanthera clotteniana*.

The values generated from the Offsets Assessment Guide indicate the proposed offset is suitable to acquit the offset requirements of the project and the percentage of impact offset is over 100% for all values. The offset area provides for the long-term protection of habitat for the seven threatened species and through effective management and monitoring strategies, the habitat will be protected and maintained.

5.0 Securing the Offset

5.1 Offset Deed

The owners of the land have entered into a formal "Call Option to Purchase Property" agreement with MEWFPL. Under the contractual terms of this agreement the owners agree to sell the Property to MEWFPL should MEWFPL exercise its Call Option on the terms specified in the deed.

It is intended for Call Option to be exercised by MEWFPL upon the project reaching financial bankable status and confirmation from DEE on its suitability as an Offset Area. At this time the ownership of the Offset Area property will fall to MEWFPL, with the intention of remaining so until the completion of all operational activities at the site.

5.2 Securing the Offset Area

The offset area will be secured as a nature refuge, as recognised by the *Nature Conservation Act 1992* (Qld).

A nature refuge agreement acknowledges the commitment to protect the offset land with significant conservation value, while allowing compatible and sustainable land uses to continue.

A nature refuge agreement will be:

- Negotiated between EHP and the landholder, and provides a framework for sustainably managing a nature refuge and protecting its significant values;
- Tailored to suit the landholder's management needs;
- Able to be negotiated with owners of freehold land,
- Able to be negotiated over the whole of the property;
- Perpetual, registrable on title and binds successive owners or lessees of the land; and
- A draft Nature Refuge Agreement will be developed with the Queensland Government.

6.0 Offset Area Management

6.1 Objectives and Outcomes

The offset area provides for the long term protection of habitat for seven threatened species and through the implementation of adaptive management practices the quality of the habitat will be improved and maintained over time.

The offset area is to be protected in perpetuity through an appropriate mechanism as outlined in **Section 5.2**.

The management plan objectives and outcomes are to:

- Protect all vegetation within the offset area from future clearing;
- Protect all fauna within the offset area from introduced weeds and pests;
- Protect the site vegetation and fauna from un-prescribed burn and wildfire;
- Maintain the ecological condition of remnant of-concern and least concern vegetation within the Offset area where the BioCondition Class of 1 for each assessment unit does not change;
- Implement a Translocation Plan based on the criteria and guidelines detailed in the *Guidelines for the translocation of threatened plants in Australia* (Vallee *et al*, 2004) should be developed to identify MNES plant species appropriate for relocation as well as target and recipient sites.

7.0 Restrictions on the Use of the Offsets Area

The restrictions below (**Table 10**) will be implemented within the Offset Area Management Plan.

Table 10 Offsets Area Restrictions

Restriction	Implementation
Fire	Fire is to be, where possible, managed in the offset area by: (a) Maintaining firebreaks relative to the offset area; (b) Co-locating firebreaks with existing roads and fence lines on the property where possible; and (c) Utilising prescribed burning strategies as outlined in the *MEWF Bushfire Management and Emergency Evacuation Plan* (2016).
Pest Animal Management	Minimise the introduction of pest animals and control of existing populations of pest animals within the Offset Area in accordance with the *Biosecurity Act 2014.* The MEWF *Pest Management Plan* (2016) identifies strategies to protect and/or eradicate vertebrate pests from the Mt Emerald massif. Minimise the risk of invasion and spread of any invasive species within the Offset area in accordance with **Table 12 Management Actions**.
Weeds	Keep the introduction; establishment and spread of non-native weeds including Declared Pest Plants listed under the *Biosecurity Act 2014* to no more than 5% weed cover over the Offset Area. Control any existing infestations of non-native weeds including Declared Pest Plants under the *Biosecurity Act 2014* to ensure the non-native weeds do not cover more than 5% of the Offset Area. Minimise the spread of any non-native pasture species within the Offset Area in accordance with **Table 12 Management Actions**.
Access (including livestock)	The offset area will be fenced to restrict access. Access to the offset area will be for authorised personnel only.
Limited vehicle access and movements within the offset area	Vehicle movement will be limited to designated access tracks in the offset area to minimise impacts to the ecological communities and minimise erosion.

8.0 Analysis of Risks to Achieving Management Objectives and Outcomes

The following risk assessment (**Table 11**) has considered:

- Any real or potential risks associated with achieving the management objectives and outcomes;
- The actions taken to minimise those risks and;
- Any remedial action that will be undertaken if any of the risks occur.

Table 11 Risk Analysis

Number	Risk	Level of Risk (Extreme, High, Moderate or Low)	Proposed Actions to Minimise Risk	Proposed Remedial Actions if Risk occurs
1	Fire	Moderate	Maintain fire break, Manage fuel loads through controlled fire regime	Allow offset area to recover post fire with control of weeds. Rehabilitate and revegetate sensitive areas where necessary.
2	Pest Animals and Weeds	Moderate	Limit the introduction of pest and weed animals	Implement and/or increase control methods where required.
3	Grazing, Human Access	Low	Fence where required in accordance with this plan	Prevent access from neighbouring properties.

9.0 Management Measures

9.1 Management Actions

The following table (**Table 12**) identifies the actions which will be undertaken for the offset area, by whom, and the corrective actions for each management action.

Table 12 Offset area management, monitoring and reporting schedule

ACTION	UNDERTAKEN BY	DETAILS (LOCATION, METHOD, TIMING AND FREQUENCY)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	CORRECTIVE ACTIONS
Weed Management													
Weed distribution survey		Conduct biennial surveys to determine the occurrence and distribution of weeds. Map the extent and density of weed infestations with GIS.	✓		✓		✓		✓		✓		
Weed control plan	TBD	Implement MEWF Weed Management Plan (**Appendix I**) incorporating Offset Site attributes at the start of management and update as required based on the results of weed distribution surveys.	✓										
Active weed control	TBD	▪ Triggers for weed control include any new or unusual weed sightings should be reported immediately to allow for rapid control to occur to prevent outbreaks or new populations. Locations should then be added to a register of all known weed locations. ▪ Activate monitoring from incursions on adjacent MEWF site – additional management activities (**Appendix I**). ▪ Check and control priority weed and contain weed infestations. Keep the access road free of weeds, with particular attention to Grader Grass and any other tall grasses. Maintain a 2 m wide weed-free clear zone each side of access from Lemontree Drive. The weed-free clear zone should allow for 2 m clearance each side of the largest expected vehicle that will enter the site. ▪ Implement annual weed control measures to reduce the density and area of occupation in the offset area in accordance with the weed control plan. ▪ Weed control methods will be chosen based on the results of the weed control surveys to suit individual weed species. Weed control to include a combination of biological, mechanical and herbicide control methods.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▪ Investigate alternative weed management regimes or techniques. ▪ Develop an updated weed management regime. ▪ Submit the proposed revised weed management program, as part of a revised Offset Area Management Plan, to the Department of the Environment and Energy. ▪ Implement the revised and approved plan. ▪
Short term monitoring of weeds	TBD	Monitoring of targeted weed infestations will be conducted as follow up after weed control events to ensure infestations have been sufficiently eradicated and to conduct re-control where required. Review Weed Management Plan: amend and adapt weed management practices as required throughout the duration of the construction and operational stages of the wind farm (**Appendix I**)	As required										
Weed prevention/hygiene	All approved visitors to the offset area	Practice Good Weed Management: Always work from the cleanest, weed-free areas towards contaminated areas. Prevent the movement of weed material from weed infested areas into the offset area. Ensure that all vehicles and equipment entering the offset area are clean and free of weed seed prior to entry.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Managing access by humans, livestock													
Fencing	TBD	The majority of the offset area is not accessible to livestock given its topography. Areas considered to be accessible would be fenced with a four strand barbed wire, stock proof fence.	✓										▪ Interim exclusion options will be used if fence construction or repairs are delayed. ▪ Conduct quarterly audits of the offset area until actions are completed as agreed
Fire management													
Bushfire Management and Emergency Evacuation Plan	TBD	MEWF Bushfire and Emergency Evacuation Plan (**Appendix J**) identifies a program of actions that will be utilised on the Offsets site.	✓										▪ Investigate alternative fire management regimes or techniques such as prescribed burning ▪ Develop updated fire management regime ▪ Submit the revised fire management regime to the Department of Environment for approval ▪ Implement revised and approved plan.
Firebreaks	TBD	▪ If appropriate, establish firebreaks around the perimeter of the offset ▪ area to prevent unplanned fires entering the offset area, ▪ Inspect firebreaks and maintain as required.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Fuel loads	TBD	▪ Monitor fuel loads during short term weed monitoring events and annual weed inspections ▪ Maintain fuel loads through annual weed control to include a combination of biological, mechanical and herbicide control.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

ACTION	UNDERTAKEN BY	DETAILS (LOCATION, METHOD, TIMING AND FREQUENCY)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	CORRECTIVE ACTIONS
Pest management													
Pest animal control	TBD	▪ Refer to MEWF Pest Management Plan (**Appendix K**) and incorporate the adjoining offsets site. Record the incidental occurrence of pests at key locations on offset site. Identify if the pest has been observed on the site before, is breeding and occupies a small area. This population may be controlled. ▪ Triggers for pest control include incursion on adjacent MEWF site – additional monitor and management activities (**Appendix K**). ▪ Conduct an annual assessment of need for pest animal control measures. ▪ Measures to include live trapping or shooting. ▪ Control by baiting will not be undertaken.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▪ Investigate reasons for poor pest animal control. ▪ Develop updated Pest Animal Plan. ▪ Submit the proposed revised pest animal management program, as part of a revised Offset Area Management Plan, to the Department of Environment and Energy for approval ▪ Implement the revised and approved plan
Translocation of threatened plants													
Translocation Management Plan	TBD	Refer to MEWF Translocation Management Plan (**Appendix B**) outlining specific management measures associated with the translocation of threatened plant species to the offset area.	✓										
Site preparation	TBD	Prior to planting, reduce ground cover within the planting site so as not to limit the establishment of any of the translocated species.	✓										
Planting	TBD	Undertake planting during a suitable time of year. General management measures for the translocated plants will include but not be limited to the following: ▪ Track each plant with a unique code and record a GPS location. ▪ Water each plant immediately after planting. ▪ Monitor predation by insects and apply insecticide onto the foliage if required. Any weeds occurring within the vicinity of translocated individuals will be hand removed whilst watering.	✓										▪ Replace dead plants in order to achieve the required number of individuals
Watering	TBD	Water translocated plants immediately after planting and every week for the first four weeks following translocation (if required).	✓										
Monitoring													
Photo monitoring	TBD	Establish four photo monitoring points within the offset area to enable a visual assessment of changes over time including the following: ▪ Mark photo monitoring points with flagging tape and the GPS points recorded. ▪ Take annual photographs in north, southeast and west directions. ▪ Maintain a record of the photographs, including GPS co-ordinates, date and time of each photograph, the direction in which the photograph was taken; and the height above the ground at which the photograph was taken.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	▪ Investigate reasons for why management actions are not achieving desired outcome ▪ Revise management strategies and implement as required
Opportunistic visual monitoring	TBD	Undertake visual monitoring opportunistically during the implementation of management actions to assess the following: ▪ the status of fencing in the offset area ▪ the status of weeds in the offset area ▪ areas of erosion and/or areas with high erosion potential ▪ firebreaks and fuel loads ▪ evidence of pest animals in the offset area (including feral cats and dogs).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Fauna surveys	TBD	Targeted surveys will be undertaken annually in year 1 and year 2, then every two years. The fauna survey methodologies will be developed in consultation with DEE and will be consistent with Australian Government fauna survey guidelines. All surveys will be undertaken by a suitably qualified person (e.g. fauna ecologist). More detail regarding fauna surveys is provided in Section 1.2. Prior to undertaking the fauna monitoring program, ensure all necessary licenses relating to the capture of wildlife are current, including animal ethics approval and DEHP wildlife trapping permit. Prepare report on the statistical analysis of changes in species diversity and provide to DEE within three months of monitoring completion.	✓	✓		✓		✓		✓		✓	▪ Investigate reasons for low native species diversity ▪ Develop a program improve or manage fauna species diversity ▪ Submit the proposed management program, as part of a revised Offset Management Plan, to the DoEE for approval Implement the revised and approved plan

ACTION	UNDERTAKEN BY	DETAILS (LOCATION, METHOD, TIMING AND FREQUENCY)	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	CORRECTIVE ACTIONS
Biocondition assessments	TBD	Two permanent transects for undertaking BioCondition assessment will be established and marked using flagged star pickets or other markers (See Eyre *et al*. 2011). Biennial BioCondition assessments will be undertaken in accordance with the BioCondition Methodology (version 2.1, Eyre *et al*. 2011).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Monitoring of translocated threatened plant species populations	TBD	Monitor the translocated *Grevillea glossadenia, Prostanthera clotteniana, Acacia purpureopetala*,*Homoranthus porteri*, *Melaleuca uxorum* and *Plectrathus amoenus* populations in order to assess the success of the translocation program. Conduct monitoring monthly for the first 12 months and then quarterly for the next four years. Table 14 lists the parameters to be monitored and the performance criteria against which they will be assessed (**Appendix B**)	✓ Monthly	✓ Quarterly	✓ Quarterly	✓ Quarterly	✓ Quarterly						▪ Investigate reasons for why the translocation program is not achieving desired outcome. ▪ Revise the Translocation Management Plan and implement as required.
Reporting													
Annual report submitted to Department of the Environment and Energy (DEE)	TBD	Provide an annual report to DEE by 30 June. It will include: ▪ results of monitoring activities ▪ the outcomes of management actions including annual weed surveys and pest animal control ▪ a general description of climatic conditions and other factors that may impact the offset area (fires, drought, flood, etc.).	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

(From RATCH Offset Management Plan, 2013)

9.2 Translocation and Propagation

A management action for threatened plants includes taking opportunities to remove a living plant from its natural habitat and planting it into a suitable recipient site, where there is a reasonable probability of it surviving and forming a healthy and functional population in the future. This process is called translocation and is an accepted impact mitigation technique used for threatened plants listed under the EPBC Act and the NC Act.

The translocation of living threatened plants requires a detailed and site-specific *Translocation Plan* (**Appendix B**) to be developed in order that a number of matters including the selection of suitable recipient sites; the technique of translocation; and a monitoring component are clearly defined. This Threatened Plants Management Plan is not a dedicated translocation plan; however, a brief summary of the predicted likelihood of successfully translocating the threatened plant species recorded from the Mt Emerald Wind Farm site is shown in **Table 13**.

Table 13 Predicted Success Rates for Translocating Threatened Plant Species

Species	Transplant/translocation	Stem/leaf cuttings	Seed propagation
Acacia purpureopetala (Purple-flowered Wattle)	Low. Adult plants could have underground perennating stems or other plant parts. Possible higher success rate transplanting seedlings. Plants (on Mt Emerald) have peculiar and very specific habitat requirements.	Low.	Low-moderate. Seeds germinate okay, but new seedlings are prone to fungal disease and difficult to grow on to more mature stages.
Grevillea glossadenia (no common name)	Adult plants - low. Seedlings - would need to select relatively fresh seedling material (post-fire germination event). Plants are likely to require mycorrhyzal inoculation from parent soil to improve success rates.	Low.	Moderate to high.
Homoranthus porteri (no common name)	Low. Insufficient knowledge of propagation. Plants have very specific habitat requirements.	Low - insufficient knowledge of propagation through cuttings, although other species of *Homoranthus* have been propagated using this method.	Insufficient knowledge to determine validity of this method.
Prostanthera clotteniana (Mint Bush)	Low for adult plants. Juvenile material may have higher rates of transplanting success. Insufficient knowledge to determine validity of this method.	Moderate, but would require specialised nursery set-up.	Insufficient knowledge to determine validity of this method.
Melaleuca uxorum (no common name)	Low. Natural regeneration appears to be from resprouting stems from adult plants. Seedlings not observed in wild - insufficient knowledge.	Low to moderate, although insufficient knowledge of propagation through cuttings.	Moderate to high. Fresh seed material would need to be collected.
Plectranthus amoenus (Plectranthus)	Moderate to high. Would need to have recipient site and dedicated process to increase success rates.	High. Plectranthus plants are likely to be successfully propagated through leaf or stem cuttings.	Insufficient knowledge, although other methods of propagation or transplanting are likely to prove successful and are a more valid means of horticultural reproduction.

(Gleed, 2016)

10.0 Monitoring and Reporting

10.1 Monitoring

Ongoing monitoring is required to ensure the offset area management plan achieves the objectives outlined above. Monitoring activities will be undertaken to assess how the offset site is progressing over time and inform ongoing management activities should additional management activities be required. **Table 12** also outlines the Monitoring and Reporting Schedule over a ten year time frame.

10.2 Procedures

10.2.1 Training Requirements

The effectiveness of the Offset Area Management Plan will depend on those responsible for its implementation. Those responsible must be familiar with the content and able to interpret and successfully implement the management actions of the Plan. The MEWF Site Manager will ensure relevant personnel are trained in the procedures of the OAMP and are capable of implementation.

Employees and contractors entering the Offset Area will have an induction which will cover:

- Procedures to reduce spreading weeds and pests;
- General fire awareness and response procedures;
- Vehicle access management; and
- Response procedures to mitigate impacts.

10.2.2 Roles and Responsibilities

Contractors undertaking site works must be instructed directly of the requirements of this plan. A copy of this OAMP is to be retained and displayed on site at all times during the life of the Offset program. The site manager should ensure all relevant contractual documents specify the OAMP as a responsibility.

10.3 Reporting

Reports will be submitted to the Department of the Environment and Energy by 30 June of each calendar year detailing the progress against the proposed management outcomes until the outcomes are achieved.

As a minimum each report will include:

- Departmental reference number;
- Name and contact details of landholder;
- Lot on plan property description and postal address;
- A general description of climatic conditions which may impact the offset area;
- Activities undertaken within each management action and the outcomes achieved;
- Schedule of management actions with progress section completed;
- Program of action for the next management period;
- Results of BioCondition assessments;
- Photo monitoring results;

- Progress towards the achievement of offset area objectives and outcomes;
- Problems, issues and impediments to achieving the objectives and outcomes of the management plan; and
- Adaptive management actions (e.g. adverse climatic conditions such as storm damage or flooding; bushfire; or pest species invasion).

11.0 Consent

Consent must be provided by the owner/s and signed off by the chief executive delegate.

SIGNED by delegate of the Chief Executive Officer (Department of Environment and Energy) to indicate approval of the Offset Area Management Plan.

Name:..... Signature.....

Witness name:.....Signature.....

Date:.....

SIGNED by being the current owner/s of the abovementioned property to indicate that the terms of this offset area management plan including responsibilities under the management plan, have been read, understood and accepted.

The landholder agrees that any non-compliance with the requirements of this Offset Area Management Plan shall constitute a breach of the terms and conditions of the legally binding mechanism entered into.

Name:..... Signature.....

Witness name:.....Signature.....

Date:.....

Name:..... Signature.....

Witness name:.....Signature.....

Date:.....

12.0 References

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K. APPROVAL OF OFFSET AREA MANAGEMENT PLAN

Australian Government
Department of the Environment and Energy

Our reference: 2011/6228

Mr Terry Johannesen
Project Manager
RATCH-Australia Corporation Limited
Level 4, 231 George Street
BRISBANE 4000

Dear Mr Johannesen

EPBC 2011/6228 Mount Emerald Wind Farm Proposal, Queensland

Thank you for your letter dated 16 December 2016 to the Department, for and on behalf of Mount Emerald Wind Farm Pty Ltd, requesting approval of the *Mount Emerald Wind Farm Offset Area Management Plan, December 2016 R76073/PR132974-1*.

Officers of the Department have reviewed and advised me on the *Mount Emerald Wind Farm Offset Area Management Plan, December 2016 R76073/PR132974-1*.
On this basis, and as a delegate of the Minister for the Environment and Energy, I have decided to approve the *Mount Emerald Wind Farm Offset Area Management Plan, December 2016 R76073/PR132974-1*. This plan must now be implemented.

EPBC 2011/6228 condition 29 allows you (under certain circumstances) to implement revised plans without seeking the Minister's approval. If you require any advice on whether or not to submit a revised plan for approval, please contact the officer below. When submitting any revised plan to the Minister under condition 29, please provide a 'tracked changes' version of the plan. I also attach a fact sheet providing guidance on 'new or increased impact' relating to changes to approved management plans under EPBC Act environmental approvals.

Should you require any further information please contact Robin Nielsen, on 02 6274 1004 or by email: post.approvals@environment.gov.au

Yours sincerely

Monica Collins
Assistant Secretary
Compliance & Enforcement Branch
Environment Standards Division

20 December 2016

Enc.

L. DATE OF COMMENCEMENT NOTIFICATION

RATCH-Australia Corporation
A Ratchaburi Holdings and Transfield Services Company

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13 February 2017

Contact: Monica Collins

Assistant Secretary
Compliance and Enforcement Branch
Department of the Environment and Energy
GPO Box 787
Canberra ACT 2601

Via Email: post.approvals@environment.gov.au

Copy to: Peter Blackwell, Panna Patel, Robin Nielsen

Dear Monica

EPBC 2011/6228 – COMMENCEMENT OF THE ACTION

In reference to Condition 23 of decision approval 2011/6228 made in respect of the Mount Emerald Wind Farm project (**the Project**) and dated 26 November 2015 (**Decision Approval**); please be advised the date for Commencement of the Action is 7 February 2017.

If you have any questions in relation to this letter, please do not hesitate to contact me on 07 3214 3401 or at Terry.Johannesen@ratchaustralia.com.

Yours sincerely

Terry Johannesen
Project Development Manager
RATCH-Australia Corporation Limited

M. ACKNOWLEDGEMENT OF DATE OF COMMENCEMENT

Australian Government
Department of the Environment and Energy

Our reference: 2011/6228

Contact Officer: Keith Horwood
Telephone: (02) 6274 1933
Email: epbcmonitoring@environment.gov.au

Mr Terry Johannesen
Project Development Manager
RATCH-Australia Corporation Limited
PO Box 1058
NORTH SYDNEY NSW 2059

Dear Mr Johannesen

Commencement of the Action, Mount Emerald Wind Farm, QLD, EPBC 2011/6228

I write in relation to *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) approval 2011/6228, for which notification of commencement was received by the Department on 13 February 2017 in accordance with condition 23.

As the date of commencement has been notified as 7 February 2017, I draw to your attention the following due dates for actions required under the conditions of approval:

Condition 26 - Annual Compliance Report

The Annual Compliance Report for the period 7 February 2017 to 6 February 2018 must be published and submitted to the Department before 7 May 2018. The Annual Compliance Report must continue to be published and submitted to the Department each year until 31 July 2045.

It is the preference of the Department that the Annual Compliance Report and details of publication are submitted in electronic format to the email address at the top of this letter, with attention to the EPBC Compliance Monitoring Team.

Please ensure to maintain accurate records of all activities associated with, or relevant to, the conditions of the approval so that they can be made available to the department on request. Such documents may be subject to audit and be used to verify compliance. Summaries of audits may be published by the department. Information about the Monitoring and Audit program can be found on the department's website at http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/complian-2

If you would like to discuss this matter further please contact Keith Horwood on (02) 6274 1933.

Yours sincerely

Alex Taylor
Acting Director
Monitoring and Assurance Section
Compliance & Enforcement Branch
Environment Standards Division

15 February 2017