



27th July 2018

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Dear Mr Davies,

Flyers Creek Wind Farm MP 08_0252 – Modification 4

1. Introduction

Flyers Creek Wind Farm ("the Project") is an approved 38 wind turbine wind farm located approximately 20 kilometres ("km") south of Orange.

The Project is located predominantly in the Blayney Shire local government area although the proposed 132 kilovolt ("kV") grid connection which forms part of this application is located partly in Cabonne Council local government area.

Project approval MP 08_0252 was granted under Part 3A of the *Environmental Planning and Assessment Act 1979 (NSW)* ("EP&A Act") to Flyers Creek Wind Pty Ltd ("the Proponent") for the Project by the NSW Planning and Assessment Commission on 14 March 2014 ("Project Approval"). The Project Approval has been modified 3 times since originally being granted and was transitioned to State significant development ("SSD") on 6 July 2018 (see section 3 below for details).

The Proponent forms part of the Infigen Energy corporate group ("Infigen"). Infigen Energy is a developer, owner and operator of generation assets delivering energy solutions to Australian businesses and large retailers. Infigen is focused on continuing to invest in new and existing renewable energy projects to extend the current development pipeline. Infigen's current operating wind and solar farms generate enough renewable energy to meet the needs of over 250,000 homes and represents a saving of approximately a million tonnes of carbon dioxide a year. Infigen's development pipeline comprises approximately 1,200 megawatts of large-scale wind and solar projects in Australia. The Project forms an integral part of Infigen's development pipeline.

The Proponent seeks a modification to the Project Approval under section 4.55(2) of the EP&A Act ("Modification 4") so as to:

- increase the wind turbine envelope so as to accommodate the newer, more efficient turbine models now available; and
- include a 132 kV) transmission line and switching station so as to enable the Project to connect to the electrical grid.

The modification also includes some minor clarifications to project components.

2. Structure

This modification application and environmental assessment includes the following:

- Section 3: Project Approval history
- Section 4: Modification 4
- Section 5: Justification
- Section 6: Environmental Assessment
- Section 7: Statement of Commitments
- Section 8: Consultation
- Section 9: Project Approval Conditions
- Section 10: Summary
- Appendix A: Turbine Locations
- Appendix B: Project Figures
 1. Figure 1: Regional Location
 2. Figure 2: Project Layout
 3. Figure 3: Project Layout (aerial image)
 4. Figure 4: Noise Monitoring and Receivers
 5. Figure 5: Grid Connection Routes
- Appendix C: Visual Impact Assessment (Green Bean Design)
- Appendix D: Shadow Flicker Impact Assessment (WSP)
- Appendix E: Bird and Bat Impact Assessment (Brett Lane & Associates)
- Appendix F: Noise Impact Assessment (Vipac)
- Appendix G: Traffic and Transport Impact Assessment (Aurecon)
- Appendix H: Electromagnetic Interference Assessment (Telecoms) (Aitken & Partners)
- Appendix I: Aviation Assessment (Aviation Projects)
- Appendix J: Biodiversity Impact Assessment (NGH Environmental)
- Appendix K: Aboriginal and Historical Heritage Impact Assessment (NSW Archaeology)
- Appendix L: Community Newsletter (July 2018)

3. Project Approval History

The Project Approval as originally granted, authorised the:

- construction and operation of a wind farm with up to 42 turbines;
- associated infrastructure including access tracks, local road infrastructure upgrades and electrical connections between the turbines (both underground cable and under and aboveground power lines);
- an on-site substation (inclusive of switch room, control room and auxiliary services building); and
- a transmission line from the on-site substation to the Essential Energy 132kV transmission line on the Cadia Mine site to the north-west of the site.

A modification to the Project Approval was approved on 13 March 2015 ("Modification 1") and authorised a 6 month extension to comply with the deferred commencement condition provisions.

A second modification to the Project Approval was approved on 14 September 2015 ("Modification 2") and authorised the:

- removal of the 132kV transmission line proposed to connect the wind farm substation to the electrical grid (on the existing Orange to Cadia Mine 132kV line) from the scope of the Project Approval;
- removal of deferred commencement conditions B1 and B2;
- a revised substation location and access tracks; and
- minor changes to the Project Approval conditions including related to provision for alternative locations to monitor background noise if required.

A third modification to the Project Approval was approved on 30 November 2017 ("Modification 3") and authorised the:

- removal of Project infrastructure from 3 properties that exited from the Project, including 4 wind turbines;
- the relocation of turbines 15 and 3 so as to minimise impacts on the properties who exited from the Project; and
- a realignment of the 33kV overhead power line to Errowanbang Road; and
- minor changes to access tracks, laydown areas and cabling and bushfire asset protection zones.

As a result of Modification 3, the total wind turbines approved as part of the Project was reduced from 42 to 38 wind turbines.

The Project was transitioned to SSD by an order made under clause 6 of Schedule 2 of the *Environmental Planning and Assessment (Savings, Transitional and Other Provisions) Regulation 2017* ("Savings Regulations") which was gazetted on 6 July 2018. As a result:

- clause 6(3)(a) of the Savings Regulations operates so that the Project Approval is taken to be a SSD development consent granted under Part 4 of the EP&A Act; and
- the Project Approval may be modified under section 4.55(2) of the EP&A Act.

4. Modification 4

The following changes are proposed as part of Modification 4:

- increase the wind turbine envelope so as to accommodate the newer, more efficient turbine models now available; and
- include a 132 kV transmission line and switching station so as to enable the Project to connect to the electrical grid.

Modification 4 also includes some minor clarifications to project components as outlined at section 4.3 below.

No changes to the approved locations of wind turbines are proposed as part of Modification 4.

4.1 Increased wind turbine envelope

Since the original Environmental Assessment (Aurecon, 2011) ("Original EA") for the Project was prepared and the Project was initially approved in 2014, there have been significant advancements in wind turbine technology. The newer turbine models generate more electricity per wind turbine, increasing the amount of renewable wind energy harnessed by the Project.

Modification 4 seeks approval to increase the maximum wind turbine envelope, including an increase in the maximum tip height by 10m (from 150m to 160m) so as to enable newer and more efficient wind turbine models to be installed at the site.

The Proponent has not made a final decision on the turbine model which will be installed at the site. However, the increase to the maximum turbine envelope proposed as part of Modification 4 would allow for the installation of a turbine model with an installed capacity of up to 4.2 MW, as compared to the turbine models ranging between 2.0 and 3.6 MW which have been considered for the Project. By using the more efficient turbine models now proposed as part of Modification 4, the Project has the potential to generate approximately 430 GWh of electricity per year - sufficient for the average consumption of approximately 58,000 homes.

The proposed new maximum wind turbine envelope would have:

- a maximum tip height of 160m;
- a maximum rotor diameter of 140m, with blades measuring up to 70m; and
- a maximum hub height of 92m.

Table 4.1 outlines the currently approved maximum turbine dimensions and the proposed new maximum turbine dimensions.

Table 4.1 Approved and proposed maximum wind turbine envelope

Turbine Component (m)	Approved Turbine	Proposed Turbine	Change
Tip Height	Up to 150m	Up to 160m	+10m (6.7% increase)
Rotor Diameter	Up to 112m	Up to 140m	+28m (25% increase)
Blade Length	Up to 56m	Up to 70m	+14m (25% increase)
Hub Height	80m to 100m	90m to 92m	No change

It is noted that:

- No changes are proposed to the approved wind turbine locations as part of Modification 4. Rather, the final location of the 38 wind turbines approved for the Project will remain subject to the micro siting allowance authorised by condition C7 of the Project Approval. Appendix A includes a list of the wind turbine centre point locations authorised by the Project Approval subject to the micro siting authorised by condition C7.
- The descriptions of the wind turbine technical specifications or details contained in the Original EA, for example rotor speed etc are superseded by the technical specifications and details associated with the wind turbine parameters proposed in this modification.

4.2 132 kV transmission line and switching station

The proposed 132 kV electrical transmission line ("Reinstated Transmission Line") which forms part of this modification application is required to connect the wind farm to the electrical grid network.

The Project was originally proposed to be connected to the grid via an up to 15 km long transmission line from the on-site substation to the existing 132 kV transmission line which runs from Orange North to the Cadia Mine site ("Original Transmission Line"). The Original Transmission Line was removed from the Project as part of Modification 2 to enable land access negotiations to be finalised with relevant landholders.

The Reinstated Transmission Line connects into the same existing 132 kV transmission line as the Original Transmission Line but at a revised location, some 4.6km north east, so as to reflect the outcome of the final land access negotiations with relevant landholders.

The Reinstated Transmission Line has a length of approximately 14 km and will be located within a 100m wide route corridor. In addition, a small switching station on an area of land approximately 100m by 100m may be required at the northern end of the line where it connects into the existing 132kV line ("Switching Station").

Figure 5 contained in Appendix B shows the route of the Reinstated Transmission Line as compared to the route of the Original Transmission Line for ease of reference.

The Reinstated Transmission Line is currently proposed to be a mixture of overhead lines and underground cable, but may end up being constructed completely as overhead lines. This assessment has been carried out based on the scenario of the full length of the line being overhead line so as to ensure an appropriate degree of conservatism.

The overhead line sections of the Reinstated Transmission Line would consist of overhead conductors strung along the transmission line route linking poles

approximately 20 to 30m above ground level. The cleared easement required for the construction and operation of the Reinstated Transmission Line would be 45m wide for overhead sections and 6m wide for underground sections, with all parts of the line remaining within the assessed 100m wide route corridor.

It is proposed that the Reinstated Transmission Line will commence at the approved onsite wind farm substation. At this point, it will be overhead line and travel westwards across open rural land before reaching the Errowanbang Road. At this point, it is currently proposed that the line will travel underground in a westwards direction along the Panuara Road reserve and then travel northwards on the eastern side of the Cadia Road reserve until the southern edge of the Forestry plantation. However, if agreements with relevant landowners of adjoining land in this area are reached, then the underground sections of the line may be constructed as overhead lines in this section. The line would then keep travelling above ground northwards on the eastern side of the Cadia Road reserve and on the edge of State Forest coniferous plantation until it reaches the existing 132 kV line which runs from Orange North to Cadia. As outlined above, a small Switching Station may be required to enable the Project to connect into this line.

4.3 Minor Clarifications

The modification includes the following minor clarifications to project components:

- **Wind monitoring masts:** There are 2 existing 80m high wind monitoring masts onsite (a third was decommissioned in 2015). The Original EA contemplated that "additional monitoring masts similar to the existing masts may also be required". This modification clarifies that the monitoring masts required for the Project will have an increased height, from the 80m contemplated in the Original EA to 92m to reflect the proposed revised wind turbine hub height and allow for wind monitoring to occur at wind turbine hub height. It is likely that the 2 existing monitoring masts would be decommissioned and replaced with 2 new monitoring masts and that up to 2 additional monitoring masts would also be required;
- **Turbine assembly hard-stand areas:** The Original EA contemplated that the turbine assembly hard-stand areas adjacent to each wind turbine would have approximate dimensions of 50 by 40m with a total disturbance footprint for all turbines of approximately 8.8 hectares ("ha"). This modification updates this to reflect the increased wind turbine dimensions which require a hard-stand area for each turbine of approximately 50 by 25m as well as a turbine blade laydown area of approximately 12 by 70m with the total disturbance footprint for all approved turbines remaining approximately 8.8ha (noting that a number of turbines have been deleted from the layout assessed in the Original EA);
- **Turbine footings:** The Original EA contemplated that the turbine footings would be 12 by 12m with a total disturbance footprint of approximately 1ha. This modification updates this to reflect the increased wind turbine dimensions which require increased to footings of between 17 by 17m to 19 by 19m (depending on the final turbine model selected) with a total disturbance footprint for all approved turbines of between approximately 1.09 to 1.4ha; and
- **Concrete batching plant:** The Original EA contemplated that a temporary concrete batch plant may be required. This modification clarifies that the temporary concrete batching plant will be required as part of the Project and that it will be located in accordance with the limitations on the location of ancillary facilities in condition F18 of the Project Approval and included in the Construction Compound

and Ancillary Facilities Management Plan required under condition F21(a) of the Project Approval.

4.4 Figures

Appendix B contains 5 figures:

- Figure 1: Regional Location Plan – showing the project area in a regional context;
- Figure 2: Project Layout – showing the project area and location of the Reinstated Transmission Line and associated Switching Station;
- Figure 3: Project Layout (aerial image) – showing same as Figure 2 with an aerial image background;
- Figure 4: Noise Monitoring and Receivers – showing monitoring and receiver locations in distance bands from approved wind turbine layout: and
- Figure 5: Showing the location of the Original Transmission Line and Reinstated Transmission Line.

4.5 Additional Properties

The new properties which are included in the project site as part of Modification 4 are identified in Table 4.2.

Table 4.2 Modification 4 – Properties included in Project Site

Landowner	Lot	DP
A	103	1040753
	22	1078095
	21	1078095
	8	1040755
	7	1040755
B	101	881593
	52	39600

The Project site also includes:

- any Crown land, including road reserves or watercourses contained within the Project site;
- the 132kV transmission line corridor affecting the Errowanbang Road, Panuara Road and Cadia Road reserves, which are Council roads; and
- all land on which the infrastructure or works currently approved by the Project Approval is located, including any road upgrades required under the conditions of the Project Approval.

5. Justification

The modifications proposed as part of this Modification 4 are required to enable newer and more efficient wind turbine models to be installed as part of the Project and the approved wind farm to be connected to the grid.

The Flyers Creek Wind Farm, as modified by Modification 4 will provide the following primary benefits:

- In full operation, the Project would generate approximately 430 Gigawatt hours ("GWh) of electricity per year - sufficient for the average consumption of approximately 58,000 homes.
- It would assist in replacing the 1,000 megawatt ("MW) shortfall identified by the Australian Energy Market Operator as being required to supplement the lost generation capacity which will result from the planned closure of the Liddell Power Station in 2022.
- It would contribute to the State and Federal Governments' target of providing 33,000 GWh from renewable sources by 2020.
- It would contribute to the NSW Government's target of reducing greenhouse gas emissions by 60% by the year 2050.
- It will contribute to inter-generational equity by reducing greenhouse gas emissions and reducing consumption of finite fossil fuel resources.
- It will provide full time employment for a peak of 140 people during construction and up to 6 to 10 ongoing regional jobs during its operational life.
- It will result in a direct injection of approximately \$1 million per annum to the local community through payments to landholders, permanent staff and community fund contributions.

In particular, Modification 4 will:

- enable these important benefits to be realised by reinstating the 132 kv transmission line so as to connect the Project to the electricity grid; and
- increase the total generation capacity of the Project by between 15 to 20% compared to the currently approved Project through the use of more efficient turbine technology than was available when the Project was originally approved.

6. Environmental Assessment

6.1 Overview

This section assesses the potential environmental impacts of Modification 4. The scope of the environmental assessments which require to be reviewed and updated to reflect the proposed modification were determined in consultation with the Department of Planning and Environment and include:

- Visual;
- Shadow flicker;
- Bird and bat;
- Noise;
- Traffic and transport;

- Electromagnetic interference (telecommunications);
- Aviation;
- Biodiversity; and
- Aboriginal and historical heritage.

A high level summary of these assessments is provided below and the complete assessments are contained in Appendix C to K.

Based on these assessments, it is considered that the Project, as modified by Modification 4, will remain substantially the same development as the development for which the Project Approval was originally granted and before it was modified within the meaning of section 4.55(2)(a) of the EP&A Act.

6.2 Visual

Green Bean Design have undertaken an updated visual impact assessment ("VIA") to assess the potential visual impacts resulting from Modification 4.

The VIA has compared the approved wind turbine envelope against the increased wind turbine envelope proposed as part of Modification 4 and concludes that:

- The area of land from which the turbines currently approved and the turbines as proposed to be modified by Modification 4 would be very similar in extent.
- Modification 4 would not result in unacceptable levels of visual impact from surrounding view locations.
- The overall assessment of visual effects associated with the Modification 4 turbines is summarised as Low to Negligible. The difference between the approved turbine envelope and the proposed Modification 4 wind turbine envelope is not considered to be of a magnitude that would significantly increase visual effects associated with the approved development.
- Additional levels of wind turbine visibility would be very limited and largely confined to upper portions of rotor blades and blade tips. Visibility toward wind turbine hubs would likely decrease where the hub is currently partially visible or located just above a ridge or hill slope view.
- The proposed Modification 4 turbine envelope is not considered to be of a magnitude that would significantly increase visual effects and visual impact ratings associated with the approved Project.
- The proposed reinstatement of the 132kv transmission line and associated Switching Station proposed as part of Modification 4 would be unlikely to have a significant visual impact on surrounding dwelling locations.
- The implementation of both on site and off site landscape works would provide visual mitigation for a number of dwellings surrounding the approved Project in accordance with the Project Approval conditions.
- Overall the existing conditions imposed on the Project Approval, together with requested amendments to condition D26 (see section 9 below for details), are considered to remain appropriate to continue to manage the visual impacts from Modification 4.

The complete assessment, including wireframes, is contained in Appendix C.

6.3 Shadow Flicker

WSP Australia Pty Limited have undertaken an updated shadow flicker assessment which considers the potential for shadow flicker impacts from the approved turbine locations on nearby receptors resulting from the proposed increase in the maximum turbine envelope.

The updated shadow flicker assessment included the results of both:

- an updated conservative "worst case" shadow flicker assessment which assumed, among other things, that no cloud coverage ever occurs and the wind turbine rotor is always angled so as to cast the maximum possible shadow; and
- a "realistic case" which accounted for cloud coverage so as to provide a statistical average annual estimate of shadow flicker.

The results of the shadow flicker assessment indicate that no receptors will experience over 30 hours a year of shadow flicker under the realistic case. Only 15 receptors were predicted to experience any shadow flicker effects, of which none will experience over 15 hours 46 minutes in the realistic case.

However, 5 dwellings (all of which are "associated residences" within the meaning of the Project Approval) were modelled to exceed the 30 hours a year shadow flicker limit under the "worst case" scenario which, given its conservative assumptions, is deemed unlikely to occur in practice.

Accordingly, the shadow flicker assessment confirms that the Project is predicted to remain fully compliant with the shadow flicker limits of a maximum of 30 hours per annum at any residence unless otherwise agreed, which applies under condition D23 of the Project Approval.

The update shadow flicker assessment is contained in Appendix D.

6.4 Bird and Bat

Brett Lane & Associates Pty Ltd have undertaken a bird and bat impact assessment of the impacts of the increased maximum turbine envelope proposed as part of this Modification 4. The complete assessment is contained in Appendix E.

The key findings of the bird and bat impact assessment are that:

- The species of birds recorded at the site include common, widespread species which occur in wooded agricultural landscapes in south eastern Australia. Given that the rotor-swept area ("RSA") of the turbines will increase between 20 and 50m, the increased risk of the larger turbines may impact on up to 16% of all bird observations at the site. This is unlikely to lead to significant population impacts for those bird species not listed on state and federal lists as species of conservation concern.
- Species listed as state/federal lists as species of conservation concern, including the Superb Parrot, the Little Eagle, the Diamond Firetail and the Varied Sittella are considered not to be at significant increased risk from the modification.
- The non- listed Wedge-tailed Eagles and other high-flying raptors may be at increased in risk of collision from the larger and higher turbines. However, overall the risk from collision with turbines was considered to be low. The White-throated Needletail, listed as a federal marine and migratory species, may be at increased risk from the larger RSA. However, the incremental change in risk is low given that the species is widespread, and its frequency at the wind farm is likely to be low.

- Modification 4 is unlikely to cause significant adverse impacts to any populations of bat species recorded at the site, noting that the state listed yellow-bellied sheathtail occurred with a low frequency at the project site and there is an increase in the existing low risk of impact commensurate with the proposed modification.

Accordingly, the increased maximum turbine envelope proposed as part of Modification 4 is not expected to have a significant increase on bird and bat species as a result of bird and bat strike.

Condition B4 of the Project Approval requires the preparation and approval of a Bird and Bat Adaptive Management Program prior to the commencement of construction. The Bird and Bat Adaptive Management Program must incorporate specified monitoring, and a decision matrix that clearly sets out how the Proponent will respond to the outcomes of monitoring. This is required to include identification of the "potential mitigation measures and implementation strategies in order to reduce impacts on birds and bats such as minimising the availability of raptor perches, swift carcass removal, pest control including rabbits, use of deterrents, and sector management including switching off turbines that are predicted to or have had an unacceptable impact on bird / bat mortality at certain times". Condition B4 requires the Proponent to implement all feasible and reasonable mitigation measures where the need for further action is identified through the Bird and Bat Adaptive Management Program, or as otherwise agreed with the Secretary. It is considered that the impacts arising from the increased maximum turbine envelope will remain able to be appropriately managed under the Bird and Bat Adaptive Management Program required under condition B4 of the Project Approval.

6.5 Noise

An updated assessment of the noise impacts resulting from Modification 4 has been carried out by Vipac Engineering & Scientists Ltd. The complete assessment is contained in Appendix F.

Noise impacts were modelled based on the proposed wind turbine hub height of up to 92m and the noise model was run using a candidate wind turbine with a maximum tip height of 160m.

The assessment concluded that the proposed modification is likely to generate a slight increase in predicted noise levels at most receivers compared to the approved Project. However, the predicted noise levels at all relevant receivers is predicted to remain compliant with relevant criteria under the applicable "Wind farms – environmental noise guidelines" (SA 2009) as adopted by the "Wind Energy: Noise Assessment Bulletin" (DPE 2016) ("Relevant Criteria") apart from at residences R077 and R078, where a small exceedance of less than 1dB is predicted based on the modelling between the hub height wind speeds 8m/s to 10m/s.

Due to the small exceedances predicted, mitigation will be applied to ensure compliance with the Relevant Criteria at all times. This mitigation may take the form of micrositing relevant turbines within the micrositing limits approved under the Project Approval and/or applying wind sector management using lower turbine power modes for relevant turbines during some wind speed conditions. It is noted that, given the conservative assumptions in the model (such as fully reflective ground factor and the assumption of wind blowing from all directions simultaneously from all turbines to the receivers), these measures may not be required.

The proposed 132 kV overhead transmission line is not likely to be within 50m of any residences and as a result corona discharge noise or Aeolian noise is not likely to be an issue. The Switching Station (at the northern end of the 132kV overhead

transmission line) is not likely to cause any significant noise impact at the nearest receivers (located over 250m away). The original assessment showed that the relevant noise criteria for construction and substation noise are likely to be achieved at all relevant receivers and as a result, the original assessment of no significant noise impact remains.

The Project Approval conditions relating to noise will be sufficient to achieve compliance with the relevant criteria and this will be verified by the operational noise monitoring required under Condition G9.

6.6 Traffic and Transport

An updated traffic and transport impact assessment has been provided by Aurecon and is contained in Appendix G.

The assessment concludes that Modification 4:

- is not expected to result in any additional traffic movements associated with the construction or operation of the wind farm from that previously identified and assessed as part of the Project; and
- would result in the tower and blade components of the Project being longer than previously considered, which would increase the size of the largest trailer accessing the site. However, this is not expected to have a significant impact.

The traffic impacts of the Project will remain managed in accordance with the conditions of the Project Approval. These relevantly require:

- an independent assessment to be carried out, in consultation with the relevant roads authorities, prior to the commencement of construction to identify whether any road upgrades are required to allow for safe access of construction and operational vehicles (including over-mass or over-dimensional vehicles accessing the site) associated with the Project. All such road upgrades form part of the Project authorised by the Project Approval and must be implemented prior to relevant construction activities;
- the repair of all damage caused to roads during construction, including a road dilapidation report to enable this to be assessed; and
- the preparation and implementation of a detailed Construction Traffic and Access Management Plan.

6.7 Electromagnetic Interference (Telecommunications)

An updated electromagnetic interference (telecoms) impact assessment has been carried out by Aitken and Partners in relation to Modification 4.

The conclusions of the assessment are:

- The increased turbine envelope is not expected to have any material effect on television reception. The geometrical relationship of the television transmitter, the television receiver and the reflecting object (turbine) determine whether interference can occur. As there has been no change in the location of the turbines, the reflection mechanisms are unchanged and the potentially affected area remains the same. The amplitude of reflected signals will increase slightly due to the increased reflecting area. The 132 kV power transmission line proposed in Modification 4 will not affect television reception.
- The communication links operated by these licensees have been reviewed in this analysis. With the exception of Paths E and F Modification 4 has no impact on the

operation of the communication links. The increased maximum turbine envelope will require micro-siting of Turbines 21, 23 and 35 to maintain clearance on Path E. For Path F, the location of Turbine 34 should be reviewed as the calculated clearance is within the error of topographic map data and antenna location data. The location of Turbine 35 should be adjusted to provide adequate clearance for Path F. These changes can be made within the micro-siting tolerances of the approved Project and is not considered a significant impact.

- The existing conditions imposed on the Project Approval in relation to telecommunication impacts remain appropriate to manage telecommunications impacts resulting from the Project.

The complete assessment is contained in Appendix H.

6.8 Aviation

An Aviation Impact Assessment has been provided by Aviation Projects.

Key findings are:

- Modification 4 does not change the potential impact to aviation from that previously assessed for the approved Project.
- Aviation Projects has assessed that the Project as modified will not require obstacle lighting to maintain an acceptable level of safety to aircraft.
- The existing condition D11 (a), D11 (b) and D12 imposed on the Project Approval in relation to aviation impacts require updates to reflect the updated assessment (refer section 9) and the remainder of conditions relevant to aviation remain appropriate to manage aviation impacts resulting from the Project.

The complete assessment is contained in Appendix I.

6.9 Biodiversity

A biodiversity impact assessment has been undertaken by NGH Environmental relating specifically to the route of the Reinstated Transmission Line. The complete assessment is contained in Appendix J.

The impact assessment concluded that:

- The Reinstated Transmission Line would result in the removal of up to 6.8ha of native vegetation and 1.4ha of planted native vegetation.
- The Reinstated Transmission Line would not have a significant impact on the threatened species or ecological communities in the study area; and
- Mitigation measures have been recommended to avoid or minimise any potential impacts.

6.10 Aboriginal Heritage

An aboriginal and historic heritage impact assessment has been carried out by NSW Archaeology relating specifically to the route of the 132kV transmission line. The complete assessment is contained in Appendix K.

The assessment concluded that based on the extent of previous impacts in the area from road construction, farming activity and commercial forestry operations and the nature of the landscape, the transmission line route corridor is of low archaeological sensitivity and potential and there are no Aboriginal or heritage constraints in regard to the proposed 132 kV transmission line route.

Accordingly, Modification 4 is not expected to have an increased impact on aboriginal heritage from the approved project.

7. Statement of Commitments

A Statement of Conditions ("SoC") was included in the Original EA and updated in the Preferred Project Report. The commitments contained in the SoC have been largely superseded by the detailed conditions imposed on the Project Approval and are inconsistent with certain requirements under these conditions. Modification 4 confirms that the SoC has been superseded by the Project Approval conditions and that the detailed mitigation measures proposed in the SoC will be incorporated into the management plans and strategies required under the Project Approval conditions where relevant.

8. Consultation

Ongoing community and stakeholder consultation has been carried out throughout the development of the Project. Recent consultation specific to Modification 4 is outlined in Table 8.1 below:

Table 8.1 Modification 4 Consultation Summary

Consultee	Consultation Activity
Blayney Shire Council	- Meeting held on 16th May 2018 to discuss planning Modification 4 and general Project update. - Presentation provided at Council meeting on 16th July 2018 to provide update on the Project and Modification 4.
Cabonne Council	Ongoing discussion about the route of the 132kV transmission line has occurred by phone and email.
Community Consultative Committee ("CCC")	- CCC meetings take place approximately every 3 months. - The latest CCC meetings where Modification 4 was discussed were 16th May 2018 and 15th June 2018. Minutes are available on Infigen's website: www.infigenenergy.com/our-business/development-pipeline/wind-energy-projects/
Newcrest Mining (Cadia Valley Operations)	Email was sent providing update on the Project and Modification 4 on 30th April 2018.
NSW Department of Planning and Environment	- Meeting to discuss Modification 4 held on 29th March 2018. - Further consultation carried out regarding assessment requirements for Modification 4.
Host Landowners	- Consultation with host landowners by email, face to face and phone occurs on a regular basis. - Modification 4 has been discussed with all host landowners and a formal letter regarding Modification 4 was sent to all host landholders in late April 2018.
CENREC (Central New South Wales Renewable Energy Cooperative)	Board meetings take place on a monthly basis. Planning modification 4 was discussed at the meetings held on 20th April and 17th May 2018.
Community within ~3km of wind turbine	A project newsletter was issued in July 2018 to ensure the community was made aware of the amendments proposed as part of Modification 4 (Appendix L). The project newsletter will also be

Consultee	Consultation Activity
	distributed to all consultees listed in Table 8.1 and displayed on the Flyers Creek web page. The project website was also updated in July 2018 to include information on the Modification 4 application: www.infigenenergy.com/flyers-creek.
Aviation Stakeholders	Consultation has also occurred with the following: - Aerial Agricultural Association Australia; - Aerial Agricultural Service; - Airservice Australia; - Civil Aviation Safety Authority; - Commonwealth Department of Defence; and - Orange City Council (Orange Aerodrome).

9. Project Approval Conditions

A number of minor modifications are proposed to the conditions of the Project Approval to reflect Modification 4 and contemporary wind farm approval conditions imposed on SSD consents. The following clarifications are sought to the conditions of the Project Approval as part of Modification 4:

- **Schedule A, Project Definition** – The Proponent requests that this definition be updated to reflect the changes being proposed in Modification 4 by including the 132 kV transmission line (overhead and underground) and associated Switching Station.
- **Definitions** - Definition of "EA" to be updated to include this assessment. The Proponent also requests that the legislative definitions throughout the Project Approval be updated to reflect recent legislative amendments.
- **Condition D1 & D3** - The Proponent requests that these conditions be updated as follows to ensure that they reflect the outcomes of the Biodiversity Assessment (Appendix J) of the proposed 132kV transmission line and the updated baseline mapping of the vegetation and key habitat required to be carried out under Conditions D5(a) and F21(f)(i) prior to the commencement of construction:
 - o **Condition D1(a):** should be updated to reflect that "any clearing of EEC should be limited to the minimum extent Reasonable and Feasible within the approved disturbance footprint subject to the outcomes of the updated baseline mapping of vegetation and key habitat required under condition D5(a) and the Construction Flora and Fauna Management Plan required under condition F21(f)(i)"; and
 - o **Condition D3:** should be updated to reflect that "removal of hollow bearing trees should be limited to the minimum extent Reasonable and Feasible within the approved disturbance footprint subject to the outcomes of the updated baseline mapping of vegetation and key habitat required under condition D5(a) and the Construction Flora and Fauna Management Plan required under condition F21(f)(i)".
- **Condition D11 (a) and (b)** – The Proponent requests that these sub-conditions are deleted. In relation to D11(a), Orange City Council has advised that there would be no impact on future obstacle limitation surfaces of Orange Airport being the only aerodrome within 30km. In relation to D11(b), redesign of the Non-Directional Beacon ("NDB") Approach at Orange Airport is no longer required as the NDB has now been decommissioned and AirServices Australia has advised that there will be

no impacts on current instrument approach procedures at aerodromes including navigational aids, communications and surveillance facilities.

- **Condition D12** - During recent consultation the RAF AIS advised that all future correspondence should be directed through AirServices Australia. Accordingly, the Proponent requests that reference to notification to the Royal Australian Air Force – Aeronautical Information Services is removed.
- **Condition D23** - The Proponent requests that this condition is updated to clarify, in line with standard SSD conditions, that the shadow flicker limits apply to non-associated residences as defined by the Project Approval.
- **Condition D26** – Condition D26 requires that the Design and Landscaping Plan be prepared prior to commencement of construction. However:
 - o the final layout and extent of works subject to potential landscape screening may undergo adjustments during the construction period. Accordingly, the Proponent requests that the Design and Landscaping Plan be prepared prior to commencement of operation; and
 - o the finishes component of the plan are already covered by condition D22 imposed as part of Modification 3. Accordingly, the Proponent requests that condition D26(a) be deleted.
- **Condition G6** - The Proponent requests that this condition is deleted to reflect the fact that it has been superseded by the newer condition H2 imposed as part of Modification 2.
- **Condition G7** – The Proponent requests that this condition is updated to reflect updated noise assessment and clarify, in line with standard SSD conditions, that the noise criteria apply to non-associated residences as defined by the Project Approval.

10. Conclusion

This assessment outlines and assesses the changes proposed to the approved Flyers Creek Wind Farm as a result of Modification 4 which includes:

- an increase in maximum wind turbine envelope;
- the reinstatement of a 132 kV transmission line and associated Switching Station; and
- minor clarifications to project components.

Significant consultation with relevant stakeholders, including community members and representatives, has been carried out in relation to Modification 4. The key outcomes from this consultation have been incorporated into Modification 4 and this assessment where relevant.

A detailed environmental assessment has been undertaken by relevant experts in relation to the key aspects of Modification 4 including visual, shadow flicker, bird and bat, noise, traffic and transport, telecommunications, aviation, biodiversity and aboriginal heritage. The assessments prepared by the experts confirm that the changes contemplated as part of Modification 4 can largely be constructed and operated with minimal increase to the impacts identified in the approved Project. It is acknowledged that Modification 4 is likely to:

- result in Low to Negligible increased visual impacts; and

- generate a slight increase in predicted noise levels.

However, these impacts are considered to be relatively minor and able to be appropriately managed by the existing conditions of the Project Approval as proposed to be updated and the updated Statement of Commitments.

The approved Project will provide a substantial economic benefit to the local and regional community during construction and long term operation (25 to 30 years) of the wind farm. During construction there will be employment opportunities for a peak of 140 people and 6 to 10 ongoing regional jobs during its operational life. There will also be a direct injection of approximately \$1 million per annum to the local community throughout construction and operation through payments to landholders, permanent staff and community fund contributions.

The changes proposed as part of Modification 4 are required to:

- enable the important public benefits from the approved Project to be realised by reinstating the 132Kv transmission line required to connect the Project to the electricity grid; and
- increase the total generation capacity of the Project to 430 GWh without increasing the number of wind turbines at the site. This is a significant contribution to the NSW Government's target of reducing greenhouse gas emissions by 60% by the year 2050.

Regards,



Megan Richardson
Development Manager
02 8031 9900

Appendices

Appendix A	Turbine Locations
Appendix B	Project Figures • Figure 1: Regional Location • Figure 2: Project Layout • Figure 3: Project Layout (aerial image) • Figure 4: Noise Monitoring and Receivers • Figure 5: Grid Connection Routes
Appendix C	Visual Impact Assessment (Green Bean Design)
Appendix D	Shadow Flicker Impact Assessment (WSP)
Appendix E	Bird and Bat Impact Assessment (Brett Lane & Associates)
Appendix F	Noise Impact Assessment (Vipac)
Appendix G	Traffic and Transport Impact Assessment (Aurecon)

Appendix H	Electromagnetic Interference Assessment (Telecommunications) (Aitken & Partners)
Appendix I	Aviation Impact Assessment (Aviation Projects)
Appendix J	Biodiversity Assessment (NGH Environmental)
Appendix K	Aboriginal and Historical Heritage Impact Assessment (NSW Archaeology)
Appendix L	Community Newsletter (July 2018)

Appendix A

Turbine Locations

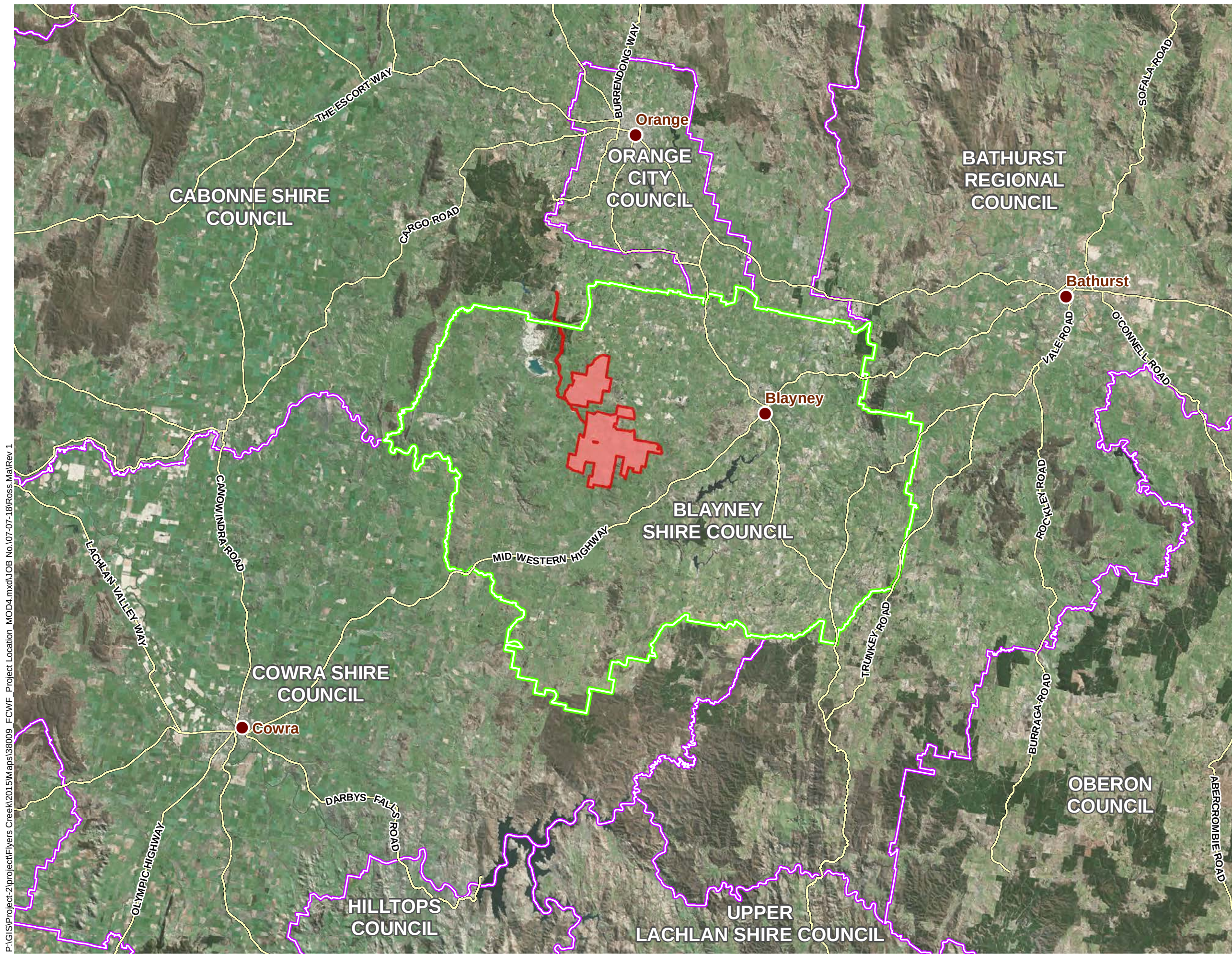
Appendix A: Flyers Creek Wind Farm Wind Turbine Locations

Wind Turbine	MGA Coordinates		Latitude & Longitude	
Ref Number	Easting (m)	Northing (m)	Latitude	Longitude
3	692487	6290959	-33° 30' 13"	149° 4' 20"
5	692610	6290375	-33° 30' 32"	149° 4' 26"
6	692438	6289879	-33° 30' 48"	149° 4' 19"
7	692375	6289621	-33° 30' 57"	149° 4' 16"
8	691922	6289293	-33° 31' 7"	149° 3' 58"
9	691710	6288716	-33° 31' 26"	149° 3' 50"
10	690463	6289008	-33° 31' 18"	149° 3' 4"
11	690764	6288686	-33° 31' 28"	149° 3' 14"
15	694616	6287092	-33° 32' 17"	149° 5' 45"
18	693315	6284663	-33° 33' 37"	149° 4' 55"
19	693106	6284262	-33° 33' 50"	149° 4' 48"
20	693633	6283962	-33° 33' 59"	149° 5' 10"
21	691091	6283878	-33° 34' 4"	149° 3' 32"
22	691440	6283635	-33° 34' 11"	149° 3' 47"
23	691436	6283205	-33° 34' 25"	149° 3' 47"
24	690258	6283778	-33° 34' 7"	149° 3' 0"
25	690357	6283178	-33° 34' 27"	149° 3' 4"
26	690381	6282714	-33° 34' 42"	149° 3' 4"
27	689933	6282625	-33° 34' 45"	149° 2' 49"
28	689635	6282686	-33° 34' 43"	149° 2' 35"
29	689403	6282413	-33° 34' 52"	149° 2' 28"
30	689820	6282149	-33° 35' 1"	149° 2' 42"
31	690231	6282050	-33° 35' 3"	149° ° 3' 0"
32	692382	6282353	-33° 34' 52"	149° 4' 23"
33	692173	6281920	-33° 35' 6"	149° 4' 16"
34	692320	6281639	-33° 35' 15"	149° 4' 19"
35	692379	6281358	-33° 35' 25"	149° 4' 23"
36	692852	6280328	-33° 35' 58"	149° 4' 41"
37	692897	6279893	-33° 36' 12"	149° 4' 44"
38	694007	6282678	-33° 34' 41"	149° 5' 24"
39	695178	6283099	-33° 34' 26"	149° 6' 11"
40	695285	6282880	-33° 34' 33"	149° 6' 14"
41	695383	6282655	-33° 34' 40"	149° 6' 18"
42	695229	6282331	-33° 34' 51"	149° 6' 14"
43	696494	6283966	-33° 33' 57"	149° 7' 1"
44	696745	6283761	-33° 34' 4"	149° 7' 12"
45	696940	6283488	-33° 34' 12"	149° 7' 19"
46	697221	6283308	-33° 34' 18"	149° 7' 30"

Appendix B

Project Figures

- **Figure 1: Regional Location**
- **Figure 2: Project Layout**
- **Figure 3: Project Layout (aerial image)**
- **Figure 4: Noise Monitoring and Receivers**
- **Figure 5: Grid Connection Routes**



Legend

- Town
- Main Road
- Blayney Shire Council
- Local Government Area
- Project area

Source: Aurecon, LPI

Service Layer Credits: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,



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Projection: GDA 1994 MGA Zone 55

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aurecon

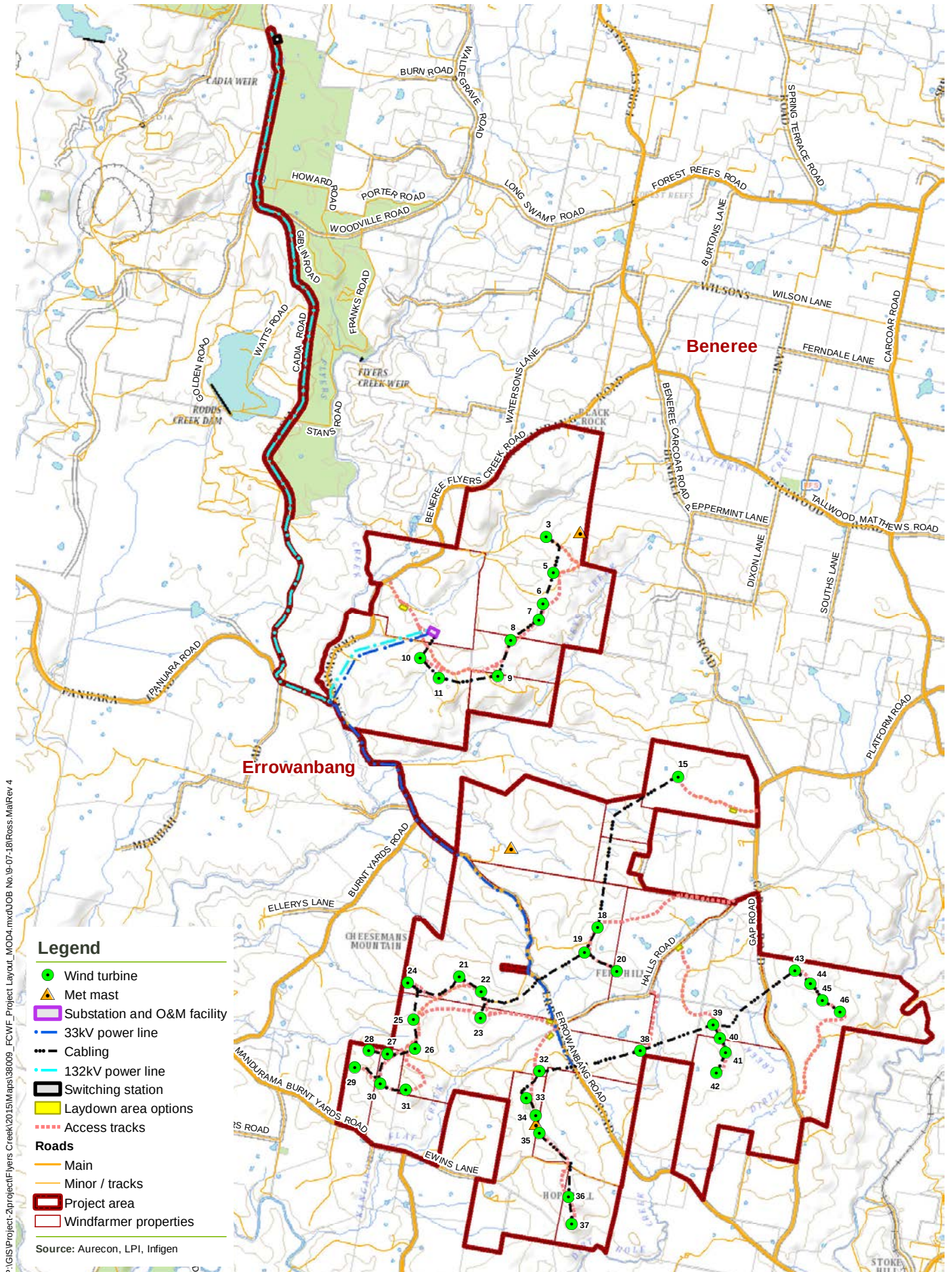
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Flyer Creek Wind Farm

Figure 1: Project Location



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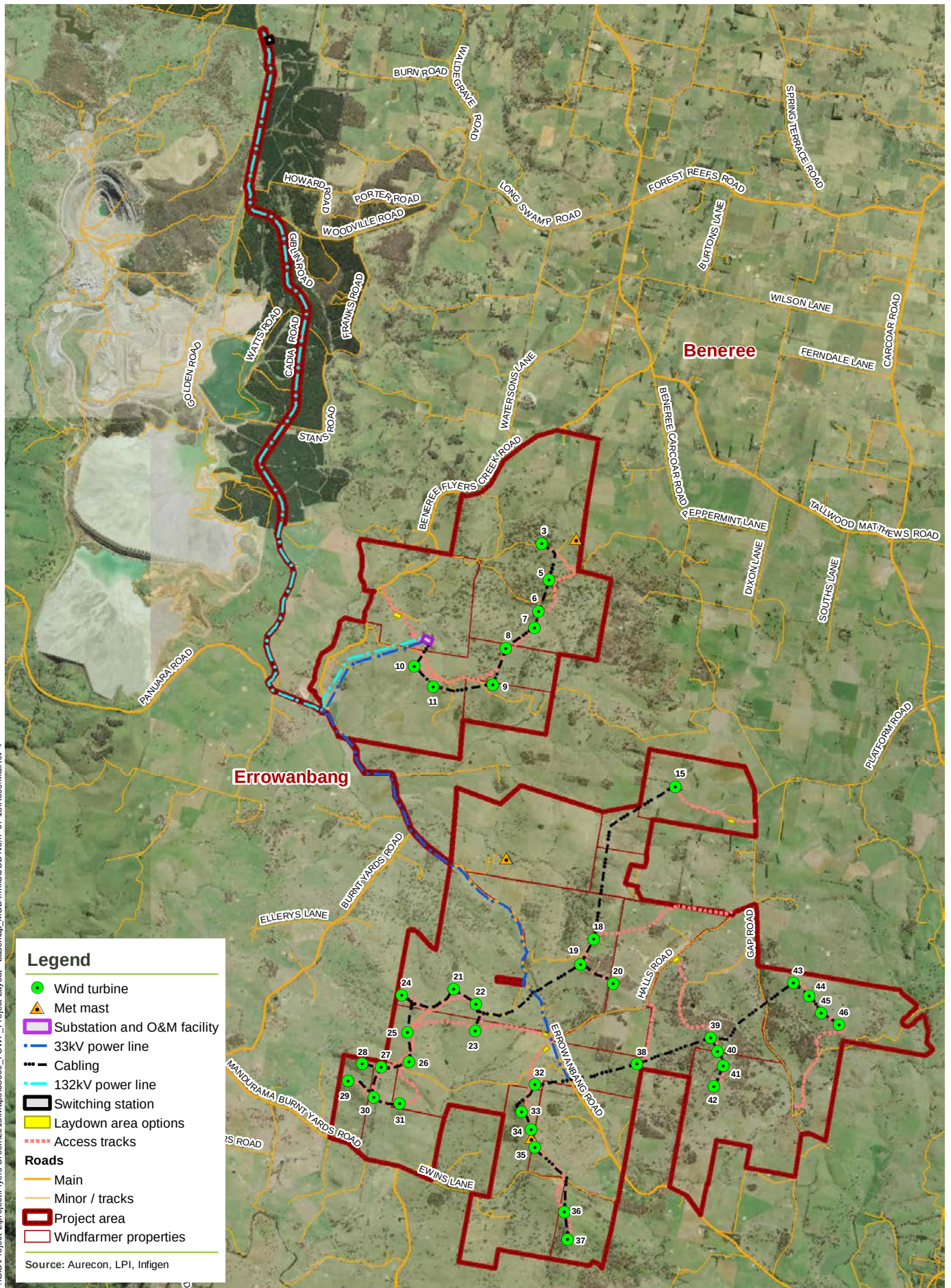
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Projection: GDA 1994 MGA Zone 55

Flyers Creek Wind Farm

Figure 2: Project Layout

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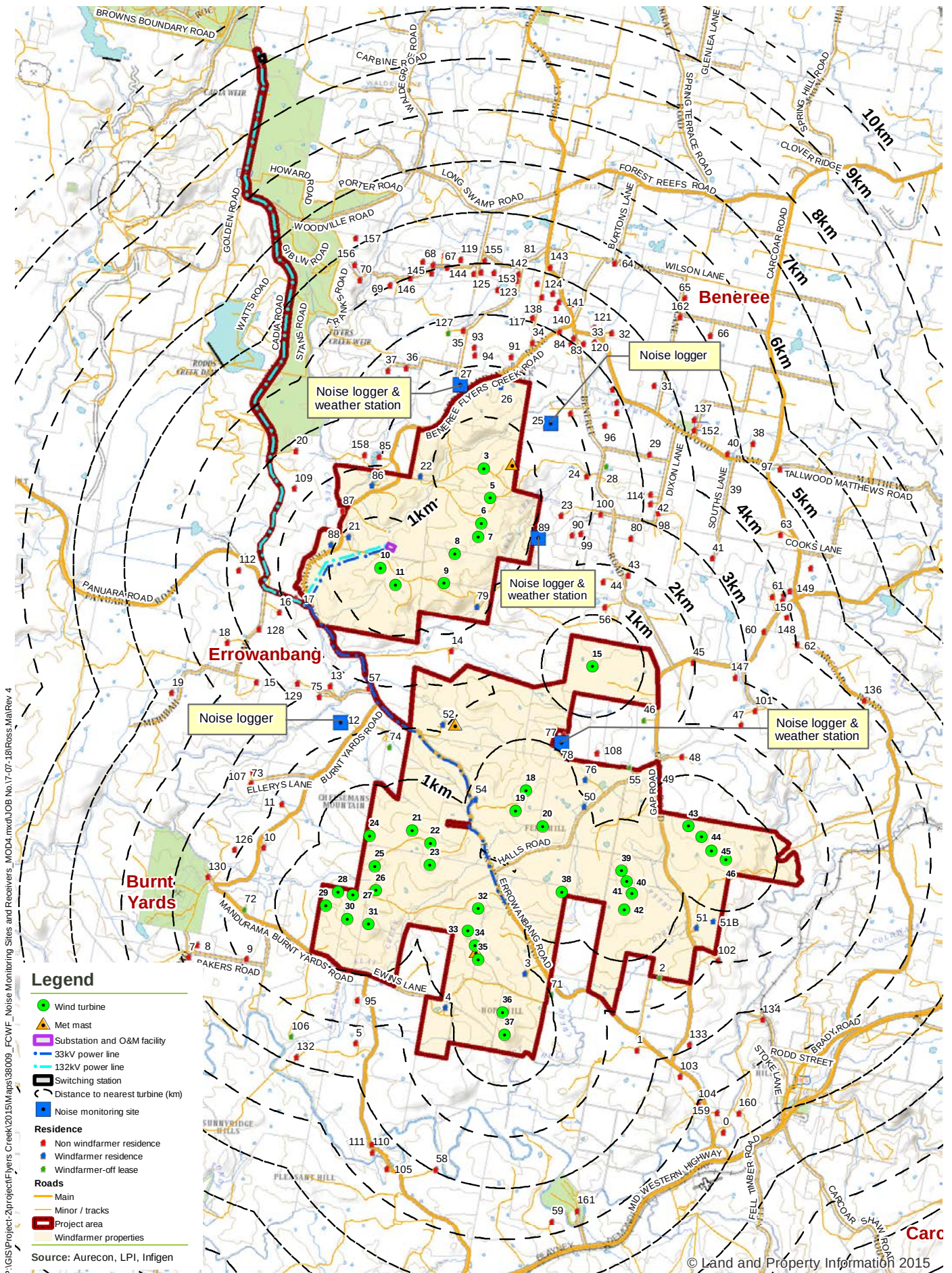


1:82,500
0 1 2km

Projection: GDA 1994 MGA Zone 55

Flyers Creek Wind Farm

Figure 3: Project Layout (aerial image)



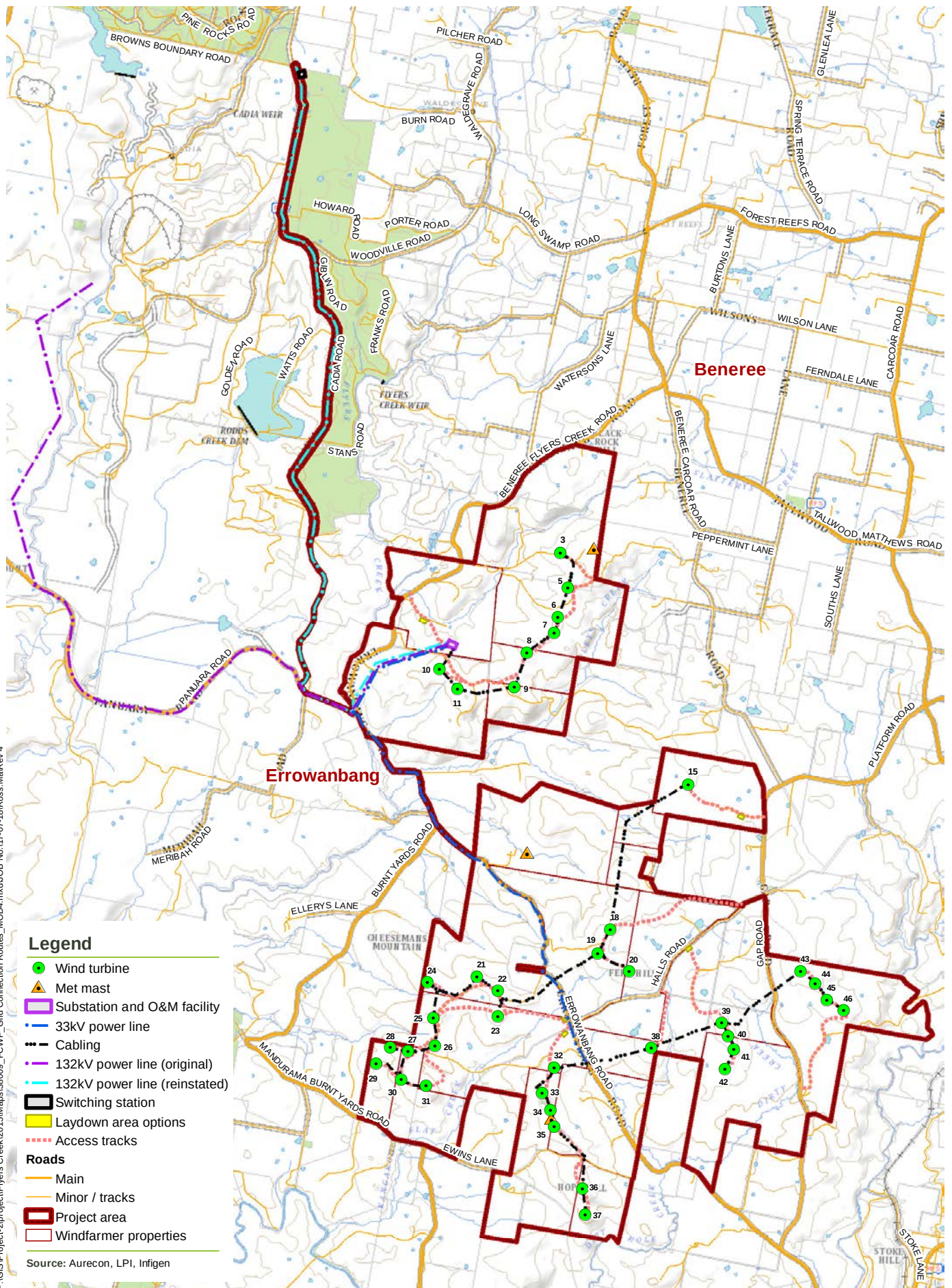
1:100,000
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Projection: GDA 1994 MGA Zone 55

Flyers Creek Wind Farm

Figure 4: Noise Monitoring Sites and Receivers

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1:86,500
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Projection: GDA 1994 MGA Zone 55

Flyers Creek Wind Farm

Figure 5: Grid Connection Routes

Appendix C

Visual Impact Assessment (Green Bean Design)

Flyers Creek Wind Farm Modification 4

VISUAL IMPACT ASSESSMENT

Prepared for:

FLYERS CREEK WIND FARM PTY LTD

Prepared by:

GREEN BEAN DESIGN
landscape architects

GREEN BEAN DESIGN PTY LTD
PO Box 3178 Austral NSW 2179
Principal: Andy Homewood BSc (Dual Hons), DipLM, DipHort, Registered Landscape Architect, AILA
(ABN: 86 603 575 702)

July 2018

DOCUMENT CONTROL

Item	Detail
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Report Title:	Visual Impact Assessment
Project Number:	18-252
Version Number:	v3
Status:	Final
Author:	Andrew Homewood , Registered Landscape Architect, AILA <i>Graduate Diploma Landscape Management, Bachelor Science (Dual Honours)</i> <i>Landscape Design and Archaeology, National Diploma Horticulture</i>
Date:	27 July 2018

Contents		Page
	Executive summary	6
1	Introduction	8
2	Report structure	9
3	Methodology	11
4	Proposed Mod 4	13
5	Zone of Visual Influence Diagrams	16
6	Ancillary structures	19
7	Visual effects	20
8	Visual assessment	39
9	Wire frame models	67
10	Mod 4 switching station and 132kV powerline	84
11	Review of Conditions of Consent	97
12	Conclusion	101

Figures

Figure 1	FCWF approved wind turbine layout
Figure 2	FCWF ZVI Diagram approved 150m tip height
Figure 3	FCWF ZVI Diagram at 160m tip height
Figure 4	FCWF approved and Mod 4 wind turbine comparison
Figure 5	FCWF approved and Mod 4 wind turbine overlay
Figure 6	FCWF approved and Mod 4 wind turbine view angle comparison
Figure 7	FCWF approved and Mod 4 comparison at 2km and 5km view distance
Figure 8	FCWF approved and Mod 4 wind turbine overlay from dwelling R14
Figure 9	FCWF approved and Mod 4 wind turbine view angle comparison from dwelling R14
Figure 10	Mod 4 wireframe locations
Figure 11	Wireframe W1 from Beneree Flyers Creek Road
Figure 12	Wireframe W2 from Beneree Flyers Creek Road and Watsons Lane
Figure 13	Wireframe W3 from Platform Road
Figure 14	Wireframe W4 from Burnt Yards Road
Figure 15	Wireframe W5 from Carcoar (off Rodd Street)
Figure 16	Wireframe W6 from Dixons Lane
Figure 17	Wireframe W7 from Beneree Road
Figure 18	Wireframe W8a (south) from Dunstaffnage Lane
Figure 19	Wireframe W8b (north) from Dunstaffnage Lane
Figure 20	Wireframe W9 from residence 89
Figure 21	Wireframe W10 from residence 25
Figure 22	Wireframe W11 from residence 94
Figure 23	Wireframe W12 from residence 12
Figure 24	Wireframe W13 from residence 44
Figure 25	Wireframe W14 from residence 17
Figure 26	Mod 4 132kV powerline indicative alignment
Figure 27	Mod 4 132kV powerline typical illustrations

Tables

Table 1 Glossary

Table 2 Report structure

Table 3 FCWF approved and Mod 4 design criteria

Table 4 FCWF approved and Mod 4 swept area

Table 5 Distance and hub height changes

Table 6 Magnitude of visual effect

Table 7 Visual Effects Matrix

Table 8 Visual Assessment Matrix

Table 9 Electrical infrastructure visual assessment matrix

Table 10 Conditions of Consent

Executive summary

Green Bean Design Pty Ltd has been commissioned by Flyers Creek Wind Farm Pty Ltd to prepare a Visual Impact Assessment (VIA) report for the Flyers Creek Wind Farm Modification-4 Application (Mod 4).

This VIA has been prepared with regard to the visual assessment process outlined in the New South Wales State Government Wind Energy: Visual Assessment Bulletin December 2016 (the Guidelines) as applicable to the Flyers Creek Wind Farm (FCWF) Mod 4 Application.

The FCWF Project Approval permits the construction and operation of up to 38 wind turbines to a maximum 150 metre (m) tip height. This VIA has been prepared to assess the potential visual effect of the Flyers Creek Wind Farm Mod 4 amendments which include:

- tip height up to 160m
- hub height 90 to 92m
- rotor diameter up to 140m
- blade length up to 70m, and
- rotor swept area up to 15,386m²

The total number of wind turbines would be 38, as approved and in accordance with the Project Approval. The 38 wind turbines would remain located in accordance with the existing Project Approval.

The Zone of Visual Influence Diagrams (**Figures 2 and 3**) demonstrate the area of land from which the FCWF approved and Mod 4 wind turbines would be theoretically visible (as well as overall number of wind turbines being visible at tip height), would be very similar in extent.

Apart from the reinstatement of a 132kv transmission line, there would be no significant change to previously approved ancillary wind farm infrastructure.

This VIA included a consideration of 78 residential dwellings within 3.2km of the approved wind turbine locations. The overall assessment of visual effects associated with the Mod 4 wind turbines is summarised as Low to Negligible. The difference between the FCWF approved and Mod 4 wind turbine is not considered to be of a magnitude that would significantly increase visual effects associated with the approved development. Key differences between the FCWF approved and Mod 4 wind turbines are illustrated in **Figures 4, 5, 6 and 7**.

Fifteen wire frame diagrams have been prepared to illustrate the wind turbines within the approved FCWF and Mod 4 wind turbine layout. The wireframes have been prepared from the photomontage locations included in the original FCWF Visual Assessment (Aurecon May 2011).

The proposed amendments to the FCWF wind turbines would result in a low level of visual magnitude and an unchanged visual rating in accordance with the FCWF approved project. The proposed Mod 4 amendments would not introduce elements that are any more prominent or out of character with the approved FCWF project,

and the potential for the Mod 4 wind turbines to result in any additional significant cumulative visual effects is considered to be low.

1 Introduction

1.1 Introduction

This VIA has been prepared to compare the potential visual effect of the FCWF Mod 4 project with the visual ratings determined for the approved FCWF project. The FCWF approved visual ratings have been extracted from the Flyers Creek Wind Farm Visual Assessment Report, Aurecon May 2011, together with additional visual analysis presented in the approved Flyers Creek Wind Farm MP 08_0252 – Modification 3 Application.

The comparison between the approved FCWF and Mod 4 wind turbines has been used to determine if any of the approved FCWF visual ratings applied to view locations within 3.2 kilometres (km) of the approved FCWF are subject to an increased level of visual effect as a result of the Mod 4 amendments. This VIA has not undertaken an assessment to verify the visual ratings determined in prior approved FCWF applications.

GBD confirm the following information has been provided by the Proponent, or procured by GBD, for consideration and/or incorporation into this VIA:

- confirmation of FCWF Mod 4 wind turbine layout
- FCWF Mod 4 wind turbines description and design criteria
- Zone of Visual Influence (ZVI) diagrams
- wireframe models illustrating the approved FCWF and the Mod 4 wind turbines
- Flyers Creek Wind Farm Project Approval and Consolidated Conditions of Consent and
- Flyers Creek Wind Farm Visual Assessment Report, Aurecon May 2011.

2 Report structure

2.1 Report structure

This VIA report been structured into twelve parts as outlined in Table 2:

Table 2 – Report structure

Report section	Description
Section 1 Introduction	This section provides an introduction to the Mod 4 VIA.
Section 2 Mod 4 VIA report structure	This section outlines the Mod 4 VIA report structure and the report sections included in the Mod 4 VIA.
Section 3 Methodology	This section sets out the methodology employed in the Mod 4 VIA preparation.
Section 4 Approved FCWF and proposed Mod 4 amendments	This section describes the key differences between the approved FCWF and Mod 4 amendments.
Section 5 Zone of Visual Influence (ZVI) diagrams	This section identifies the area of land surrounding the wind farm from which the approved FCWF and Mod 4 wind turbines, or portions of wind turbine structures, may be theoretically visible.
Section 6 Ancillary structures	This section describes infrastructure associated with the wind farm other than the wind turbines.
Section 7 Visual effects	This section describes the assessment and determination of residual visual effects between the approved FCWF and proposed Mod 4 amendments.
Section 8 Visual assessment	This section considers the NSW State Government Wind Energy: Visual Assessment Bulletin December 2016 as applicable to the Mod 4 VIA.
Section 9 Wire frame models	This section describes and presents wire frame models prepared for the Mod 4 VIA.

Table 2 – Report structure

Report section	Description
Section 10 Mod 4 switching station and 132kV powerline	This section considers potential visual effects associated with the Mod 4 132kV powerline and switching station connection to the existing Orange North to Cadia 132kV powerline.
Section 11 Review of Consolidated Conditions of Consent	This section identifies the FCWF Consolidated Conditions of Consent (November 2017) relevant to visual amenity and confirms their applicability to the proposed Mod 4 amendments.
Section 12 Conclusion	Conclusions are drawn on the overall visual effect of the proposed Mod 4 amendments within the surrounding viewshed.

3 Methodology

3.1 Introduction

The VIA Mod 4 methodology included the following activities:

- desktop review of the approved FCWF wind turbine layout
- desktop review of the switching station location and 132kV powerline alignment
- preparation of ZVI diagrams
- assessment of significance of residual visual effects and
- preparation of wire frame models and illustrative figures.

3.2 Desktop study

A desktop study was carried out to review the FCWF approved project together with associated reports and approval documentation. The desktop study also included a review of the approved wind turbine layout, proposed switchyard location and 132kV powerline alignment, as well as the surrounding landscape and dwelling locations. This was carried out by reference to topographic maps as well as aerial photographs of the surrounding landscape.

3.3 ZVI diagrams

ZVI Diagrams were prepared to illustrate the theoretical visibility of the approved FCWF wind turbines (tip height at 150m) and Mod 4 wind turbines (tip height at 160m). The ZVI Diagrams are illustrated in **Figures 2 and 3**.

3.4 Wind turbine magnitude of visual effects

The determination of residual visual effects resulting from the Mod 4 amendments would result primarily from observable differences between the approved FCWF and the Mod 4 wind turbines. Observable differences may include views toward wind turbines (hubs, rotor face and blade tips) where previously screened by landform.

3.5 Wind turbine visual effects

This VIA has considered the potential visual effects for dwellings located within 3.2km of the approved FCWF project. The 3.2km threshold distance (blue line, refer Figure 1) has been established by reference to the NSW Wind Energy Visual Bulletin, December 2016 (Figure 5 Visual magnitude thresholds for visual assessment).

This VIA has not addressed the Stage 1 Preliminary Environmental Assessment (pre-lodgement) guidelines as these are not pertinent to the proposed Mod 4 VIA. Similarly, Stage 2 of the Guidelines (Figure 1, Steps in the Visual Assessment), addresses the preparation of a Visual Baseline Study as part of the Environmental Impact Statement, which is also not pertinent to the proposed Mod 4 VIA.

This VIA has considered the Visual Assessment Process set out in Appendix 1 of the Guidelines against the proposed Mod 4 project where relevant to the Modification Application.

3.6 Proposed switching station and 132kV powerline visual assessment

This VIA has considered and assessed the potential visual effect of the proposed switching station and 132kV powerline on people at residential dwellings within 1km of this infrastructure. In determining the potential visual effect this VIA considers the overall visibility of the electrical infrastructure as well as the capability of the landscape to visually absorb infrastructure elements.

3.7 Wind turbine wire frame models

Wire frame models have been prepared from fifteen locations included in the approved FCWF Visual Assessment Report. The wire frame models illustrate and contrast the approved FCWF wind turbines and the proposed Mod 4 wind turbines. The wireframe locations are illustrated in **Figure 10** and the wireframes in **Figures 11 to 25**.

4 Proposed Mod 4

4.1 Approved FCWF wind turbine

The FCWF Development Consent permits construction and operation of up to 38 wind turbines to a maximum 150m tip height in addition to a range of ancillary wind farm infrastructure.

4.2 Proposed Mod 4 wind turbine

The Mod 4 wind turbine would include:

- a 90m hub height (or 92m with a 136m rotor diameter)
- blade length up to 70m
- rotor diameter up to 140m (or 136m with a 92m hub height) and
- wind turbine tip height up to 160m.

Table 3 outlines the approved FCWF and Mod 4 wind turbine design criteria.

Table 3: Approved FCWF and Mod 4 design criteria

	Hub height	Rotor diameter	Tip height	Total number
Approved FCWF wind turbine	100m	112m	150m	38
Mod 4 wind turbine	Up to 92m	Up to 140m	Up to 160m	38
Difference	- 8m	+28m	+10m	0
Percentage difference	-8%	+25%	+6.7%	0%

Table 4: Approved FCWF and proposed Mod 4 swept area

	Rotor diameter	Swept area
Approved FCWF wind turbine	112m	9,847m ²
Mod 4 wind turbine	140m	15,386m ²
Difference	+28m	+5,539m ²
Percentage difference	+25%	+56%

No changes are proposed to the approved turbine locations as part of Mod 4. The approved turbine locations are shown on **Figure 1**.

4.3 Proposed Mod 4 distance and hub visibility

The Mod 4 wind turbine layout would not result in any changes to distances between residential dwellings and the approved FCWF wind turbines. The number of wind turbine hubs visible from residential dwellings surrounding the wind farm site would be subject to some minor variations due to a reduction in the hub height.

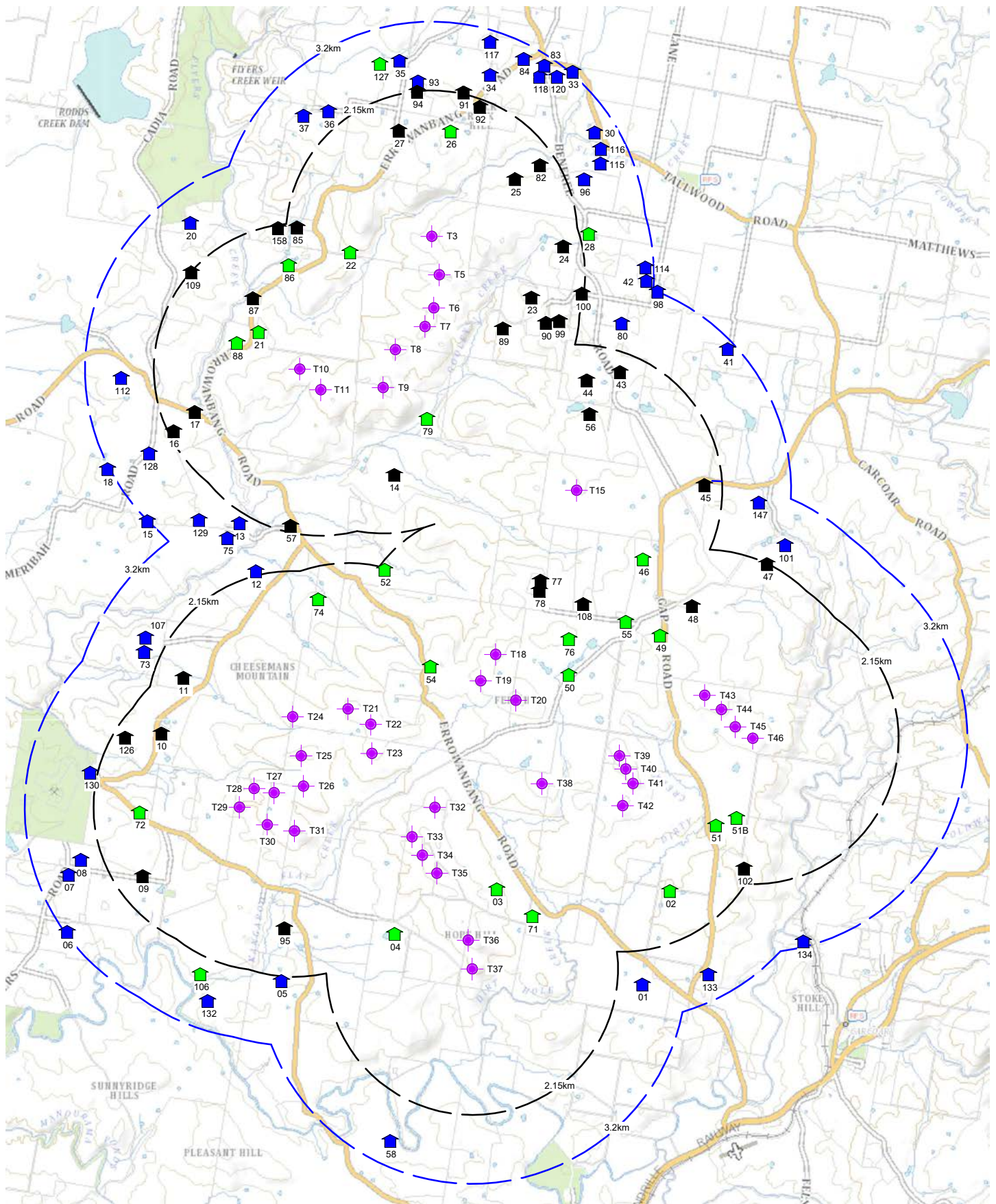
4.4 Proposed Mod 4 switching station and 132kV powerline

The key visual components of the switching station and 132kV powerline would likely comprise:

- control building and access road

- security fence surrounding the proposed switching station
- transformer and bus bar
- lighting mast and lighting for security and maintenance
- single tapered powerline poles up to approximately 24m high (including angle pole arrangements where required)
- aluminium alloy conductors and
- an aerial earth wire and communications link.

Views toward a typical 132kV powerline are illustrated in **Figure 27**.



Legend

-  Approved FCWF wind turbine location (indicative location)
-  Associated dwelling within 3.2 km of an approved FCWF wind turbine
-  Non associated dwelling within 2.15 km of an approved FCWF wind turbine
-  Non associated dwelling between 2.15 km and 3.2 km of an approved FCWF wind turbine
-  2.15 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height
-  3.2 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height

0km 1km



Figure 1
FCWF approved wind turbine layout

Flyers Creek Wind Farm Modification 4

Note:
FCWF Mod-4 wind turbine locations are as per approved wind turbine locations.

5 Zone of Visual Influence Diagrams

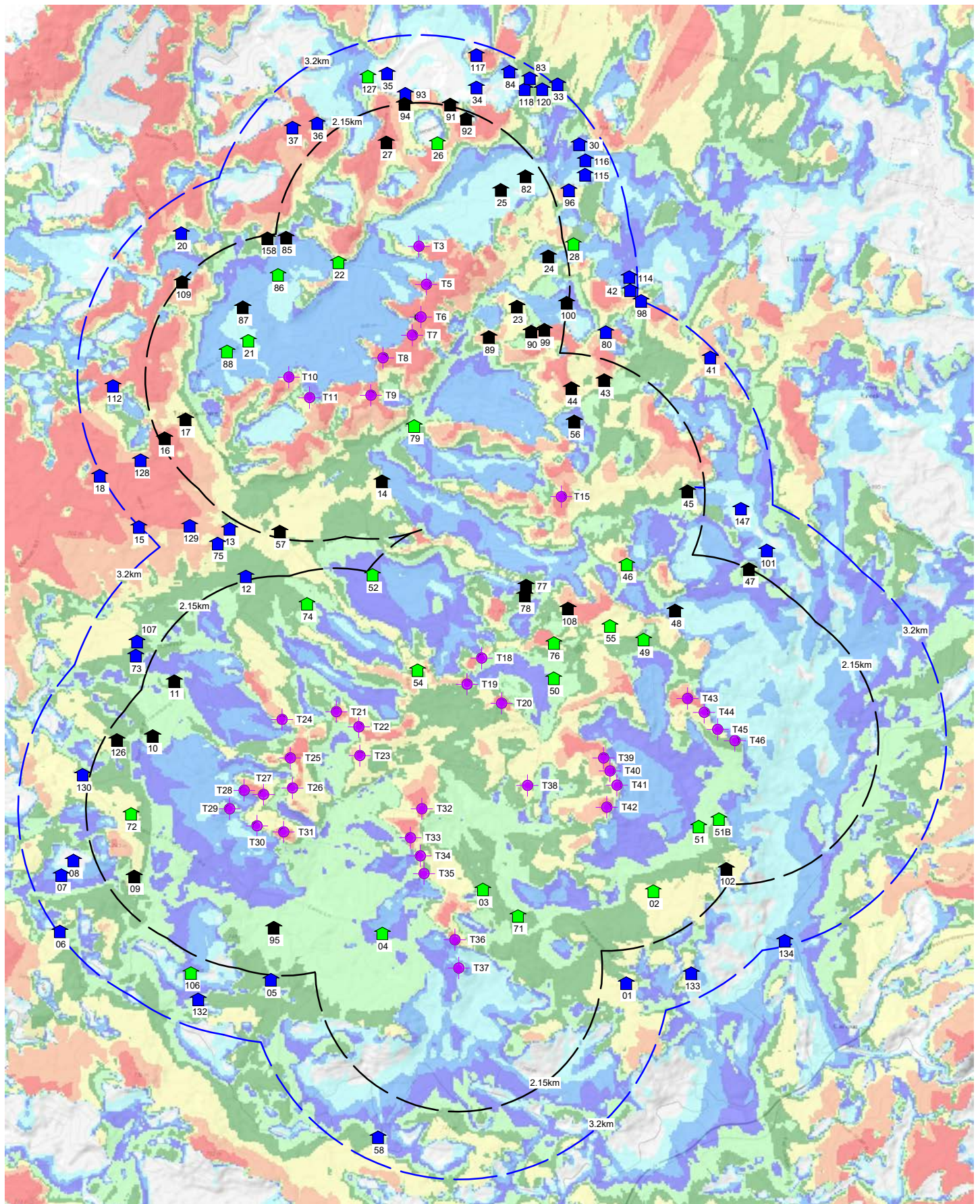
5.1 Introduction

Figures 2 and 3 illustrate the theoretical visibility of the approved FCWF wind turbines at 150m tip height, and Mod 4 wind turbines at 160m tip height. The ZVI diagrams do not account for the screening influence of vegetation or built structures.

Within the recognised limitations of ZVI diagrams, the overall extent of approved FCWF and Mod 4 wind turbine visibility, covers a very similar extent across the landscape surrounding the approved FCWF wind farm.

The similarity in theoretical wind turbine visibility demonstrates the influence of local topographical features on views toward the approved FCWF and Mod 4 wind turbines, together with the relatively minor differences in wind turbine tip height. The ZVI diagrams also illustrate that the Mod 4 wind turbines would have a limited increase in visual effects across the FCWF viewshed.

Whilst the overall extent of wind turbine visibility would be varied by topography for both the approved FCWF and the Mod 4 wind turbines, the number of wind turbines visible (to tip height) from receiver locations within the wind farm viewshed is likely to be subject to a very minor increase. However, when compared to the approved FCWF wind turbines, the increase in wind turbine visibility would be largely restricted to the upper sections (rotor blades) of wind turbine structures, rather than whole wind turbines.



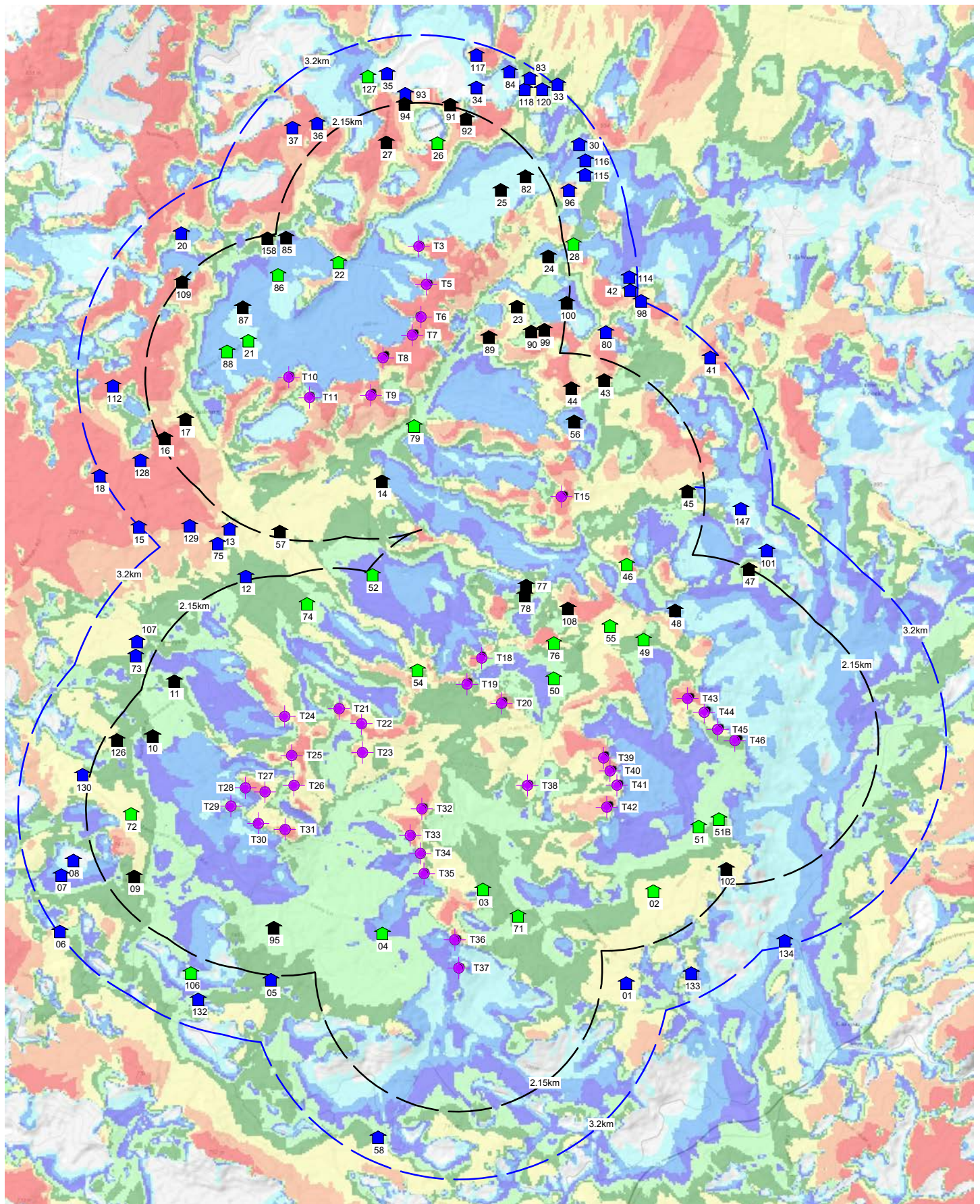
- Approved FCWF and proposed Mod-4 wind turbine (indicative location)
- Associated dwelling within 3.2 km of an approved FCWF wind turbine
- Non associated dwelling within 2.15 km of an approved FCWF wind turbine
- Non associated dwelling between 2.15 km and 3.2 km of an approved FCWF wind turbine
- 2.15 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height
- 3.2 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height

- 1 - 5 turbines
- 6 - 10 turbines
- 11 - 15 turbines
- 16 - 20 turbines
- 21 - 25 turbines
- 26 - 30 turbines
- 31 - 35 turbines
- 36 - 38 turbines

0km 1km



Figure 2
FCWF ZVI Diagram approved
150 metre tip height



- Approved FCWF and proposed Mod-4 wind turbine (indicative location)
- Associated dwelling within 3.2 km of an approved FCWF wind turbine
- Non associated dwelling within 2.15 km of an approved FCWF wind turbine
- Non associated dwelling between 2.15 km and 3.2 km of an approved FCWF wind turbine
- 2.15 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height
- 3.2 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height

- 1 - 5 turbines
- 6 - 10 turbines
- 11 - 15 turbines
- 16 - 20 turbines
- 21 - 25 turbines
- 26 - 30 turbines
- 31 - 35 turbines
- 36 - 38 turbines

0km 1km



Figure 3
FCWF ZVI Diagram at
160 metre tip height

6 Ancillary structures

6.1 Introduction

The approved FCWF includes a range of ancillary structures which include, but are not limited to:

- wind monitoring masts
- on-site access tracks
- substation
- 33kV overhead powerline and
- control and operation facilities building.

The proposed Mod 4 amendment includes the reinstatement of a 132kV transmission line from the wind farm substation to a connection with the North Orange to Cadia 132kV powerline and associated switching station as detailed in Section 10 of this VIA. Subject to this, the proposed Mod 4 amendment would not result in any fundamental change to approved FCWF ancillary structures and would not result in any additional visual impacts to those outlined in the approved application.

7 Visual effects

7.1 Introduction

Whilst the Mod 4 wind turbine tip height would extend up to 10m above the approved FCWF wind turbine height, this VIA has determined that the overall scale of the Mod 4 wind turbine would not result in an order of visual magnitude that is significantly above the visual magnitude of the approved FCWF wind turbines. A comparison of the approved FCWF and Mod 4 wind turbines is illustrated in **Figures 4 and 5**.

It is also noted that the Mod 4 wind turbines would be consistent with the approved FCWF wind turbines with regard to their visual form, design, pattern and colour. The location of associated and non-associated residential dwellings within 3.2km of the Mod 4 wind turbine layout is illustrated in **Figure 1**.

Figures 6 illustrates the elevated angle of view (toward tip height) for the approved FCWF and Mod 4 wind turbines from a view distance of 2km and 5km respectively. **Figure 6** illustrates that the Mod 4 wind turbine would result in less than one third of a degree view angle above the approved FCWF wind turbine from a 2km view distance. The additional view angle from a view distance of 5km would be approximately 7 minutes (around one tenth of one degree) increase in view angle.

Figure 7 illustrates the perceived and relative height difference between the approved FCWF wind turbine and the Mod 4 wind turbine. From a view distance of 5km the approved FCWF and Mod 4 wind turbines would be perceived at less than half the height of the Mod 4 wind turbine when viewed at a distance of 2km. The relatively small increase in view angle toward the Mod 4 wind turbine tip height, at a view distance of 5km (and beyond) is considered unlikely to result in a level of visual magnitude greater than the approved FCWF wind turbines. Within the parameters of normal human vision, the Mod 4 wind turbines are not considered to give rise to an increased level of visual magnitude over and above the approved FCWF project.

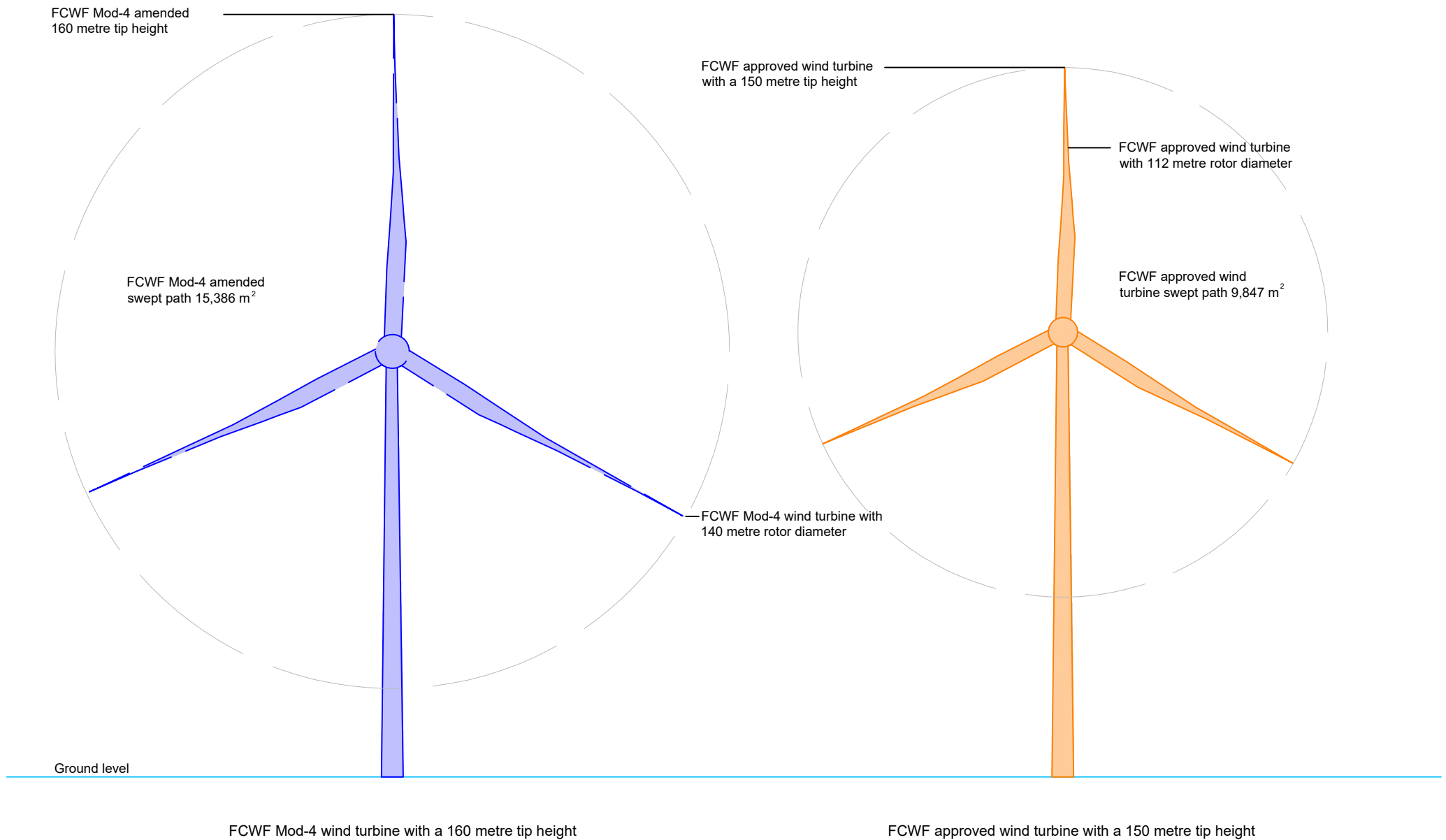


Figure 4-
FCWF approved and Mod-4 wind
turbine comparison

Flyers Creek Wind Farm Modification 4

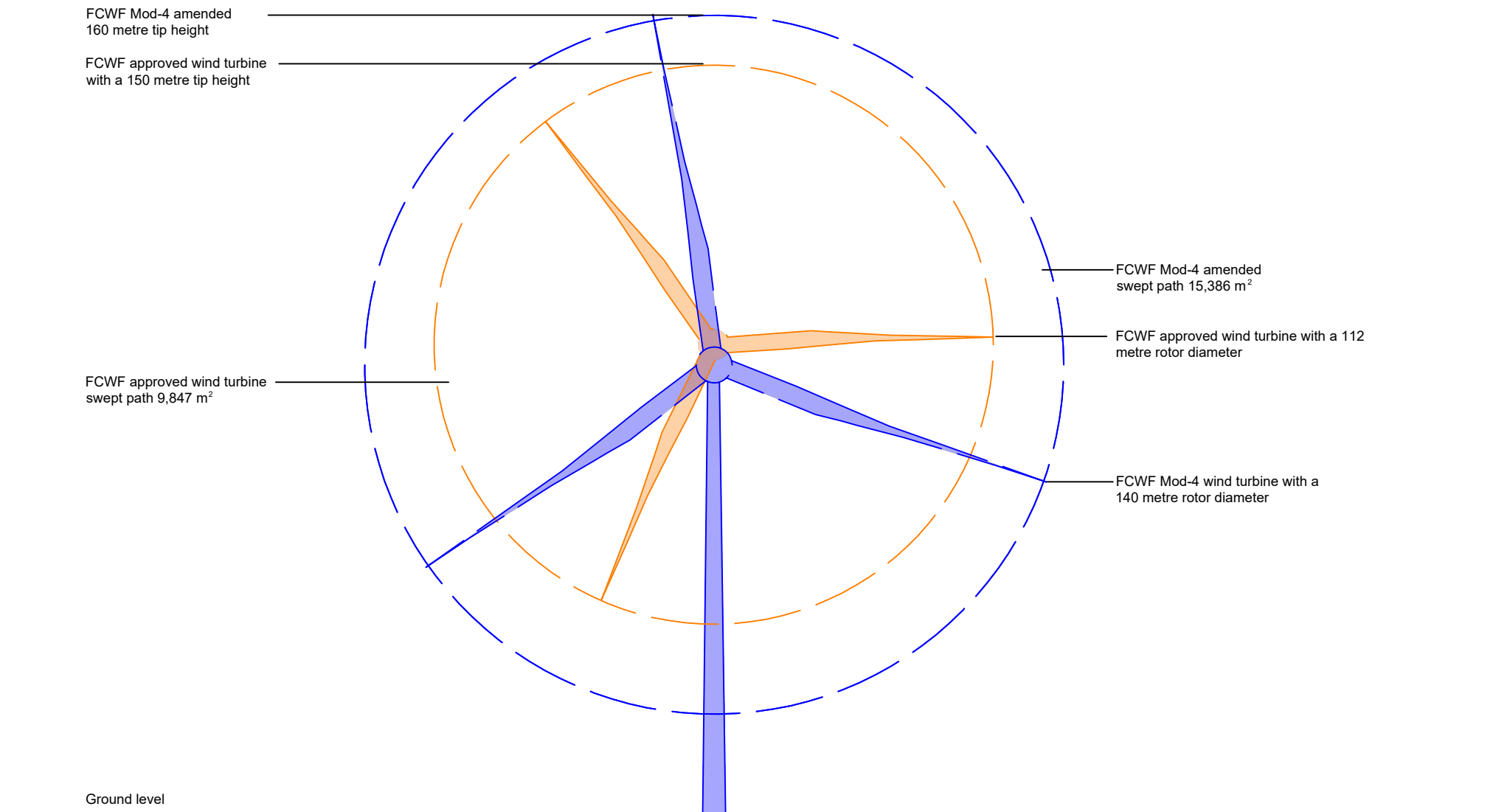


Figure 5-
FCWF approved and Mod-4 wind
turbine overlay

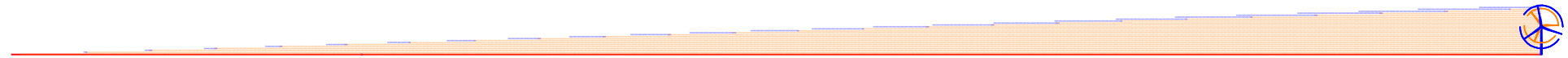
Flyers Creek Wind Farm Modification 4

Orange line = view line toward tip height of FCWF approved wind turbine (150 metres)

Blue line = view line toward tip height of Mod-4 wind turbine (160 metres)



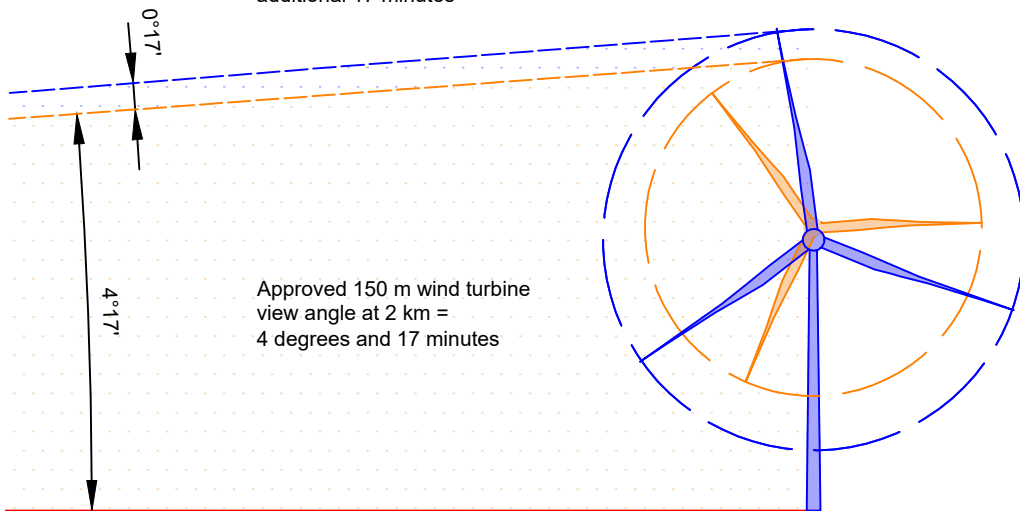
Comparative height of approved FCWF and Mod-4 wind turbine from a 2 km view distance



Comparative height of approved FCWF proposed Mod-4 wind turbine from a 5 km view distance

Proposed 160 m wind turbine
view angle at 2 km =
additional 17 minutes

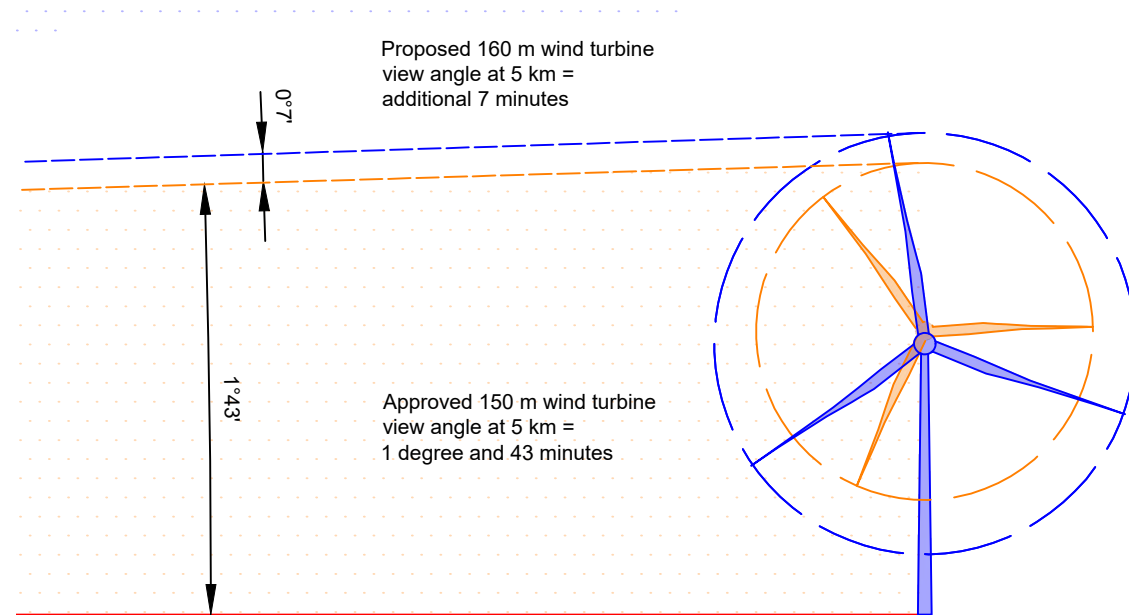
Approved 150 m wind turbine
view angle at 2 km =
4 degrees and 17 minutes



View angle toward approved FCWF and Mod-4 wind turbine tip of blade from a 2 km view distance

Proposed 160 m wind turbine
view angle at 5 km =
additional 7 minutes

Approved 150 m wind turbine
view angle at 5 km =
1 degree and 43 minutes



View angle toward approved FCWF and Mod-4 wind turbine tip of blade from a 5 km view distance

Figure 6 - FCWF approved and Mod-4 wind turbine view angle comparison at 2 km and 5 km view distance

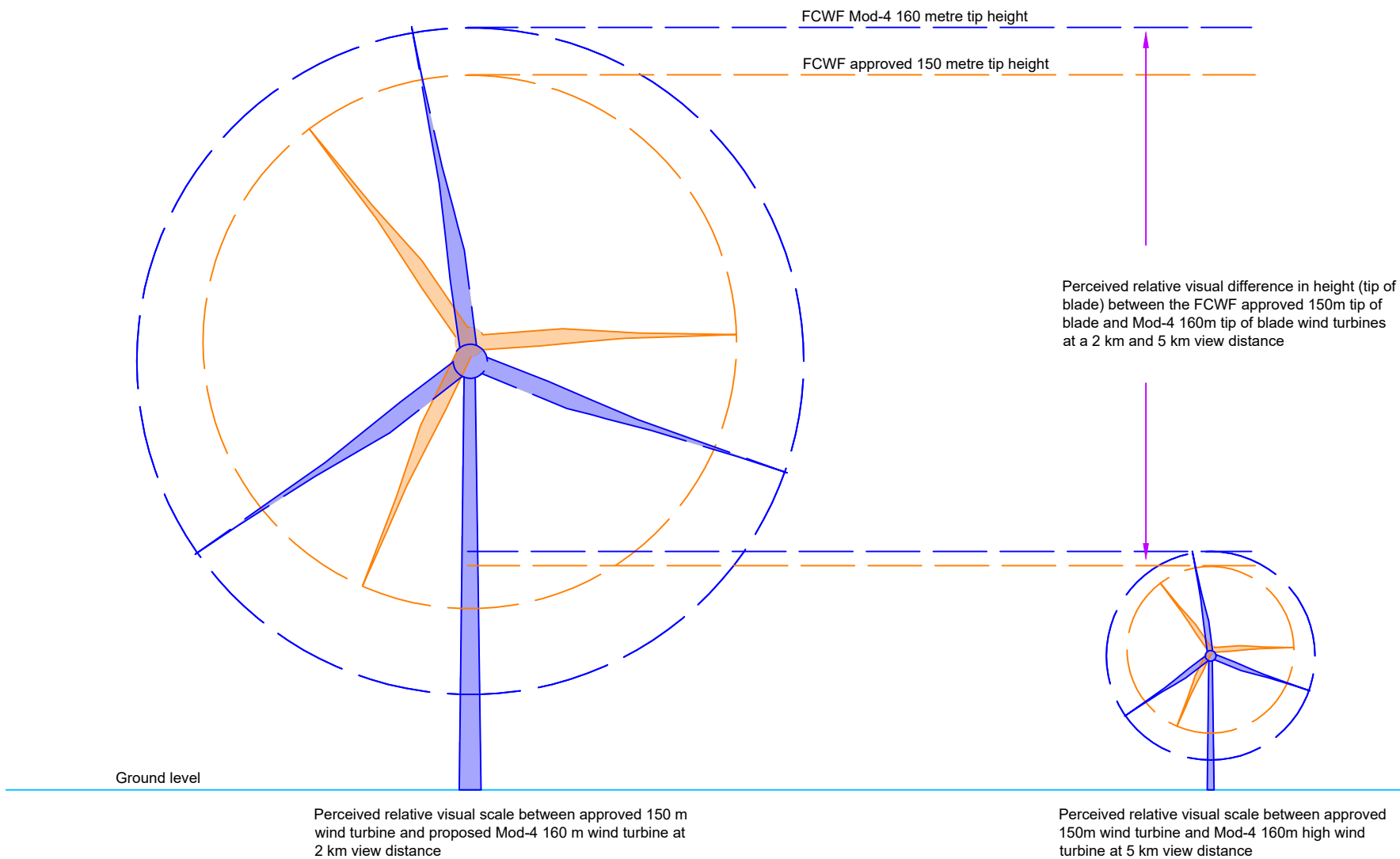


Figure 7 - FCWF approved and Mod-4 wind turbine comparison at 2 km and 5 km view distance

For the purpose of this VIA the magnitude of visual effect takes account of the scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition or contrast with the landscape, including the proportion of the view occupied by the Mod 4 wind turbine relative to the approved FCWF wind turbine. For the purpose of this VIA **Table 6** outlines ratings and definitions associated with the magnitude of visual effects.

Table 6 – Magnitude of visual effect

Visual effect	Magnitude
Amendments to the approved FCWF project would result in a major and prominent visual effect and introduce elements that contrast or are not in character with the approved FCWF project.	High
Amendments to the approved FCWF project would result in a partial visual effect and introduce elements which may be prominent, but not completely out of character with the approved FCWF project.	Medium
Amendments to the approved FCWF project would result in minor visual effects and introduce elements which are not prominent or out of character with the approved FCWF project.	Low
Amendments to the approved FCWF project would result in a very minor visual effect and introduce elements which are not prominent or uncharacteristic of the approved FCWF project. There would likely be 'no change' to the approved FCWF visual effect.	Negligible

7.2 Magnitude of visual effect matrix

Table 7 sets out the assessment of visual effects from residential dwellings up to 2.15km from the approved FCWF project. The locations of residential dwellings included in this VIA are illustrated in **Figure 1**.

Whilst the assessment includes a determination of visual effects from dwellings, it also takes into account any curtilage surrounding each dwelling which may be considered an extension to the dwelling for domestic or social activities. The criteria set out in **Table 6** are noted against each dwelling, with a visual effect rating determined against the matrix in **Table 7**.

Table 7 – Magnitude of visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
Residential dwellings within 2.15 km of approved FCWF wind turbine					
09	Non-associated residential dwelling	1,866	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
10	Non-associated residential dwelling	1,674	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
11	Non-associated residential dwelling	1,767	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer **Figure 1** for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
14	Non-associated residential dwelling	1,339	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
16	Non-associated residential dwelling	2,140	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
17	Non-associated residential dwelling	1,672	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer **Figure 1** for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
23	Non-associated residential dwelling	1,459	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
24	Non-associated residential dwelling	1,935	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
25	Non-associated residential dwelling	1,591	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
27	Non-associated residential dwelling	1,709	High-Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
43	Non-associated residential dwelling	2,008	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
44	Non-associated residential dwelling	1,689	Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
45	Non-associated residential dwelling	1,968	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
47	Non-associated residential dwelling	2,238	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
48	Non-associated residential dwelling	1,358	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer **Figure 1** for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
56	Non-associated residential dwelling	1,046	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
57	Non-associated residential dwelling (former school)	2,287	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
77	Non-associated residential dwelling	1,325	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer **Figure 1** for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
78	Non-associated residential dwelling	1,154	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
82	Non-associated residential dwelling	2,013	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
85	Non-associated residential dwelling	2,055	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer **Figure 1** for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
87	Non-associated residential dwelling	2,333		The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
89	Non-associated residential dwelling	1,199	High-Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
90	Non-associated residential dwelling	1,762	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
91	Non-associated residential dwelling	2,242	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
92	Non-associated residential dwelling	2,126	Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
94	Non-associated residential dwelling	2,211	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
95	Non-associated residential dwelling	1,481	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
99	Non-associated residential dwelling	1,903	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
100	Non-associated residential dwelling	2,179	Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
102	Non-associated residential dwelling	1,989	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
108	Non-associated residential dwelling	1,573	Moderate-Low	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
109	Non-associated residential dwelling	2,277	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

Table 7 – Magnitude of visual effect matrix (Refer **Figure 1** for non-associated residential dwelling locations)

Residential dwelling ID	Category of receiver location	Approximate distance to Mod 4 wind turbine (m)	Approved FCWF Visual Rating*	Description and magnitude of Mod 4 visual effect	Mod 4 magnitude
126	Non-associated residential dwelling	2,169	Nil	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment
158	Non-associated residential dwelling	2,326	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved FCWF wind turbine. There would be very limited change in the composition or contrast between the approved FCWF and proposed Mod 4 development. Magnitude rating Low – resulting in no change to the approved FCWF visual impact rating.	Unchanged from approved FCWF Impact Assessment

* Approved FCWF Visual Impact Assessment as determined by Aurecon FCWF Environmental Assessment (Appendix C, C1- Visual Assessment May 2011)

7.3 Magnitude of visual effect summary

The Magnitude of Visual Effects Matrix includes 35 non-associated dwellings within 2.15km of an approved FCWF wind turbine. An additional 41 non-associated dwellings occur between a distance of 2.15 and 3.2km from an approved FCWF wind turbine.

The overall assessment of the magnitude of visual effect associated with dwellings within 2.15km of the Mod 4 wind turbines is summarised as Low. The delta (degree of change) between the approved FCWF and Mod 4 wind turbine structures, whilst noticeable from proximate dwelling view locations would not result in any significant increased degree of visibility above that of the approved FCWF wind turbines.

With regard to dwellings beyond 2.15km of the FCWF approved project, GBD note that the Department of Planning and Environment determined that:

'...the Department agrees with the Proponent that the visual impact of turbines on residences outside of 5km for this project is low, and so it is acceptable for the impact assessment to be confined to within this radius. The Department further considers that for the vast majority of non-associated residences, (those greater than 2km from a turbine) the distance between turbines and the distance between the residences and turbines, would be sufficient to ensure that their view field would not be dominated by the turbine structures. From outside of this distance sufficient natural and other man-made elements would exist to add variety and "break up" any views towards the turbines' (Flyers Creek Wind Farm Director General's Environmental Assessment Report November 2011).

8 Visual assessment

8.1 Introduction

Following the assessment of the magnitude of visual effects between the approved FCWF and the proposed Mod 4 wind turbines, this VIA has undertaken a further consideration of the potential visual effect of the Mod 4 project on people at dwellings surrounding the approved wind farm development. The consideration of visual effects has been prepared with regard to the Guidelines, and specifically the inputs required for the baseline study outlined in the Guidelines Appendix 1: Visual Assessment Process.

8.2 Sensitive Land Use Designations

The approved FCWF wind farm project is wholly located within land use zone RU1 (Primary Production). Land use zone RU1 is not considered to be a sensitive land use designation as per the Guidelines, Appendix 1 Table 3.

8.3 Viewer sensitivity levels and visibility distance zones

Viewer sensitivity and visibility distance zones are included in Table 8. These predominantly include Level 2 Sensitivity Levels from rural dwellings. Visibility distance zones have been classified from far foreground to near middle ground views.

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
09	Non-associated residential dwelling Level 2	1,866 Far foreground	VIZ1	Moderate-Low	<i>Wind farm is at 1.9 km to the north-east of the residence with a view angle of 90°. The visual impact is assessed as being Moderate to Low due to significant tree screening on all sides of the residence which will limit the wind farm visibility (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
10	Non-associated residential dwelling Level 2	1,674 Far foreground	VIZ1	Moderate	<i>Close views of the wind farm to the east and more distant views to the north. The visual impact is assessed as Moderate due to the screening by extensive tree plantings (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
11	Non-associated residential dwelling Level 2	1,767 Far foreground	VIZ1	Moderate	<i>Close views of the wind farm to east and south-east. The visual impact is assessed as Moderate due to partial screening that will limit some of the wind farm visibility (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
14	Non-associated residential dwelling Level 2	1,339 Far foreground	VIZ1	Moderate	<i>Visibility is high due to close distance to turbines, viewangle and elevation above residence. Screening by trees on ridges may limit some of the wind farm visibility (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height. Figures 8 and 9 have been prepared to illustrate the approved FCWF and Mod 4 wind turbines, as well as the increase in view angle (less than half of 1 degree) associated with the Mod 4 wind turbine viewed from dwelling 14. These figures demonstrate that the Independent Planning Commission recommendation to provide screen planting with regard to achieving a satisfactory level of visual

Table 8 – Visual assessment matrix (Refer Figure 1 for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					impact for dwelling 14 could also be readily achieved for the Mod 4 amended wind turbine.
16	Non-associated residential dwelling Level 2	2,140 Near middle-ground	VIZ2	Moderate	<i>The visual impact is assessed as Moderate due to elevated location of the residence and aspect toward the wind farm but the wide viewfield angle being broken up by extensive vegetation screening at the residence (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
17	Non-associated residential dwelling	1,672 Far foreground	VIZ1	Moderate to Low	<i>Some clear views to parts of the northern group of turbines. The visual impact is assessed as Moderate to Low due to low position in</i>

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
	Level 2				<i>narrow valley with tree screening that limits visibility of parts of the wind farm (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
23	Non-associated residential dwelling Level 2	1,459 Far foreground	VIZ1	Moderate	<i>The visual impact is assessed as Moderate due to close distance to turbines, viewfield angle and elevation above residence. Partial screening is available which will limit visibility of some parts of the wind farm (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
24	Non-associated residential dwelling	1,935 Far foreground	VIZ1	Moderate	<i>The visual impact is assessed as Moderate due to northerly aspect of the residence away from nearest turbines. There is some tree screening which could limit some visibility (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
25	Non-associated residential dwelling Level 2	1,591 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to the east, north and westerly aspects for the house and trees on southern side. Only three turbines are likely to be visible but the closest is at 1.1km (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
27	Non-associated residential dwelling Level 2	1,709 Far foreground	VIZ1	High to Moderate	<i>The visual impact is assessed as High to Moderate due to elevated position of residence and limited screening. Removal of Turbines 1 and 2 has reduced impact for this location (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
43	Non-associated residential dwelling Level 2	2,008 Near middle-ground	VIZ2	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to significant topographic and tree screening for the residence (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
44	Non-associated residential dwelling Level 2	1,689 Far foreground	VIZ1	Low	<i>The visual impact is assessed as Low due to significant topographic and tree screening for the residence. See Section C1.3 for more details (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
45	Non-associated residential dwelling Level 2	1,968 Far foreground	VIZ1	Moderate	<i>The visual impact is assessed as Moderate due to partial screening by trees and topography (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
47	Non-associated residential dwelling Level 2	2,238 Near middle-ground	VIZ2	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to partial to full screening by vegetation (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
48	Non-associated residential dwelling	1,358 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to limited number of turbines potentially visible, low position of the residence</i>

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
	Level 2				<i>and presence of trees that will reduce the visibility of the wind farm further (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
56	Non-associated residential dwelling Level 2	1,046 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to the residence being low set on the north-eastern side of the hill with aspect away from the wind farm and there being substantial tree and shrub screening at the residence (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
57	Non-associated residential dwelling (former school) Level 2	2,287 Near middle-ground	VIZ1	Moderate	<i>Some views to the wind farm site are screened by trees and this will reduce the visibility rating to Moderate (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
77	Non-associated residential dwelling Level 2	1,325 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to some tree and landscape screening and minor topographic fluctuations. Photomontage 8a demonstrates that only 3 turbines are prevalent in the primary view (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
78	Non-associated residential dwelling Level 2	1,154 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to some tree screening and minor topographic fluctuations near the residence not fully represented by Windfarmer software (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
82	Non-associated residential dwelling Level 2	2,013 Near middle-ground	VIZ2	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to northerly aspect of the residence away from nearest turbines and some tree screening which could limit some wind farm visibility (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
85	Non-associated residential dwelling Level 2	2,055 Near middle-ground	VIZ2	Moderate to Low	<i>The visual impact is assessed as Moderate to Low. While portions of up to 24 turbines are potentially visible, the views of complete turbines will be reduced by vegetation and intervening topography (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
87	Non-associated residential dwelling	2,333 Near middle-ground	VIZ2	Low	<i>The visual impact is assessed as Low due to the few potentially visible turbines being screened by existing vegetation surrounding the residence (Aurecon 2011).</i>

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
	Level 2				The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
89	Non-associated residential dwelling Level 2	1,199 Far foreground	VIZ1	High to Moderate	<i>The visual impact is assessed as High to Moderate due to close distance to turbines wide viewfield angle and elevation of some turbines above residence. Many of the turbines are potentially visible and there is little screening at this residence which is located on a cleared knoll (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
90	Non-associated residential dwelling Level 2	1,762 Far foreground	VIZ1	Moderate	<i>The visual impact is assessed as Moderate due to close distance to some turbines and wide viewfield angle. Existing screening by large trees likely to reduce the number of visible turbines (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
91	Non-associated residential dwelling	2,242 Near middle-ground	VIZ2	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to many of the potentially visible turbines not being visible at the residence due to</i>

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
	Level 2				<i>northerly aspect (northern side of hill) and mature trees on ridge to south of the residence (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
92	Non-associated residential dwelling Level 2	2,126 Near middle-ground	VIZ2	Low	<i>The visual impact is assessed as Low due to substantial screening to the south of the residence (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
94	Non-associated residential dwelling Level 2	2,211 Near middle-ground	VIZ2	Moderate	<i>The visual impact is assessed as Moderate due to viewfield angle, distance and position of the residence on ridgeline with southerly aspect and limited existing screening (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
95	Non-associated residential dwelling	1,481 Far foreground	VIZ1	Moderate	<i>The visual impact is assessed as Moderate due to close distance to some turbines, wide viewfield angle and elevation of turbines above residence. Topography will reduce the number of complete visible</i>

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
	Level 1 (Local Heritage Listing)				turbines. Turbine 31 has been relocated to the north to reduce its impact at this location (Aurecon 2011). The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
99	Non-associated residential dwelling Level 2	1,903 Far foreground	VIZ1	Moderate	The visual impact is assessed as Moderate due to close distance to turbines, very wide viewfield angle and elevation of the residence on hill with views to much of the wind farm site. However existing screening will reduce the number of visible turbines (Aurecon 2011). The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
100	Non-associated residential dwelling Level 2	2,179 Near middle-ground	VIZ2	Low	<i>The visual impact is assessed as Low due to only a few turbines likely to be visible due to existing screening around residence (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
102	Non-associated residential dwelling Level 2	1,989 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low due to aspect. While a significant part of the wind farm may be visible from this location it is indicated that there is no residence at this site (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
108	Non-associated residential dwelling Level 2	1,573 Far foreground	VIZ1	Moderate to Low	<i>The visual impact is assessed as Moderate to Low. While some turbines are close and overall viewfield angle (without screening) is large there is significant existing screening that will reduce views to parts of the wind farm (Aurecon 2011).</i>

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
109	Non-associated residential dwelling Level 2	2,277 Near middle-ground	VIZ2	Moderate	<i>The visual impact is assessed as Moderate due to only 2 turbines being within 3 km. The residence is on an elevated location with easterly aspect and little vegetation that would serve to screen views to the wind farm (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any

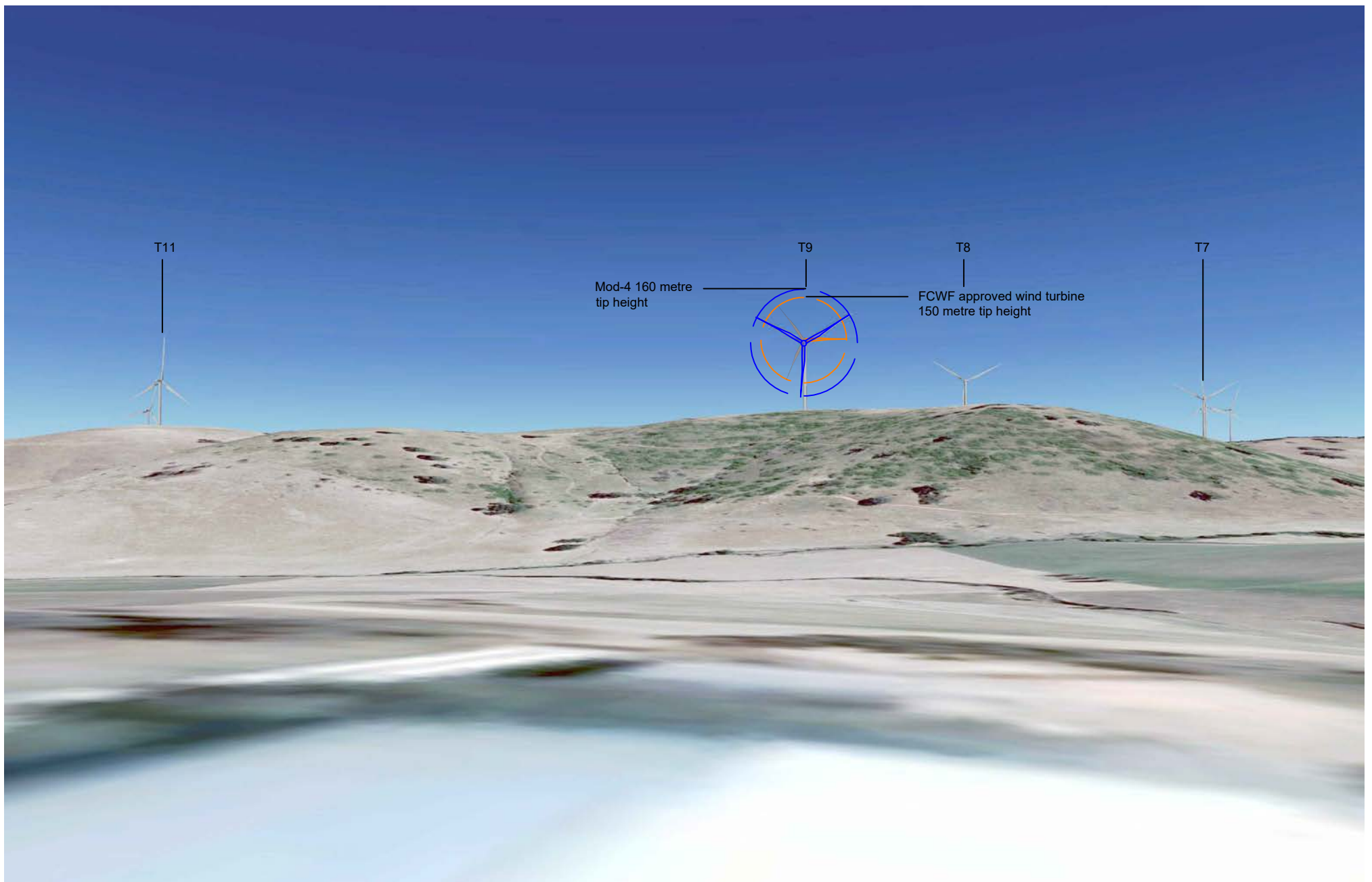
Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.
126	Identified as former mine site -	2,169 Near middle-ground	-	Nil	The visual impact is assessed as Nil as the location is a former mine site rather than a residence.
158	Non-associated residential dwelling Level 2	2,326 Near middle-ground	VIZ2	Moderate	<i>The visual impact is assessed as Moderate with up to 27 turbine hubs being potentially visible and with the elevated residence, easterly aspect and little vegetation to reduce the wind farm visibility. Visibility on the ridges between the residence and the turbine sites will provide some mitigation. The deletion of Turbine 2 has reduced the visual impact at this location (Aurecon 2011).</i> The Mod 4 amendment is not considered to result in any significant increase in wind turbine visibility from this dwelling location over and above the approved FCWF project. The Mod 4 amendment would decrease the wind turbine tower height and lower the nacelle. An increase to the swept area of the rotor face, and a 10m increase to the wind turbine tip height would not result in any

Table 8 – Visual assessment matrix (Refer **Figure 1** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to proposed Mod 4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved FCWF Visual Rating*	FCWF approved and Mod 4 amendments
					greater visual dominance when compared to the approved FCWF wind turbine at a 150m tip height.

* Approved FCWF Visual Rating as determined by Aurecon (Flyers Creek Wind Farm, Environmental Assessment, Appendix C May 2011)



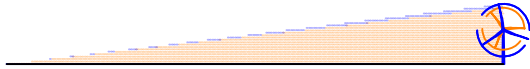
Google Earth model view toward FCWF approved and Mod-4 wind turbine T9 from dwelling R14.
Approximate view distance 1.3 km

Figure 8
FCWF approved and Mod-4 wind turbine overlay from dwelling R14

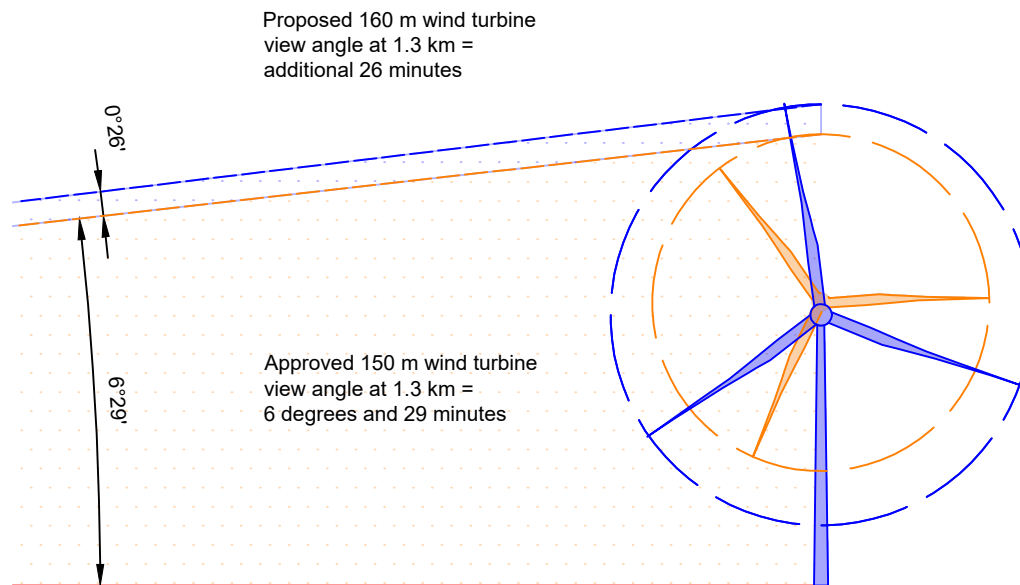
Flyers Creek Wind Farm Modification 4

Orange line = view line toward tip height of FCWF approved wind turbine (150 metres)

Blue line = view line toward tip height of Mod-4 wind turbine (160 metres)



Comparative height of approved FCWF proposed Mod-4 wind turbine from a 1.3 km view distance



View angle toward approved FCWF and Mod-4 wind turbine tip of blade from a 1.3 km view distance

Figure 9 - FCWF approved and Mod-4 wind turbine view angle comparison at 1.3 km view distance

9 Wire frame models

9.1 Introduction

The wireframe model locations have been selected to illustrate viewpoints from public and dwelling locations with views toward the approved FCWF.

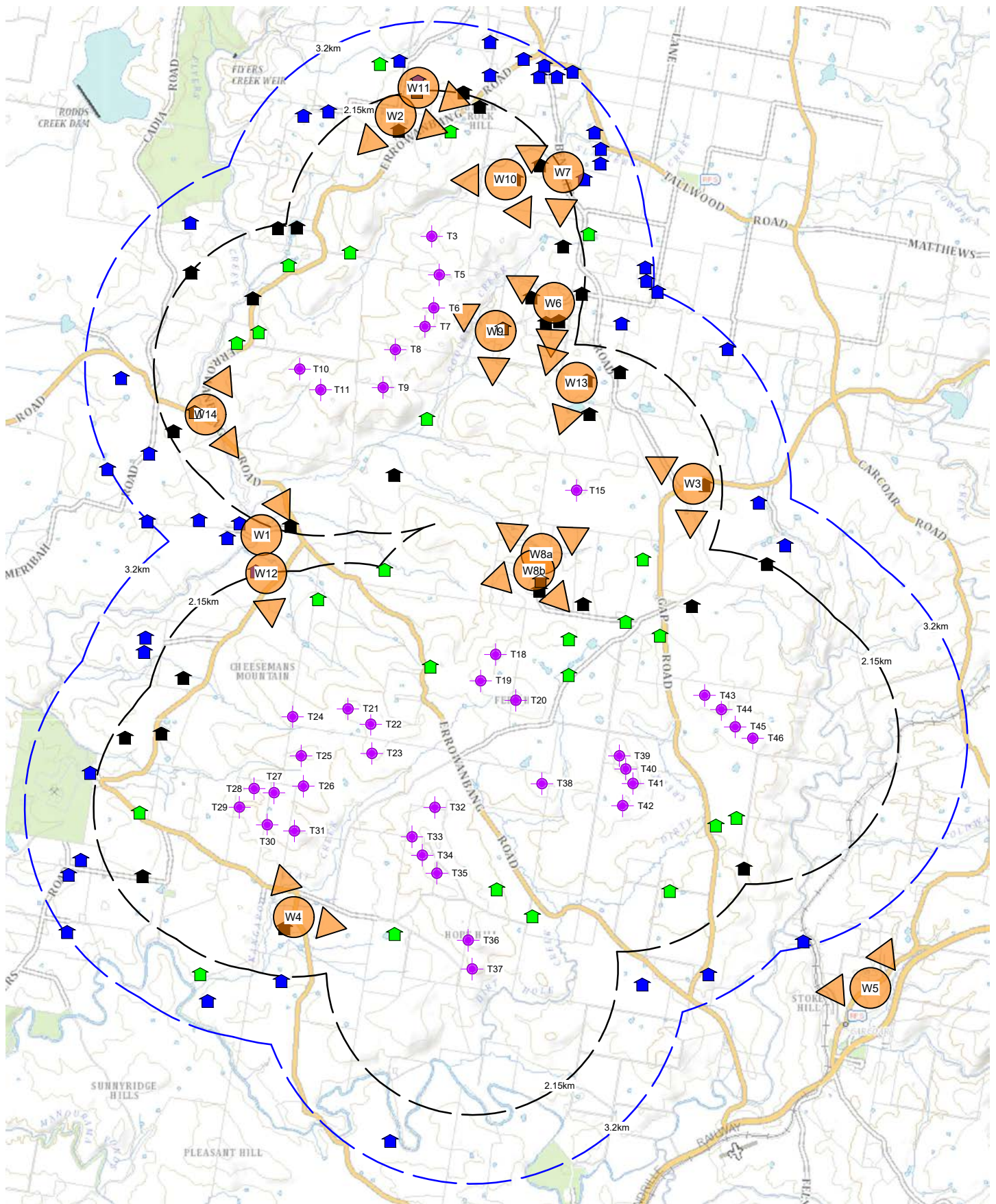
The 15 wireframe locations are illustrated in **Figure 10**, and the wireframes presented in **Figures 11 to 25**. The wireframe models illustrate views toward the approved FCWF and the Mod 4 amendment. The wire frame models illustrate the wind turbines with and without their individual identification numbers for clarity.

The wire frame models do not include, or illustrate, the location of tree planting between the wire frame view point and the approved FCWF and Mod 4 wind turbines. The wire frame models are therefore considered to be very conservative in both the extent of view and visibility of wind turbines indicated in each wire frame model.

9.2 Wireframe model preparation

The wireframes have been prepared with regard to the general guidelines set out in the Scottish Natural Heritage (2017) Visual representation of windfarms: good practice guidance. The wireframe models were generated through the following steps:

- a digital terrain model (DTM) of the project site was created from a terrain model of the surrounding area using digital contours
- the site DTM was loaded in the DNV-GL 'WindFarmer' software package
- the layout of the wind farm and 3D representation of the wind turbine was configured in 'WindFarmer'
- the location of each viewpoint was configured in 'WindFarmer'
- the view from each wireframe model location was then assessed in 'WindFarmer'. This process requires accurate mapping of the terrain as modelled
- the final image was converted to JPG format and imported and annotated as the final figure.



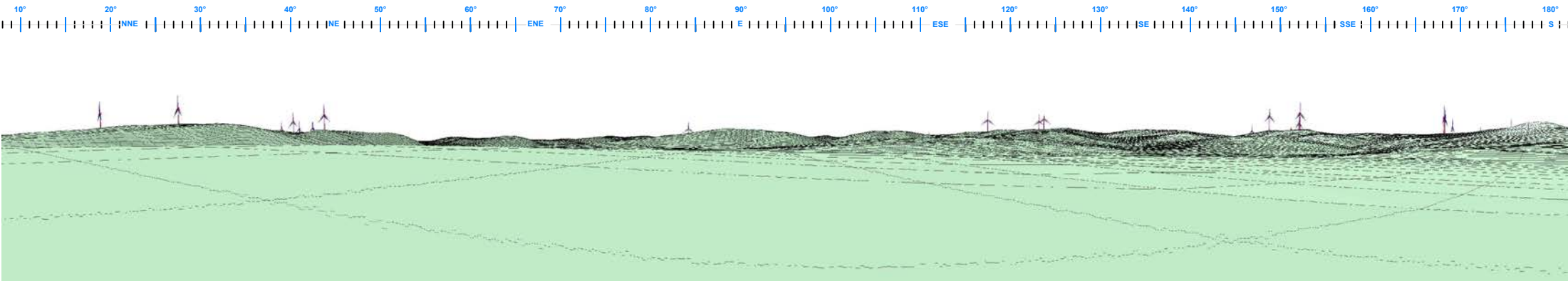
Legend

- ✦ FCWF approved wind turbine location (indicative location)
- Associated dwelling within 3.2 km of approved wind turbine
- Non associated dwelling within 2.15 km of approved wind turbine
- Non associated dwelling between 2.15 km and 3.2 km of approved wind turbine
- 2.15 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height
- 3.2 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 160 m tip height
- Indicative wire frame location and general view direction

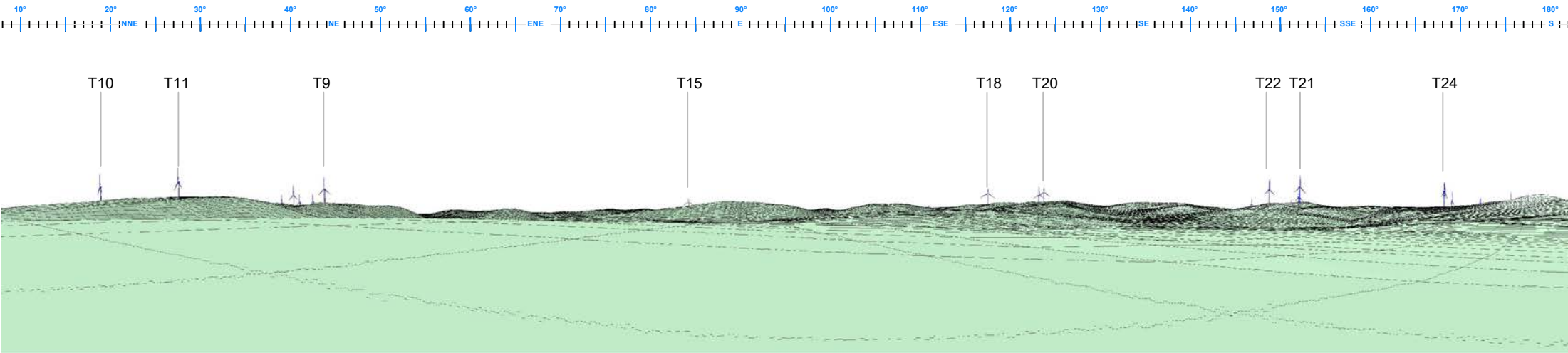
0km 1km



Figure 10
FCWF wire frame locations



Flyers Creek Wind Farm, Viewpoint W1 looking north east to south east from Beneree Flyers Creek Road: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T11) 2,000 metres



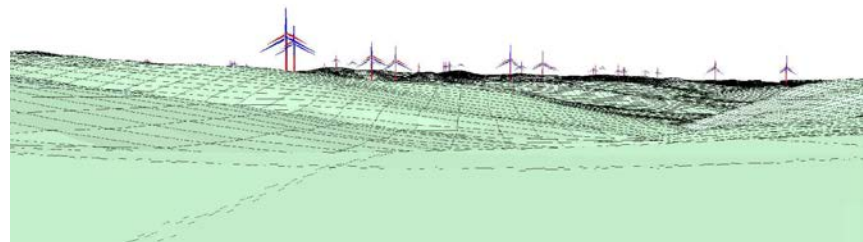
Flyers Creek Wind Farm, Viewpoint W1 looking north east to south east from Beneree Flyers Creek Road: Proposed Mod 4 160m tip of blade wind turbines (blue) only



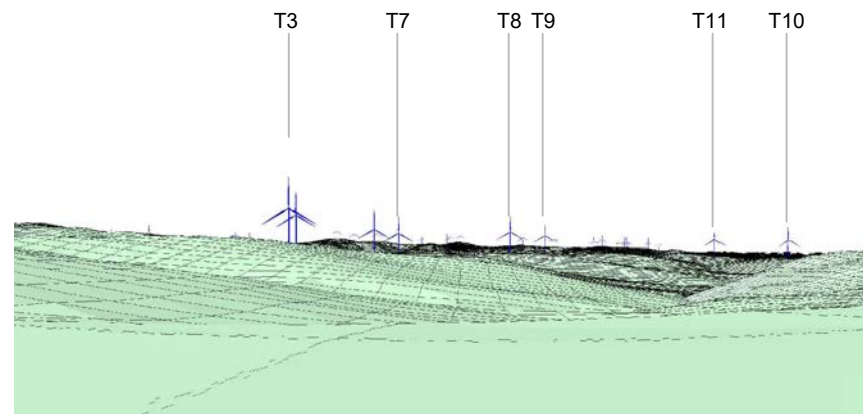
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W2 looking south east to south west from Beneree Flyers Creek Road and Watsonsons Lane intersection: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T3) 1,540 metres



Flyers Creek Wind Farm, Viewpoint W2 looking south east to south west from Beneree Flyers Creek Road and Watsonsons Lane intersection: Mod 4 160m tip of blade wind turbines (blue) only.
 Approximate distance to closest approved wind turbine (T3) 1,540 metres



FCWF approved wind turbine at 150m tip height

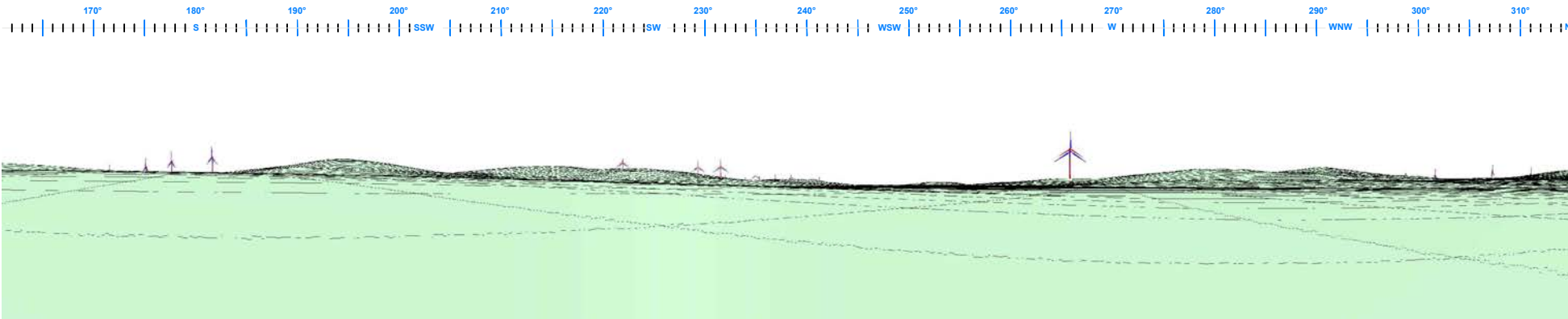


Proposed FCWF Mod 4 wind turbine at 160m tip height

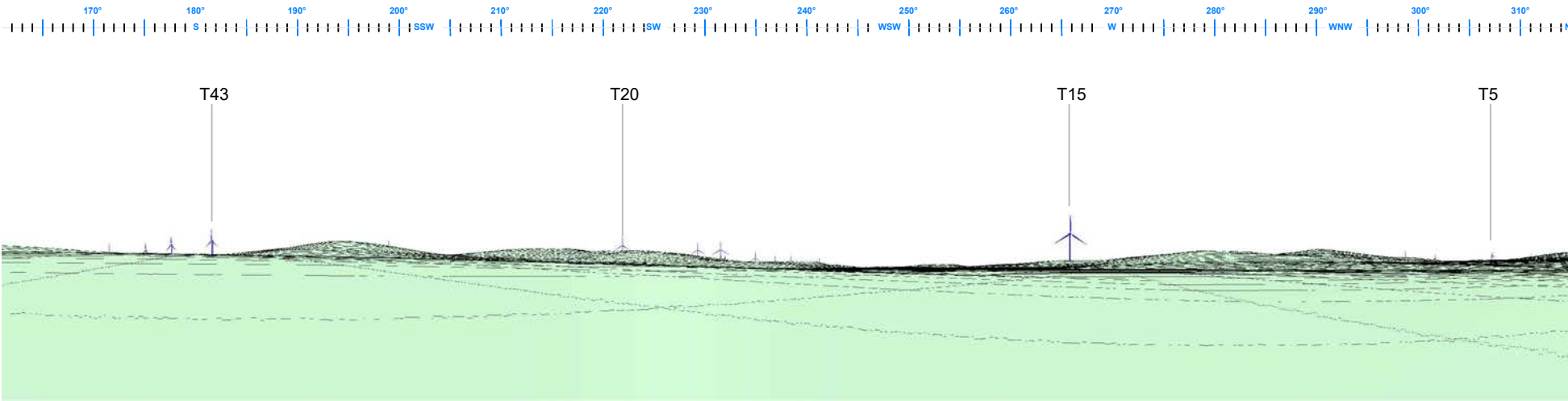
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

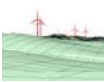
Figure 12 -
 Wire frame W2 from
 Beneree Flyers Creek Road
 and Watsonsons Lane



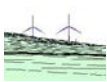
Flyers Creek Wind Farm, Viewpoint W3 looking south south east to north west from Platform Road: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T15) 1,835 metres



Flyers Creek Wind Farm, Viewpoint W3 looking south south east to north west from Platform Road: Proposed Mod 4 160m tip of blade wind turbines (blue) only



FCWF approved wind turbine at 150m tip height



Proposed FCWF Mod 4 wind turbine at 160m tip height

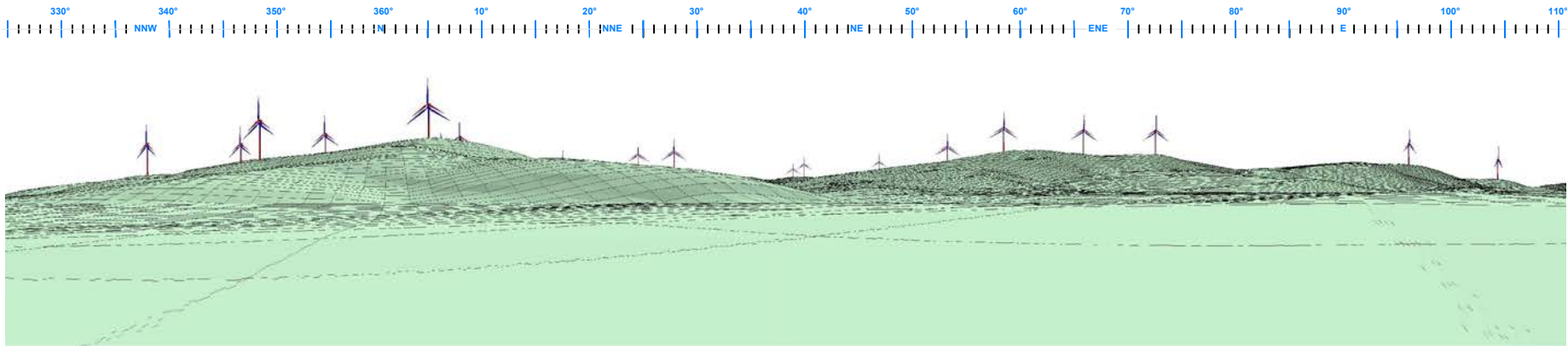
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

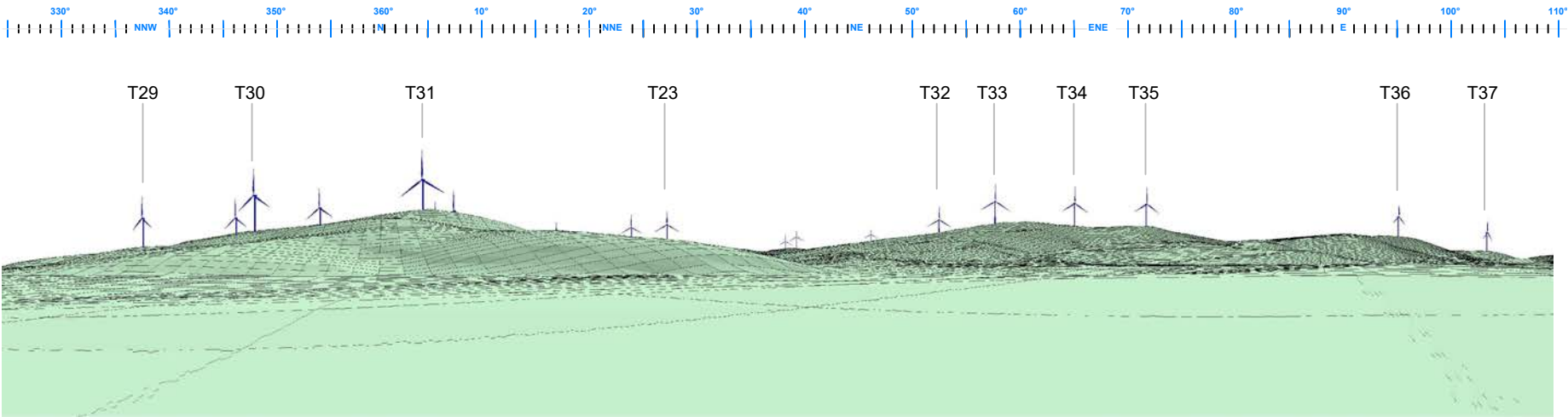
Figure 13 -
 Wire frame W3 from
 Platform Road

GREEN BEAN DESIGN
landscape architects

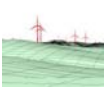
Flyers Creek Wind Farm Modification 4



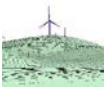
Flyers Creek Wind Farm, Viewpoint W4 looking north north west to east south east from Mandurama to Burnt Yards Road: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue) Approximate distance to closest approved wind turbine (T31) 1,360 metres



Flyers Creek Wind Farm, Viewpoint W4 looking north north west to east south east from Mandurama to Burnt Yards Road: Proposed Mod 4 160m tip of blade wind turbines (blue) only



FCWF approved wind turbine at 150m tip height



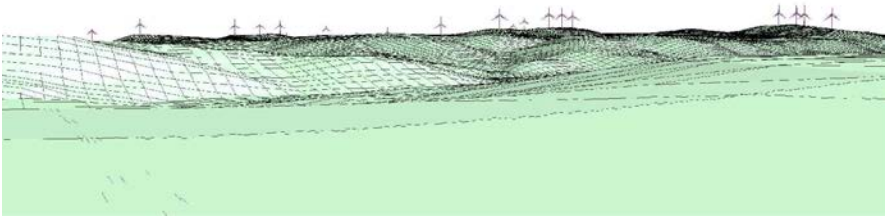
Proposed FCWF Mod 4 wind turbine at 160m tip height

Notes:
Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

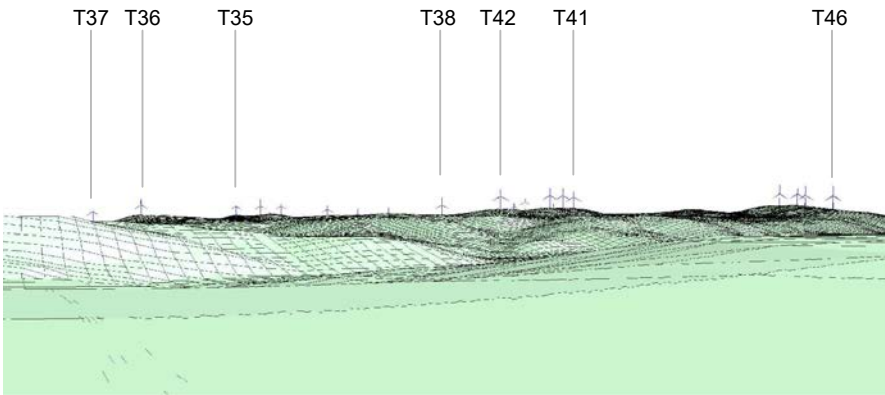
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Figure 14 - Wire frame W4 from Mandurama to Burnt Yards Road

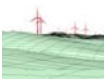
Flyers Creek Wind Farm Modification 4



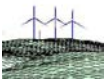
Flyers Creek Wind Farm, Viewpoint W5 looking west to north north west from Carcoar (off Rodd Street):
Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
Approximate distance to closest approved wind turbine (T31) 4,400 metres



Flyers Creek Wind Farm, Viewpoint W5 looking west to north north west from Carcoar (off Rodd Street):
Proposed Mod 4 160m tip of blade wind turbines (blue) only



FCWF approved wind turbine at 150m tip height



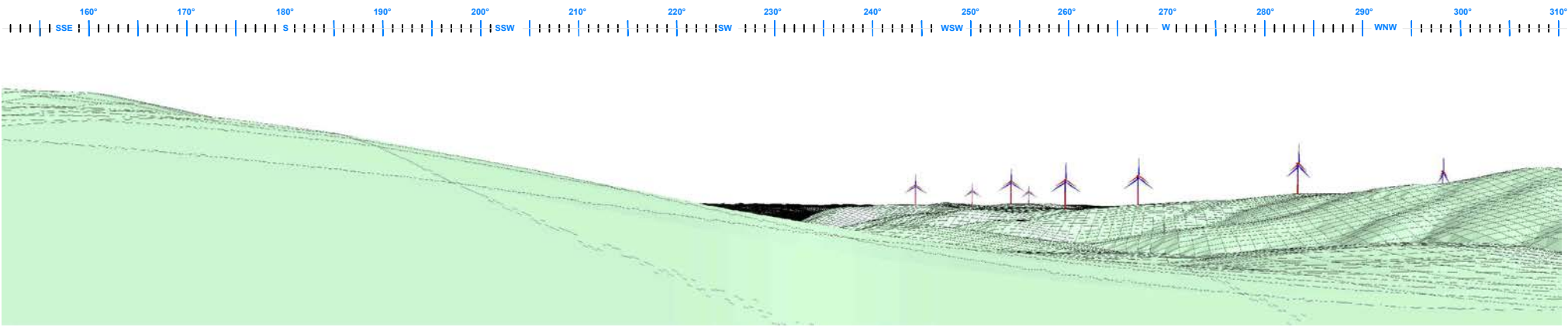
Proposed FCWF Mod 4 wind turbine at 160m tip height

Notes:
Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

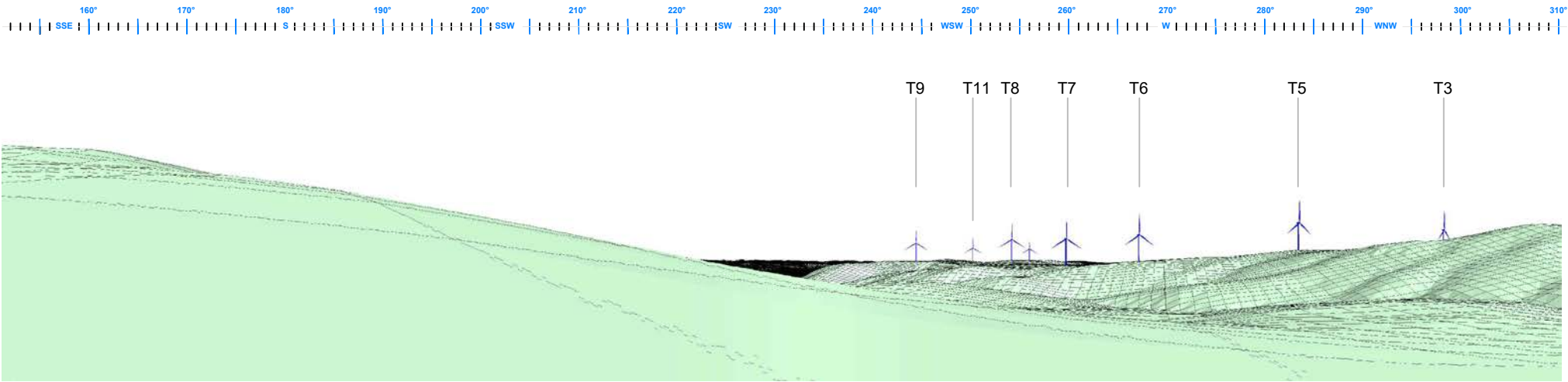
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Figure 15 -
Wire frame W5 from Carcoar (off Rodd Street)

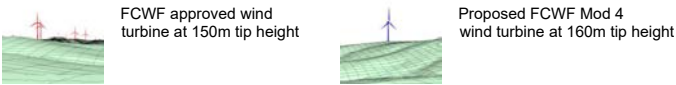
Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W6 looking south south east to west north west from Dixons Lane: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T5) 1,680 metres



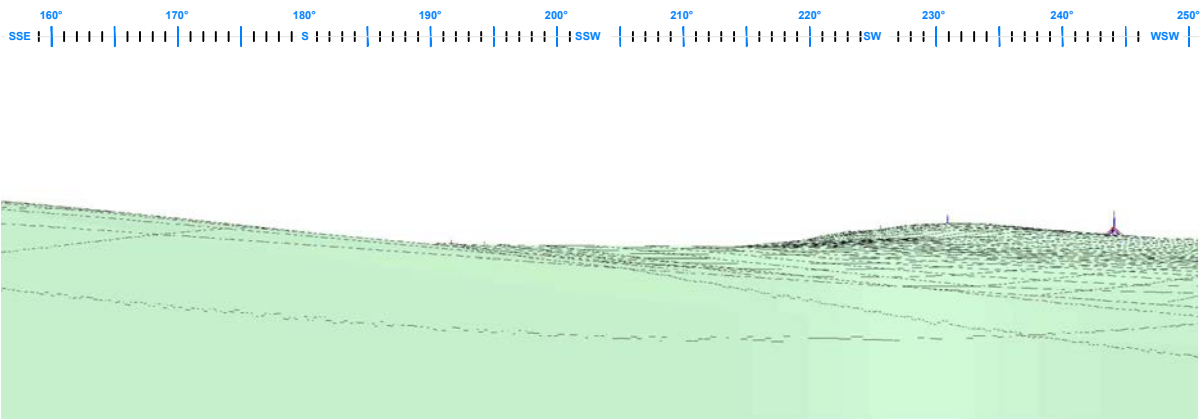
Flyers Creek Wind Farm, Viewpoint W6 looking south south east to west north west from Dixons Lane:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



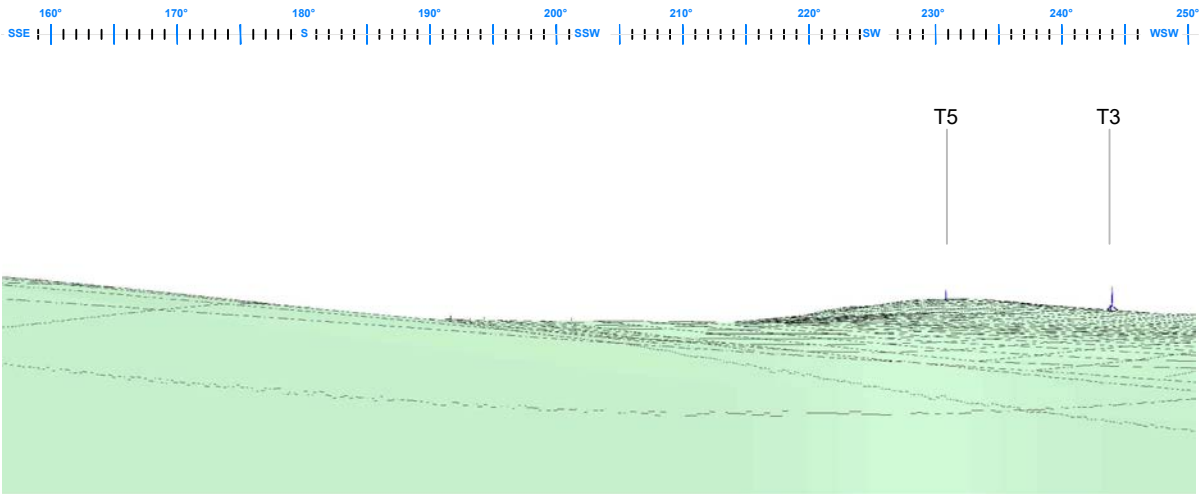
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

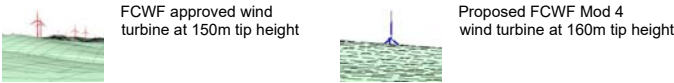
Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W7 looking south south east to west south west from Beneree Road:
 Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T3) 2,250 metres



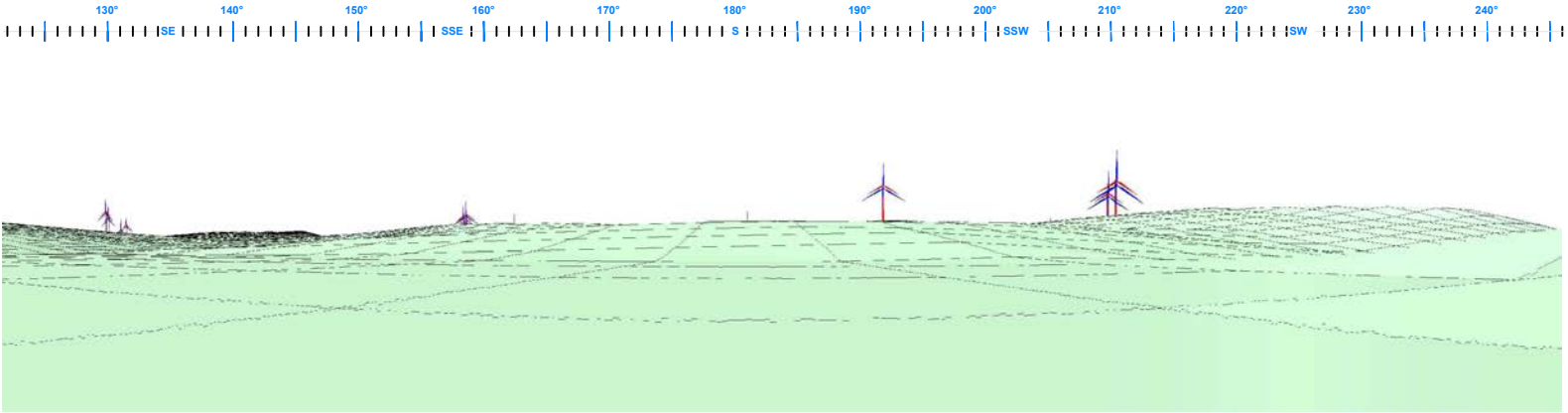
Flyers Creek Wind Farm, Viewpoint W7 looking south south east to west south west from Beneree Road:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



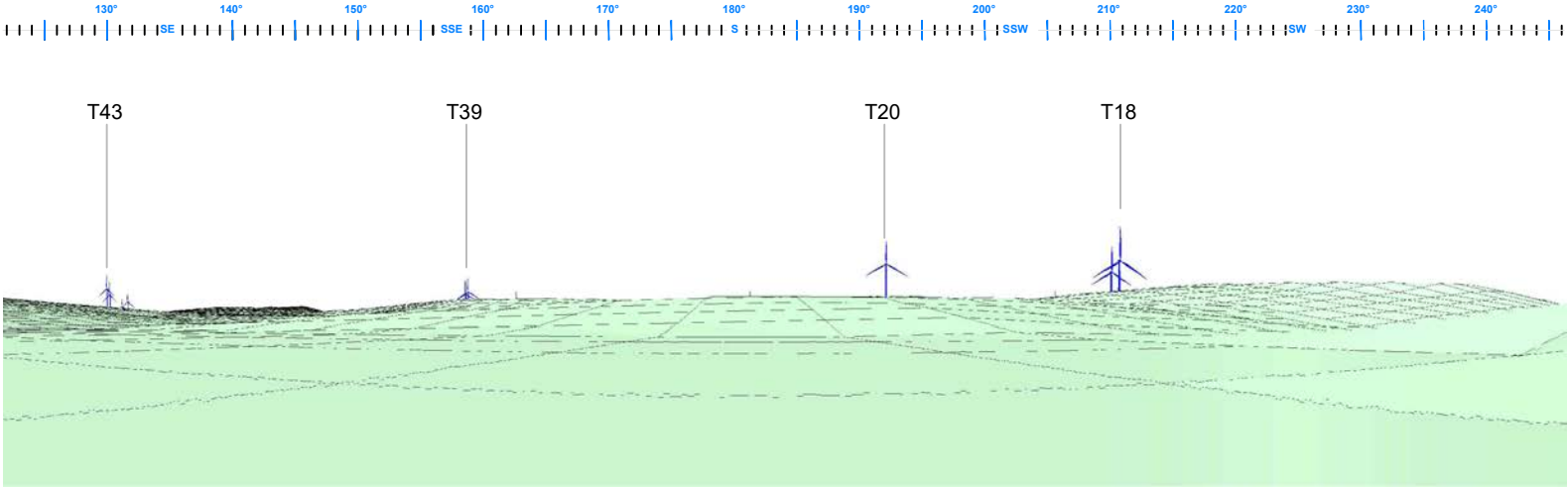
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W8a looking south east to south west off Dunstaffnage Lane:
 Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T18) 1,350 metres



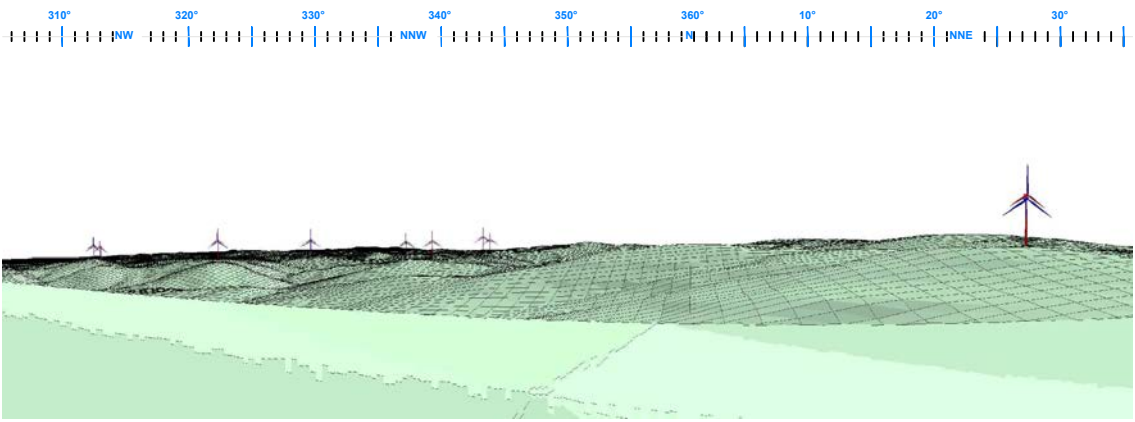
Flyers Creek Wind Farm, Viewpoint W8a looking south east to south west from Dunstaffnage Lane:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



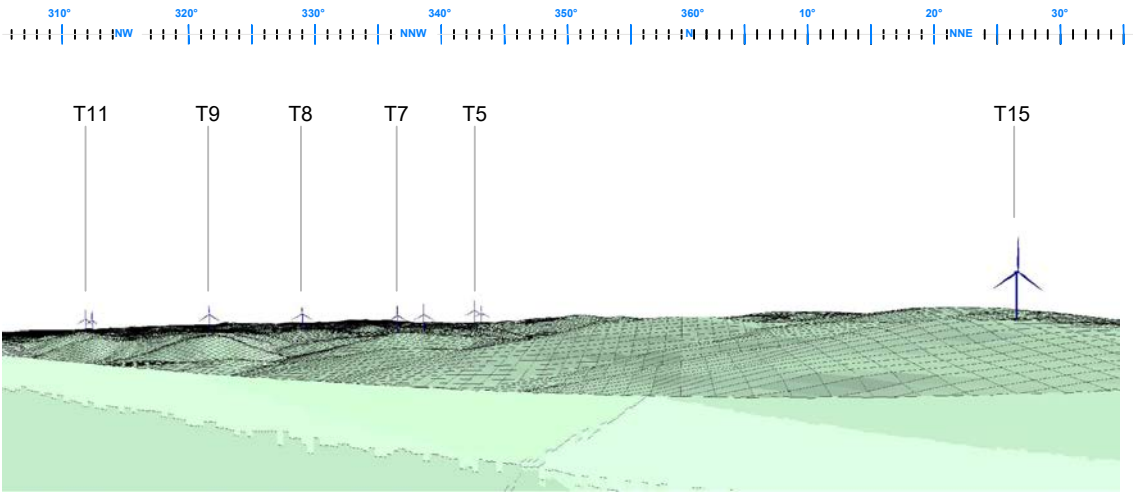
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

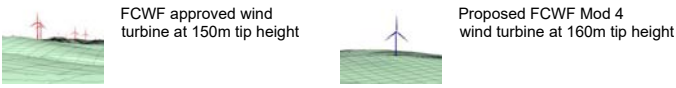
Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W8b looking north west to north north east off Dunstaffnage Lane:
 Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T15) 1,400 metres



Flyers Creek Wind Farm, Viewpoint W8b looking north west to north north east from Dunstaffnage Lane:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only

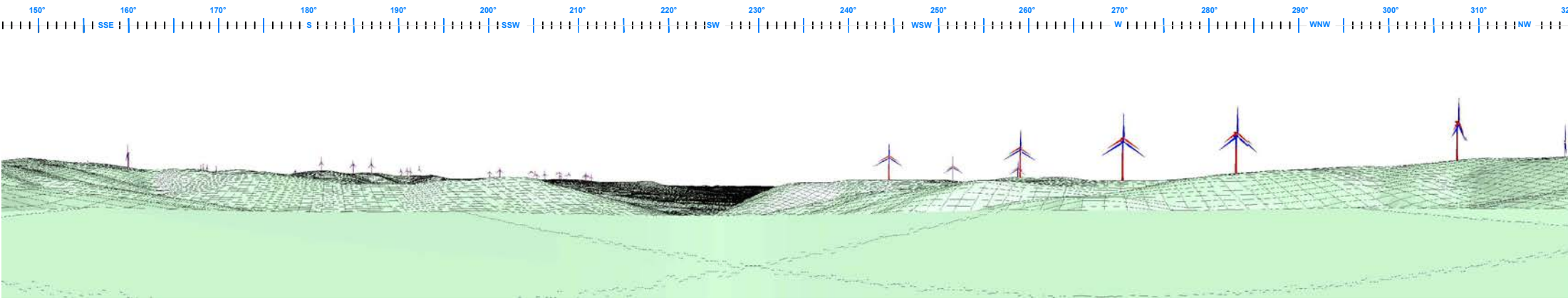


Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

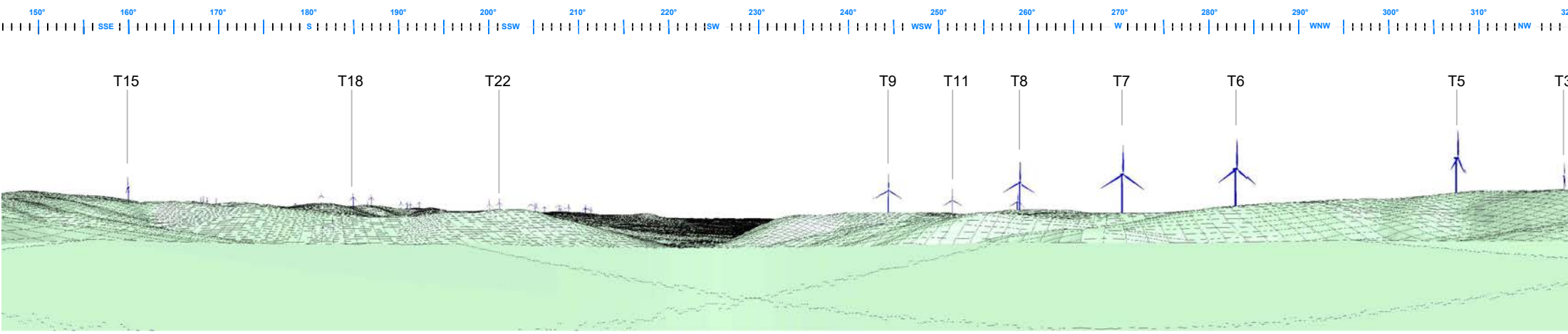
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Figure 19 -
 Wire frame W8b off
 Dunstaffnage Lane

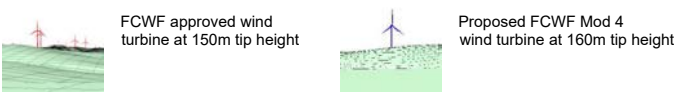
Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W9 looking south south east to north west from dwelling 89: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T6) 1,144 metres



Flyers Creek Wind Farm, Viewpoint W9 looking south south east to north west from dwelling 89:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only

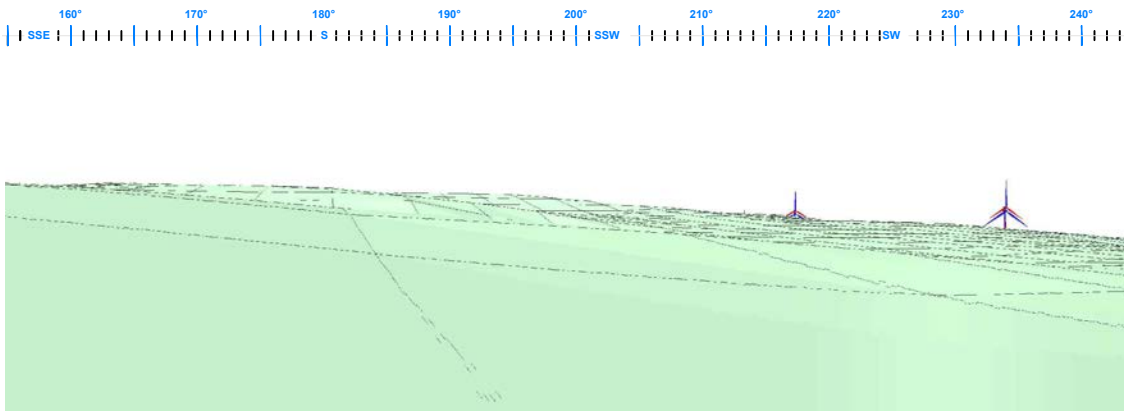


Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

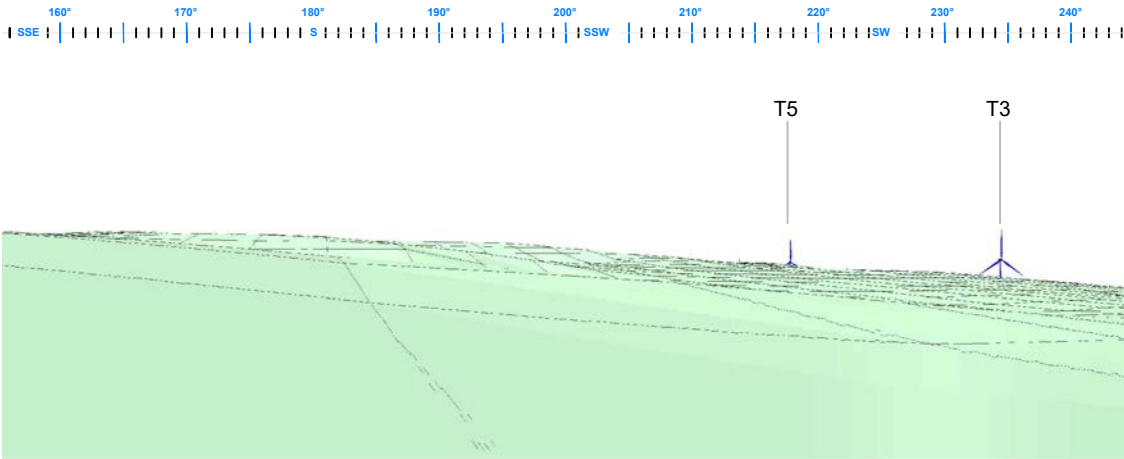
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Figure 20 -
 Wire frame W9
 Residence 89

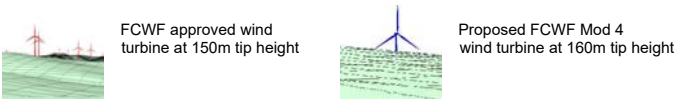
Flyers Creek Wind Farm Modification 4



Flyers Creek Wind Farm, Viewpoint W10 looking south south east to west south west from dwelling 25:
 Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T3) 1,550 metres

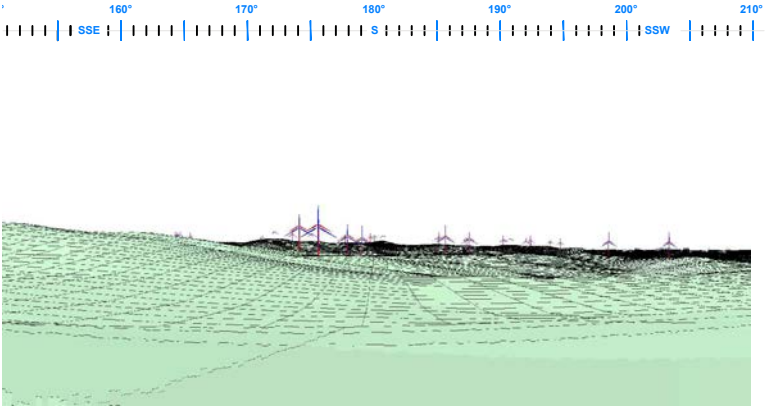


Flyers Creek Wind Farm, Viewpoint W10 looking south south east to west south west from dwelling 25:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only

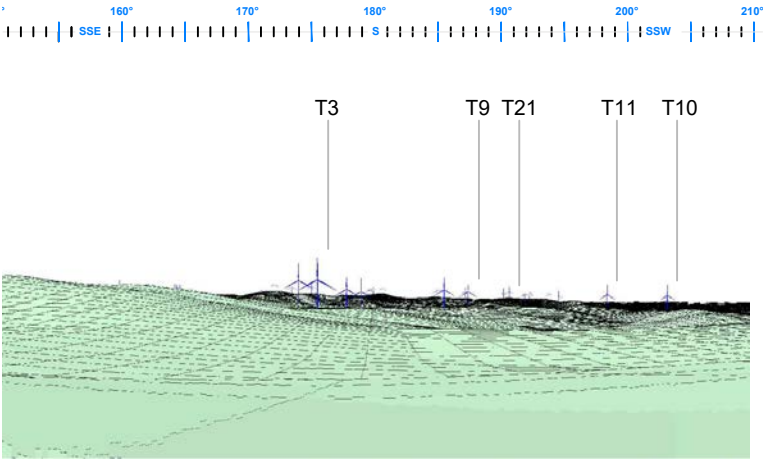


Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

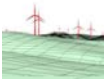
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.



Flyers Creek Wind Farm, Viewpoint W11 looking south south east to south south west from dwelling 94:
 Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T3) 2,190 metres



Flyers Creek Wind Farm, Viewpoint W11 looking south south east to south south west from dwelling 94:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



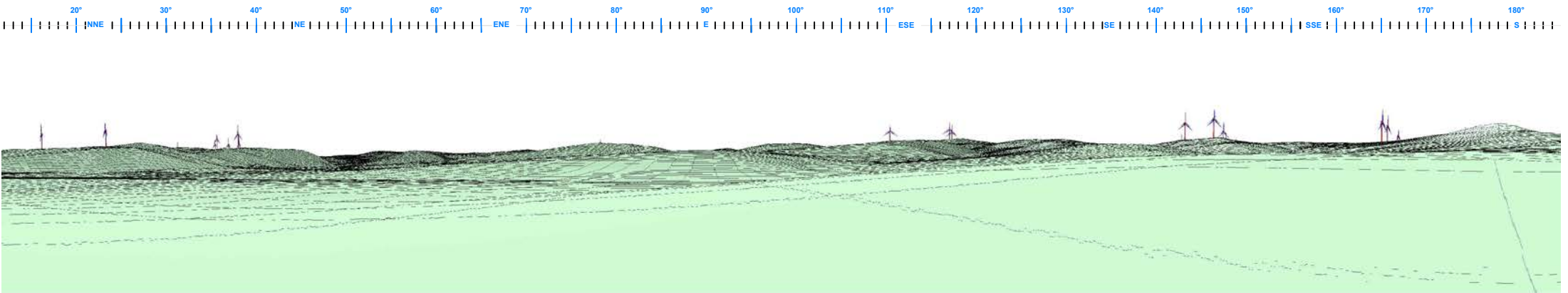
FCWF approved wind turbine at 150m tip height



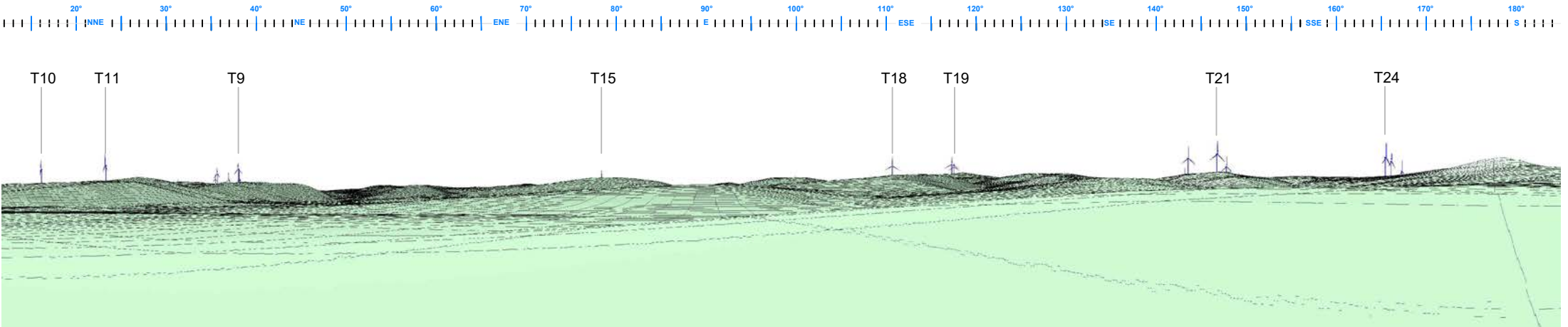
Proposed FCWF Mod 4 wind turbine at 160m tip height

Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

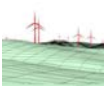
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.



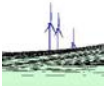
Flyers Creek Wind Farm, Viewpoint W12 looking south south east to south south west from dwelling 12: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T24) 2,290 metres



Flyers Creek Wind Farm, Viewpoint W12 looking south south east to south south west from dwelling 12:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



FCWF approved wind turbine at 150m tip height

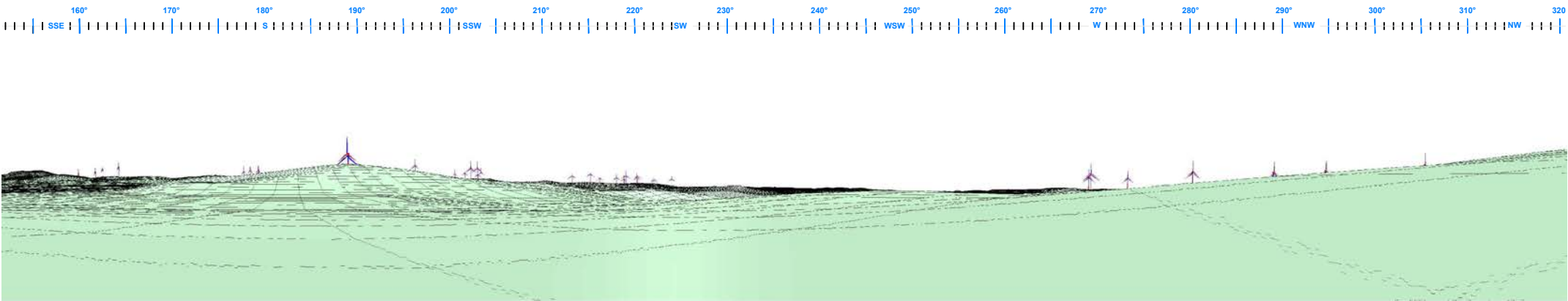


Proposed FCWF Mod 4 wind turbine at 160m tip height

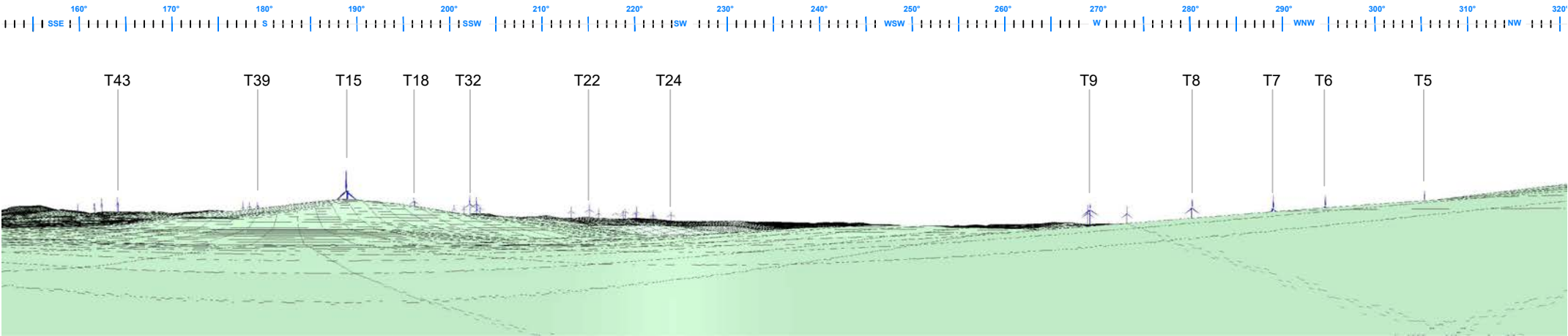
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

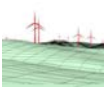
Figure 23 -
 Wire frame W12
 Residence 12



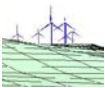
Flyers Creek Wind Farm, Viewpoint W13 looking south south east to north west from dwelling 44: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T15) 1,675 metres



Flyers Creek Wind Farm, Viewpoint W13 looking south south east to north west from dwelling 44:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



FCWF approved wind turbine at 150m tip height

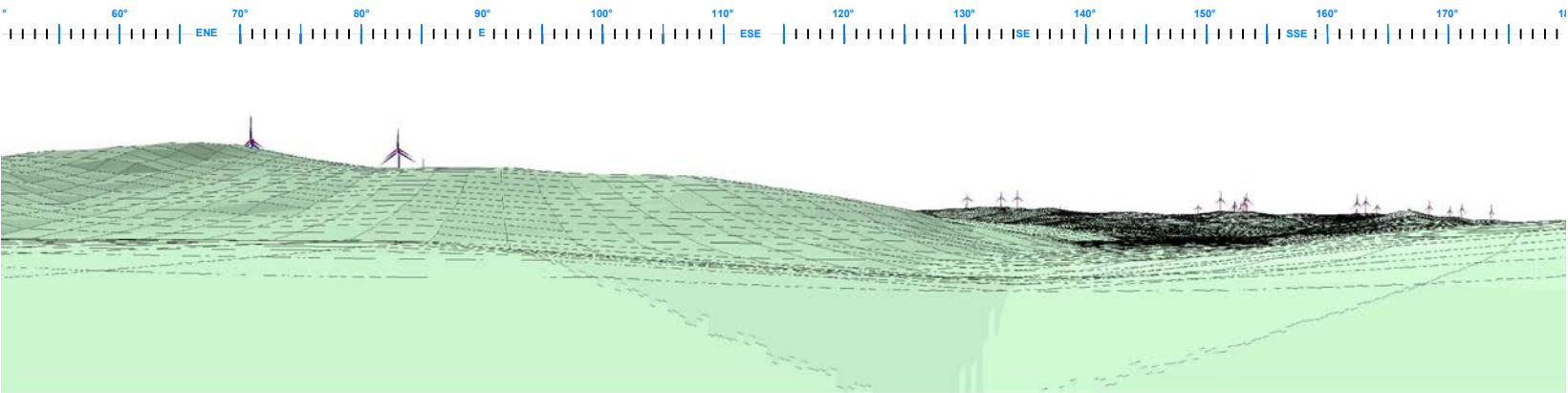


Proposed FCWF Mod 4 wind turbine at 160m tip height

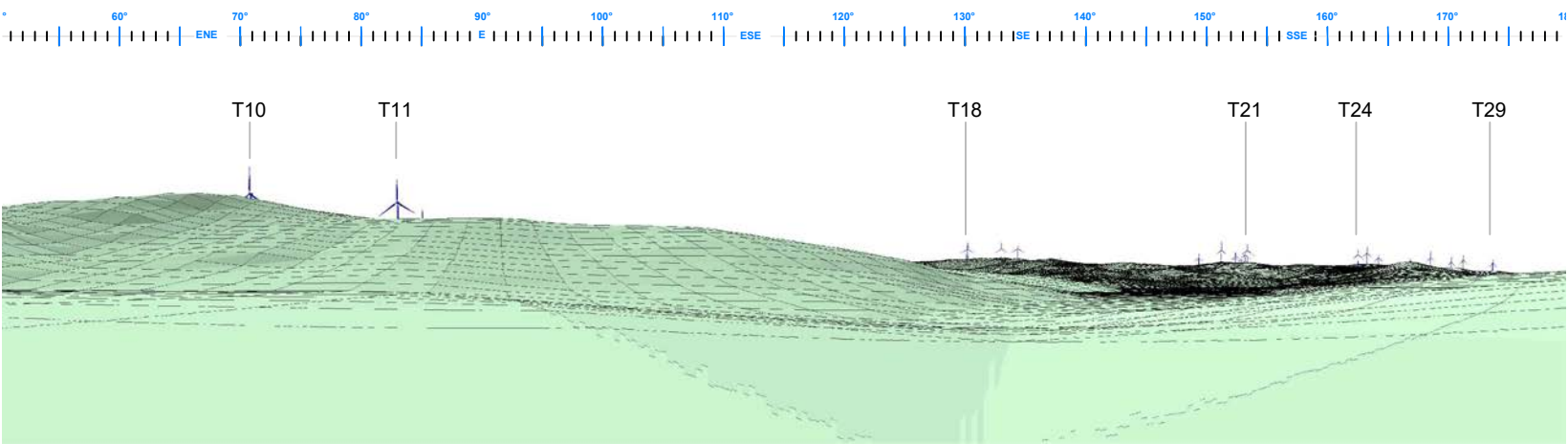
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

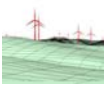
Figure 24
 Wire frame W13
 Residence 44



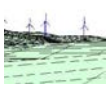
Flyers Creek Wind Farm, Viewpoint W14 looking east north east to south from dwelling 17: Approved 150m tip of blade wind turbines (red) and Mod 4 160m tip of blade wind turbines (blue)
 Approximate distance to closest approved wind turbine (T10) 1,660 metres



Flyers Creek Wind Farm, Viewpoint W14 looking east north east to south from dwelling 17:
 Proposed Mod 4 160m tip of blade wind turbines (blue) only



FCWF approved wind turbine at 150m tip height



Proposed FCWF Mod 4 wind turbine at 160m tip height

Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Flyers Creek Wind Farm Modification 4

10 Mod 4 switching station and 132kV powerline

10.1 Introduction

The Mod 4 amendment includes a proposed 132kV powerline and switching station to collect and connect electricity from the approved FCWF substation to the existing Orange North to Cadia 132kV powerline.

The proposed Mod 4 132kV powerline would extend south for around 11.3km from the proposed switching station site alongside the Cadia Road corridor to Panuara Road. The proposed 132kV powerline would then extend alongside Panuara Road before turning north east for around 3km connecting to the FCWF wind farm substation.

Subject to landowner agreements, the proposed 132kV powerline would be installed as an overhead structure for its entire length of around 14.3km. Without necessary landowner agreements, around 3.6km of the Mod 4 132kV powerline would be installed underground alongside Panuara Road and north to the southern edge of the pine plantation east of the Cadia Road corridor.

Both the overhead and underground Mod 4 132kV powerline options would require the removal of some existing vegetation, including trees alongside Panuara Road and the establishment of a 45m wide easement on the edge of the pine plantation east of Cadia Road.

The Mod 4 132kV powerline route in **Figure 26** illustrates alternative powerline options for sections of both overhead or underground installations subject to landowner agreements.

10.2 Visual absorption capability

Visual absorption capability (VAC) is a classification system used to describe the relative ability of the landscape to accept modifications and alterations without the loss of landscape character or deterioration of visual amenity. Whilst the application of a VAC classification system is not particularly useful for large scale structures, it can be applied to smaller ancillary structures, such as powerline infrastructure, where scale and form is more readily absorbed by elements (topography and vegetation) within the surrounding landscape. VAC relates to physical characteristics of the landscape that are often inherent and often quite static in the long term.

Undulating areas with a combination of open views interrupted by groups of trees and small forested areas would have a higher capability to visually absorb the proposed switching station and powerline without significantly changing its amenity.

On the other hand, areas of cleared vegetation on level ground with limited screening, or areas spanning across prominent ridgelines without significant vegetation, would have a lower capability to visually absorb the proposed switching station and powerline without changing the visual character and potentially reducing visual amenity.

Given the extent and combination of existing natural and cultural character within the wind farm site, the capability of the landscape to absorb the key components of the electrical infrastructure would be primarily dependent upon vegetation cover and landform.

For the purpose of this VIA, the VAC ratings have been determined as:

Low – electrical infrastructure components would be highly visible either due to lack of screening by existing vegetation or surrounding landform (e.g. open flat farmland cleared of vegetation, or steep hillside crossing ridgeline).

Medium – electrical infrastructure components would be visible but existing vegetation and surrounding landform would provide some screening or background to reduce visual contrast.

High – electrical infrastructure components would be extensively screened by surrounding vegetation and undulating landform.

10.3 VAC summary

The landscape along the majority of the powerline route, including the switching station site, is considered to have an overall moderate to high VAC, with some ability to accept modifications and alterations without the loss of landscape character or deterioration of existing levels of visual amenity. A higher VAC would occur in areas that present a backdrop of timbered or scattered tree cover. Areas of lower VAC would occur over cleared and/or pasture land as well as sections spanning road corridors. Whilst the portions of the powerline route would be located close residential dwellings, views toward the powerline would occur with sloping hillside beyond which would tend to increase the overall VAC and reducing visual effect.

The overall moderate level of VAC would largely result from the location of the proposed powerline route relative to densely timbered areas and scattered tree cover alongside road corridors. The moderate VAC would also tend to reduce the potential for cumulative impacts to occur where views toward the powerline included views toward proposed electrical infrastructure elements.

10.4 Assessment of proposed electrical infrastructure visual effect

The potential visual effect of the switching station and powerline infrastructure would primarily result from the combination of the degree of visual magnitude and the sensitivity of view locations. The degree of visual magnitude is determined through a combination of:

- the extent to which the switching station and powerline would be visible from sensitive view locations
- the degree of visual contrast between the switching station and powerline and the surrounding landscape that would be visible from surrounding view locations and
- the distance between the proposed switching station and powerline.

The sensitivity of view locations is dependent on the category and type of situation from which people may view the switching station and powerline (e.g. resident or motorist).

The potential visual catchment of the proposed switching station and powerline is the extent to which they would be visible from surrounding areas. Identification of the visual catchment considers the character of the landscape, landform and existing structural elements with regard to their potential for localised visual screening effects.

For the purpose of this VIA, the electrical infrastructure visual catchment has been determined within an approximate 1km offset from the proposed switching station location on each side of the Mod 4 132kV powerline. Views from beyond 1km would have a greater tendency to be screened by undulating landform or the presence of vegetation for portions of the powerline route. Whilst the powerline may be noticeable from areas beyond a 1km distance, the powerline is unlikely to appear as a dominant visual element within the landscape beyond this distance.

The 1km visual catchment is a generalised assessment, where views toward the proposed powerline could, in some situations, be blocked by buildings, vegetation or local landform features at specific points within the 1km offset, and similarly glimpses of the proposed powerline would be available from isolated positions outside the view catchment area. **Table 9** presents the receiver location matrix for electrical infrastructure. Dwelling locations within 1km of the switching station and powerline infrastructure are illustrated in **Figure 26**.

Distance criteria have been adopted as follows:

Category	Distance
Long distance view	>1 km
Medium distance view	500 m – 1km
Short distance view	200m – 500m
Very short distance view	< 200m

The potential visual magnitude of the switching station and/or 132kV powerline is expressed as a rating of High, Medium, Low or Nil. For the purposes of this VIA visibility ratings have been defined as:

High – The switching station and 132kV powerline may result in a very dominant and physical change to the landscape and includes the potential for proximate views toward extensive portions of the powerline from sensitive receptor locations.

Medium – The construction of the powerline may result in a prominent physical change to the landscape although the powerline would not appear to be substantially different in scale and character to the existing landscape from surrounding receptor locations.

Low – The construction of the powerline is unlikely to result in a prominent change to the landscape and views from surrounding receptor locations toward the powerline may be difficult to distinguish from elements within the surrounding landscape.

Nil – The construction of the powerline would not create a noticeable change to the existing landscape and is unlikely to result in views toward the powerline from surrounding receptor locations.

Table 9 – Electrical infrastructure visual effect matrix (Refer **Figure 26** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to Mod 4 132kV powerline and/or switching station	VAC	Mod 4 visual effect
16	Non-associated residential dwelling Level 2	340m	Low to Moderate	Short distance views north west to north east will extend toward short sections of the overhead 132kV powerline alongside the Panuara Road corridor; however, views will be partially obstructed by scattered tree cover surrounding the dwelling. A short extent of powerline (generally in excess of 500 m) may be visible as the 132kV powerline spans the Beneree Flyers Creek Road and extends north east across gently rising land toward the FCWF substation. Views toward the 132kV powerline would significantly reduced if a section of the powerline were to be installed underground. The Mod 4 switching station location would not be visible from this location. Mitigation through landscape planting could be installed to screen the majority of views toward the overhead 132 kV powerline.
17	Non-associated residential dwelling Level 2	75m	Low to Moderate	Short distance views will extend north east toward a short section of the overhead 132kV powerline across gently rising land toward the FCWF substation. Rising land to the east of the dwelling would provide a backdrop to views from the dwelling, which will also be partially screened by scattered tree cover surrounding the dwelling.

Table 9 – Electrical infrastructure visual effect matrix (Refer **Figure 26** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to Mod 4 132kV powerline and/or switching station	VAC	Mod 4 visual effect
				Views toward the 132kV powerline would partially reduced if a section of the powerline were to be installed underground. The Mod 4 switching station location would not be visible from this location. Mitigation through landscape planting could be installed to screen the majority of views toward the overhead 132 kV powerline.
20	Non-associated residential dwelling Level 2	500m	Moderate	Medium distance views west to south west toward the overhead 132kV powerline alongside the Cadia Road corridor would be largely screened by tree cover beyond the dwelling, with tree cover to the west of Cadia Road forming a backdrop to views from the east. The Mod 4 switching station location would not be visible from this location. Mitigation through landscape planting could be installed to screen the majority of any views toward the overhead 132 kV powerline.
87	Non-associated residential dwelling	920m	High	Medium distance views toward the overhead 132kV powerline would be largely screened by a combination of landform and tree cover beyond the dwelling.

Table 9 – Electrical infrastructure visual effect matrix (Refer **Figure 26** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to Mod 4 132kV powerline and/or switching station	VAC	Mod 4 visual effect
	Level 2			The Mod 4 switching station location would not be visible from this location.
109	Non-associated residential dwelling Level 2	250m	Low to Moderate	Short distance views west to south west toward the overhead 132kV powerline alongside the Cadia Road corridor would be partially screened by tree cover beyond the dwelling, with tree cover to the west of Cadia Road forming a backdrop to views from the east. The Mod 4 switching station location would not be visible from this location. Mitigation through landscape planting could be installed to screen the majority of any views toward the overhead 132 kV powerline.
112	Non-associated residential dwelling Level 2	480m	Low	Short to Medium distance views north east to south east would extend toward the overhead 132kV powerline alongside a short section of the Cadia Road corridor, as well as more distant views toward the powerline east of the Beneree Flyers Creek Road (generally beyond 1.4km). The Mod 4 switching station location would not be visible from this location.

Table 9 – Electrical infrastructure visual effect matrix (Refer **Figure 26** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to Mod 4 132kV powerline and/or switching station	VAC	Mod 4 visual effect
				Mitigation through landscape planting could be installed to screen the majority of any views toward the overhead 132 kV powerline.
128	Non-associated residential dwelling Level 2	800m	High	Medium distance views toward the overhead 132kV powerline would be largely screened by a combination of landform and tree cover beyond the dwelling. The Mod 4 switching station location would not be visible from this location.
H1	Non-associated residential dwelling Level 2	1,000m	High	Long distance views toward the overhead 132kV powerline and switching station would be largely screened by a tree cover beyond the dwelling. Short distance views generally west toward the existing North Orange to Cadia 132kV powerline would also be largely screened by vegetation surrounding and beyond the dwelling. Mitigation through landscape planting could be installed to screen the majority of any views toward the overhead 132 kV powerline and the switching station facility.

Table 9 – Electrical infrastructure visual effect matrix (Refer **Figure 26** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to Mod 4 132kV powerline and/or switching station	VAC	Mod 4 visual effect
H2	Non-associated residential dwelling Level 2	310m	Low to Moderate	Short distance views south toward the switching station site would be partially screened from the dwelling by tree planting surrounding the curtilage. Views toward the Mod 4 132kV powerline would be largely screened by scattered tree cover beyond the dwellings as well as the denser pine plantation south of the proposed switching station location. Short distance views generally east to south toward the existing North Orange to Cadia 132kV powerline would also be partially screened by vegetation surrounding and beyond the dwelling. Mitigation through landscape planting could be installed to screen the majority of any views toward the switching station facility from the dwelling.
H3	Non-associated residential dwelling Level 2	120m	Moderate to High	Short distance views east toward the Mod 4 132kV powerline and north toward switching station site would be partially screened from the dwelling by tree planting surrounding the curtilage, as well as tree planting alongside the Cadia Road corridor. Short distance views west toward the existing North Orange to Cadia 132kV powerline are largely screened by tree planting around the dwelling. Mitigation through landscape planting could be installed to screen the majority of any views toward the switching station from the dwelling.

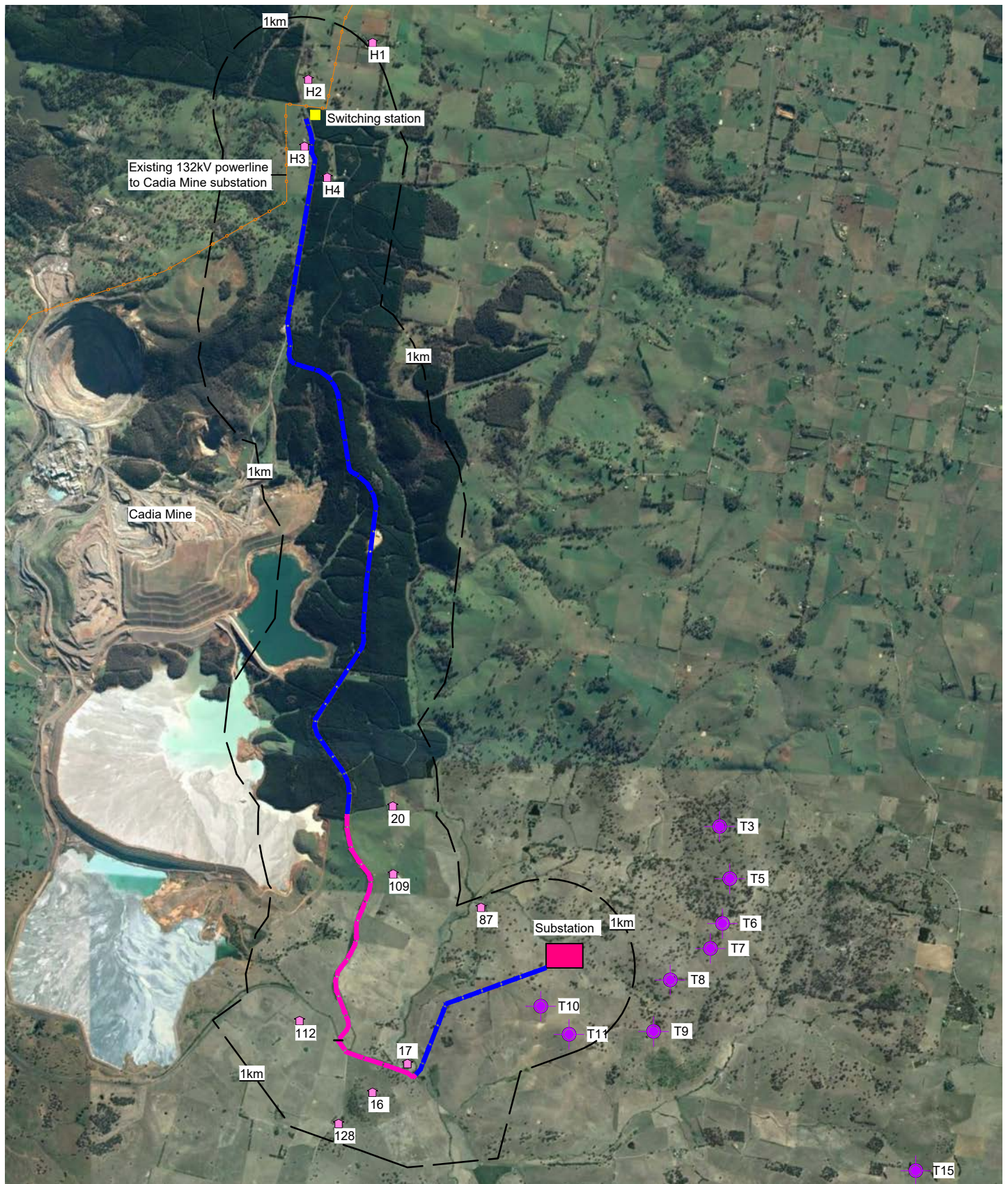
Table 9 – Electrical infrastructure visual effect matrix (Refer **Figure 26** for dwelling locations)

Receiver location	Category of receiver location and viewer sensitivity level	Approximate distance to Mod 4 132kV powerline and/or switching station	VAC	Mod 4 visual effect
H4	Non-associated residential dwelling Level 2	105m	High	Short distance views west toward the Mod 4 132kV powerline, switching station site and the existing North Orange to Cadia 132kV powerline, would be screened from the dwelling by tree planting surrounding the curtilage and beyond the dwelling.

A total of 11 non-associated dwellings have been identified within a 1km offset from the Mod 4 132kV powerline route. An assessment of visual effect determined that existing tree cover and undulating landform would screen or partially screen views toward sections of the Mod 4 132kV powerline, including an 8.5km section located within the pine plantation either side of the Cadia Road corridor.

The proposed powerline would span a small number of local unsealed and sealed roads including the Beneree Flyers Creek Road, Panuara Road and Cadia Road. These roads carry a generally low volume of traffic, and transitory views from vehicles travelling along these roads would be unlikely to result in a significant level of impact.

Overall, this VIA has determined that the electrical infrastructure associated with the Mod 4 amendments would be unlikely to have a significant visual impact on surrounding dwelling locations.



Legend

-  FCWF approved wind turbine location (indicative location)
-  Dwelling within 1 km of Mod 4 132kV powerline
-  Mod 4 132 kV powerline indicative overhead route option
-  Mod 4 132 kV powerline indicative underground route option (or overhead subject to landowner agreement)
-  Approved FCWF substation (indicative location)
-  Mod 4 switching station (indicative location)
-  Mod 4 132 kV powerline 1 km distance offset

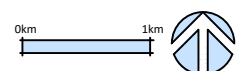


Figure 26
FCWF 132kV powerline
indicative alignment

132kV double circuit line



132kV single circuit line

Comparative single and double circuit 132kV powerline (supporting structures)

132kV double circuit line



Double circuit 132kV powerline (supporting structure) along road

132kV double circuit line - angle poles



Double circuit 132kV powerline (angle pole structure) at road crossing

132kV double circuit line



132kV double circuit powerline crossing rural agricultural land

132kV double circuit line



132kV double circuit powerline crossing rural agricultural land

132kV double circuit line - angle poles



Double circuit 132kV powerline (angle pole structure) at road crossing

Figure 27-
132kV powerline, typical illustrations

11 Review of Conditions of Consent

11.1 Introduction

The FCWF consolidated Conditions of Consent have been reviewed as part of this VIA to determine the type and extent of additional mitigation measures that would be required or should be modified as a result of the proposed Mod 4 amendments.

11.2 Review of Conditions of Consent

The following Table outlines the existing Conditions relevant to mitigate the potential visual effects of the FCWF Mod 4 amendments.

Table 10 Conditions of Consent

Condition	Description	Comment
D20	For a period of 5 years from the commencement of construction of any wind turbine, the owner of any non-associated residence within 4 km of any wind turbine may ask the Proponent to implement visual impact mitigation measures on their land to minimise the visual impacts of the development on their residence (including its curtilage). Upon receiving such a written request from the owner of these residences, the Proponent must implement appropriate mitigation measures (such as landscaping and vegetation screening) in consultation with the owner. These mitigation measures must be reasonable and feasible, aimed at reducing the visibility of the wind turbines from the residence and its curtilage, and commensurate with the level of visual impact on the residence. All mitigation measures must be implemented within 12 months of receiving the written request, unless the Secretary agrees otherwise. If the Proponent and the owner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.	This condition remains valid.

Condition	Description	Comment
	Notes: • To avoid any doubt, mitigation measures are not required to be implemented to reduce the visibility of wind turbines from any other locations on the property other than the residence and its curtilage. • The identification of appropriate visual impact mitigation measures will be more effective following the construction of the wind turbines. While owners may ask for the implementation of visual impact mitigation measures shortly after the commencement of the erection of the turbine, they should consider the merits of delaying this request until the relevant wind turbines are visible from their residence.	
D21	Landscaping works to reduce the visual impact of the Project shall generally comprise of indigenous and locally occurring species.	This condition remains valid.
D22	The Proponent must: (a) minimise the off-site visual impacts of the development; (b) ensure the wind turbines are: • painted off white/grey, unless otherwise agreed by the Secretary; and • finished with a surface treatment that minimises the potential for glare and reflection; (c) ensure the visual appearance of all ancillary infrastructure (including paint colours) blends in as far as possible with the surrounding landscape; and (d) not mount any advertising signs or logos on wind turbines or ancillary infrastructure.	This condition remains valid.
D23	Shadow flicker from the Project must not exceed 30 hours / annum at any residence, unless the owner of the residence agrees to a higher level.	These conditions remain valid.
D24	The substation and associated facility site shall be designed and constructed to minimise visual intrusion to the nearest sensitive receivers as far as feasible and reasonable including appropriate external finishes to	This condition remains valid.

Condition	Description	Comment
	minimise glare or reflection, landscape planting to screen views and external lighting requirements in accordance with condition D25.	
D25	With the exception of aviation hazard lighting implemented in accordance with the requirements of this condition, no external lighting other than low intensity security night lighting is permitted on site unless otherwise agreed or directed by the Secretary or required by Civil Aviation Safety Authority. Prior to the commencement of construction, the Proponent shall consult with the Civil Aviation Safety Authority on the need for aviation hazard lighting in relation to the wind turbines. Any aviation hazard lighting shall be implemented in a manner that minimises visual intrusion to surrounding non-associated receivers as far as feasible and reasonable.	This condition remains valid.
D26	A Design and Landscaping Plan shall be prepared to outline measures to ensure appropriate development and maintenance of landscaping on the site to achieve adequate landscape buffers and address the visual impacts arising from the Project, including turbines, site access roads and associated above ground infrastructure, as far as is feasible and reasonable. The Plan shall be prepared by a qualified landscape architect and where relevant meet any requirements of Council. The Plan shall include design treatments for the turbines and ancillary infrastructure, including, but not necessarily limited to: (a) landscape elements and built elements, including proposed treatments, finishes and materials of exposed surfaces (including colour specifications); (b) lighting; (c) a schedule of species to be used in landscaping; (d) details of the timing and progressive implementation of landscape works; and	We note the requirement for provision of a Design and Landscaping Plan prior to commencement of construction. However, the final layout and extent of works subject to potential landscape screening may undergo adjustments during the construction period. Accordingly, we request that the Design and Landscaping Plan be prepared prior to the wind farm commissioning. We note that requirements for condition D26 (a) have been previously addressed in condition D22. We request that D26 (a) be deleted.

Condition	Description	Comment
	(e) procedures and methods to monitor and maintain landscaped areas. The Plan shall be submitted for the approval of the Secretary prior to the commencement of construction, unless otherwise agreed by the Secretary.	

Overall the existing conditions imposed on the Project Approval, together with requested amendments, are considered to remain appropriate to continue to manage the visual impacts from Mod 4.

12 Conclusion

12.1 Conclusion

The potential level of change to visual effects determined for the approved FCWF has been based upon professional judgement in consideration of:

- the proposed amendments to the approved FCWF wind turbines
- the overall magnitude of the Mod 4 wind turbines compared to the approved FCWF wind turbines
- the overall visual effect of the Mod 4 wind turbines compared to the approved FCWF wind turbines
- the location and visibility of the Mod 4 switching station and 132kV powerline
- the overall VAC of the landscape within which the Mod 4 switching station and 132kV powerline would be located and
- the overall visual effect of the Mod 4 switching station and 132kV powerline.

This VIA has compared the approved FCWF wind turbines against the proposed Mod 4 wind turbine design and concludes that the proposed change to wind turbine tip height would be discernible from some surrounding and proximate view locations where views toward the approved FCWF wind turbines exist.

Additional levels of wind turbine visibility would be very limited and largely confined to upper portions of rotor blades and blade tips. Visibility toward wind turbine hubs would likely decrease where the hub is currently partially visible or located just above a ridge or hill slope view.

The Mod 4 wind turbine is not considered to be of a magnitude that would significantly increase visual effects and visual impact ratings associated with the approved FCWF project.

Overall, this VIA has determined that the proposed reinstatement of the 132kV transmission line and switching station proposed as part of Mod 4 would be unlikely to have a significant visual impact on surrounding dwelling locations.

The implementation of both on site and off-site landscape works would provide visual mitigation for a number of dwellings surrounding the approved FCWF wind farm site in accordance with the Conditions of Consent.

Limitations

GBD has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Flyers Creek Wind Farm Pty Ltd. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the GBD Proposal dated 17th April 2018.

The methodology adopted and sources of information used are outlined in this report. GBD has made no independent verification of this information beyond the agreed scope of works and GBD assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to GBD was false.

This report was prepared between April and July 2018 and is based on the conditions encountered and information reviewed at the time of preparation. GBD disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

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Appendix D

Shadow Flicker Impact Assessment (WSP)



MEMO

TO: Megan Richardson (Flyers Creek Wind Farm Pty Limited)
FROM: Jack Solano & Heather Hurree (WSP Australia Pty Limited)
SUBJECT: **Shadow Flicker – Flyers Creek Wind Farm**
OUR REF: PS108266-WIN-MEM-002 RevE.docx
DATE: **20 July 2018**

1. INTRODUCTION

Flyers Creek Wind Farm Pty Limited (FCWFPL) is currently developing Flyers Creek Wind Farm (FCWF) in New South Wales. FCWFPL has engaged WSP Australia Pty Limited (WSP) to carry out a shadow flicker assessment for the FCWF.

The shadow flicker assessment has been undertaken on the proposed 160 metre (m) tip height wind turbine generator (WTG). Several candidate WTG models are currently under consideration for installation at FCWF, therefore the largest case scenario has been used in the assessment. The candidate WTG assessed has the following parameters:

- WTG hub height of 92 m and max tip height of 160 m
- WTG rotor diameter of 136 m
- Max chord length of 4.1 m

It should be noted that the WTG dimensions within the maximum tip height of 160m may change based on the final WTG which is installed at the site. The following document outlines the methodology, assumptions and limitations used by WSP in developing the shadow flicker assessment.

2. SHADOW FLICKER ASSESSMENT

WSP has previously undertaken a shadow flicker assessment as part of the Environmental Assessment which accompanied the original planning application for FCWF and the results are presented in [1]. Calculation assumptions (such as locations of shadow receptors and window dimensions) have been kept consistent with the previous shadow flicker assessment. This updated analysis is now based on revised WTG layouts and increased WTG hub height related to planning modification 4. WSP has undertaken a realistic case scenario as well as a worst-case shadow flicker assessment.

The Australian guidelines for the allowable exposure for shadow flicker is typically 30 hrs per year [2] [3]. This corresponds to the existing Project Approval [4] Condition D23 which states “Shadow flicker from the Project must not exceed 30 hours per annum at any residence, unless the owner of the residence agrees to a higher level”.

The following section outlines the shadow flicker methodology and results in addition to the assumptions and limitations used by WSP in assessing the extent of shadow flicker at FCWF.

2.1 METHODOLOGY AND ASSUMPTIONS

WindPro v.3.1 has been used to assess the extent of shadow flicker at FCWF. WSP has used the WTG with the largest chord length in determining the estimated extent of shadow flicker at FCWF.

2.1.1 WORST CASE SCENARIO

The following assumptions have been made by WSP in assessing the extent of worst case shadow flicker at FCWF:

- The approved 38 No. WTG centrepont locations have been modelled in the assessment [4];
- The shadow flicker assessment has been conducted for the worst-case shadow flicker scenario, which assumes;
 - Direct sunlight during all daylight hours (e.g. no clouds are ever experienced over the wind farm site).
 - WTGs are always operating (e.g. it is always windy, and the WTGs are never inoperable due to maintenance or faults).
 - WTGs are always turned in the horizontal plane to face the sun (e.g. the WTG rotor casts the maximum possible shadow).
- Eye level is 1.5 m, above ground level (AGL).

In addition to the above assumptions, these calculations are based on the turbine dimensions listed in Section 1. Results are presented in Appendix A.

2.1.2 REALISTIC CASE SCENARIO

For the realistic case, WSP has applied a reduction factor to account for cloud cover at FCWF to provide a statistical average annual estimate of shadow flicker. This is based on recorded information on sunlight and cloud cover by the Bureau of Meteorology (BoM). The closest reference site is located at Orange Agricultural Centre (Station Number 063254), approximately 23 km north of FCWF. The average daily sunshine hours are shown below in Table 2.1 .

Table 2.1 Average sunshine hours per day on a monthly mean basis [5]

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Orange Agricultural Centre	9.7	9.1	8.1	7.5	5.9	4.9	5.2	6.5	7.5	8.6	9.0	9.7

In addition, FCWFPL has provided wind speed and direction data from Meteorological Mast 8853, which has been collecting data at the site for approximately 7 years. The recorded data has been used as an input into the shadow flicker calculation to determine WTG orientation. The operational hours have been determined by applying the power curve, provided by FCWFPL, to the wind speed data at a sheared hub height of 92 m.

The following assumptions have been made by WSP in assessing the extent of the realistic scenario of shadow flicker at FCWF:

- The candidate WTG modelled in the assessment is the turbine model of the largest chord length;
- The approved 38 No. WTG centrepont locations have been modelled in the assessment [4];
- The list of receptors surrounding the proposed site as [1];
- The shadow flicker assessment has been conducted for the realistic case shadow flicker scenario, which assumes;
 - Sunlight data obtained from Orange Agricultural Centre BoM site [5];
 - WTG operational hours based on the considered WTGs power curve and Mast 8853 wind data;
 - WTG orientation based on Mast 8853 wind data;
- Minimum sun height over the horizon for influence of 3°;
- Topographic shadow considered; and
- Eye level is 1.5 m AGL.

It should be noted that the final layout and turbine parameters will impact the results of this assessment. As such, should the turbine locations deviate by more than 100 m from their original locations assessed here and/or should

the final turbine model exceed the approximate dimensions assessed here, the resulting shadow flicker impacts may vary from the numbers presented here.

Results are presented in Appendix A.

3. RESULTS

The estimated extent of shadow flicker predicted at each receptor for the approved project layout and candidate WTG for the worst case and realistic case scenarios are included in Appendix A. Results show that no receptors will experience over 30 hours a year of shadow flicker under the realistic case scenario.

It should be noted however that five dwellings have been modelled to exceed the 30 hours limit under the worst case scenario. The worst-case scenario considers conservative assumptions which are deemed unlikely to occur in combination over an annual period. WSP also notes that the five (5) dwellings that exceed the worst case scenario limit are all Associated residences.

Consequently, based on the realistic case results, it is unlikely that the shadow flicker impacts resulting from the operation of FCWF will exceed the maximum allowable hours at any receptor. The realistic case scenario assessment indicates that the condition specified in the Planning Approval Condition D23 will still be satisfied with the revised turbine dimensions proposed in planning modification 4.



Jack Solano
Graduate Wind Engineer



Heather Hurree
Technical Manager- Wind Engineering

4. REFERENCES

- [1] WSP - Parsons Brinckerhoff, “Environmental Assessment - Appendix C,” Flyers Creek Wind Farm Pty Ltd, Melbourne, December 2010.
- [2] Planning & Environment, “Wind Energy: Visual Assessment Bulletin,” NSW Government, [Online]. Available: <http://www.planning.nsw.gov.au/~media/Files/DPE/Bulletins-and-Community-Updates/wind-energy-visual-assessment-bulletin-2016-12.ashx>.
- [3] Environmental Protection and Heritage Council, “Draft National Wind Farm Development Guidelines,” Adelaide, 2010.
- [4] Flyers Creek Wind Farm Pty Ltd, “Project Approval - Application Number MP08_0252,” Infigen, March 2014.
- [5] Bureau of Meteorology, “Climate statistics for Australian locations,” 02 July 2018. [Online]. Available: <http://www.bom.gov.au/jsp/ncc/cdio/cvg/av>. [Accessed 2018 June 29].
- [6] International Organization for Standardization, *Acoustics — Attenuation of sound during propagation outdoors. Part 2: General method of calculation*, International Organization for Standardization, 1996.

APPENDIX A SHADOW FLICKER RESULTS FOR FCWF

Table A.1 Shadow flicker results for FCWF (UTM Zone 55H, WGS 84)

ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
0	Stokefield	697170	6277991	Non-Associated Residence	0	0	0	0
1	Hillcrest	695480	6279583	Non-Associated Residence	0	0	0	0
2	Haverton	695919	6280995	Associated Residence	0	0	0	0
3	Glen Ayr	693290	6281079	Associated Residence	51:40	143	34	15:46
4	Lochewen	691740	6280418	Associated Residence	35:25	94	29	14:24
5	Glenarvon	689988	6279727	Non-Associated Residence	0	0	0	0
6	Tettenhall	686673	6280542	Non-Associated Residence	0	0	0	0
7	Glendale	686729	6281398	Non-Associated Residence	0	0	0	0
8	Rockdale	686895	6281635	Non-Associated Residence	0	0	0	0
9	Sunnyview	687863	6281361	Non-Associated Residence	0	0	0	0
10	Hill View	688196	6283545	Non-Associated Residence	0	0	0	0
11	Rhondda Villa	688548	6284390	Non-Associated Residence	0	0	0	0
12	Errowanbang	689697	6285992	Non-Associated Residence	0	0	0	0
13	Old Errowanbang	689493	6286700	Non-Associated Residence	0	0	0	0
14	Willow Park	691859	6287385	Non-Associated Residence	0	0	0	0
15	Stockton	688049	6286778	Non-Associated Residence	0	0	0	0
16	Meribah Cottage	688498	6288144	Non-Associated Residence	0	0	0	0
17	Triangle Park	688810	6288422	Non-Associated Residence	7:00	29	19	2:22
18	Meribah	687479	6287542	Non-Associated Residence	0	0	0	0
19	South Log	686400	6286566	Non-Associated Residence	0	0	0	0
20	North West	688821	6291307	Non-Associated Residence	0	0	0	0
21	Rembo	689845	6289617	Associated Residence	0	0	0	0
22	Wallaby	691254	6290797	Associated Residence	24:49	79	26	10:29

ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
23	Towradgee	693998	6290034	Non-Associated Residence	28:23	147	22	9:42
24	Windella	694504	6290794	Non-Associated Residence	0	0	0	0
25	Bromley	693794	6291840	Non-Associated Residence	0	0	0	0
26	Thrushley	692827	6292548	Associated Residence	0	0	0	0
27	Willow Creek East	692030	6292590	Non-Associated Residence	0	0	0	0
28	Hillview	694887	6290992	Associated Residence	0	0	0	0
29	Fairview	695725	6291229	Non-Associated Residence	0	0	0	0
30	Vermont	695003	6292497	Non-Associated Residence	0	0	0	0
31	Strathfield	695822	6292571	Non-Associated Residence	0	0	0	0
32	Loloma	694991	6293599	Non-Associated Residence	0	0	0	0
33	Dogwind	694654	6293413	Non-Associated Residence	0	0	0	0
34	Westerham	693441	6293402	Non-Associated Residence	0	0	0	0
35	Timaru	692095	6293649	Non-Associated Residence	0	0	0	0
36	Willow Creek	690975	6292913	Non-Associated Residence	0	0	0	0
37	Braithwaite	690622	6292862	Non-Associated Residence	0	0	0	0
38	Carlingford	697744	6291449	Non-Associated Residence	0	0	0	0
39	Hillview	697156	6290613	Non-Associated Residence	0	0	0	0
40	The Cottage	697253	6291238	Non-Associated Residence	0	0	0	0
41	Crenvor	696957	6289196	Non-Associated Residence	0	0	0	0
42	Euronga	695744	6290256	Non-Associated Residence	0	0	0	0
43	Bellevue	695309	6288867	Non-Associated Residence	0	0	0	0
44	Willow Dale	694827	6288747	Non-Associated Residence	0	0	0	0
45	Castle Hill	696576	6287157	Non-Associated Residence	0	0	0	0
46	Bulwarra	695613	6286034	Associated Residence	0	0	0	0

ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
47	Weston	697517	6285936	Non-Associated Residence	0	0	0	0
48	Fairbanks	696357	6285318	Non-Associated Residence	0	0	0	0
49	Wattlecomb	695841	6284902	Non-Associated Residence	0	0	0	0
50	Nullawonga	694452	6284339	Associated Residence	23:46	72	28	9:49
51	Beulah Park	696637	6281968	Associated Residence	23:28	79	24	7:49
51B	Beulah Park B - Barry Baker	696967	6282107	Associated Residence	13:15	53	20	5:08
52	Carramar	691683	6285950	Associated Residence	0	0	0	0
54	Hillcrest	692331	6284482	Associated Residence	71:35	110	54	14:59
55	House	695336	6285112	Associated Residence	0	0	0	0
56	Cooramilla	694850	6288242	Non-Associated Residence	0	0	0	0
57	Errowanbang School (residence)	690243	6286658	Non-Associated Residence	0	0	0	0
58	Ridge End	691558	6277254	Non-Associated Residence	0	0	0	0
59	House	693818	6276240	Non-Associated Residence	0	0	0	0
60	Carradowns	697959	6287754	Non-Associated Residence	0	0	0	0
61	Caithness	698124	6288446	Non-Associated Residence	0	0	0	0
62	Tralee	698615	6287506	Non-Associated Residence	0	0	0	0
63	Long View	698286	6289654	Non-Associated Residence	0	0	0	0
64	Sunnyside	695193	6294854	Non-Associated Residence	0	0	0	0
65	Greenbank	696414	6294288	Non-Associated Residence	0	0	0	0
66	Ferndale	696920	6293544	Non-Associated Residence	0	0	0	0
67	Karinya	691781	6294883	Non-Associated Residence	0	0	0	0
68	Mirraweena	691505	6294942	Non-Associated Residence	0	0	0	0
69	Narrawong	690656	6294539	Non-Associated Residence	0	0	0	0
70	Warrengong	690073	6294640	Non-Associated Residence	0	0	0	0

ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
71	Platt	693808	6280666	Associated Residence	41:32	102	35	18:39
72	House	687821	6282338	Associated Residence	0	0	0	0
73	Braeburn	687953	6284796	Non-Associated Residence	0	0	0	0
74	Stuart	690651	6285519	Associated Residence	0	0	0	0
75	House	689275	6286492	Non-Associated Residence	0	0	0	0
76	Hart	694469	6284864	Associated Residence	25:30	99	25	12:33
77	House	694049	6285751	Non-Associated Residence	0	0	0	0
78	House	694012	6285598	Non-Associated Residence	0	0	0	0
79	House	692359	6288256	Associated Residence	37:37	71	41	7:49
80	House	695362	6289589	Non-Associated Residence	0	0	0	0
81	Unknown	693283	6295029	Non-Associated Residence	0	0	0	0
82	House	694183	6292036	Non-Associated Residence	0	0	0	0
83	House	694241	6293494	Non-Associated Residence	0	0	0	0
84	House	693969	6293621	Non-Associated Residence	0	0	0	0
85	House	690447	6291187	Non-Associated Residence	0	0	0	0
86	House	690308	6290617	Associated Residence	0	0	0	0
87	House	689734	6290127	Non-Associated Residence	0	0	0	0
88	McKensie	689502	6289460	Associated Residence	11:11	35	24	4:14
89	House	693550	6289600	Non-Associated Residence	25:30	100	26	11:04
90	House (empty)	694219	6289645	Non-Associated Residence	2:02	25	7	0:39
91	House	693030	6293126	Non-Associated Residence	0	0	0	0
92	House	693277	6292929	Non-Associated Residence	0	0	0	0
93	House	692306	6293308	Non-Associated Residence	0	0	0	0
94	House	692314	6293160	Non-Associated Residence	0	0	0	0

ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
95		690018	6280556	Non-Associated Residence	0	0	0	0
96	House	694850	6291802	Non-Associated Residence	0	0	0	0
97	House	698279	6290936	Non-Associated Residence	0	0	0	0
98	House	695904	6290084	Non-Associated Residence	0	0	0	0
99	House	694392	6289672	Non-Associated Residence	0	0	0	0
100	House	694772	6290052	Non-Associated Residence	0	0	0	0
101	House	697785	6286217	Non-Associated Residence	0	0	0	0
102	House	697065	6281327	Non-Associated Residence	0	0	0	0
103	House	696332	6279079	Non-Associated Residence	0	0	0	0
104	House	696683	6278525	Non-Associated Residence	0	0	0	0
105	House	690596	6277280	Non-Associated Residence	0	0	0	0
106	House	688728	6279860	Associated Residence	0	0	0	0
107	House	687977	6285007	Non-Associated Residence	0	0	0	0
108	House	694704	6285394	Non-Associated Residence	0	0	0	0
109	Brendan Kilby	688500	6290500	Non-Associated Residence	0	0	0	0
110	House	690318	6277598	Non-Associated Residence	0	0	0	0
111	House	690304	6277759	Non-Associated Residence	0	0	0	0
112	Unknown	687709	6288967	Non-Associated Residence	0	0	0	0
114	Unknown	695751	6290438	Non-Associated Residence	0	0	0	0
115	Unknown	695087	6292048	Non-Associated Residence	0	0	0	0
116	Unknown	695091	6292246	Non-Associated Residence	0	0	0	0
117	Unknown	693441	6293890	Non-Associated Residence	0	0	0	0
118	Unknown	694196	6293386	Non-Associated Residence	0	0	0	0
119	Unknown	692045	6295040	Non-Associated Residence	0	0	0	0



ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
120	Unknown	694438	6293383	Non-Associated Residence	0	0	0	0
121	Unknown	694640	6293697	Non-Associated Residence	0	0	0	0
122	Unknown	694220	6294171	Non-Associated Residence	0	0	0	0
123	Unknown	693138	6294634	Non-Associated Residence	0	0	0	0
124	Unknown	693533	6294569	Non-Associated Residence	0	0	0	0
125	Unknown	692443	6294799	Non-Associated Residence	0	0	0	0
126	Unknown	687625	6283504	Non-Associated Residence	0	0	0	0
127	Unknown	691799	6293599	Non-Associated Residence	0	0	0	0
128	Unknown	688104	6287804	Non-Associated Residence	0	0	0	0
129	Unknown	688852	6286757	Non-Associated Residence	0	0	0	0
130	Unknown	687105	6282971	Non-Associated Residence	0	0	0	0
131	Unknown	685837	6280004	Non-Associated Residence	0	0	0	0
132	Unknown	688837	6279448	Non-Associated Residence	0	0	0	0
133	Unknown	696510	6279699	Non-Associated Residence	0	0	0	0
134	Unknown	697944	6280180	Non-Associated Residence	0	0	0	0
136	Unknown	699920	6286420	Non-Associated Residence	0	0	0	0
137	Unknown	696604	6291909	Non-Associated Residence	0	0	0	0
138	Unknown	693623	6294311	Non-Associated Residence	0	0	0	0
139	Unknown	693835	6294380	Non-Associated Residence	0	0	0	0
140	Unknown	693913	6294091	Non-Associated Residence	0	0	0	0
141	Unknown	693957	6294212	Non-Associated Residence	0	0	0	0
142	Unknown	693165	6294750	Non-Associated Residence	0	0	0	0
143	Unknown	693788	6294889	Non-Associated Residence	0	0	0	0
144	Unknown	692299	6294767	Non-Associated Residence	0	0	0	0

ID	NAME	EASTING	NORTHING	RESIDENCE STATUS	WORST CASE			REALISTIC CASE
					Hr:min/yr	days/yr	mins/day	Hr:min/yr
145	Unknown	691475	6294777	Non-Associated Residence	0	0	0	0
146	Unknown	691058	6294683	Non-Associated Residence	0	0	0	0
147	Unknown	697406	6286869	Non-Associated Residence	0	0	0	0
148	Unknown	698405	6288043	Non-Associated Residence	0	0	0	0
149	Unknown	698465	6288564	Non-Associated Residence	0	0	0	0
150	Unknown	698346	6288483	Non-Associated Residence	0	0	0	0
151	Unknown	698324	6288379	Non-Associated Residence	0	0	0	0
152	Unknown	696605	6291705	Non-Associated Residence	0	0	0	0
153	Unknown	692763	6294447	Non-Associated Residence	0	0	0	0
154	Unknown	692694	6294781	Non-Associated Residence	0	0	0	0
155	Unknown	692513	6295017	Non-Associated Residence	0	0	0	0
156	Unknown	689967	6294937	Non-Associated Residence	0	0	0	0
157	Unknown	689987	6295452	Non-Associated Residence	0	0	0	0
158	Unknown	690162	6291224	Non-Associated Residence	0	0	0	0
159	Unknown	697048	6278361	Non-Associated Residence	0	0	0	0
160	Unknown	697471	6278353	Non-Associated Residence	0	0	0	0
161	Unknown	694314	6276458	Non-Associated Residence	0	0	0	0
162	Unknown	696326	6293916	Non-Associated Residence	0	0	0	0
163	Unknown	698875	6,289010	Non-Associated Residence	0	0	0	0
164	Unknown	691296	6295002	Non-Associated Residence	0	0	0	0
165	Unknown	691725	6295131	Non-Associated Residence	0	0	0	0

Appendix E

Bird and Bat Impact Assessment (Brett Lane & Associates)

FLYERS CREEK WIND FARM

PLANNING MODIFICATION 4

BIRD AND BAT IMPACT ASSESSMENT

Flyers Creek Wind Farm Pty Ltd



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CONTENTS

1. INTRODUCTION.....	2
1.1. The proposed modification.....	2
1.2. The assessment	2
2. BIRD AND AVIFAUNA ASSESSMENT	4
2.1. Impacts of modification on birds	4
2.1.1. Review of bird species at FCWF	4
2.1.2. Review of flight height data.....	5
2.1.3. Assessment of modified turbine impacts.....	5
2.1.4. Summary of potential impact on birds from modification	8
2.2. Impacts of modification on bats	9
2.2.1. Bat species recorded on site.....	9
2.2.1.1. Yellow-bellied Sheathtail Bat.....	9
2.2.2. Assessment of modification on bats	10
3. CONCLUSION AND SUMMARY	12
3.1. Impacts of modification on bats	12
3.2. Impacts of modification on bats	12
3.2.1. Bat species recorded on site.....	12
3.3. Bird & Bat Adaptive Management Plan (BBAMP)	12
4. REFERENCES.....	14

TABLES

Table 1: Proposed modifications to turbine specifications.....	2
Table 2: Change in RSA at each height range (Source: KMA 2011)	5

1. INTRODUCTION

The Flyers Creek Wind Farm (FCWF) located near Orange in the Central Tablelands region of New South Wales received Planning Approval on 14 March 2014. There have been 3 subsequent planning modifications, with the latest modification gaining approval on 30 November 2017. The current Project Approval details the specifications of the wind farm and allows the construction of up to 38 wind turbines with a maximum blade tip height of 150 metres above ground level.

This document provides an assessment of the change in potential impacts to birds and bats in relation to planning modification 4.

1.1. The proposed modification

In this report, rotor swept area (RSA) is defined as the zone encompassing the area of an operating wind turbine within which the blades rotate, defined in terms of an upper “maximum” and lower “minimum” RSA height, and a total circular swept area.

This document assesses the changes in bird and bat impacts arising from the proposed new turbine specifications indicated in Table 1, below.

Table 1: Proposed modifications to turbine specifications

Turbine specification	Approved turbine specifications	Proposed modification	Change
Maximum RSA height (tip height)	150 m	160 m	10 m higher blade tip height
Minimum RSA height (above ground)	30 m	20 m	10 m lower minimum RSA
Rotor diameter	112 m (radius 56 m - in an envelope between 30 – 1560 metres)	Up to 140 m (radius up to 70 m)	28 m larger blade diameter (14 m increase in radius per blade)
Total RSA m ² / turbine	9,852 m ²	15,394 m ²	56% increase in RSA
Number of turbines	38	38	Original assessment based on 42 turbines. Most recent approval (November 2017) allows 38 turbines

Modification 4 also includes a 132kv electrical line which will connect the project substation to the wider grid network. This is noted, but not considered further in this assessment because the potential for impact from the electrical line on birds and bats in the pine forest plantation to the north is considered as low.

1.2. The assessment

Previous reports that assessed the potential bird and bat impacts of the project have been reviewed for the current assessment, including:

- Kevin Mills & Associates 2011, ‘Flora and Fauna Assessment, Flyers Creek Wind Farm, Shire of Blayney, Central Tablelands, New South Wales’. Prepared for Aurecon Australia Pty Limited, Sydney, April 2011; and

- Richards, G.C. 2011, 'An Assessment of the Bat Fauna at the Proposed Flyers Creek Wind Farm, NSW', Appendix E of Flyers Creek Wind Farm Environmental Assessment, Aurecon Energy, Sydney, April 2011.

2. BIRD AND AVIFAUNA ASSESSMENT

This report considers the impacts of modification 4 on birds and bats separately.

2.1. Impacts of modification on birds

2.1.1. Review of bird species at FCWF

The site has been extensively cleared with only scattered paddock trees and remnant patches of trees remaining. It is not located to national parks or areas of substantial forest.

The original bird utilisation surveys (BUS) of the Flyers Creek Wind Farm (KMA 2011) were undertaken in November 2008, February 2009 and October 2010. During these, the height of birds above the ground was recorded at:

- Ground level;
- Less than 10 metres,
- 10-20 metres;
- 20-50 metres; and
- Greater than 50 metres.

In total, eighty-six bird species were recorded during the bird surveys within the overall wind farm study area, the majority of which were common farmland or open woodland birds (KMA, 2011). Bird diversity during the survey period was in line with expectations for similar wind farms in the central and southern tablelands regions of New South Wales.

No species were recorded flying above 150 m during the bird utilisation surveys. This does not indicate that these flights do not occur, but rather that the frequency with which these flights occurs is very low.

In relation to listed species

- The Superb Parrot listed as threatened on both the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *NSW Biodiversity Conservation Act 2016* (BC Act) was recorded in small numbers;
- The EPBC Act listed migratory species, the White-throated Needletail, was recorded nearby at the Cadia mine site or its vicinity (Western Research Institute & Resource Strategies, 2009 cited in KMA 2011) and although not since recorded, is likely to be an occasional visitor to the wind site while feeding on insects above the site.
- Three additional threatened species listed on the BC Act were recorded during the BUS. These were:
 - o Diamond Firetail, a seed-eater that mainly feeds on the ground and not expected to fly above treetop height;
 - o Varied Sittella - a tree dwelling species considered unlikely to fly at RSA height; and
 - o Little Eagle - occurred at low frequency such that it was considered at low risk of a collision with a turbine at Flyers Creek Wind Farm.

2.1.2. Review of flight height data

The flight height results from the FCWF BUS data are presented in Figure 1 below.

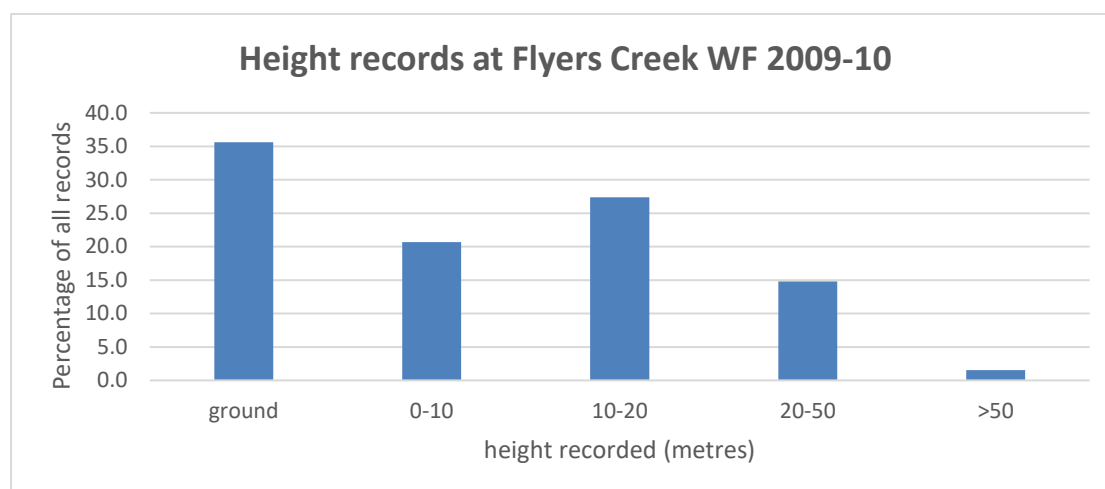


Figure 1: Height records at proposed turbine locations (source: KMA, 2011)

2.1.3. Assessment of modified turbine impacts

The change in the area of RSA at various height bands is analysed in Table 2 below.

Table 2: Change in RSA at each height range (Source: KMA 2011)

Height range (m)	% bird flights at height interval	RSA of 112 m diameter blades (m ²)	RSA of 140 m diameter blades (m ²)	Change in area of exposure /turbine (m ²)	Incremental % change in RSA area
Ground	36%				
0-10	21%				
10-20	27%				
20-30	14.5%	-	488	488	increase
30-40		434	861	427	98%
40-50		758	1,070	312	41%
50-60		930	1,211	280	30%
60-80	1.5%	2,133	2,672	539	25%
80-100		2,222	2,790	568	26%
100-120		2,008	2,672	665	33%
120-140		1,327	2,280	953	72%
140-160		40	1,349	1,309	3299%
160-180		-		-	-
Total	100%	9,852	15,394	5,542	56%

The total area of RSA between 20 and 50 metres increases by just over 100%, representing a doubling of the collision risk in this height band. The percentage of bird flights recorded between 20 to 50m is 14.6% and are assessed to be about twice as likely to collide with the turbine proposed in modification 4. The majority of the birds recorded in this range are common birds from this largely agricultural landscape.

Above 50 metres there is an increase in the total area of RSA in bands up to 160 metres of about 50%. Only 1.5% of bird flights were recorded above 50 metres. The bird species likely to be impacted at heights above 50 metres are higher flying

species. These include raptors as a group, including the Wedge-tailed Eagle and Little Eagle, and the migratory White-throated Needletail (see discussion below).

Although flights may occur above 150 metres, none were recorded during the BUS. Studies from 11 other wind farm sites across south-eastern Australia (BL&A, unpublished data) recorded no flights above 140 metres. This does not mean that these flights do not occur, but rather they were not recorded during the surveys. These results indicate that flights in the zone affected by increased turbine height are rare and the increase in height is unlikely to lead to an increase in collision rates of conservation concern.

Impacts of the proposed changes on listed bird species are considered in more detail below.

Superb Parrot

The Superb Parrot was recorded in low numbers at FCWF site during formal surveys in October 2010 (Kevin Mills & Associates, 2011). Ten birds were recorded, three of them flying at a height of between 20 and 50 metres. The Superb Parrot is listed as Vulnerable under the both the Commonwealth EPBC Act and BC Act (NSW).

The Superb Parrot is primarily a ground feeder, eating grass seeds and other herbaceous plants. Flowering or fruiting trees are also visited for nectar and berries in the tree canopy (Higgins 1999). While known to fly at heights up to 50 metres above ground, most flights are typically recorded at tree height (BL&A unpublished observation). The Orange region is at the north-eastern edge of a core breeding area that extends from Cowra in the north to Yass in the south (Webster & Ahern 1992).

The increase in RSA between 20 to 50 metres will increase the risk of Superb Parrot flights to blade strike due to the decrease of the minimum RSA to 20 metres and the doubling of the RSA extent between 20 and 50 metres.

This species feeds within treed canopies and on the ground, and its routine flights are within and between wooded habitats. The species has been observed flying up to 30 metres above the ground (BL&A, unpublished data) and KMA (2011) recorded it in the 30 to 50 metre height band. The increase in risk results from the lowering of the RSA height from 30 to 20 metres above the ground.

During the site flora and fauna investigations between 2008 and 2011, the Superb Parrot was found in small groups of between one and seven individuals. All were found associated with treed vegetation, most on treed roadside reserves. All but two records were in lower-lying country away from the ridgetops where wind turbines are to be constructed. As most of the wind farm comprises untreed ridges, only a small proportion of turbines are likely to have the Superb Parrot flying near them. For this reason, the changed turbine height and dimensions is unlikely to increase the risk to the species to a level of conservation concern.

The activities of the Superb Parrot on the site should be further monitored through the implementation of the project Bird and Bat Adaptive Management under Condition D4 of the Project Approval.

Little Eagle

The Little Eagle was recorded at FCWF site once in February 2009 (Kevin Mills & Associates, 2011) flying over the site (height not recorded since the sighting was an incidental record outside formal survey periods.) There are no other records of the Little Eagle at the site.

The increase in the total RSA and height of the turbines will increase the number of Little Eagle flights potentially at risk of collision. This species is considered Vulnerable at the state level under the BC Act. The proposed modification presents a theoretical increase in risk when compared with the currently permitted turbine envelope for the Little Eagle. However, given the single record at the site the overall level of risk remains low. The risk to Little Eagle should however be further monitored and evaluated, and risks reduced through the implementation of mitigation recommendations in a Bird and Bat Adaptive Management Plan. This will be managed under Condition D4 of the Project Approval which states that a Bird & Bat Adaptive Management Plan will be developed pre-construction.

Other BC Act listed species

Two other threatened species listed under the NSW *Biodiversity Conservation Act* (BC) Act may be at increased risk from the modification:

- Diamond Firetail - is a ground and tree dwelling species considered rarely to fly at RSA height; the lower RSA of the proposed modification is unlikely to place flights of this species at risk of collision;
- Varied Sittella – usually a bark-forager in trees and is not expected to fly regularly above tree top height, therefore unlikely to be at increased risk of collision under the modification scenario;

Other species of note – raptors and Wedge tailed Eagles

Wedge tailed Eagles (WTE) were recorded at FCWF site and flew at greater than 50 metres (Kevin Mills & Associates, 2011) within the RSA heights.

The increase in both the total RSA and height of the turbines will increase the overall risk of collision by the WTE. However, as this species is considered secure at the state and national level and is not listed by the EPBC Act and BC Act as threatened or endangered, the potential for a significant population impact from the proposed modification compared with the approved turbine envelope is considered unlikely. The risk to WTE should also be reduced through the implementation of mitigation recommendations in a Bird and Bat Adaptive Management Plan. This will be managed under Condition D4 of the Project Approval which states that a Bird & Bat Adaptive Management Plan will be developed pre-construction.

White-throated Needletail

The EPBC Act White-throated Needletail (WTNT) was not recorded at FCWF site during the 2009-10 surveys, however it was recorded at the nearby Cadia mine site environs (Western Research Institute & Resource Strategies, 2009) and is likely to be an occasional visitor to the area around FCWF in summer and early autumn. The WTNT is a listed migratory species under the EPBC Act and as it annually migrates from the northern to the southern hemisphere. It is not listed as a threatened or

endangered. The Needletail is an aerial forager over a variety of habitat although preferring forested ranges (Higgins 1999). It is known to fly at RSA heights and occasional casualties are known from wind farms in south-eastern Australia (BL&A, unpublished data). It is a common species that ranges over much of eastern Australia during its non-breeding season in Australia from breeding grounds in north-east Asia (e.g. Higgins 1999).

The increase in both the total RSA and height of the turbines will increase the number of needletail flights potentially at risk of collision. However, as this species is considered secure at the state, national and international level, and is not listed by the EPBC Act and BC Act as threatened or endangered, the potential for a significant population impact from the proposed modification compared with the approved turbine envelope is considered negligible.

2.1.4. *Summary of potential impact on birds from modification*

The species of birds recorded at FCWF include common, widespread species which occur in wooded agricultural landscapes in south eastern Australia. Given that the rotor-swept area (RSA) will increase between 20 and 50 metres, (85% of birds were recorded under 20 metres height during formal surveys), the increased risk of the larger turbines may impact on up to 16% of all bird observations at FCWF, and unlikely to lead to significant population impacts for those species not listed on state and federal lists as species of conservation concern.

Of those species listed state and federal lists as species of conservation concern:

- The Superb Parrot is listed as Vulnerable under the EPBC Act and NSW BC Act (2016). This species was recorded in small numbers and is likely to be seasonally recorded around the FCWF. It would be exposed to an increased risk of collision from the lowered minimum RSA from 30 to 20 metres and the larger RSA between 30 and 50 metres. However, given the low numbers of records of the Superb Parrot on-site and characteristic flights at tree canopy height, the increase in risk is not considered as significant;
- The Little Eagle, listed under the state BC Act, was considered to be potentially at greater risk from a turbine collision. However, given the limited records from FCWF the overall risk remains low;
- Two woodland species listed under the BC Act were considered unlikely to be at increased risk as they typically fly at tree height and are unlikely to be recorded at RSA height (Diamond Firetail and Varied Sittella);

In relation to other species potentially at risk, that are not listed as threatened or endangered:

- The Wedge-tailed Eagles (WTE) and other high-flying raptors may be at increased in risk of collision from the larger and higher turbines. However, overall the risk to the WTE from collision with turbines was considered to be low given the low population using the area, the low frequency with which these flights occur and the non-threatened status of the mainland Australian sub-species of the eagle; and
- The White-throated Needletail, listed as a marine and migratory species listed under the EPBC Act (not listed as a threatened species), may be at increased risk from the larger turbine rotor swept area. However, the incremental change

in risk is low given that the species is widespread, and its frequency at the wind farm is likely to be low;

The implementation of mitigation measures in a Bird and Bat Adaptive Management Plan will contribute to lowering any potential risk.

2.2. Impacts of modification on bats

2.2.1. *Bat species recorded on site*

The bat surveys were conducted at the FCWF and surrounding areas in October–November 2008 (9 nights) and March 2009 (11 nights). Ultrasonic bat detectors were deployed at a number of sites at ground level and on three wind towers (in Oct/Nov 2008) at between 50–70 metres in height. The recordings were distributed across representative habitats near planned wind turbine locations (October–November 2008) and larger remnant woodland blocks in the surrounding area (March 2009). A total of ten sites were surveyed (Richards, 2011).

Twenty calls per night were recorded in the open pasture habitat at the meteorological towers, which is indicative of poor quality habitat for bats. The recording of 140 calls per night recorded in the remnant woodland is indicative of a higher quality habitat. In the wooded remnants survey of March 2009, the vast majority (>99%) of calls from 7,120 calls recorded were from widespread, common and secure species (Richards, 2011). Listed threatened species are discussed below.

The Yellow-bellied Sheathtail Bat listed as a *vulnerable* threatened species under the BC Act was recorded at very low frequencies (totalling 7 calls combined out of over 7,120 calls identified, i.e. less than 0.1% of all bat calls recorded at Flyers Creek Wind Farm). No species listed on the Commonwealth EPBC Act were recorded (Richards, 2011).

The 2008 surveys of the meteorological towers recorded 210 calls from the ground-based detectors while 50 calls were recorded from the detectors at 50 to 60 metres height. This provides a comparison of the distribution of flights between ground level and at height. As bat detectors generally do not record bat calls beyond about 25 metres from the recorder and for some species less. Thus, for the recordings at height, a 25-metre height separation can be assumed to be sampling different height zones. At Flyers Creek data was recorded from both ground level and 50-70 metres.

The results indicated that with increasing height bat activity became lower (Richards, 2011). Thus, in general terms, calls of bats 25-30 metres and above were 19% of those at ground. Two species represented over 67% of the calls at height and were from the known high-flying bat species namely the White-striped Free-tailed bat and other freetail bats, i.e. *Mormopterus* sp (Richards, 2011).

2.2.1.1. *Yellow-bellied Sheathtail Bat*

This species is listed as Vulnerable under the NSW BC Act. It was recorded seven times out of a total 7,120 calls in the March 2009 survey (<0.1% frequency of calls). Work cited by Richards (2011) from a variety of locations around the NSW tablelands, shows that densities of Yellow-bellied Sheathtail Bat (YBSB) are strongly correlated with large patches of natural woodland or forest remnants. Richards

(2011) found that the number of YBSB calls increased sharply once remnant size exceeded 650 hectares and even more so above 800 hectares. It is therefore expected that there is some increased risk of collision with the lower and larger turbines. However, given the low numbers of bats that move through the site the species would be unlikely to suffer any regional population decrease due to turbine mortality because the turbines are located in sub-optimal habitat with low populations of the bat.

2.2.2. **Assessment of modification on bats**

The impact to bats is assessed in relation to the turbine proposed in modification 4 as outlined below.

The turbine proposed in Modification 4 decreases the lower minimum RSA height from the approved turbines by 10 metres. This decrease in the lower minimum RSA from 30 metres above ground to 20 metres above ground will increase the risk to bats flying between 20 and 30 metres. This increase in risk will be predominately on species that are not listed as threatened or endangered.

The total area of RSA between 20 and 50 metres increases by just over 100%, representing a doubling of the collision risk in this height band. Bats flying between 20-50 metres above the ground are at about twice as likely to collide with the larger turbine. The majority of the bats recorded in this range are common bats from this largely agricultural landscape.

It is expected that bats that fly at tree top level (20 to 25 metres) or below would not be affected by the altered turbine specifications as there is some separation between the turbines and vegetation. Pooled bat data (BL&A, unpublished data) indicates that the number of bats flying at and above 50 metres is 15% of those recorded at ground level and that species diversity at 50 metres is lower, with recorded bats dominated by higher-flying species such as White-striped Freetail Bat and Gould's Wattled Bat, which are not listed as species of conservation concern. This accords closely with data collected from FCWF which found 25% of bat flights were recorded from detectors placed at 50-70 metres height when compared to recordings at ground level.

Above 100 metres the difference between the proposed and larger turbine design puts turbine blades into an additional zone likely to have very little bat activity (i.e. between 100 and 160 metres). If any bats were recorded above 100 metres, the species diversity is lower and bats likely to be higher-flying species such as White-striped Freetail Bat and Gould's Wattled Bat, which are not listed as species of conservation concern.

The change in turbine proposed in planning modification 4 is unlikely to cause significant adverse impacts to the populations of bat species, both threatened and non-threatened, at FCWF for the following reasons:

- The species of bats recorded during spring 2008 and autumn 2009 survey work overwhelmingly (>99%) comprised common, widespread species of wooded agricultural landscapes in south-eastern Australia;
- One listed threatened species under the TSC Act (Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris*) was present and recorded at very low frequencies (i.e. present on less than 30% of sampling nights and from 3 of 10 sites at Flyers Creek Wind Farm). The habitat on-site was considered suboptimal with of small

woodland remnants on the wind farm as opposed to being present in much larger numbers in wooded remnants of 650 hectares or greater in the wider Orange region (Richards, 2011). Given the low frequency of its occurrence an increase in the low risk commensurate with the proposed modification is expected under the modified scenario;

- No EPBC Act-listed species are known to occur at the FCWF (Kevin Mills & Associates, 2011) therefore there are no known risks to nationally listed threatened bats;
- Bat species potentially at increased risk are mainly the higher-flying species such as White-striped Freetail Bat *Tadarida australis* and Gould's Wattled Bat *Chalinolobus gouldii*, both species are not listed as species of conservation concern.

3. CONCLUSION AND SUMMARY

3.1. Impacts of modification on bats

The species of birds recorded at FCWF include common, widespread species which occur in wooded agricultural landscapes in south eastern Australia. Given that the rotor-swept area (RSA) will increase between 20 and 50 metres, the increased risk of the larger turbines may impact on up to 16% of all bird observations at FCWF, and unlikely to lead to significant population impacts for those species not listed on state and federal lists as species of conservation concern.

Species listed as state/federal lists as species of conservation concern, including the Superb Parrot (Vulnerable - EPBC Act and NSW BC Act (2016)), and the BC listed Little Eagle, Diamond Firetail and Varied Sittella are considered not to be at significant increased risk from the modification.

The non- listed Wedge-tailed Eagles (WTE) and other high-flying raptors may be at increased in risk of collision from the larger and higher turbines. However, overall the risk to the WTE from collision with turbines was considered to be low.

The White-throated Needletail, listed as a marine and migratory species listed under the EPBC Act (not listed as a threatened species), may be at increased risk from the larger turbine rotor swept area. However, the incremental change in risk is low given that the species is widespread, and its frequency at the wind farm is likely to be low.

3.2. Impacts of modification on bats

3.2.1. *Bat species recorded on site*

The change in turbine proposed in planning modification 4 is unlikely to cause significant adverse impacts to the populations of bat species, both threatened and non-threatened, at FCWF as most bats recorded at the site comprised common, widespread species of wooded agricultural landscapes in south-eastern Australia and the increased risk will impact on mainly the higher-flying species such as White-striped Freetail Bat *Tadarida australis* and Gould's Wattled Bat *Chalinolobus gouldii*, both species are not listed as species of conservation concern. No EPBC Act-listed species are known to occur at the FCWF (Kevin Mills & Associates, 2011) therefore there are no known risks to nationally listed threatened bats

The BC Act listed Act Yellow-bellied Sheathail occurred with a low frequency and the there is an increase in the low risk commensurate with the proposed modification under the modified scenario.

3.3. Bird & Bat Adaptive Management Plan (BBAMP)

Condition B4 of the Project Approval requires the preparation and approval of a Bird and Bat Adaptive Management Program prior to the commencement of construction. The Bird and Bat Adaptive Management Program must incorporate specified monitoring, and a decision matrix that clearly sets out how the Proponent will respond to the outcomes of monitoring. This is required to include identification of the "potential mitigation measures and implementation strategies in order to reduce impacts on birds and bats such as swift carcass removal, pest control including rabbits, use of deterrents, and sector management including switching

off turbines that are predicted to or have had an unacceptable impact on bird / bat mortality at certain times".

Condition B4 requires the Proponent to implement all feasible and reasonable mitigation measures where the need for further action is identified through the Bird and Bat Adaptive Management Program, or as otherwise agreed with the Secretary. It is considered that the impacts arising from the increased maximum turbine envelope will remain able to be appropriately managed under the Bird and Bat Adaptive Management Program required under condition B4 of the Project Approval.

4. REFERENCES

- Aurecon Australia, 2011, 'Flyers Creek Wind Farm Environmental Assessment', Aurecon Australia Pty Ltd, Sydney, April 2011.
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Appendix F

Noise Impact Assessment (Vipac)



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Flyers Creek Wind Farm NSW – Noise Assessment of Planning Modification 4

Vipac Engineers & Scientists Ltd (Vipac) provides the following statement of the assessment of noise impacts of Planning Modification 4 to the Flyers Creek Wind Farm.

1 INTRODUCTION

A noise assessment has been performed of the Flyers Creek Wind Farm Planning Modification 4. This assessment is based on a review of the amendments proposed as part of the Planning Modification 4 to the Flyers Creek Wind Farm and an assessment of the noise impacts.

Vipac prepared the original noise assessment for the project in December 2010 [Ref 1] and also the updated assessment for the changes made to the Project as part of Planning Modification 3 [Ref 2]. This report has been prepared to update Vipac's previous assessments and assess the noise impacts arising as a result of Planning Modification 4. The original noise assessment was based on the original layout of up to 44 wind turbines while the current layout is 38 wind turbines (i.e. an overall reduction of 6 turbines).

2 PLANNING MODIFICATION 4

This report provides the noise assessment of the following proposed amendments as part of Planning Modification 4:

- Proposed increase in the maximum turbine dimensions. The noise model has been revised with an updated candidate wind turbine, which has a maximum blade tip height of 160m AGL and a corresponding hub height of up to approximately 92m AGL.
- The candidate wind turbine model is proposed to generate the worst-case Sound Power Levels given in Table 2-1 (from cut-in wind speed to rated power wind speed at hub height).
- This assessment has been based on one of the turbine models under consideration for installation at the site, noting that the final turbine model has not yet been selected by the Proponent.
- Reinstatement of a 132kV transmission line and associated switching station.

Table 2-1: Sound power levels (dB(A) re 1pW) at hub height integer wind speeds (using candidate turbine)

Hub Height Wind Speed (m/s)	3	4	5	6	7	8	9	10	11	12	13
Sound Power Level (dB(A) re 1pW)	92.5	92.5	94.5	98.5	101.9	105.0	106.5	107.0	107.0	107.0	107.0

The 1/3 octave band sound power level data for the candidate wind turbine was used for the noise spectrum in the noise model. All the relevant receivers are applicable as in Planning Modification 3 [Ref 2].

3 NOISE CRITERIA FOR RECEIVERS

The NSW "Wind Energy: Noise Assessment Bulletin" (DPE 2016) confirms that NSW has adopted the SA EPA "Wind farms – environmental noise guidelines" (SA 2009). The SA EPA guidelines [Ref 5] set base noise criteria of:

- *The predicted equivalent noise level ($L_{Aeq,10 \text{ minute}}$), adjusted for tonality and low frequency noise in accordance with these guidelines, should not exceed 35 dB(A) or the background noise ($L_{A90,10 \text{ minute}}$) by more than 5 dB(A), whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the wind turbine generator and each integer wind speed in between.*

The SA EPA guidelines [Ref 5] also recognise that different considerations apply to landowners (who are associated with wind farm projects) and the guidelines confirm that for such associated landowners:

- *If the wind farm noise does not exceed 30dB(A) indoors and 45dB(A) outdoors at the localities belonging to the financial stakeholders it is considered acceptable. In particular situations the expected noise impact can be above the recommended limits. In this case the landowner has to agree in writing with the higher level of exposure and the developer should discuss the issue with the EPA.*

A complete criteria/limit table has been generated for wind speeds up to 13 m/s (at 92m AGL hub height wind speeds) for the key receivers at the five background noise monitoring locations (and is based on the noise monitoring at the 5 monitoring locations [Ref 1] including the latest noise monitoring results for R078 [Ref 3] and R089 [Ref 4]). This is provided in Table 3-1.

Table 3-1: Noise criteria at hub height wind speeds for key receivers

Monitoring Location & Key Receivers	Noise Criteria, dB(A), with Reference to Hub Height Wind Speed (ms^{-1} at 92m AGL)										
	3	4	5	6	7	8	9	10	11	12	13
Monitoring Location R012 R002, R010, R011, R012, R013, R014, R046, R048, R057, R071, R072, R074, R095, R102	35	35	36	37	38	39	40	41	42	43	44
Monitoring Location R025 R023, R024, R025, R043, R055, R090, R108	35	35	35	35	36	37	38	39	40	40	41
Monitoring Location R027 R027, R044	35	35	35	35	35	36	38	39	40	41	42
Monitoring Location R078 R056, R077, R078, R099	35	35	35	35	35	35	36	37	38	40	41
Monitoring Location R089 R089	35	35	35	35	37	39	40	42	43	43	43
All other non-associated residences	The higher of 35 dB(A) or the existing background noise level (L_{A90} (10-minute)) plus 5 dB(A)										

The assignment of all relevant receivers relative to the background monitoring locations is provided in Table 3-2. The receiver assignment into groups (for receivers assessed to likely have a similar background

noise environment to each representative background site) has been based on the consideration of the general terrain/topography, vegetation and prevailing winds in the vicinity of each receiver. Associated or non-relevant properties are not included because they are subject to a noise limit of 45dBA.

Table 3-2: Representative background sites and assigned relevant receivers with similar noise criteria

Background monitoring site	Sites considered to have a similar background noise characteristic
R012	R001, R005, R007, R008, R009, R010, R011, R012, R013, R014, R015, R016, R017, R046, R047, R048, R057, R058, R072, R073, R075, R085, R087, R095, R102, R106, R107, R109, R112, R126, R128, R129, R130, R131, R132, R158
R025	R023, R024, R025, R029, R030, R031, R033, R034, R041, R042, R043, R080, R082, R083, R084, R090, R098, R108, R114, R115, R116, R137, R152
R027	R020, R027, R028, R035, R036, R037, R044, R045, R091, R092, R093, R094, R096, R117, R118, R119, R120, R121, R122, R123, R124, R125, R127, R138, R139, R140, R141, R142, R143, R144, R145, R146, R153, R154, R155, R156, R157
R078	R056, R077, R078, R099, R100, R101, R110, R111, R133, R134, R136, R147, R148, R149, R150, R151
R089	R089

Regression graphs and equations (for curve of best fit polynomial) for all background monitoring locations (locations R012, R025, R027, R078 and R089) generated for 92m AGL hub height wind speeds up to 13m/s are presented in Appendix A.

Relevant Project Approval Conditions [Ref 6] for the Flyers Creek Wind Farm are described as follows.

Condition F6 of the Project Approval requires the Project to be constructed with the aim of achieving the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009) and requires all feasible and reasonable noise mitigation measures to be implemented to achieve this outcome. Similarly, condition F21(b) requires the preparation and implementation of a construction noise management plan detailing how construction noise and vibration impacts will be minimised and managed.

Condition G7 of the Project Approval sets operational noise criteria for wind turbine noise for all residences not associated with the Project based on the noise levels predicted for the currently approved Project layout and maximum turbine dimensions.

Condition G8 of the Project Approval sets operational noise criteria for the operation of ancillary infrastructure.

Condition G9 of the Project Approval requires operational noise levels to be confirmed by the operational noise monitoring and the turbines operated so as to achieve compliance with the noise limits specified in the Project Approval (as modified).

4 NOISE PREDICTIONS AND ASSESSMENT

The noise model used during the noise assessment undertaken at Planning Modification 3 has been updated to account for updated candidate turbine model with a maximum blade tip height of 160m (and corresponding hub height of up to approximately 92m). The new sound power level data and 1/3 octave spectral noise data for the candidate wind turbine were incorporated into the updated model. The standard ISO9613 noise propagation algorithm was used as before, with a ground absorption factor conservatively set to fully reflective (G factor set to 0), and the noise model run using the SoundPLAN ver7.0 software.

The predicted noise levels have been determined for all relevant and non-relevant receivers. The tabulated results and applicable noise criteria from cut-in wind speed (3m/s) to rated power wind speed (13m/s) are presented in Appendix B.

The predicted L_{Aeq} noise levels using the updated candidate turbine model and 92m AGL hub height meets the applicable criteria developed in accordance with the SA Environmental Noise Guidelines – Wind Farms [Ref 5] at all but two (2) relevant receivers (R077 and R078), where small exceedances of less than 1 dB were noted between the hub height wind speeds 8m/s to 10m/s.

As a result, some minor noise mitigation measures may need to be applied to ensure the applicable noise criteria are met at the affected hub height wind speeds. This will take the form of either micro-siting of the closest turbines and/ or turbine wind sector management using lower turbine power modes for one or two turbines for the range of hub height wind speeds from 8m/s to 10m/s.

It is noted that, given the conservative assumptions in the model (such as fully reflective ground factor and the assumption of wind blowing from all directions simultaneously from all turbines to the receivers), these measures may not be required in reality. The noise mitigation measures proposed will be sufficient to achieve compliance with the relevant criteria and that this would be verified by the operational noise monitoring required under Project Approval Condition G9.

The proposed 132kV overhead transmission line (to the west of the substation) is not likely to be proposed to be within 50m of any residences and as a result corona discharge noise or Aeolian noise is not likely to be an issue. Transmission line noise (due to corona or Aeolian noise) is not significant or potentially annoying at distances greater than about 50 to 100 metres from the lines. One receiver location (R017) could be located within about 60-70m of the transmission line and may occasionally notice low level noise from the lines on some occasions (e.g. during high humidity conditions) but is unlikely to be an issue. A small switching station may be located at the northern end of the 132kV transmission line (at the point of connection to the existing Orange North to Cadia transmission line) and is likely to comprise basic switchgear and circuit breakers (and no transformers). An assessment of the small switching station shows that it is unlikely to have any significant noise impact on the nearest receivers (which are located greater than 250m from the likely site of the switching station).

The original noise assessment [Ref 1] assessed the noise impact from wind farm construction activities and the operational impact of the proposed substation. The original assessment showed that the relevant noise criteria for construction and substation noise are likely to be achieved at all relevant receivers. The substation has not been moved or changed relative to the previous approval, and as a result the original assessment of no significant noise impact would still hold.

5 SUMMARY

In summary, the increased maximum turbine envelope proposed in Planning Modification 4 is likely to generate a slight increase in predicted noise levels at most receivers compared to the approved project layout. This could result in the predicted noise levels slightly exceeding (by less than 1 dB) the applicable criteria at receivers R077 and R078 between the hub height wind speeds 8m/s to 10m/s. As a result, some noise mitigation measures may need to be applied in the form of turbine micro-siting and turbine wind sector management using lower turbine power modes for one or two turbines during some wind speed conditions, to ensure the applicable noise criteria are met at nearby residences. It is noted that, given the conservative assumptions in the model (such as fully reflective ground factor and the assumption of wind blowing from all directions simultaneously from all turbines to the receivers), these measures may not be required.

The proposed 132kV overhead transmission line (to the west of the substation) is not likely to be proposed to be within 50m of any residences and as a result corona discharge noise or Aeolian noise is not likely to be an issue. The switching station (at the northern end of the 132kV overhead transmission line) is not

likely to cause any significant noise impact at the nearest receivers (located over 250m away). The original assessment showed that the relevant noise criteria for construction and substation noise are likely to be achieved at all relevant receivers, and as a result the original assessment of no significant noise impact would still hold.

The Project Approval conditions relating to noise will be sufficient to achieve compliance with the relevant criteria and this will be verified by the operational noise monitoring required under Condition G9.

REFERENCES

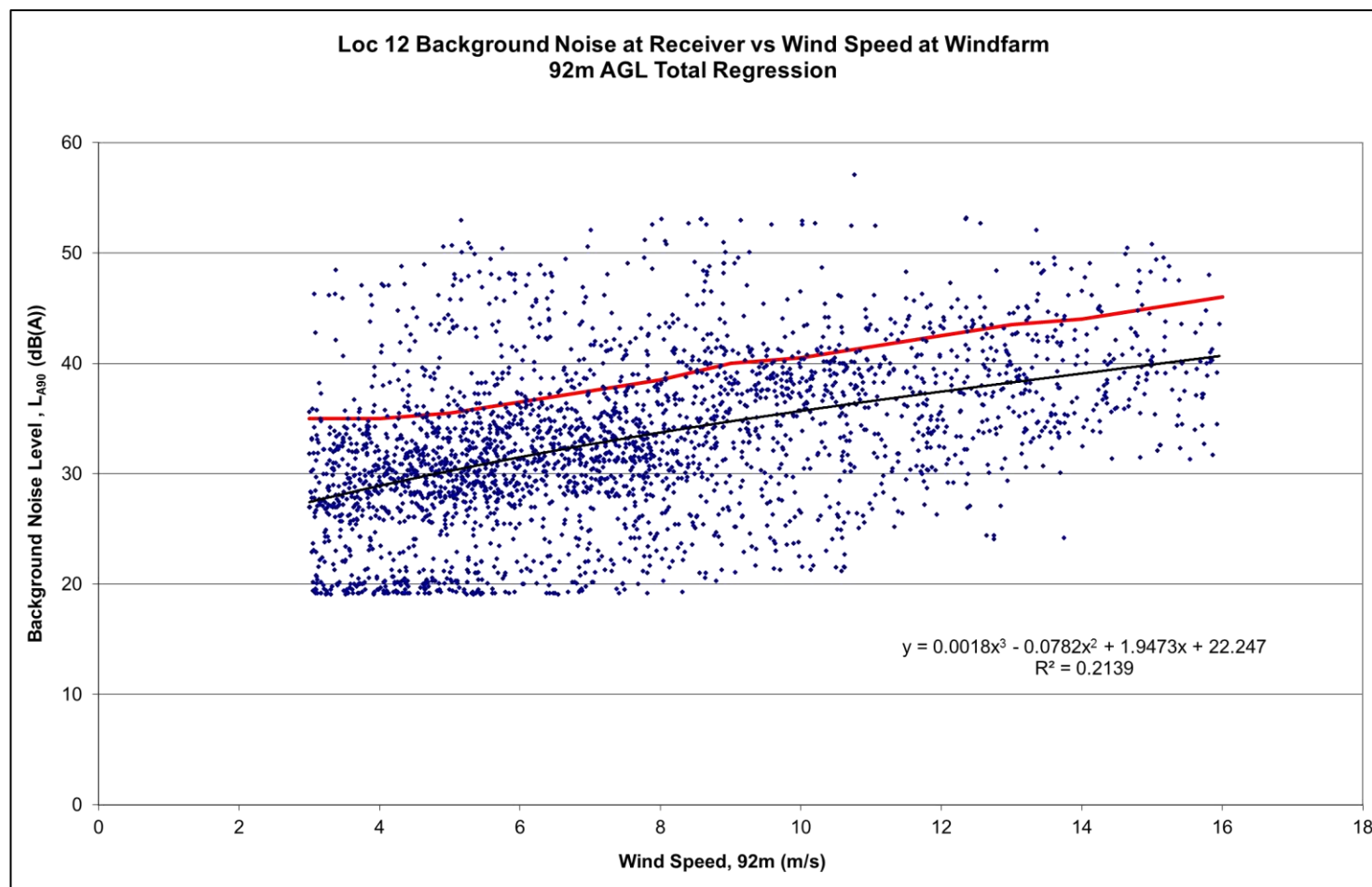
- Ref [1] Flyers Creek Wind Farm - Noise Impact Assessment, Vipac report 50B-08-0089-TRP-773906-2, dated 21 December 2010.
- Ref [2] Flyers Creek Wind Farm - Noise Assessment of Planning Modification 3, Vipac report 70Q-12-0329-TRP-541411-0, dated 19 April 2017.
- Ref [3] Flyers Creek Wind Farm – R78 Additional Background Noise Measurements, Vipac report 50B-08-0089-TRP-797028-0, dated 28 January 2015.
- Ref [4] Flyers Creek Wind Farm – Background Noise Monitoring at H89 (referenced to 91.5m wind speeds), Sonus report S3870C6, dated January 2016.
- Ref [5] Environmental Noise Guidelines – Wind Farms, SA Environment Protection Authority, South Australian Government, July 2009.
- Ref [6] Project Approval Conditions - Flyers Creek Wind Farm, Application No. MP 08_0252 (Mod 3, 30 November 2017), NSW Planning Assessment Commission.
- Ref [7] Flyers Creek Wind Farm – Planning Modification 3 Response to Submissions, Vipac report 70Q-12-0329-TRP-541979-1, dated 15 August 2017.
- Ref [8] Flyers Creek Wind Farm MP 08_0252 – Modification 3 - Further Information, Infigen letter, dated 30 October 2017.

Attachments:

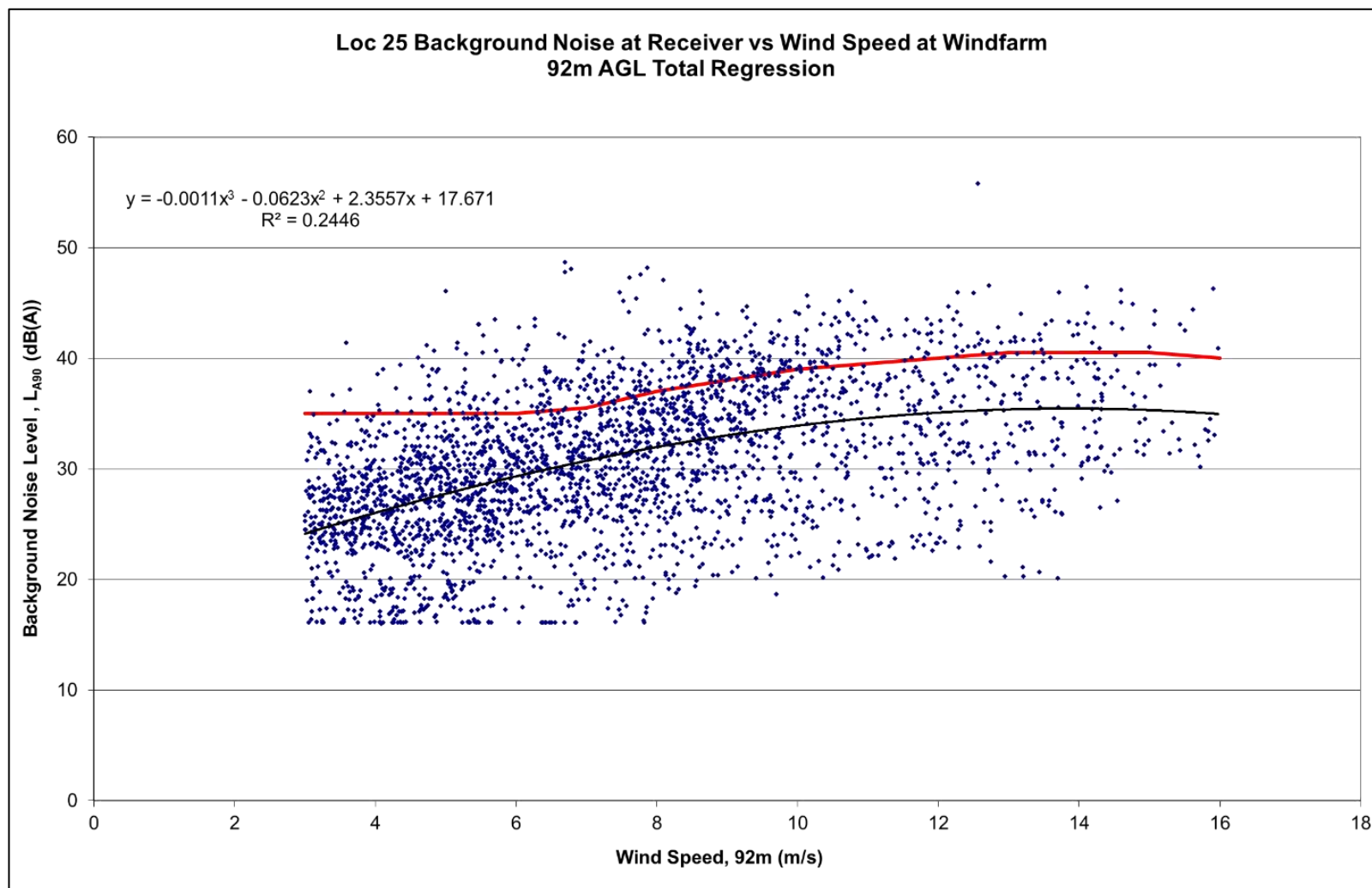
Appendix A – Figures: Regression graph and equation for each background monitoring location

Appendix B – Noise Prediction Results

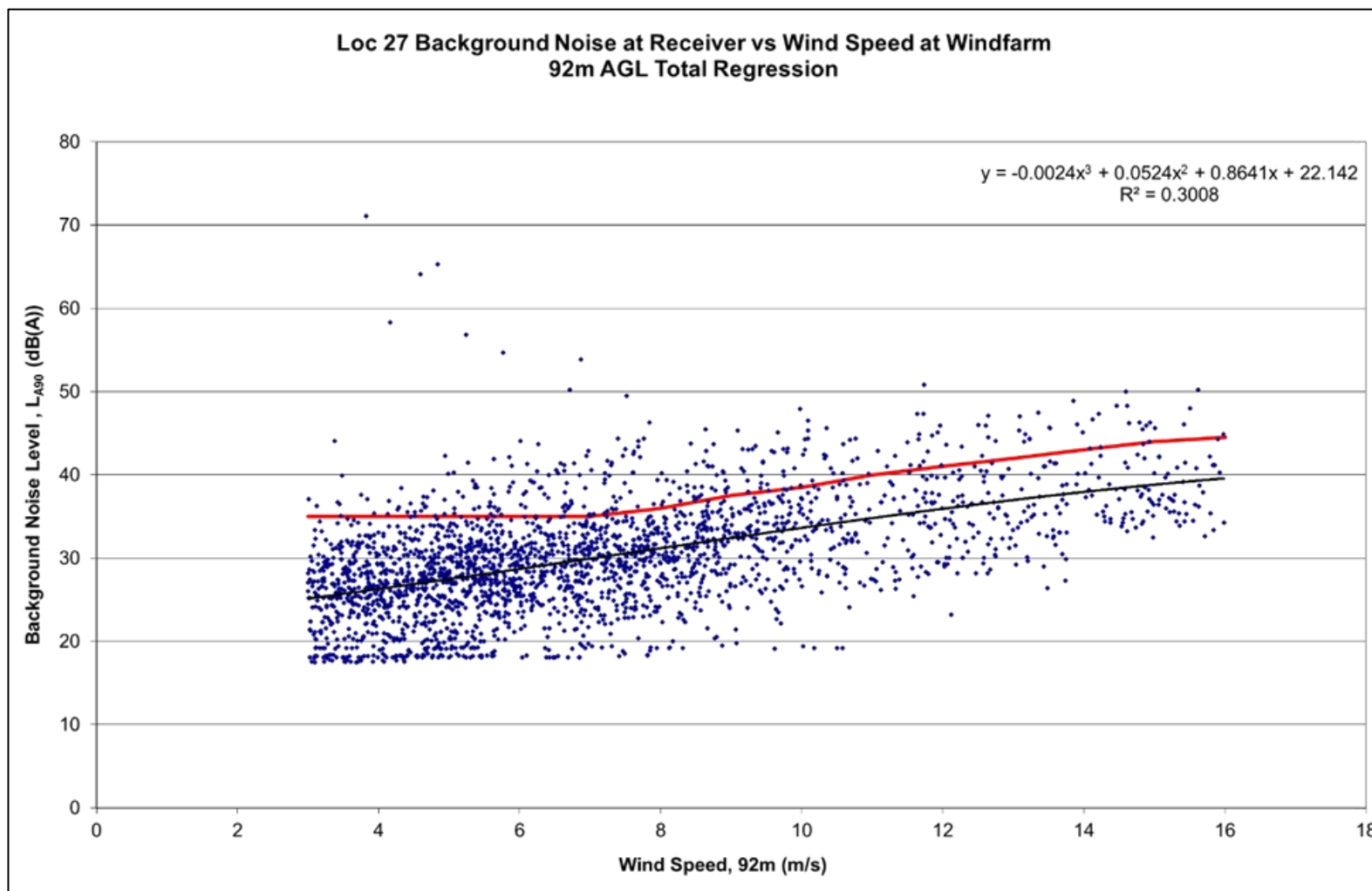
Appendix A – Figures: Regression graph and equation for each background monitoring location



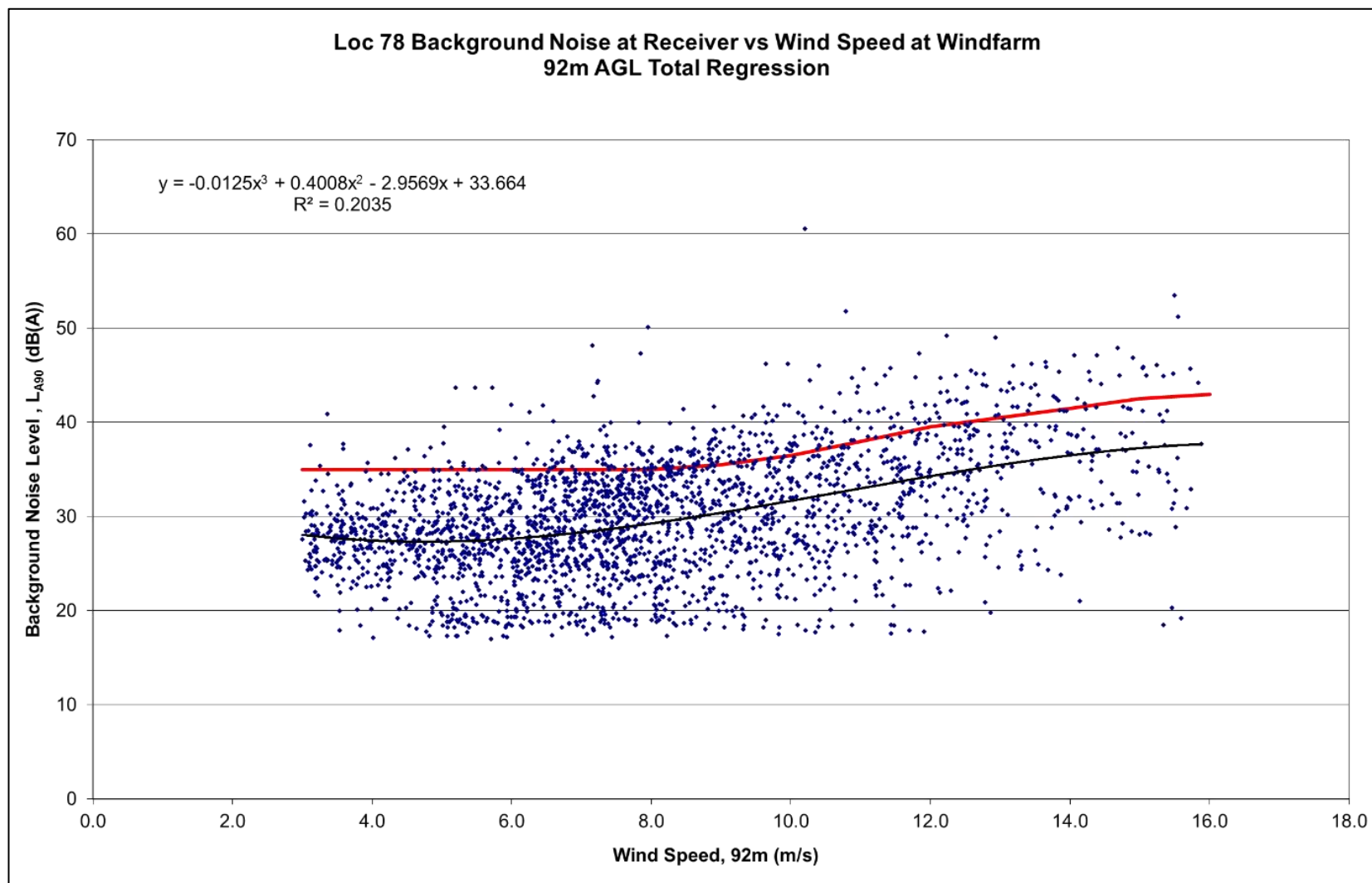
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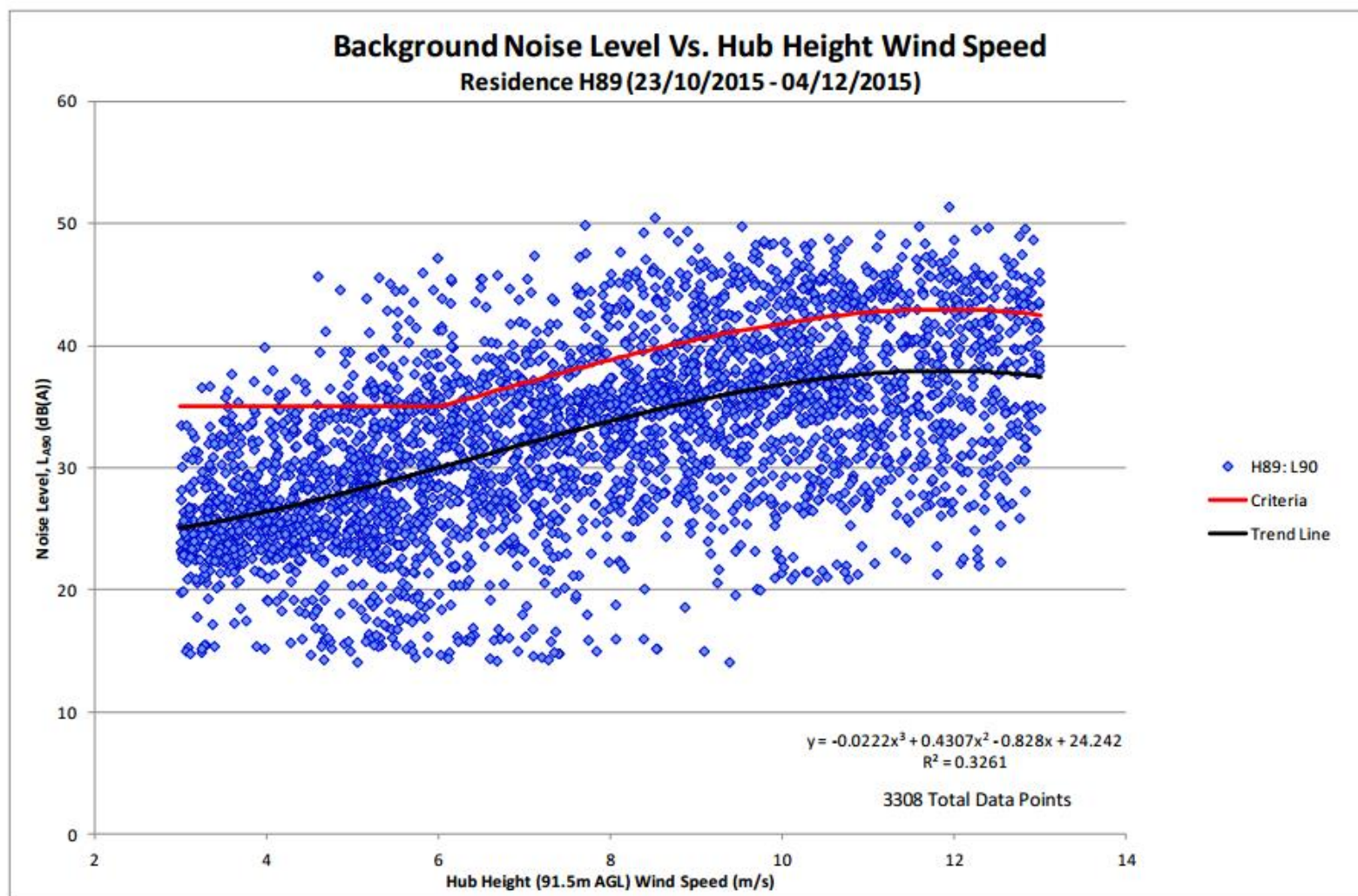
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Appendix B – Noise Prediction Results*

* Note: The receiver assignment (assessed as being similar to the representative background sites) has been based on the consideration of the general terrain/topography, vegetation and prevailing winds in the vicinity of each receiver (see also section 3).

Table B-1: Predicted Noise Levels (L_{Aeq} dB(A)) for Relevant Sites at Different Wind Speeds Using ISO9613.

Relevant Receiver	Wind Speed ms^{-1} (at 92m AGL)										
	3	4	5	6	7	8	9	10	11	12	13
Criteria set: R012 - Errowanbang											
Criteria	35	35	36	37	38	39	40	41	42	43	44
R001	17.4	17.4	19.4	23.4	26.8	29.9	31.4	31.9	31.9	31.9	31.9
R005	19.0	19.0	21.0	25.0	28.4	31.5	33.0	33.5	33.5	33.5	33.5
R007	7.6	7.6	9.6	13.6	17.0	20.1	21.6	22.1	22.1	22.1	22.1
R008	8.2	8.2	10.2	14.2	17.6	20.7	22.2	22.7	22.7	22.7	22.7
R009	19.2	19.2	21.2	25.2	28.6	31.7	33.2	33.7	33.7	33.7	33.7
R010	21.3	21.3	23.3	27.3	30.7	33.8	35.3	35.8	35.8	35.8	35.8
R011	19.1	19.1	21.1	25.1	28.5	31.6	33.1	33.6	33.6	33.6	33.6
R012	17.4	17.4	19.4	23.4	26.8	29.9	31.4	31.9	31.9	31.9	31.9
R013	17.4	17.4	19.4	23.4	26.8	29.9	31.4	31.9	31.9	31.9	31.9
R014	21.4	21.4	23.4	27.4	30.8	33.9	35.4	35.9	35.9	35.9	35.9
R015	15.7	15.7	17.7	21.7	25.1	28.2	29.7	30.2	30.2	30.2	30.2
R016	16.6	16.6	18.6	22.6	26.0	29.1	30.6	31.1	31.1	31.1	31.1
R017	16.6	16.6	18.6	22.6	26.0	29.1	30.6	31.1	31.1	31.1	31.1
R046	18.9	18.9	20.9	24.9	28.2	31.4	32.9	33.3	33.3	33.3	33.3
R047	16.7	16.7	18.7	22.7	26.1	29.2	30.7	31.2	31.2	31.2	31.2
R048	19.1	19.1	21.1	25.1	28.5	31.6	33.1	33.6	33.6	33.6	33.6
R057	18.7	18.7	20.7	24.7	28.1	31.2	32.7	33.2	33.2	33.2	33.2
R058	11.0	11.0	13.0	17.0	20.4	23.5	25.0	25.5	25.5	25.5	25.5
R072	20.8	20.8	22.8	26.8	30.2	33.3	34.8	35.3	35.3	35.3	35.3
R073	17.3	17.3	19.3	23.3	26.7	29.8	31.3	31.8	31.8	31.8	31.8
R075	15.7	15.7	17.7	21.7	25.1	28.2	29.7	30.2	30.2	30.2	30.2
R085	17.9	17.9	19.9	23.9	27.3	30.4	31.9	32.4	32.4	32.4	32.4
R087	14.5	14.5	16.5	20.5	23.9	27.0	28.5	29.0	29.0	29.0	29.0
R095	22.0	22.0	24.0	28.0	31.4	34.5	36.0	36.5	36.5	36.5	36.5
R102	19.9	19.9	21.9	25.9	29.3	32.4	33.9	34.4	34.4	34.4	34.4

Relevant Receiver	Wind Speed ms ⁻¹ (at 92m AGL)										
	3	4	5	6	7	8	9	10	11	12	13
R106	16.2	16.2	18.2	22.2	25.6	28.7	30.2	30.7	30.7	30.7	30.7
R107	16.7	16.7	18.7	22.7	26.1	29.2	30.7	31.2	31.2	31.2	31.2
R109	7.0	7.0	9.0	13.0	16.4	19.5	21.0	21.5	21.5	21.5	21.5
R112	14.1	14.1	16.1	20.1	23.5	26.6	28.1	28.6	28.6	28.6	28.6
R126	18.8	18.8	20.8	24.8	28.2	31.3	32.8	33.3	33.3	33.3	33.3
R128	12.8	12.8	14.8	18.8	22.2	25.3	26.8	27.3	27.3	27.3	27.3
R129	16.7	16.7	18.7	22.7	26.1	29.2	30.7	31.2	31.2	31.2	31.2
R130	17.2	17.2	19.2	23.2	26.6	29.7	31.2	31.7	31.7	31.7	31.7
R131	12.1	12.1	14.1	18.1	21.5	24.6	26.1	26.6	26.6	26.6	26.6
R132	14.9	14.9	16.9	20.9	24.3	27.4	28.9	29.4	29.4	29.4	29.4
R158	17.9	17.9	19.9	23.9	27.3	30.4	31.9	32.4	32.4	32.4	32.4
Criteria set: R025 – Bromley											
Criteria	35	35	35	35	36	37	38	39	40	40	41
R023	21.7	21.7	23.6	27.6	31.0	34.1	35.6	36.1	36.1	36.1	36.1
R024	14.5	14.5	16.5	20.5	23.9	27.0	28.5	29.0	29.0	29.0	29.0
R025	15.8	15.8	17.6	21.7	25.1	28.1	29.7	30.2	30.2	30.2	30.2
R029	5.6	5.6	7.6	11.6	15.0	18.1	19.6	20.1	20.1	20.1	20.1
R030	9.8	9.8	11.8	15.8	19.2	22.3	23.8	24.3	24.3	24.3	24.3
R031	7.0	7.0	9.0	13.0	16.4	19.5	21.0	21.5	21.5	21.5	21.5
R033	8.4	8.4	10.3	14.2	17.7	20.7	22.3	22.7	22.7	22.7	22.7
R034	5.6	5.6	7.6	11.6	15.0	18.1	19.6	20.1	20.1	20.1	20.1
R041	11.4	11.4	13.4	17.4	20.8	23.9	25.4	25.9	25.9	25.9	25.9
R042	6.6	6.6	8.6	12.6	16.0	19.1	20.6	21.1	21.1	21.1	21.1
R043	15.2	15.1	17.2	21.2	24.5	27.7	29.1	29.7	29.7	29.7	29.7
R080	10.4	10.4	12.4	16.4	19.8	22.9	24.4	24.9	24.9	24.9	24.9
R082	11.8	11.8	13.6	17.9	21.3	24.4	26.0	26.4	26.4	26.4	26.4
R083	5.0	5.0	7.0	11.0	14.4	17.5	19.0	19.5	19.5	19.5	19.5
R084	4.5	4.5	6.5	10.5	14.0	17.0	18.5	19.0	19.0	19.0	19.0
R090	20.3	20.3	22.3	26.3	29.7	32.8	34.3	34.8	34.8	34.8	34.8
R098	7.2	7.2	9.2	13.2	16.6	19.7	21.2	21.7	21.7	21.7	21.7
R108	21.6	21.6	23.6	27.6	31.0	34.1	35.6	36.1	36.1	36.1	36.1
R114	6.4	6.4	8.4	12.4	15.8	18.9	20.4	20.9	20.9	20.9	20.9
R115	9.6	9.6	11.5	15.6	19.0	22.0	23.6	24.1	24.1	24.1	24.1
R116	7.4	7.4	9.4	13.4	16.8	19.9	21.4	21.9	21.9	21.9	21.9

Relevant Receiver	Wind Speed ms ⁻¹ (at 92m AGL)										
	3	4	5	6	7	8	9	10	11	12	13
R137	5.8	5.8	7.7	11.7	15.1	18.2	19.7	20.2	20.2	20.2	20.2
R152	3.7	3.7	5.7	9.7	13.1	16.2	17.7	18.2	18.2	18.2	18.2
Criteria set: R027 – Willow Creek East											
Criteria	35	35	35	35	35	36	38	39	40	41	42
R020	14.1	14.1	16.1	20.1	23.5	26.6	28.1	28.6	28.6	28.6	28.6
R027	17.9	17.9	19.9	23.9	27.3	30.4	31.9	32.4	32.4	32.4	32.4
R028	10.2	10.2	12.1	16.1	19.5	22.6	24.2	24.6	24.6	24.6	24.6
R035	5.2	5.2	7.2	11.2	14.6	17.7	19.2	19.7	19.7	19.7	19.7
R036	10.2	10.2	12.2	16.2	19.6	22.7	24.2	24.7	24.7	24.7	24.7
R037	14.8	14.8	16.8	20.8	24.2	27.3	28.8	29.3	29.3	29.3	29.3
R044	16.6	16.5	18.5	22.6	25.9	29.1	30.5	31.1	31.1	31.1	31.1
R045	13.6	13.5	15.5	19.5	22.8	26.0	27.5	28.0	28.0	28.0	28.0
R091	7.2	7.2	9.1	13.2	16.6	19.6	21.2	21.7	21.7	21.7	21.7
R092	7.7	7.7	9.7	13.7	17.1	20.2	21.7	22.2	22.2	22.2	22.2
R093	6.6	6.6	8.6	12.7	16.1	19.1	20.6	21.2	21.2	21.2	21.2
R094	15.4	15.4	17.4	21.4	24.8	27.9	29.4	29.9	29.9	29.9	29.9
R096	7.3	7.3	9.3	13.3	16.7	19.8	21.3	21.8	21.8	21.8	21.8
R117	10.2	10.2	12.2	16.2	19.5	22.7	24.2	24.6	24.6	24.6	24.6
R118	4.5	4.5	6.5	10.5	13.9	17.0	18.5	19.0	19.0	19.0	19.0
R119	1.8	1.8	3.3	7.3	10.7	13.8	15.3	15.8	15.8	15.8	15.8
R120	4.8	4.8	6.7	10.7	14.1	17.2	18.7	19.2	19.2	19.2	19.2
R121	5.0	5.0	6.8	10.7	14.1	17.1	18.8	19.2	19.2	19.2	19.2
R122	4.2	4.2	6.2	10.2	13.6	16.7	18.2	18.7	18.7	18.7	18.7
R123	1.9	1.9	3.9	7.9	11.3	14.4	15.9	16.4	16.4	16.4	16.4
R124	1.9	1.9	3.9	7.9	11.3	14.4	15.9	16.4	16.4	16.4	16.4
R125	1.7	1.7	3.7	7.7	11.1	14.2	15.7	16.2	16.2	16.2	16.2
R127	5.3	5.3	7.3	11.3	14.7	17.8	19.3	19.8	19.8	19.8	19.8
R138	2.5	2.5	4.5	8.5	11.9	15.0	16.5	17.0	17.0	17.0	17.0
R139	2.1	2.1	4.1	8.1	11.5	14.6	16.1	16.6	16.6	16.6	16.6
R140	3.1	3.1	5.1	9.1	12.5	15.6	17.1	17.6	17.6	17.6	17.6
R141	2.6	2.6	4.6	8.6	12.0	15.1	16.6	17.1	17.1	17.1	17.1
R142	1.6	1.6	3.6	7.6	11.0	14.1	15.6	16.1	16.1	16.1	16.1
R143	0.9	0.9	2.9	6.9	10.3	13.4	14.9	15.4	15.4	15.4	15.4
R144	2.3	2.3	4.2	8.2	11.6	14.7	16.2	16.7	16.7	16.7	16.7

Relevant Receiver	Wind Speed ms ⁻¹ (at 92m AGL)										
	3	4	5	6	7	8	9	10	11	12	13
R145	4.2	4.2	6.2	10.2	13.6	16.7	18.2	18.7	18.7	18.7	18.7
R146	7.4	7.4	9.4	13.4	16.8	19.9	21.4	21.9	21.9	21.9	21.9
R153	2.6	2.6	4.6	8.6	12.0	15.1	16.6	17.1	17.1	17.1	17.1
R154	1.6	1.6	3.6	7.7	11.1	14.1	15.6	16.2	16.2	16.2	16.2
R155	1.0	1.0	3.0	7.1	10.5	13.5	15.0	15.6	15.6	15.6	15.6
R156	6.1	6.1	8.2	12.1	15.5	18.7	20.1	20.6	20.6	20.6	20.6
R157	7.9	7.9	9.8	13.9	17.3	20.4	21.9	22.4	22.4	22.4	22.4
Criteria set: R078 – House											
Criteria	35	35	35	35	35	35	36	37	38	40	41
R056	16.4	16.4	18.4	22.4	25.8	28.9	30.4	30.9	30.9	30.9	30.9
R077	22.2	22.2	24.2	28.2	31.6	34.7	36.2	36.7	36.7	36.7	36.7
R078	22.9	22.9	24.9	28.8	32.3	35.3	36.9	37.3	37.3	37.3	37.3
R099	19.6	19.6	21.6	25.6	29.0	32.1	33.6	34.1	34.1	34.1	34.1
R100	17.0	17.0	19.0	23.0	26.4	29.5	31.0	31.5	31.5	31.5	31.5
R101	12.6	12.6	14.6	18.6	21.9	25.1	26.6	27.1	27.1	27.1	27.1
R110	11.7	11.7	13.7	17.7	21.1	24.2	25.7	26.2	26.2	26.2	26.2
R111	11.5	11.5	13.5	17.5	20.9	24.0	25.5	26.0	26.0	26.0	26.0
R133	13.6	13.6	15.6	19.6	23.0	26.1	27.6	28.1	28.1	28.1	28.1
R134	12.0	12.0	14.0	18.0	21.4	24.5	26.0	26.5	26.5	26.5	26.5
R136	11.2	11.2	13.2	17.2	20.6	23.7	25.2	25.7	25.7	25.7	25.7
R147	7.7	7.7	9.7	13.7	17.1	20.2	21.7	22.2	22.2	22.2	22.2
R148	12.0	12.0	14.0	18.0	21.4	24.5	26.0	26.5	26.5	26.5	26.5
R149	7.8	7.8	9.8	13.8	17.2	20.3	21.8	22.3	22.3	22.3	22.3
R150	10.2	10.2	12.2	16.2	19.6	22.7	24.2	24.7	24.7	24.7	24.7
R151	9.8	9.8	11.8	15.8	19.1	22.3	23.8	24.3	24.3	24.3	24.3
Criteria set: R089 - House											
Criteria	35	35	35	35	37	39	40	42	43	43	42
R089	24.8	24.8	26.8	30.8	34.2	37.3	38.8	39.3	39.3	39.3	39.3

Table B-2: Predicted Noise Levels (L_{Aeq} dB(A)) for Non-Relevant Sites at Different Wind Speeds Using ISO9613.

Non Relevant Receiver	Wind Speed ms^{-1} (at 92m AGL)										
	3	4	5	6	7	8	9	10	11	12	13
Criteria	45	45	45	45	45	45	45	45	45	45	45
R002	21.5	21.5	23.5	27.5	31.0	34.0	35.5	36.0	36.0	36.0	36.0
R003	26.7	26.7	28.7	32.7	36.1	39.2	40.7	41.2	41.2	41.2	41.2
R004	24.8	24.8	26.8	30.8	34.2	37.3	38.8	39.3	39.3	39.3	39.3
R021	23.4	23.4	25.4	29.4	32.8	35.9	37.4	37.9	37.9	37.9	37.9
R022	23.8	23.8	25.8	29.8	33.2	36.3	37.8	38.3	38.3	38.3	38.3
R026	10.3	10.3	12.3	16.3	19.7	22.8	24.3	24.8	24.8	24.8	24.8
R049	22.8	22.8	24.8	28.8	32.2	35.3	36.8	37.3	37.3	37.3	37.3
R050	25.9	25.9	27.9	31.9	35.3	38.4	39.9	40.4	40.4	40.4	40.4
R051	24.0	24.0	26.0	30.0	33.4	36.5	38.0	38.5	38.5	38.5	38.5
R51B	24.0	24.0	26.0	30.0	33.4	36.5	38.0	38.5	38.5	38.5	38.5
R052	18.4	18.4	20.4	24.4	27.8	30.9	32.4	32.9	32.9	32.9	32.9
R054	24.3	24.3	26.3	30.3	33.7	36.8	38.3	38.8	38.8	38.8	38.8
R055	21.9	21.9	23.9	27.9	31.3	34.4	35.9	36.4	36.4	36.4	36.4
R071	24.9	24.9	26.9	30.9	34.3	37.4	38.9	39.4	39.4	39.4	39.4
R074	19.0	19.0	21.0	25.0	28.4	31.5	33.0	33.5	33.5	33.5	33.5
R076	24.2	24.2	26.2	30.2	33.6	36.7	38.2	38.7	38.7	38.7	38.7
R079	25.2	25.2	27.2	31.2	34.6	37.7	39.2	39.7	39.7	39.7	39.7
R086	18.6	18.6	20.6	24.6	28.0	31.1	32.6	33.1	33.1	33.1	33.1
R088	21.5	21.5	23.5	27.5	30.9	34.0	35.5	36.0	36.0	36.0	36.0

Appendix G

Traffic and Transport Impact Assessment (Aurecon)



Flyers Creek Wind Farm

**Planning Modification 4 Traffic and Transport
Assessment**

Flyers Creek Wind Farm Pty Ltd

24 July 2018

Revision: 4

Reference: 236242

*Bringing ideas
to life*

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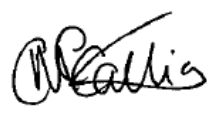
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Contents

1	Introduction	1
2	Proposal Summary	3
2.1	Existing Traffic and Transport Impact Assessment (EA, May 2011)	3
2.2	Planning Modification 4	3
3	Traffic Generation	5
3.1	Traffic Generation Background	5
3.2	Construction Traffic Standard Road Vehicles	5
3.3	RAVs or Over-sized vehicles	5
4	Traffic Routes	7
4.1	Site Access from Regional Centres	7
4.2	Local Access to Site	7
5	On-Site Access Management and Mitigation	8
5.1	Access Management	8
5.2	Mitigation Measures	8
6	Traffic and Transport Conclusions	9

1 Introduction

The Flyers Creek Wind Farm Development was approved (MP08_252) on 14 March 2014. The documentation that was submitted as part of the development application included an Environmental Assessment (EA) which incorporated an assessment of the traffic implications of the development. (Aurecon EA, dated May 2011, Section 13).

The approved development as of 14 March 2014 comprised 42 turbine wind farm with 56m blades and associated infrastructure for power transfer into the grid including a 132kV power transmission line and switching station.

It is noted that the traffic assessment that supported the application was based on a marginally larger wind farm comprising 44 turbines with blade lengths assessed as 60m, which essentially provided a conservative estimate of traffic impacts for the approved scheme.

Overtime there have been two previous modifications to the proposed wind farm, however these have not triggered a review of traffic implications. It is noted that Mod 2 involved the removal of the 132kV transmission line whilst Mod 3 included a reduction in the number of turbines to 38.

The traffic impacts of the of the approved project are managed under conditions imposed on the Project Approval including conditions F15, F16, F17 and F21(c). These conditions are provided below for information:

- F15. Unless otherwise agreed by the Secretary, the Proponent shall commission an independent, qualified person(s) to undertake the following in consultation with the relevant road authority*
- (a) Prior to commencement of construction, review the proposed route and existing access provisions to the Project to determine whether the route and existing provisions allow for safe access of construction and operational vehicles associated with the Project (including appropriate site distances and provisions for over-mass or over-dimensional transport and safety with other road users). Where improvements or changes to the proposed route are required, the Proponent shall implement these to the satisfaction of the relevant road authority, prior to the commencement of construction and at full expense of the Proponent; and*
 - (b) Assess all roads proposed to be used for over-mass and / or over dimensional transport (including intersections, bridges, culverts and other road features) prior to the commencement of construction to determine whether the existing road condition can accommodate the proposed over-mass and or over-dimensional haulage. Where improvements are required, the Proponent shall implement these to the satisfaction of the relevant road authority, prior to over-mass or over-dimensional vehicles accessing the site and at the full expense of the Proponent.*
- F16 Prior to the commencement of construction, the Proponent shall undertake a **Road Dilapidation Report** of sealed roads on haulage route(s) within the Blayney Local Government Area. The Report shall assess the current condition of the road(s) and describe mechanisms to restore any damage that may result due to traffic and transport*

related to the construction of the Project. The Report shall be submitted to the relevant road authority for review and prior to commencement of haulage.

- F17** *The Proponent shall repair all damage to sealed roads during construction. Measures undertaken to restore or reinstate roads affected by the Project shall be undertaken in accordance with the reasonable requirements of the relevant road authority (including timing requirements), and at the full expense of the Proponent. Within three months of completion of construction:*
- (a) The Proponent shall undertake gravel re-sheeting to a minimum depth of 100mm on all gravel roads used for access during construction. Works shall be completed in accordance with Roads and Maritime Services Specification M220; and*
 - (b) A Report shall be prepared to assess any damage to sealed roads that may have resulted from the construction of the Project (including mechanisms to restore any damage) and submitted to the relevant road authority for review.*
- F21** *(c) A **Construction Traffic and Access Management Plan** to manage construction traffic and access impacts of the Project. The Plan shall be developed in consultation with the relevant road authority and shall include, but not necessarily be limited:*
- i. Identification of construction traffic routes and construction traffic volumes (including heavy vehicle / spoil haulage / material haulage) on these routes;*
 - ii. Details of vehicle movements for construction sites and site compounds including parking, dedicated vehicle turning areas, and ingress and egress points;*
 - iii. Identification of construction impacts that could result in disruption of traffic, public transport (inclusive of school buses), pedestrian and cycle access, property access, including details of oversize load movements;*
 - iv. Details of management measures to minimise traffic impacts, including temporary road work traffic control measures, onsite vehicle queuing and parking areas and management measures to minimise peak time congestion (including school buses), and measures to ensure safe pedestrian and cycle access;*
 - v. A response plan which sets out a proposed response to any traffic construction or other incident; and*
 - vi. Mechanisms for the monitoring, review and amendment of this Plan.*

These conditions require more extensive pre-construction traffic impact assessment and management of construction to be undertaken once more details and definition into the construction process is known so that impacts and road damage is either mitigated or repaired to an appropriate degree.

The current modification (Mod 4) comprises the following changes from the previous approved modification (Mod 3) and includes:

- Increase to the maximum wind turbine envelope including increase of turbine tip height of 10 metres (m) from 150m to 160m and in particular in relation to the traffic assessment an increase in the blade lengths from 60m to maximum 70m; and
- Inclusion of a 132 kilovolt (kV) transmission line and switching station proposed to connect the wind farm substation to the electrical grid.

This traffic impact assessment forms an update as to the implications that Mod 4 would have to the findings of the original traffic impact assessment associated with the approved development but in the context of the changes proposed from currently approved project (Mod 3) to Mod 4.

2 Proposal Summary

2.1 Existing Traffic and Transport Impact Assessment (EA, May 2011)

As stated previously an assessment of the traffic and transport issues associated with the construction and operation of the proposed wind farm was undertaken within the EA report dated May 2011 as part of the initial Development Application. The assessment assumed the following components:

- A total of 44 turbines to be constructed, each with 150m tip height and 60m blade length;
- A substation; and
- A 132kV transmission line and switching station.

The assessment identified that the main issues with traffic management would arise during construction, due to the need for restricted access vehicles (RAV) to deliver components. Operational traffic was considered minimal, consisting of a small number of on-site staff and periodic visits by maintenance staff and mobile plants.

The report identified that a large portion of the components would be imported from overseas and due to the location of the site and shape of the components to be delivered, roads were deemed to be the best method to transport the cargo from ports to site. Determination of optimal delivery routes were separated into regional and local scales.

Bathurst, Orange and Cowra were identified as the main commercial centres surrounding the site through which RAV deliveries would pass through, and from which smaller project components and services would be sought. It was considered likely that the majority of RAV access to the site would be through Cowra via the mid-western highway, although some vehicles would potentially approach from Orange through the Newell Highway and Mitchell Highway. It was anticipated that movements through Bathurst will predominately be generated by construction workers and deliveries by non RAV vehicles, as it is not on the RAV transport route.

Due to the distributed nature and hilly terrain of the site, a number of different local access routes are required to access different parts of the site. It was proposed that the main access route be through Errowanbang and Gap Roads due their high suitability for RAVs and low degree of existing local traffic. Minor upgrade works was expected to be required for some intersections.

2.2 Planning Modification 4

Planning Mod 4 comprises the following changes to the project (Mod 3):

- Increase to the maximum wind turbine envelope including increase of turbine tip height of 10 metres (m) from 150m to 160m and in particular in relation to the traffic assessment an increase in the blade lengths from 60m to maximum 70m; and
- Inclusion of a 132kilovolt (kV) transmission line and switching station proposed to connect the wind farm substation to the electrical grid.

Mod 4 will not increase turbine numbers from the approved layout (Mod 3) and therefore the traffic impact associated with the modification considers:

- the RAV dimensions required to accommodate the larger components (primarily blades); and
- activities associated with the construction and operation of the 132kV transmission line.

The traffic impacts of the 132kV transmission line and switching station was assessed as part of the original traffic impact assessment. This report confirms that the traffic impacts associated with the construction and operation and maintenance of the 132kV transmission line and switching station will remain unchanged from that previously assessed.

Based on the above it is considered that Mod 4 would not result in any more traffic than was assessed as part of the original proposal.

3 Traffic Generation

3.1 Traffic Generation Background

The original traffic assessment for the development identified that over the period of construction the Wind Farm would generate the following one way traffic movements on public roads:

- | | |
|--|-------------|
| • Restricted Access Vehicle (RAV) ¹ | 457 |
| • Total construction vehicle movements | 3910 – 4545 |
| • Employees | 5000 |

Given that transport assessment was based on a larger number of turbines than current modifications propose and that the original proposal also included a 132kV transmission line as is currently proposed within Mod 4, it is considered that Mod 4 would not result in higher traffic volumes than was assessed as part of the approved original development

3.2 Construction Traffic Standard Road Vehicles

Standard road vehicle traffic generation of the Wind Farm is primarily associated with workforce movement and the delivery of non-turbine materials, such as concrete and reinforcement.

The number of these vehicles is unlikely to increase over and above that assessed for the original application.

3.3 RAVs or Over-sized vehicles

As identified within the previous traffic assessment there are a number of wind farm components that require use of RAV's in order to transport them to the site, these include

- Towers sections (4 per turbine)
- Hub (1 per turbine)
- Nacelle (1 per turbine)
- Blades (3 per turbine)
- Generator / transformers (substation)

Mod 4 will not result in any additional components to be transported from previous assessments however the components themselves may increase in size, as follows:

- Tower sections – these may increase by a few metres in order to accommodate the additional length of the blades (3 sections to provide additional 10m of height – tower sections may increase by between 3 and 4m); and
- Blades – these will increase to 70m which is 10m more than previously assessed and 14m more than approved.

¹ Over-mass or over-dimensional vehicle

The biggest vehicle will be that required to transport the blades which for delivery will need to include a trailer that can extend to accommodate a 70m blade. It is noted that fewer of these movements will be required than previously assessed due to the reduction in turbine numbers that has occurred through the initial approval process and modifications prior to Mod 4.

4 Traffic Routes

4.1 Site Access from Regional Centres

The original transport assessment identified long distance deliveries to site involving RAVs will likely approach from one of the following routes:

- From the south via the Mid-Western Highway and passing through Cowra.

It is likely that all RAV deliveries from NSW Ports will be via this route. RAV deliveries from Victoria (via Hume Highway) and Queensland (via Pacific and Hume Highways) will also likely be via Cowra.

- From the north via Mitchell Highway and Millthorpe Road and passing through Orange.

It is noted that any RAV using this route will require special consideration for the turn at Millthorpe Road towards Forest Reefs. It is expected that far fewer RAVs will approach from this route compared to through Cowra

It was also noted that some traffic to the site may also approach from the east through Bathurst. These movements will only involve non RAV vehicles, such as workforce movements and smaller deliveries, as Bathurst is not on the RAV transport route.

No major changes to the regional road network has been made since the approval of the initial DA, so it is expected that the routes identified in the previous assessment will remain.

4.2 Local Access to Site

Local access routes to the site are generally as per the previous approval. However, Errowanbang Road has been upgraded along the full 25km length of its carriageway as part of the South Cadia Access Route project.

The upgrade involves the construction of a new bridge at Dirt Hole Creek, realignment of dangerous corners, and the sealing / reconstruction of existing road to a 9m pavement width. This is expected to make the road trafficable for B-Double trucks.

As the proposed main access route to the wind farm in the initial DA was via Errowanbang Road and Gap Roads, the upgrades to Errowanbang Road will not change the preferred RAV route from previous recommendations. However, it is anticipated that degree of minor works required to accommodate swept paths including vegetation trimming may be reduced or not required at all due to the improved base conditions and widening of the road.

Details of specific works at intersections into and out of the public road system and along tracks to individual turbine site will be considered in more detail as part of the Construction Traffic Management Plan and will include swept paths that will be able to be undertaken with more accuracy once detailed vegetation mapping and technical survey work has been completed.

It is anticipated that specific turbine site access tracks will be determined with regard to minimising vegetation removal, safety and in consultation with relevant parties including land owners.

5 On-Site Access Management and Mitigation

5.1 Access Management

The proposed modification does not introduce any new turbine locations and therefore practical access management will be generally as within the approved concept and will comprise:

- Use of existing or construction of new unsealed tracks, as generally identified and agreed as part of the approved development proposal;
- Potential short sections of sealed track where grades require;
- Where acceptable and subject to an approved Construction Environmental Management Plan localised vegetation removal or cut back; and
- Construction of stormwater culverts as required previously.

5.2 Mitigation Measures

A number of measures will be incorporated during the construction and operation of the wind farm to ensure that transport and traffic impacts arising out of the development are minimised. These measures will be developed in consultation with Blayney Shire Council and be detailed in the Construction Traffic Management Plan for the project.

It is anticipated that Mod 4 would have no material impact on the type of mitigation measures agreed to be provided as part of the existing Project Approval, however the individual level of intersection / vegetation temporary works may increase slightly to accommodate larger vehicles.

6 Traffic and Transport Conclusions

Based on the preceding analysis it is concluded that Mod 4 to the Flyers Creek Wind Farm will:

- Increase to the maximum wind turbine envelope including increase of turbine tip height of 10 metres (m) from 150m to 160m and in particular in relation to the traffic assessment an increase in the blade lengths from 60m to maximum 70m.
- Inclusion of a 132kilovolt (kV) transmission line and switching station proposed to connect the wind farm substation to the electrical grid; and
- Have no change in the number of turbines from the approved layout.

On the basis of the above and in terms of the traffic and transport assessment of the development it is concluded that Mod 4:

- Would not result in any additional traffic movements associated with construction or operation of the wind farm than previously identified;
- Would result in the tower and blade components of the development being longer than previously considered;
- Would increase the largest trailer accessing the site from one capable of transporting a 60m blade to one capable of transporting a 70m blade;
- Will be subject to a Construction Traffic Management Plan and Construction Environmental Plan which will include swept path analysis showing the impact of the largest vehicle on intersections, culverts, bridges and vegetation along the access route; and
- Will be subject to conditions to ensure that damage to the roads during construction and post construction are repaired to the satisfaction of the relevant authorities as per the existing project Approval.

Based on the preceding analysis it is considered that Mod 4 will have no material negative transport impacts compared to those previously identified. Furthermore, all impacts can be managed and mitigated as part of the existing Project Approval conditions and in particular F15, F16, F17 and F21c which provide for pre-construction and during construction studies and plans.



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to life*

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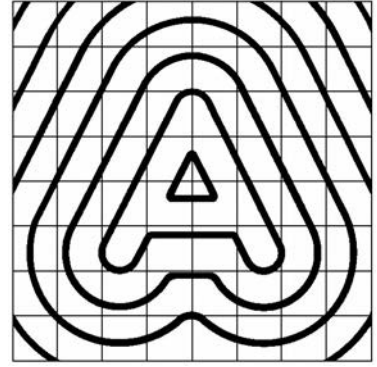
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United Arab Emirates, Vietnam, Zambia,

Appendix H

Electromagnetic Interference Assessment (Telecommunications) (Aitken & Partners)



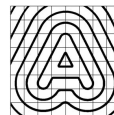
Flyers Creek Wind Farm Pty Ltd

Flyers Creek Wind Farm

Electromagnetic Interference Assessment

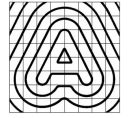
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Contents

1. INTRODUCTION	4
1.1 Background	4
1.2 Legislative Requirements	4
1.3 Clean Energy Council Best Practice Guidelines	7
1.4 Consultant's Experience	7
2. INTERFERENCE MECHANISMS	10
2.1 Overview	10
2.2 Path Obstruction	10
2.3 Shadowing	10
2.4 Mirror-like Reflections	11
2.5 Scattering	11
2.6 MF Re-Radiation	11
2.7 Terrain Obstructions	12
3. BROADCASTING	14
3.1 Radio and Television Service Areas	14
3.2 MF AM Radio	14
3.3 FM Radio	16
3.4 Television	17
3.5 Satellite Television	19
3.6 Digital Radio Broadcasting	19
4. FIXED LINKS	21
4.1 Modification 4	21
4.2 Fixed Links – Point-to-Point	21
4.3 Clearance from Electricity Transmission Lines	44
4.4 Point-to-Multipoint	49
5. MOBILE RADIO & CELLULAR	53
5.1 Mobile Radio and Cellular Planning	53
5.2 Mobile Radio	53
5.3 CB Radio Repeaters	54
5.4 Spectrum Licences	54
5.5 Summary	56
6. RADAR, AVIATION & DEFENCE	58
6.1 Aviation Services	58
6.2 Radiodetermination (RADAR) Services	58
6.3 Defence Services	58
7. EMISSIONS FROM TURBINES & POWER LINES	60
7.1 Emissions from Turbines	60
7.2 Emissions from Power Lines	60
8. CONCLUSIONS	62
9. REFERENCES	65



Introduction



1. INTRODUCTION

1.1 BACKGROUND

This electromagnetic interference assessment was commissioned by Flyers Creek Wind Farm Pty Ltd to accompany the Planning Modification 4 application and was performed by John Aitken, a director of Aitken & Partners.

The assessment updates a previous assessment performed by Lawrence Derrick & Associates for the Flyers Creek Wind Farm project on 22 December 2010 [1]. The Lawrence Derrick & Associates report was based on the original layout of up to 44 turbines, whereas the current approved layout has 38 turbines, an overall reduction of 6 turbines.

Modification 4 includes changes to the maximum turbine envelope and inclusion of a 132kV transmission line and switching station. The location of the turbines in Modification 4 is unchanged from the approved locations.

The changes to the maximum turbine envelope are listed in the table below.

Turbine Component (m)	Approved Turbine	Proposed Turbine
Tip Height	Up to 150 m	Up to 160 m
Rotor Diameter	Up to 112 m	Up to 140 m
Blade Length	Up to 56 m	Up to 70 m
Hub Height	80 m to 100 m	90 m to 92 m

Table 1-1 Changes to the maximum turbine envelope

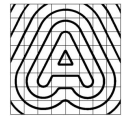
1.2 LEGISLATIVE REQUIREMENTS

1.2.1 Radiocommunications Legislation

The *Radiocommunications Act 1992* is the overarching legislation that deals with management of the radio frequency spectrum. The effects of radio frequency energy on people are managed under the *Radiocommunications (Electromagnetic Radiation — Human Exposure) Standard 2014* and the electromagnetic compatibility of equipment is managed under the *Radiocommunications (Electromagnetic Compatibility) Standard 2008*. Both these standards were made under subsection 162 (1) of the Radiocommunications Act.

The Australian Media and Communications Authority (ACMA) is the organisation responsible for implementation and management of the radio communications legislation.

The ACMA manages radio frequency spectrum usage through a licensing scheme and a spectrum allocation plan that ensures that each allocation of spectrum can be used for its assigned purpose, without intolerable interference from other uses.



Broadcasting

A part of the radio frequency spectrum is assigned for radio and television broadcasting. The allocation of this spectrum is designed to ensure adequate coverage of defined areas for radio and for television broadcasts. There is no guarantee or mandate for 100% coverage of any area and the coverage definitions are based on achieving coverage of a certain percentage of any area for a certain percentage of the time. The broadcasting and television plans make assumptions about the quality and performance of the antenna systems and receivers that will be used by the public.

Over recent years the ACMA has planned and managed the transition from analogue to digital television throughout Australia. This process has included re-planning of the allocation of television channels and the polarisation of television signals to optimise the use of allocated spectrum. The replanning process has mostly occurred since the 2012 report.

Fixed Links

Microwave dishes on radio communication towers and buildings are a familiar sight. These dishes are one of the forms of “fixed links” or “point to point” communication systems. The links usually transmit in both directions between two defined sites. The performance of these links is critical to their users and the ACMA spectrum management process has special provisions to ensure that the links can operate without unacceptable interference. The planning process for these links includes assessment of other links in the area and the extent to which they will interfere with the planned link and vice versa.

Another category of fixed link is “point to multipoint”. In this type of link there is a master location that communicates with a number of other locations; for example, a number of water monitoring sites. The link to each point is managed in the same manner as an individual fixed link.

Mobile Radio and Cellular

Mobile radio and cellular telephone systems have defined base station locations and then defined areas of coverage. The performance of the communication systems within their coverage areas is defined statistically, in a similar manner to that of broadcast systems. There is no guarantee of coverage at any particular location but there is a guarantee that there will not be intolerable interference from other sources at any location within the coverage area.

Emissions from Turbines and Power Lines

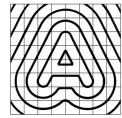
The radio communications legislation limits the electromagnetic radiation from wind farm turbines, along with every other electric component of a wind farm. The emissions are limited by the Radiocommunications (Electromagnetic Compatibility) Standard.

Interference

It is important to recognise that the radio communications legislation only considers electromagnetic energy. It does not consider the physical shape or location of devices that could interfere with radio communication. For example, a building that blocks the path of a microwave link is not covered by the radio communications legislation. Neither are reflections or obstruction of paths by wind turbines.

In the Radiocommunications Act 1992 interference means:

(a) in relation to radiocommunications—interference to, or with, radiocommunications that is attributable, whether wholly or partly and whether directly or indirectly, to an emission of electromagnetic energy by a device; or



(b) in relation to the uses or functions of devices—interference to, or with, those uses or functions that is attributable, whether wholly or partly and whether directly or indirectly, to an emission of electromagnetic energy by a device.

Compliance with these requirements is dealt with through the electromagnetic compatibility processes; identified by compliance certification from the manufacturer of the device.

1.2.2 Project Approval

Project Approval for Flyers Creek Wind Farm under Section 75J of the Environmental Planning & Assessment Act 1979, was given on 14 March 2014. The Project Approval includes conditions relating to electromagnetic interference:

D9. Any overhead transmission line associated with the Project shall be designed, constructed and operated to minimise the generation of corona and aeolian noise as far as feasible and reasonable at nearest existing sensitive receivers.

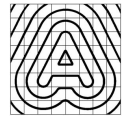
D14. Prior to the commencement of construction, the Proponent shall:

- (a) consult with the NSW Government Telecommunications Authority and other registered communications licensees (including emergency services) to ensure that risks to these services are minimised as far as feasible and reasonable. This may include the installation of additional radio sites or services to ensure coverage of radio communications are not degraded;*
- (b) in the event that any disruptions to radio communication service links (installed before construction of the Project) arise as a result of the Project, the Proponent shall undertake appropriate remedial measures in consultation with the NSW Government Telecommunications Authority and relevant licensee to rectify any issue, including arranging the deployment of temporary measures in order to maintain effective coverage whilst more permanent measures are effected, within three months of the problem being identified, and at the expense of the Proponent;*
- (c) consider remedial measures, including:*
 - i. modification to or relocation of the existing antennae;*
 - ii. installation and maintenance of additional radio sites or services;*
 - iii. installation of a directional antennae; and / or*
 - iv. installation of an amplifier to boost the signal strength.*

G3. Prior to the commencement of commissioning of the Project, the Proponent shall undertake an assessment of the existing quality of the television, radio and telephone/internet transmission available at a representative sample of receivers located within five kilometres of any wind turbine.

G4. In the event of a complaint from a receptor located within five kilometres of a wind turbine regarding television / radio / telephone / internet transmission during the operation of the Project, the Proponent shall investigate the quality of transmission at the receptor compared with the pre-commissioning assessment and where any transmission problems can be reasonably attributable to the Project, rectify the problems as soon as possible and within three months of the receipt of the complaint, through the implementation of measures including:

- (d) modification to or replacement of receiving antenna;*
- (e) installation and maintenance of a parasitic antenna system;*



- (f) *provision of a land line between the affected receptor and an antenna located in an area of favourable reception; and / or*
- (g) *other feasible measures.*

If interference cannot be overcome by the measures outlined in (a) to (d), the Proponent shall negotiate with the impacted landowner(s) about installing and maintaining a satellite receiving antenna. The Proponent shall be responsible for all costs associated with any such mitigation measures.

1.3 CLEAN ENERGY COUNCIL BEST PRACTICE GUIDELINES

The Clean Energy Council has issued Best Practice Guidelines [2] for implementation of wind energy projects in Australia. These guidelines, originally issued in 2006, were updated in the 2013 version. The Best Practice Guidelines discuss electromagnetic interference in Appendix 9. They note that wind farms may affect telecommunications systems through the following mechanisms:

- *the wind turbine tower may obstruct, reflect or refract the electromagnetic waves used in a range of communications systems for transmission*
- *the rotating blades may have similar effects, on a time- variable basis. In some cases ghosting of TV receivers close to the wind farm may occur where metal blades (or those with metallic cores or metal components such as the lightning protection system) act as an aerial to on-transmit the communication signal*
- *the wind turbine's electrical generator can produce electromagnetic interference, which may need to be suppressed by shielding design and maintenance of wind turbines (although in practice, a generator is little different from a typical electrical motor and it is quite rare for a wind turbine generator to present such a problem).*

The Guidelines suggest the following criteria for assessment:

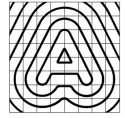
- *a wind turbine is within 2 km of a radiocommunications transmission site; or within 2 km of a radiocommunications receiver and in line with the transmission site*
- *a wind turbine is within the maximum second Fresnel zone of a point to point radio link.*

These Guidelines further refer to the *Technical Information and Coordination Process Between Wind Turbines and Radiocommunication and Radar Systems*, published by the Radio Advisory Board of Canada (RABC) & Canadian Wind Energy Association (CanWEA), 2007 [3]. The provisions of the Canadian Guidelines are discussed later in this report.

1.4 CONSULTANT'S EXPERIENCE

JJ Aitken & Partners Pty Ltd (trading as Aitken & Partners) commenced operations in 1983, practicing in radio communications consultancy. Aitken & Partners currently practices in the areas of communications, broadcasting and electromagnetic compatibility engineering.

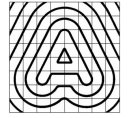
Aitken & Partners has been active in television coverage design and implementation, radio broadcasting systems and link design. We designed the transmission and



rebroadcast system for MVQ6 in Mackay (Queensland), adding a large geographic area and many mining towns to their coverage footprint.

The National Transmission Agency, which was then responsible for ABC and SBS television and radio transmitters throughout Australia, commissioned Aitken & Partners (as part of a multi-discipline team) to perform audits and then supervise upgrades of over twenty AM radio, FM radio and television sites around Australia. The work included coverage tests for many of the transmitters before and after the upgrading.

Aitken & Partners has performed pre-construction television and radio surveys for wind farms at Bodangora, Crookwell 2, Mt Gellibrand, Gunning, Woodlawn, Mortlake South, Gullen Range, Newfield, Tarago and Cherry Tree.



Interference Mechanisms



2. INTERFERENCE MECHANISMS

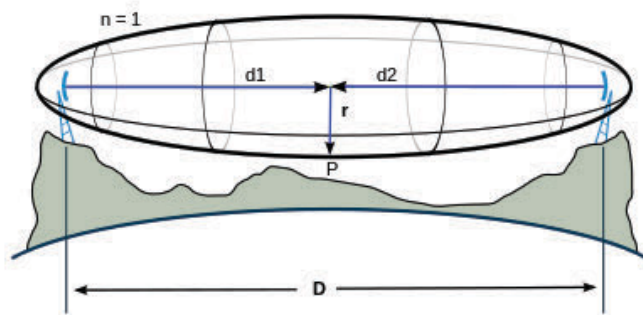
2.1 OVERVIEW

There are many possible interactions between wind turbines and communication systems, however, the most significant interference mechanisms can be summarised in a few categories. The discussion in the following section is derived in part from the Canadian technical information [3] and uses some diagrams from [3].

2.2 PATH OBSTRUCTION

High performance radio communication systems, such as microwave links, require a direct “line of sight” between the transmitting and receiving antennas. However, not only is a direct line of sight required, but there must be an unobstructed area around the line of sight, usually defined as some number of *Fresnel Zones*. The Fresnel zone is a spheroid that on which any reflected wave is either in phase with the direct signal (odd numbered Fresnel Zones) or out of phase with the direct signal (even numbered Fresnel Zones). Wave paths that are in phase with the direct signal add to the direct signal, enhancing it, while those that are out of phase with the direct signal cancel some part of the direct signal.

For microwave link design it is standard practice to ensure that at least 0.6 of the First Fresnel zone is clear of obstructions.



In Figure 2-1 D is the distance between the transmitter and receiver; r is the radius of the first Fresnel zone (n=1) at point P. P is d₁ away from the transmitter and d₂ away from the receiver.

Figure 2-1 Fresnel Zone (Wikipedia)

The Fresnel zone radius for a wavelength λ is defined as $F_n = \sqrt{\frac{n \lambda d_1 d_2}{d_1 + d_2}}$.

For 0.6 of the first Fresnel zone, the required clearance in metres is

$$F_{1(0.6)} = 10.38 \sqrt{\frac{d_1 d_2}{\text{Frequency} \times D}}$$

where the frequency is in MHz and the distances D, d₁ and d₂ are in metres.

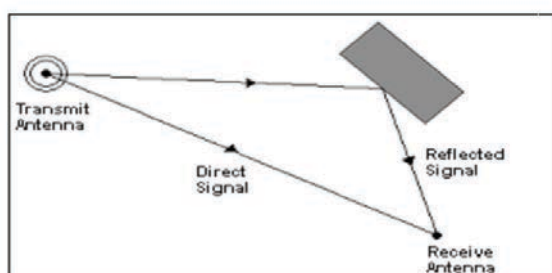
2.3 SHADOWING

Large obstacles, such as buildings, hills or wind farms can create shadowed areas where the line of sight from the transmitter to the receiver is blocked. The size of the shadowed area depends on the location and height of the obstacle. The effect of the



obstacle depends on its shape and position, with large rounded obstacles causing more loss of signal than pointed or “wedge” shaped obstacles. Any obstacle that intrudes into the area beyond 0.6 of the first Fresnel zone will reduce the signal at the receiver, with greater reduction in signal as a greater portion of the path is blocked.

2.4 MIRROR-LIKE REFLECTIONS

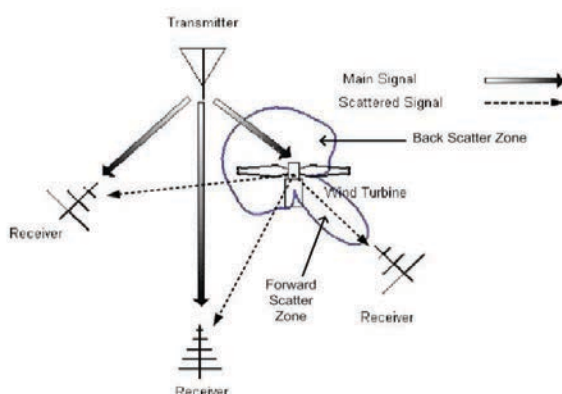


Mirror-like (specular) reflections are caused when the signal from the transmitter is reflected from a surface before reaching the receiving antenna. The reflected signal travels further than the direct signal and therefore arrives at the receiver later than the direct signal.

The reflected signal can degrade the direct signal, either due to cancellation due to the difference in path length, or to interference due to delayed signals having different modulation information from the direct signal.

Digital transmission techniques are designed to reject or compensate for some reflected signals. Delayed signals were most evident as “ghosting” on analogue television images.

2.5 SCATTERING



When a radio signal reaches a wind turbine, the support tower and the rotating blades of the turbine can produce a pulsed scattering of the signal, synchronised with the rotational speed of the blades. These scattered pulses include a Doppler component, which produces variations in the resulting signal phase and amplitude reaching a receiver. This scattering occurs all around the wind turbine but presents different characteristics in the forward scatter and back scatter zones.

In the forward scatter zone, a relatively narrow sector beyond the turbine, the effect on the transmitted signal is analogous to shadowing, with the signal varying in amplitude and phase in synchronism with the rotation of the turbine blades.

In the back scatter zone, a wider sector between the turbine and the transmitter, the effect is similar to a mirror reflection. However, here too, the scattered signal contains both phase and amplitude variations when the wind turbine is operating.

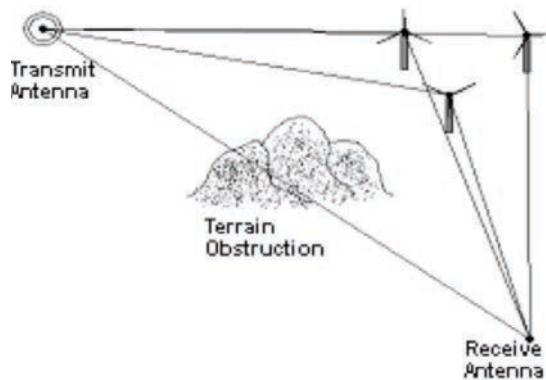
2.6 MF RE-RADIATION

If the turbine support structures are sufficiently tall and are close to medium frequency (MF) (usually AM radio) broadcasting stations, the structures can re-radiate the radio

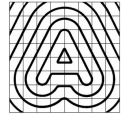


signal. This must be taken into account if a wind farm is located close to an MF radio transmitting site, particularly if the site uses a directional antenna system.

2.7 TERRAIN OBSTRUCTIONS



The impact of a turbine on a radio signal can be more severe if the direct path between the transmitter and receiver is partially obstructed by terrain, while the reflected path from the turbine is not obstructed. In this situation the wanted (direct) signal can be similar to or lower than the unwanted (reflected) signal from the turbine. The detrimental effects of turbine operation are then more pronounced.



Broadcasting



3. BROADCASTING

3.1 RADIO AND TELEVISION SERVICE AREAS

The Australian Communications and Media Authority defines the licence areas and service areas for broadcast and television services. The defined areas are those in which the transmission from a licensed station must achieve a certain level and in which their transmissions will be protected from interference.

It is often the case that transmissions from stations outside the service area of a station will be heard clearly in another service area. This is considered fortuitous reception. FM radio and television reception from distant stations may be available in locations where the terrain favours transmission, such as high areas, which often have reception from a number of FM radio stations and television stations that are not in the defined service area. This reception is not guaranteed and is not protected from interference.

The coverage information and coverage predictions provided by the ACMA have been used in this report, in conjunction with field surveys.

3.2 MF AM RADIO

3.2.1 Overview

Medium Frequency (MF) AM radio stations generally have large coverage areas and transmission at these frequencies is unaffected by wind farm turbines. The turbine structures can cause distortion of antenna radiation patterns if the structures are close to the AM transmitter. There is also a potential hazard from induced current on cranes and other structures if the construction is very close to a radio transmitting site.

The MF radio stations in the area surrounding the wind farm are shown in Figure 3-1.

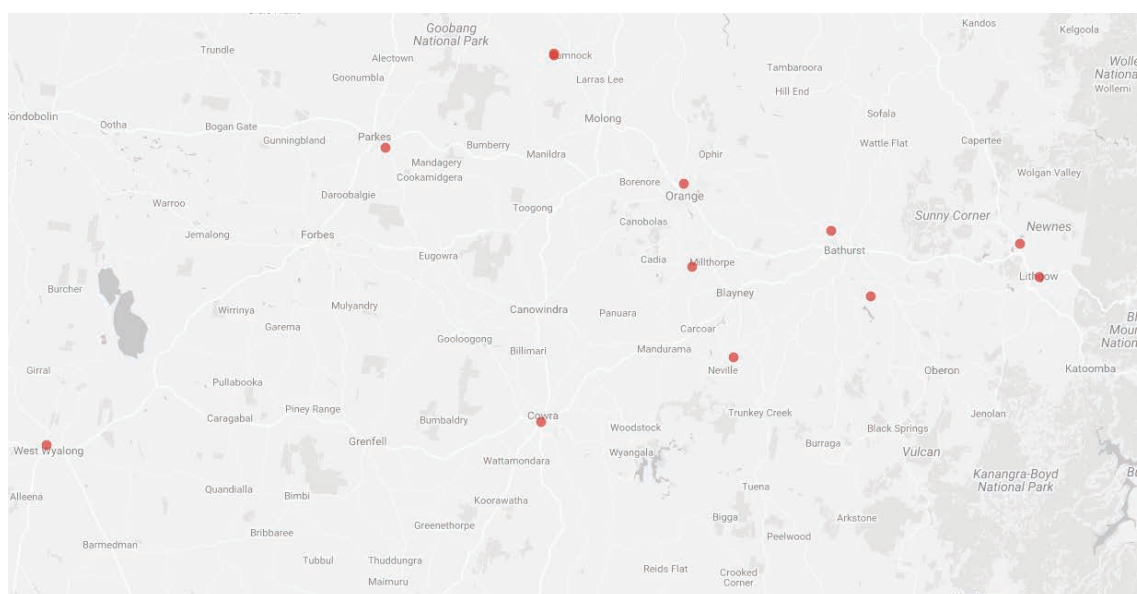


Figure 3-1 AM Broadcasting Sites

The closest AM radio station is the Orange commercial broadcaster on 1809 kHz at 43 Gartholme Lane, Forest Reefs.



There is also a narrowband area service on 1620 kHz at Waverleigh Park, Blayney. The Blayney service is at low power (400 W) and is intended to have only local coverage.

The closest transmitter is the 1089 kHz service, which is more than 6 km from the nearest turbine (Turbine 3). There is adequate separation between this radio transmitter and the wind farm.

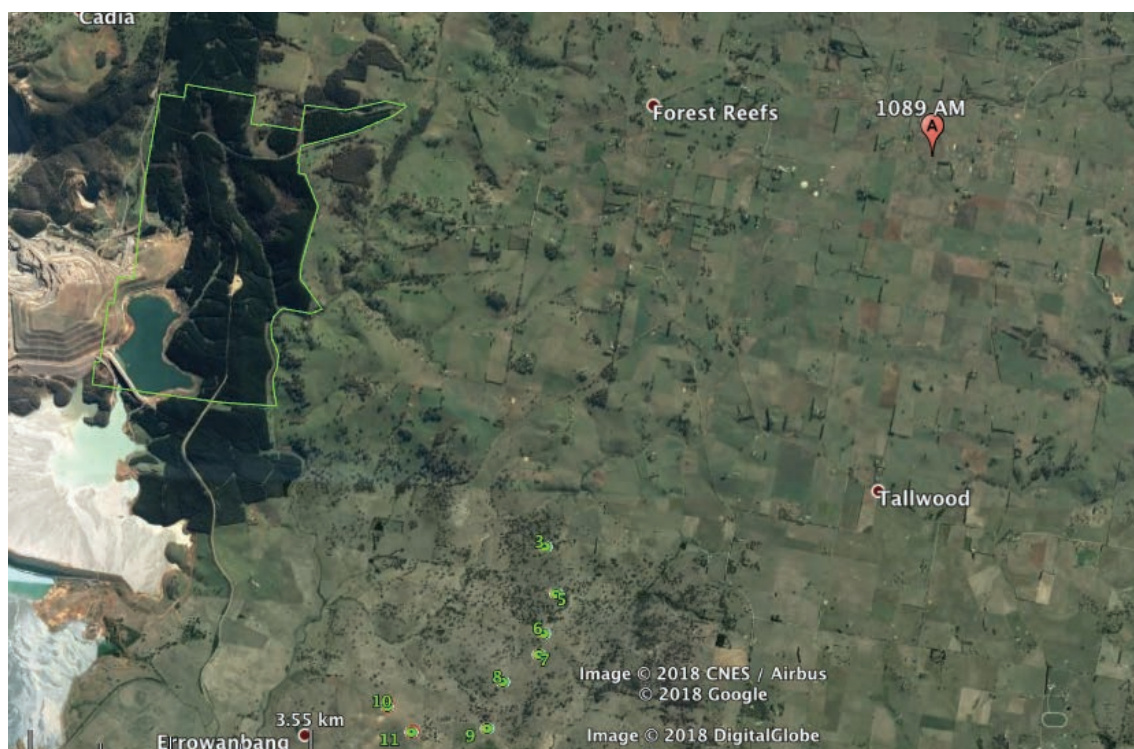


Figure 3-2 1089 kHz AM Radio transmitter location

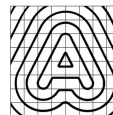
The AM radio stations defined in the Central Tablelands Licence Area Plan for Radio are listed below. The power shown in the table is the effective isotropic radiated power (EIRP).

Call Sign	Licence	Area Served	Frequency	Power
2CR	National	Cumnock	549 kHz	153 kW
2EL	Commercial	Orange	1089 kHz	22 kW

Table 3-1 AM Radio stations licenced for Central Tablelands area

3.2.2 *Potential impact of Modification 4*

The changes in the maximum turbine envelope identified in Table 1-1 will have no material effect on AM radio reception. The turbine locations are unchanged from the approved layout so there is no change in separation from AM radio stations.



3.3 FM RADIO

3.3.1 Overview

FM radio stations serving the Central Tablelands and Orange area are listed below. There are some low power stations in Blayney and Carcoar that have very limited range and are not listed here. The power shown in the table is the effective radiated power (ERP).

Call Sign	Licence	Area	Frequency	Power
2JJJ	National	Central Tablelands	101.9 MHz	80 kW
2ABCFM	National	Central Tablelands	102.7 MHz	80 kW
2ABCRN	National	Central Tablelands	104.3 MHz	80 kW
2CCB	Community	Orange	103.5 MHz	5 kW
2OAG	Commercial	Orange	105.1 MHz	5 kW
2GZF	Commercial	Orange	105.9 MHz	5 kW
2KY	Open Narrowcast	Orange	106.7 MHz	5 kW
2OCW	Community	Orange	107.5 MHz	5 kW
2BS	Commercial	Blayney	89.3 MHz	1 kW
2JJJ	Retransmission	Cadia	88.9 MHz	10 W
2ABCRN	Retransmission	Cadia	89.7 MHz	10 W
2OAG	Retransmission	Cadia	90.5 MHz	10 W
2GF	Retransmission	Cadia	92.9 MHz	10 W

Table 3-2 FM Radio Stations

The Canadian guidelines [3] recommend analysis of FM transmitters that are within 2 km of a turbine. There are no turbines within 2 km of an FM transmitter.

With the exception of areas very close to a turbine (a few hundred metres), FM radio reception should be unaffected.

3.3.2 Potential impact of Modification 4

The location of the turbines is unchanged from that in the approved design. Modification 4 does not introduce any change to FM reception.



Figure 3-3 FM Broadcasting Services within 30 km radius of the wind farm

3.4 TELEVISION

3.4.1 Overview

The terrestrial television services that serve the area neighbouring the wind farm are listed below. All television services are digital.

Service	Channel	Frequency MHz	Polarisation	Power
CENTRAL TABLELANDS				
WIN	35	578.5	Horizontal	350 kW
ABC	36	585.5	Horizontal	350 kW
CBN	37	592.5	Horizontal	350 kW
CTC	38	599.5	Horizontal	350 kW
SBS	39	606.5	Horizontal	350 kW

Table 3-3 Television Services

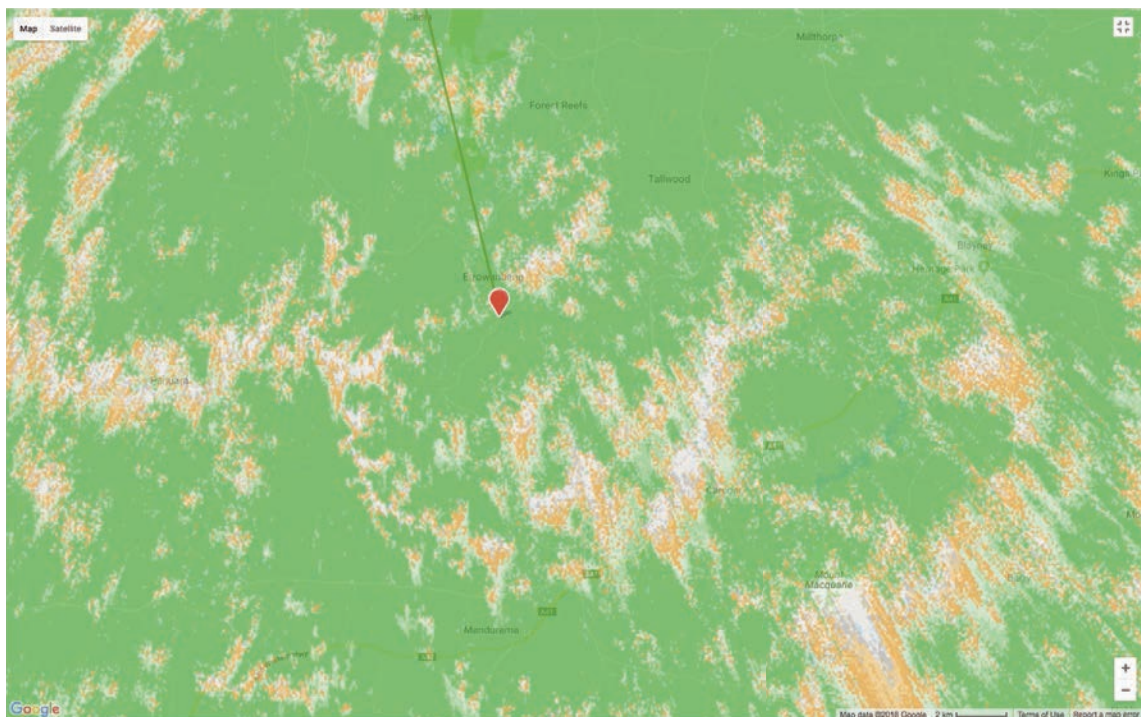
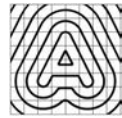


Figure 3-4 ACMA Television coverage predictions for the area

The ACMA television coverage predictions indicate that the Central Tablelands transmitters provide the most effective coverage throughout the area surrounding the wind farm. The coverage areas and channels have changed significantly since the 2010 analysis. Based on theoretical calculations, the areas shown in green in Figure 3-4 have good coverage, those shown in orange have variable coverage and grey or white areas have no coverage.

It is possible for wind farms to interfere with television reception through reflections from the turbine structures and blades. The transmissions from Central Tablelands are horizontally polarised so the reflected signals are of greatest impact when the reflecting surface is horizontal. Vertical surfaces, such as the wind turbines will have little or no impact on the television reception.

The most recent ITU studies provide improved models for analysing interference to digital television, taking into account larger groups of turbines. The analysis process remains complex and incomplete, so field measurements will be performed prior to construction to provide a baseline and more comprehensive data.

The field measurements will be performed in accordance with Condition G3 of the Project Approval:

G3. Prior to the commencement of commissioning of the Project, the Proponent shall undertake an assessment of the existing quality of the television, radio and telephone/internet transmission available at a representative sample of receivers located within five kilometres of any wind turbine.

3.4.2 Potential impact of Modification 4

Modification 4 does not introduce any change to the approved turbine locations, therefore the area potentially affected by the wind farm remains unchanged from that in the approved design.

The increased maximum envelope of the turbines increases the maximum horizontal reflecting area by 25% (blade length increase from 56 m to 70 m). This may increase



the magnitude of the reflected signal when the orientation of the blade (both in rotation and in azimuth) is such that interference can occur.

A detailed assessment of the existing quality of television, radio and telephone/internet will be undertaken prior to the commencement of construction of the Project (Condition G3 of the Project Approval) and should there be any impacts identified once the project is operational then the mitigation measures prescribed in Project Approval condition G4 will be followed.

3.5 SATELLITE TELEVISION

Satellite television services are used at many locations in the vicinity of the wind farm, as there is limited terrestrial television coverage. The satellite antennas are aimed towards a satellite that is in geo-stationary orbit above the equator, with an elevation angle of around 50 degrees above the horizontal. Interference is most unlikely.

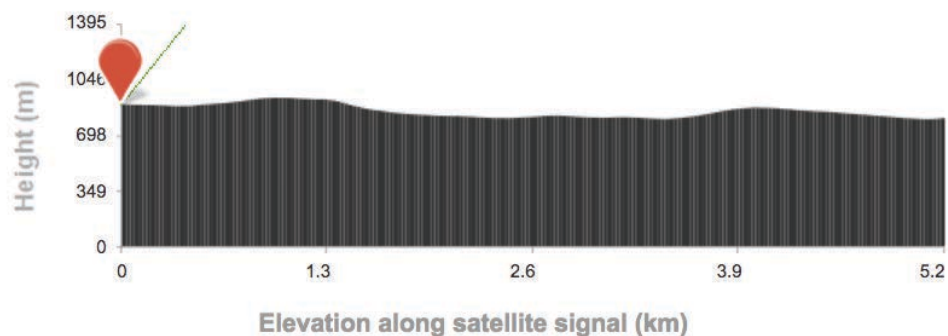
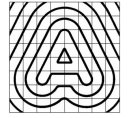


Figure 3-5 Typical Satellite Television reception path

Satellite television reception will not be affected by the changes proposed in Modification 4.

3.6 DIGITAL RADIO BROADCASTING

There are no digital radio broadcasting sites serving the area surrounding Flyers Creek Wind Farm.



Fixed Links



4. FIXED LINKS

4.1 MODIFICATION 4

The following analysis considers the impact of the wind farm on each of the identified fixed links. The analysis considers the maximum turbine envelope as proposed in Modification 4.

The turbine locations are unchanged from the Project Approval: the significant changes in Modification 4 are an increase in maximum blade height of 10 m and an increase in the maximum rotor radius of 29 m (rotor diameter increased from 112 m to 140 m).

4.2 FIXED LINKS – POINT-TO-POINT

Microwave dishes on radio communication towers and buildings are a familiar sight. These dishes are one of the forms of “fixed links” or “point to point” communication systems. The links usually transmit in both directions between two defined sites. The performance of these links is critical to their users and the ACMA spectrum management process has special provisions to ensure that the links can operate without unacceptable interference. The planning process for these links includes assessment of other links in the area and the extent to which they will interfere with the planned link and vice versa.

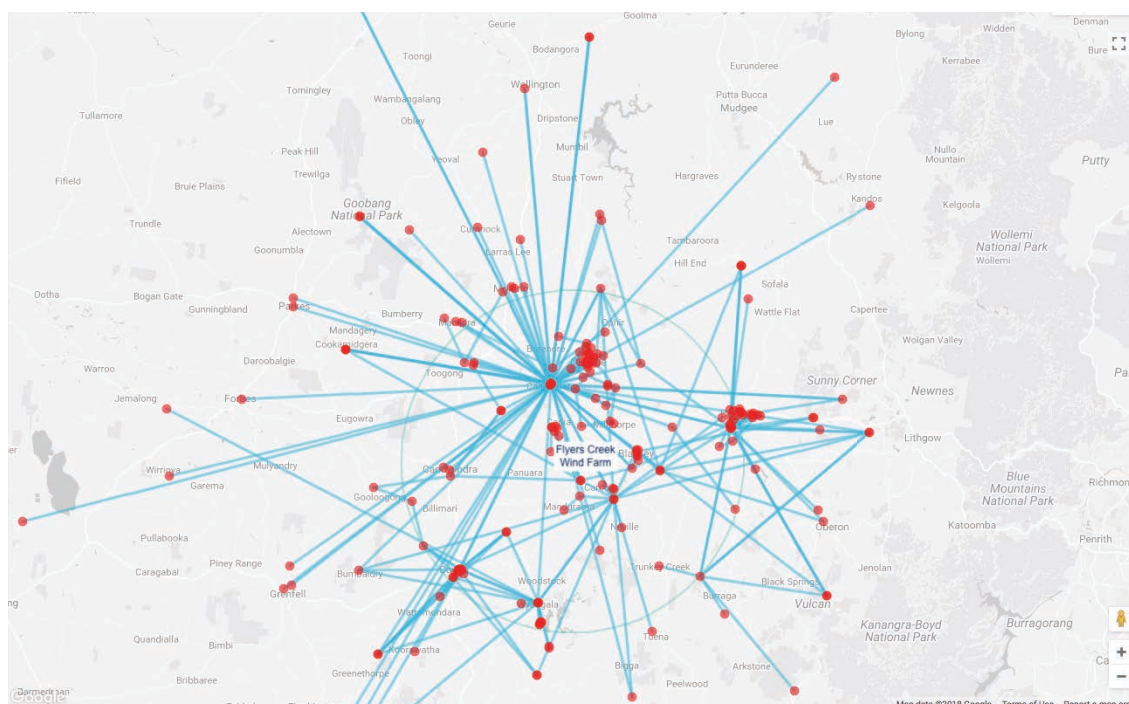


Figure 4-1 Fixed point-to-point links within 50 km of the wind farm

There is a separate licensing process for each link and a licence is allocated for each direction of the link. The licence numbers for each link are associated. The radio communication site at each end of the link is given a unique identification code, as there may be many links at a particular site. Often there are sites owned by different operators in close proximity, particularly on prominent locations such as Mt Canobolas.



Fixed links pass over the wind farm, some from the Burnt Yards radio site that is within the wind farm area, others from distant locations. The links that pass over the wind farm are summarised in Table 4-1 and can be seen in overview in Figure 4-1.

There may be more than one licenced radio link on any path between locations and this is true of most of the paths. For convenience, each of the paths discussed in this report has been given an alphabetic reference, eg "Path A", and the various licences are summarised under the relevant link path.

Path	From	To	Licences
A	Burnt Yards	Errol Trig, Blayney	1921832
B	Mt Coonambro	Mt Macquarie	1924312 1924314
C	Pennsylvania Fire Tower	Mt Canobolas	1205850
D	Bigga	Mt Canobolas	1923871
E	Burnt Yards	Cadia Road, Springside	1927529
F	Burnt Yards	Mt Canobolas	1804727 1917964
G	Mt Macquarie (Transgrid)	Mt Canobolas	1144687
H	Mt Macquarie (Reece)	Mt Canobolas	1207663 1566706 1961041
I	Canowindra	Burnt Yards	1921927

Table 4-1 Fixed Links

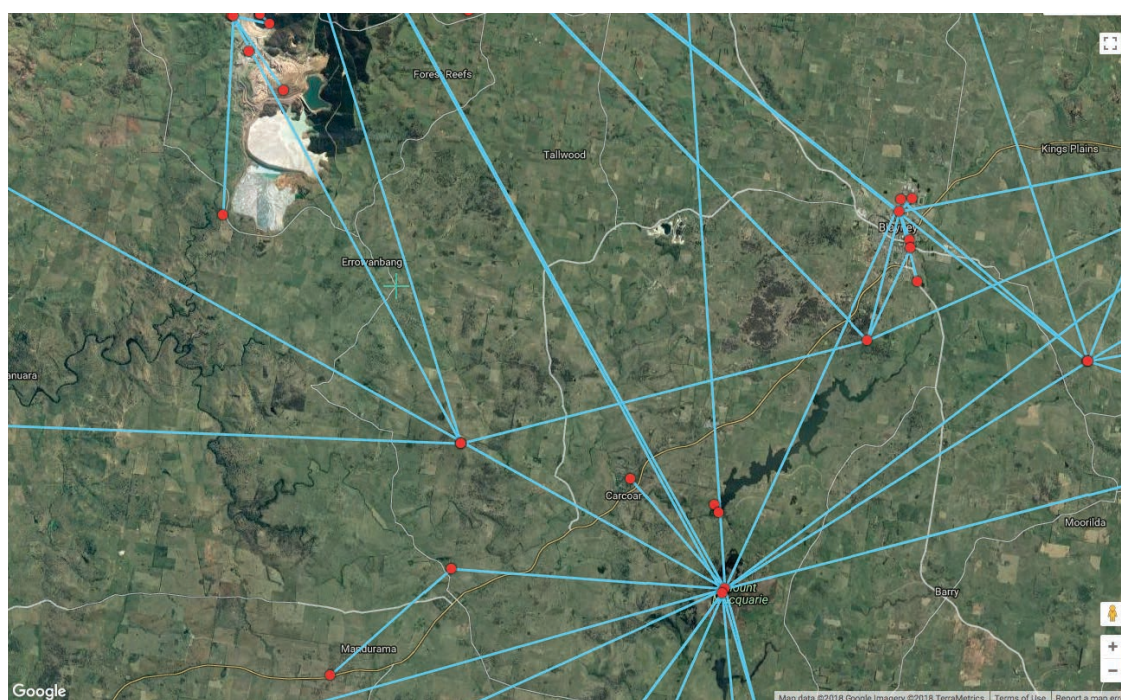


Figure 4-2 Fixed links crossing the wind farm



4.2.1 Path A – Burnt Yards to Errol Trig, Blayney

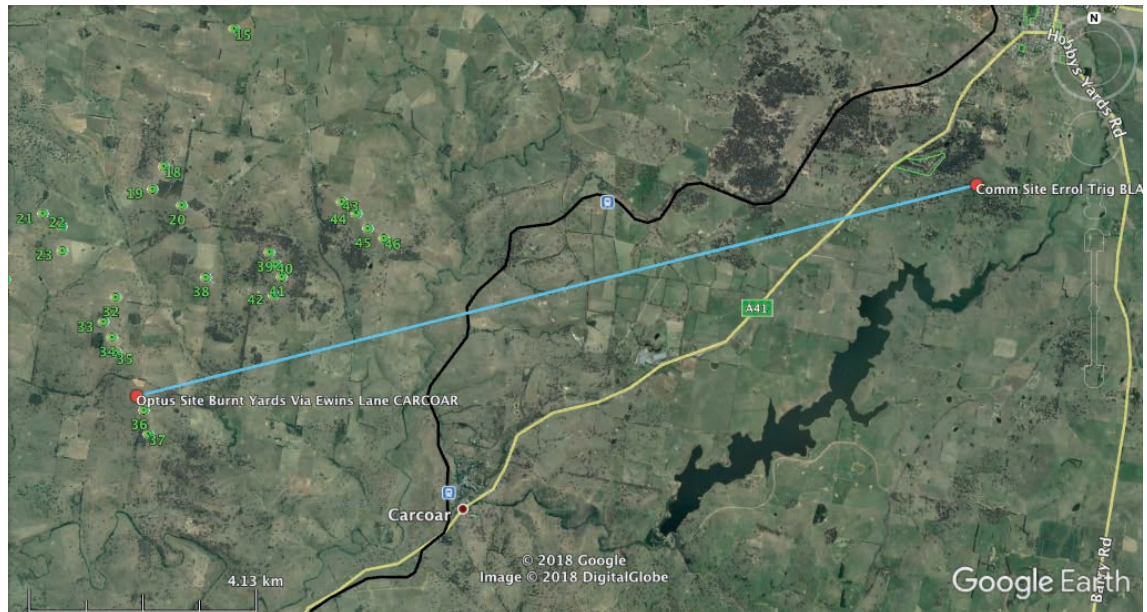


Figure 4-3 Path A – Burnt Yards to Errol Trig

This path does not cross any turbines, the nearest turbine being Turbine 36. The path is approximately 270 metres from the centre of Turbine 36.

A detail of the area around Turbine 36 is shown in Figure 4-4, with the area swept by the turbine blades show as a circle in red.

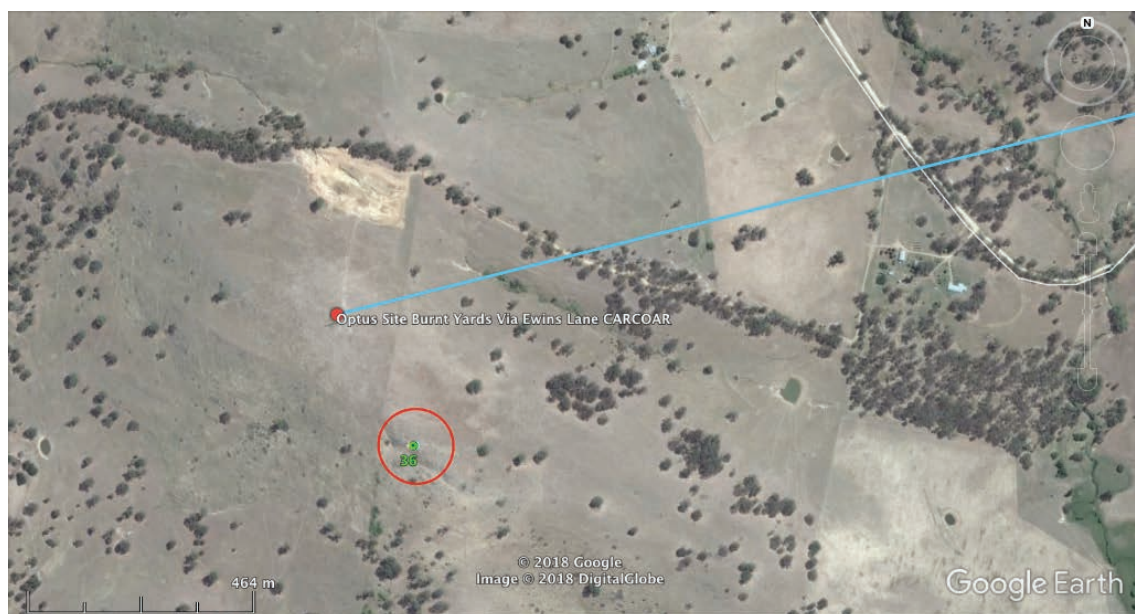


Figure 4-4 Path A – Detail at Burnt Yards

Approved Project

The wind farm layout in the approved project will not affect this path.

Potential impact of Modification 4

The changes proposed in Modification 4 have no impact on this path: it remains unaffected by the wind farm.



4.2.2 Path B – Mt Coonambro to Mt Macquarie

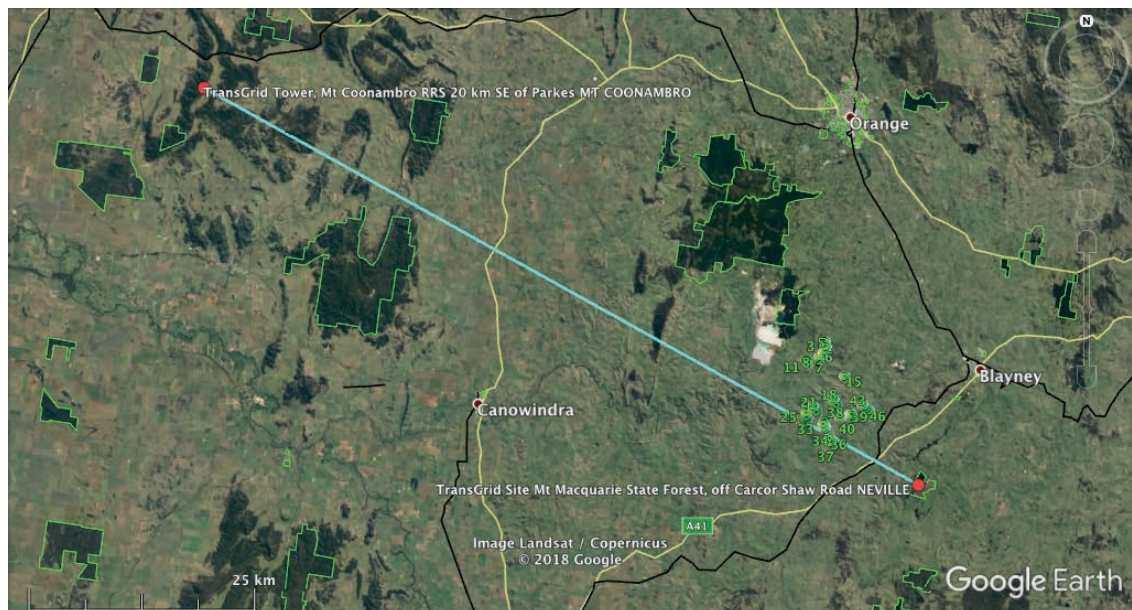


Figure 4-5 Path B – Mt Coonambro to Mt Macquarie

The path travels over Turbine 31 and through a group of turbines. The first Fresnel zone around the path is plotted in Figure 4-6, showing the relationship with the turbines in this area.

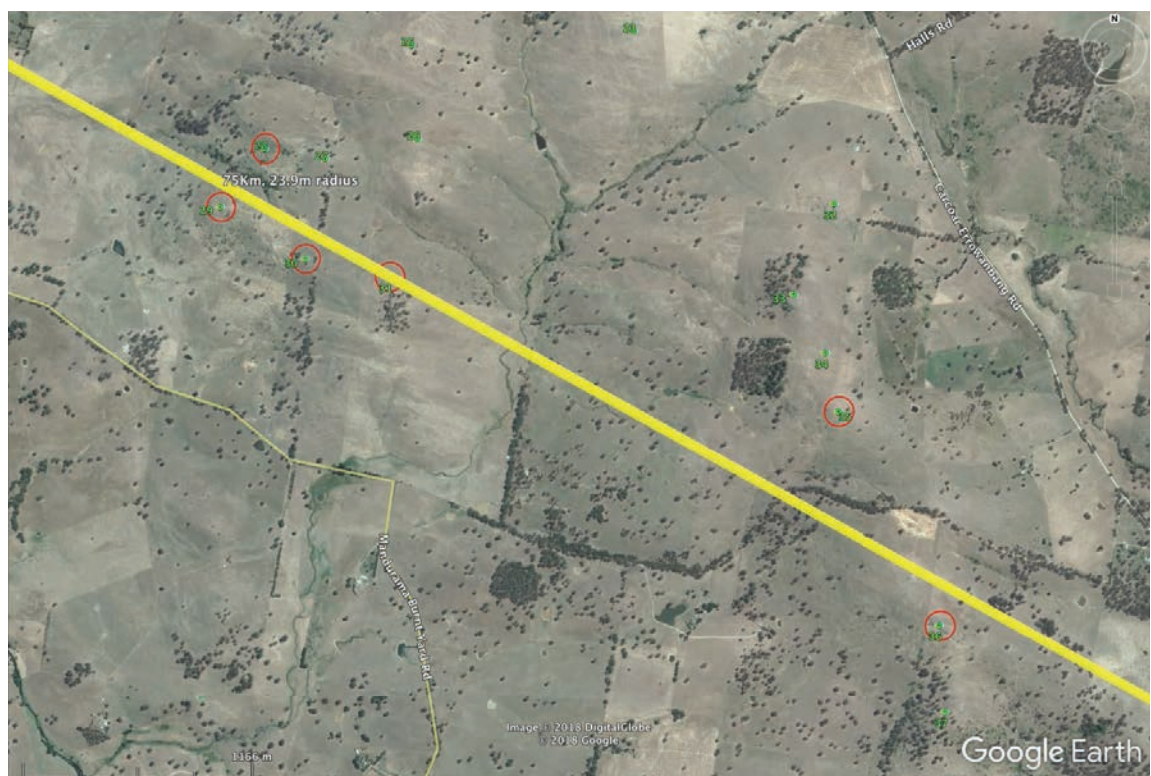


Figure 4-6 Path B - First Fresnel zone shown in yellow. The red circles indicate the area swept by the turbine blades



The turbine closest to the path is Turbine 31, which in plan view is directly on the path between the radio sites. The path is well above the turbine, as the transmitting and receiving sites are at higher elevation.

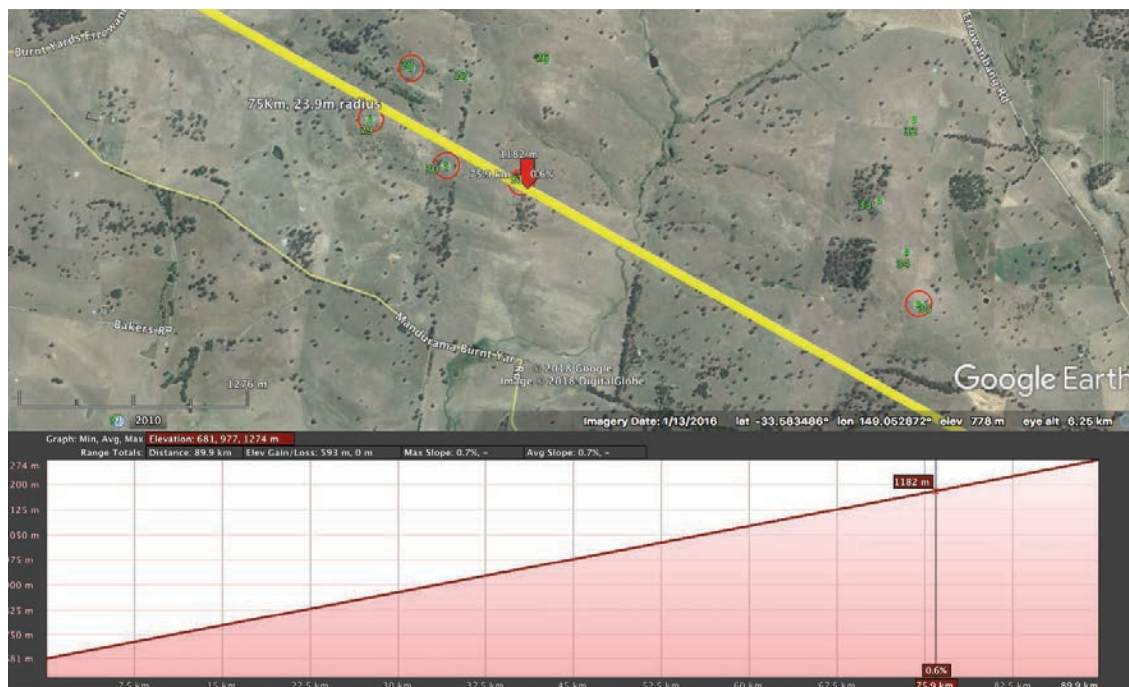


Figure 4-7 Line of sight path elevation

The calculations in the following table have been based on the link with the lowest frequency on this path, as the lowest frequency has the largest Fresnel zone radius.

Location	Ground m AHD	LOS Height m AHD	Refraction (k=1) m	Fresnel (F ₁) m	Blade Tip m AGL	Clearance m
Mt Coonambro	621	681				
Turbine 31	835	1182	0	25	160	162 m
Mt Macquarie	1210	1277				

Table 4-2 Clearance for Path B at Turbine 31 – Typical Conditions

Effect of changes in propagation conditions

The refractive index of the atmosphere varies with time and this has the effect of reducing or increasing the height of the radio path above ground. Under normal atmospheric conditions the radio ray line is refracted away from the ground, reducing the effect of the earth's curvature. The apparent “flattening” of the earth's curvature is described as an increase in the radius of the earth by a factor “k”, usually taken as 1.33 under normal atmospheric conditions. The calculations and ray line predictions in this report use a conservative “k” value of 1.0.

Approved Project

There is ample clearance between the tip of the turbine blades and the first Fresnel zone radius; the clearance exceeds twice the first Fresnel zone radius (2 x 25 m).

Modification 4

Modification 4 has no impact on this path. Path B is not affected by the wind farm.



4.2.3 Path C – Pennsylvania Fire Tower to Mt Canobolas

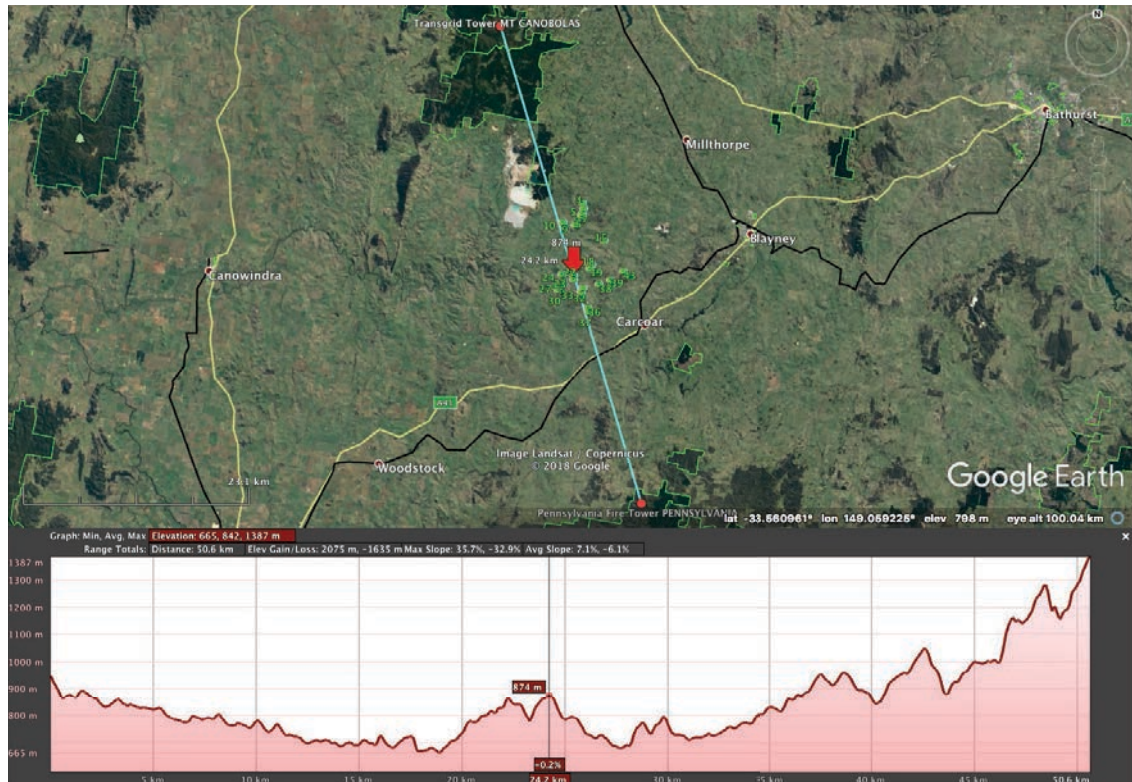


Figure 4-8 Path C – Pennsylvania Fire Tower to Mt Canobolas

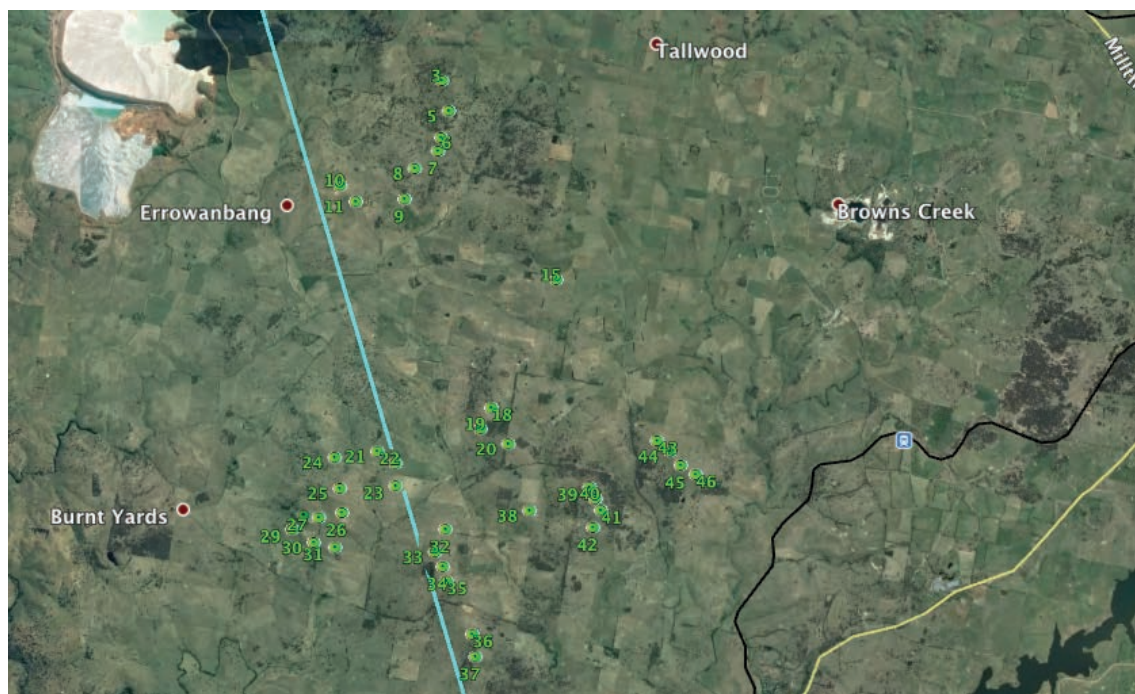


Figure 4-9 Path C - Detail

The path travels over or close to Turbines 21, 22 and 23. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.

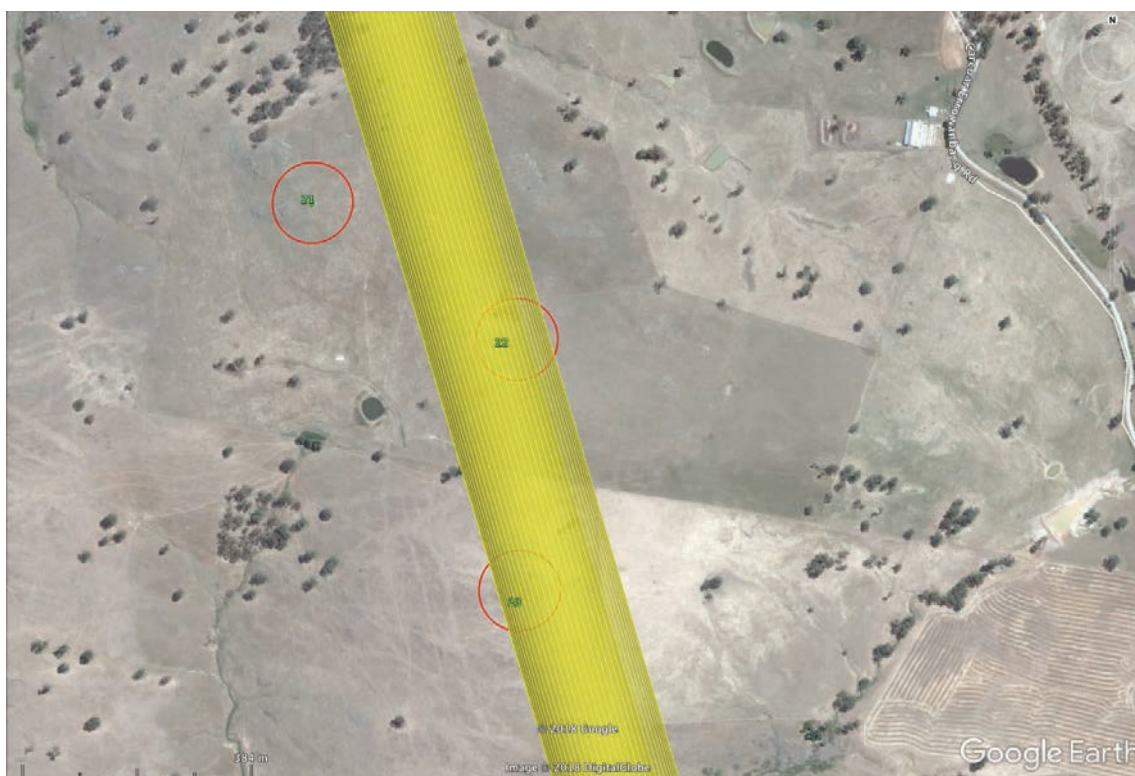


Figure 4-10 Path C - First Fresnel zone shown in yellow. The red circles indicate the area swept by the turbine blades

The turbines closest to the path are Turbines 22 and 23.

The calculations in the following table have been based on the link with the lowest frequency on this path (451.475 MHz), as the lowest frequency has the largest Fresnel zone radius. The antenna heights for this link are not specified in the ACMA database so a height of 10 metres above ground has been assumed.

Location	Ground m AHD	LOS Height m AHD	Refraction (k=1) m	Fresnel (F ₁) m	Blade Tip m AGL	Clearance m
Pennsylvania	621	10				
Turbine 22	876	1168	0	91	160	41 m
Turbine 23	835	1164	0	91	160	78 m
Mt Canobalos	1210	10				

Table 4-3 Clearance for Path C at Turbine 31 – Modification 4

Approved Project

There is ample clearance between the tip of the turbine blades and the first Fresnel zone radius. The calculation has been based on an assumed height of 10 metres for the transmitting and receiving antennas. The antenna height (and therefore the clearance) is expected to be higher than this assumed value

Modification 4

The clearance shown in Table 4-3 assumes the turbine envelope for Modification 4. Even with the greater turbine envelope there is ample clearance between the tip of the turbine blades and the first Fresnel zone radius. Modification 4 does not affect Path C.



4.2.4 Path D – Bigga to Mt Canobolas

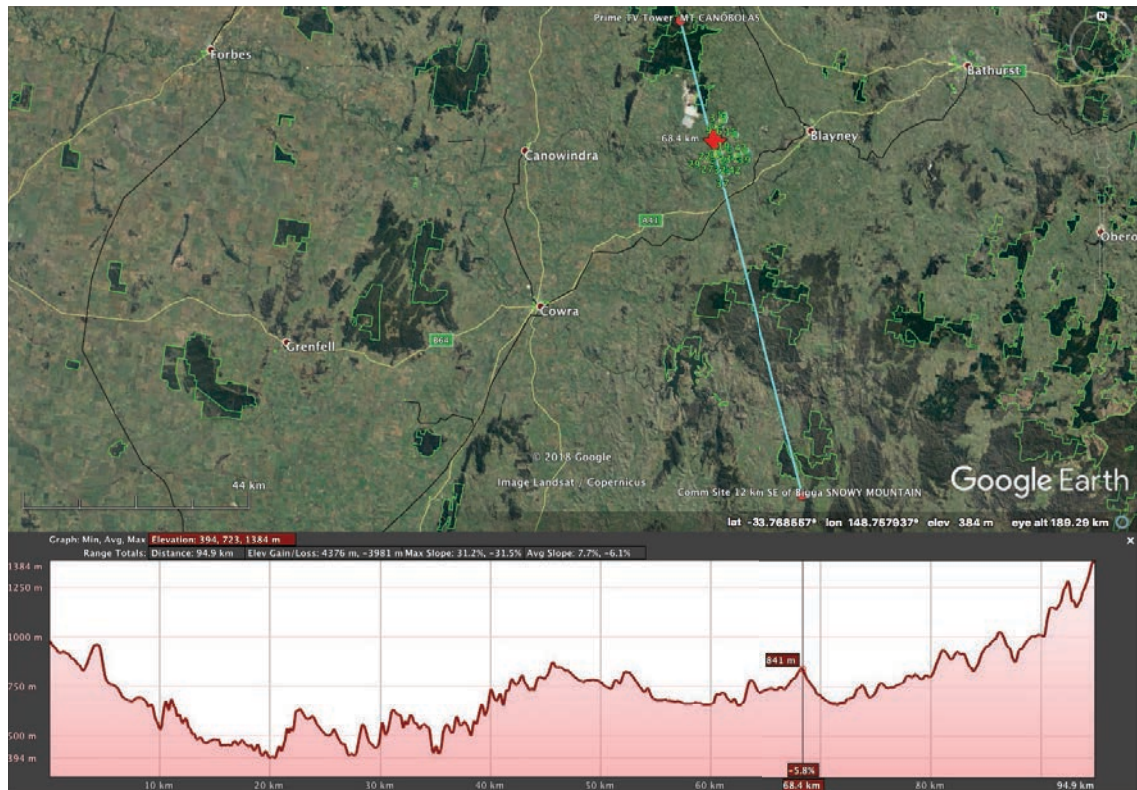


Figure 4-11 Path D – Bigga to Mt Canobolas

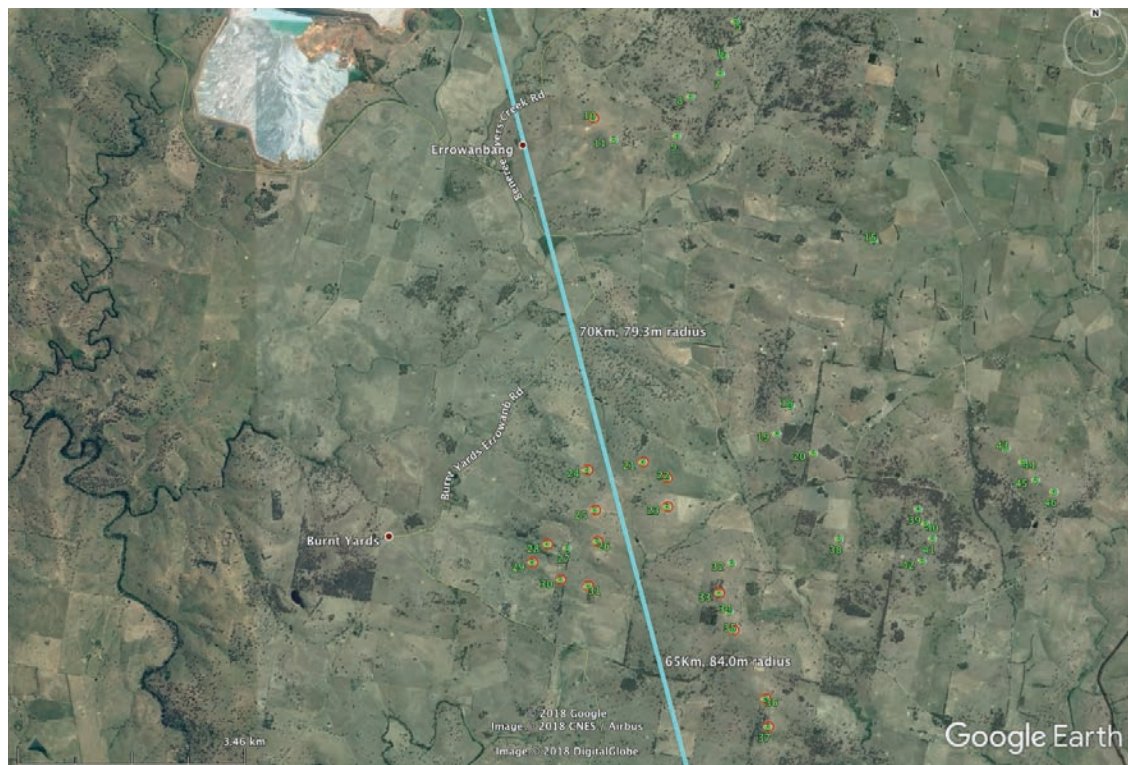


Figure 4-12 Path D - Detail



The path travels close to Turbines 21, 22, 23, 24, 25 and 26. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.

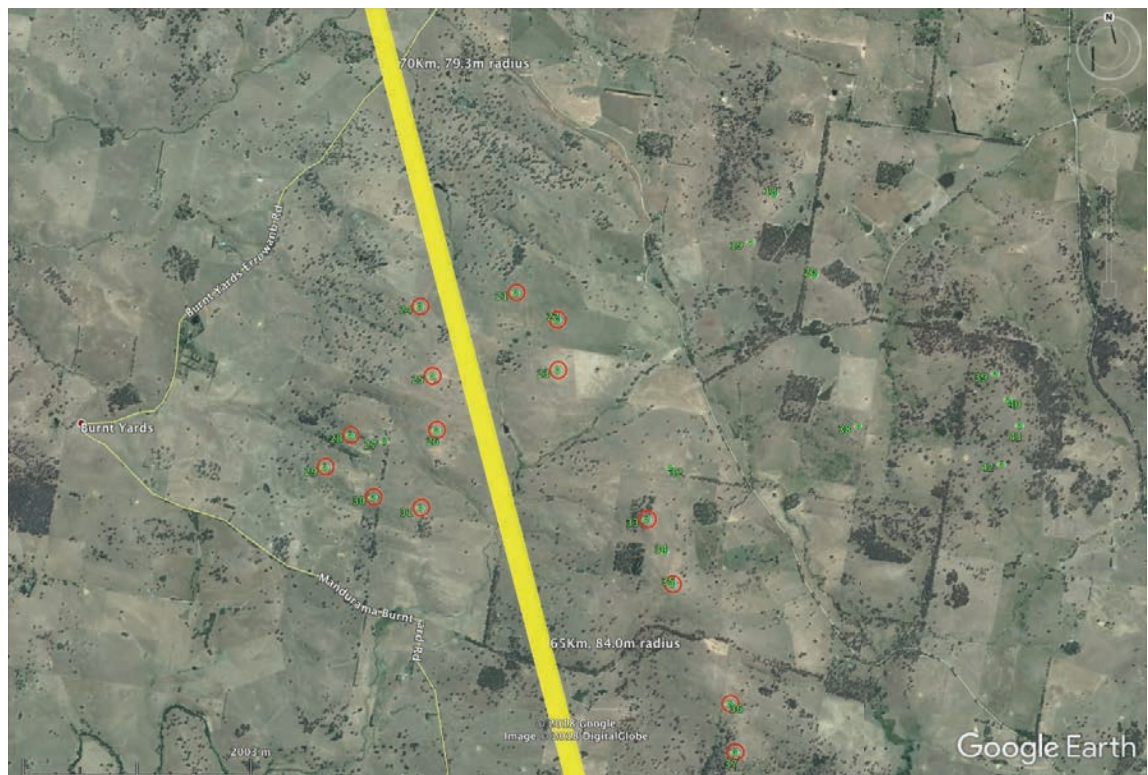


Figure 4-13 Path D - First Fresnel zone shown in yellow. The red circles indicate the area swept by the turbine blades

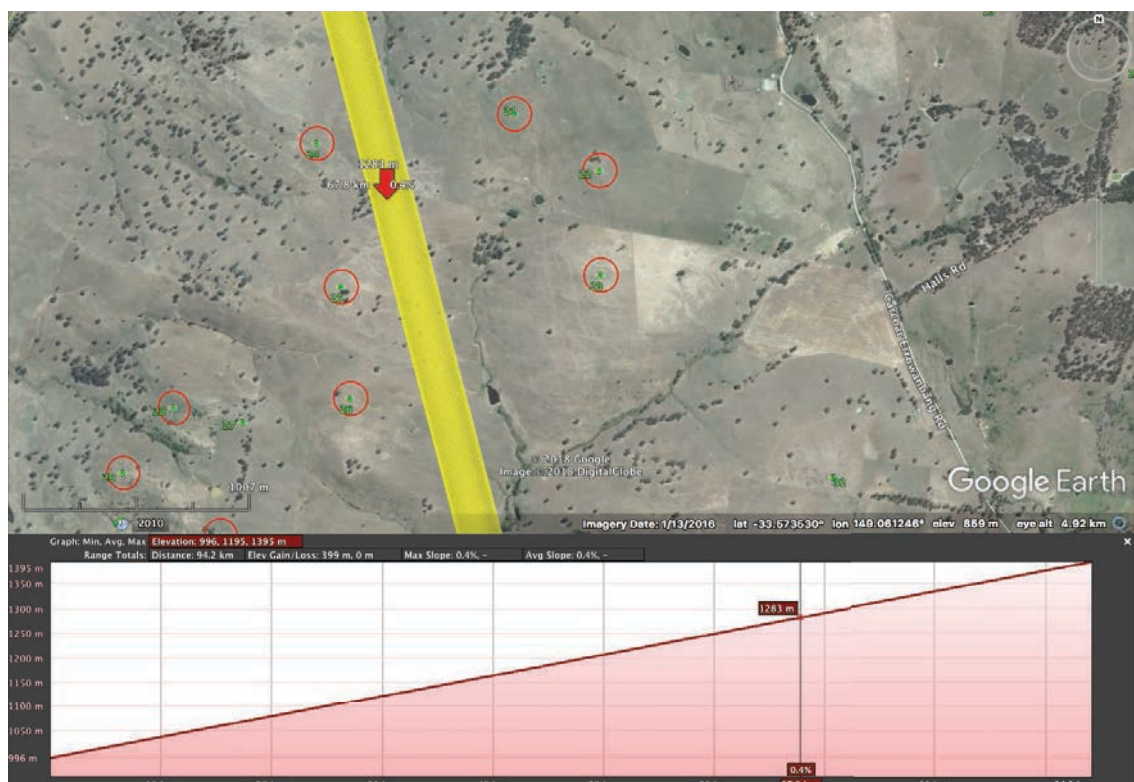
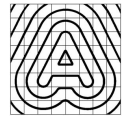


Figure 4-14 Line of sight path elevation is 1283 m near these turbines



The calculations in the following table have been based on the link with the lowest frequency on this path (854.05 MHz), as the lowest frequency has the largest Fresnel zone radius. The calculated clearances consider only the clearance of the ray line above the turbines. The horizontal offset, which has not been included, would increase the clearance.

Location	Ground m AHD	LOS Height m AHD	Refraction (k=1) m	Fresnel (F ₁) m	Blade Tip m AGL	Clearance m
Pennsylvania	621	10				
Turbine 24	822	1283	0	82	160	219 m
Turbine 25	860	1283	0	82	160	181 m
Mt Canobalos	1210	10				

Table 4-4 Clearance for Path D in vertical plane – Modification 4

Approved Project

There is ample clearance between the tip of the turbine blades and the first Fresnel zone radius (more than twice the first Fresnel zone).

Modification 4

Modification 4 does not affect Path D. There is ample clearance.



4.2.5 Path E – Burnt Yards to Cadia Road

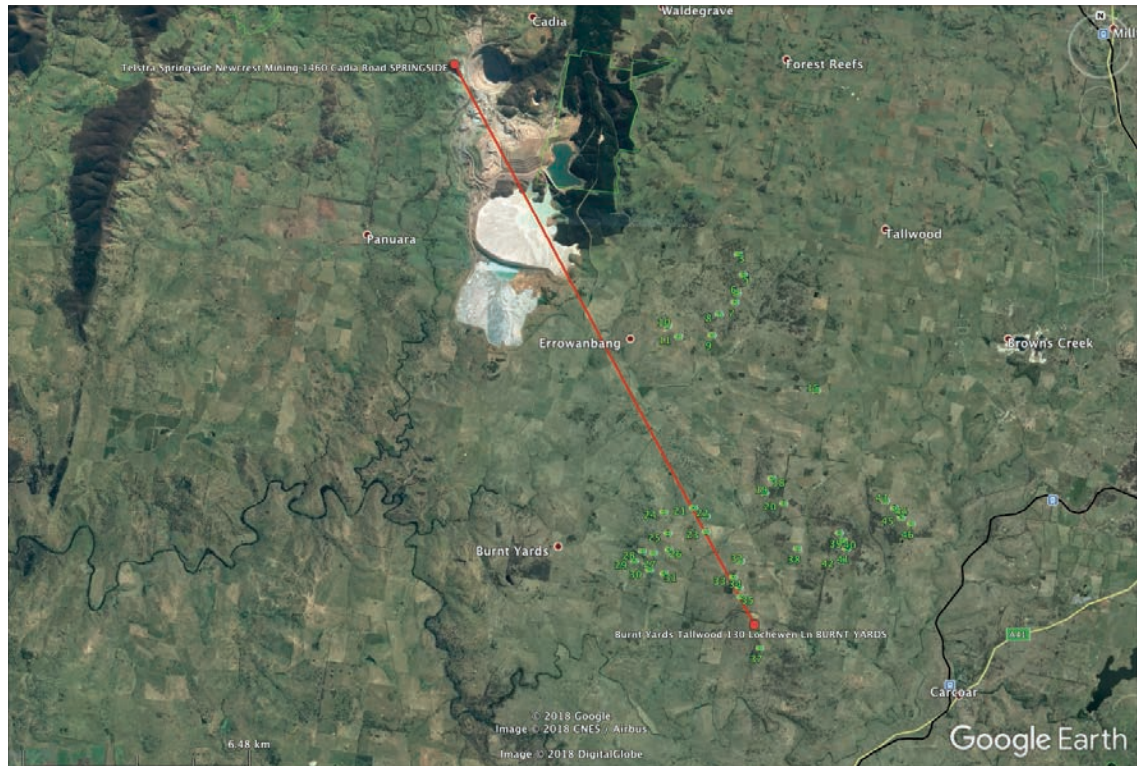


Figure 4-15 Path E – Burnt Yards to Cadia Road



Figure 4-16 Path E - Detail



The path travels close to Turbines 21, 23, 33 and 35. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.

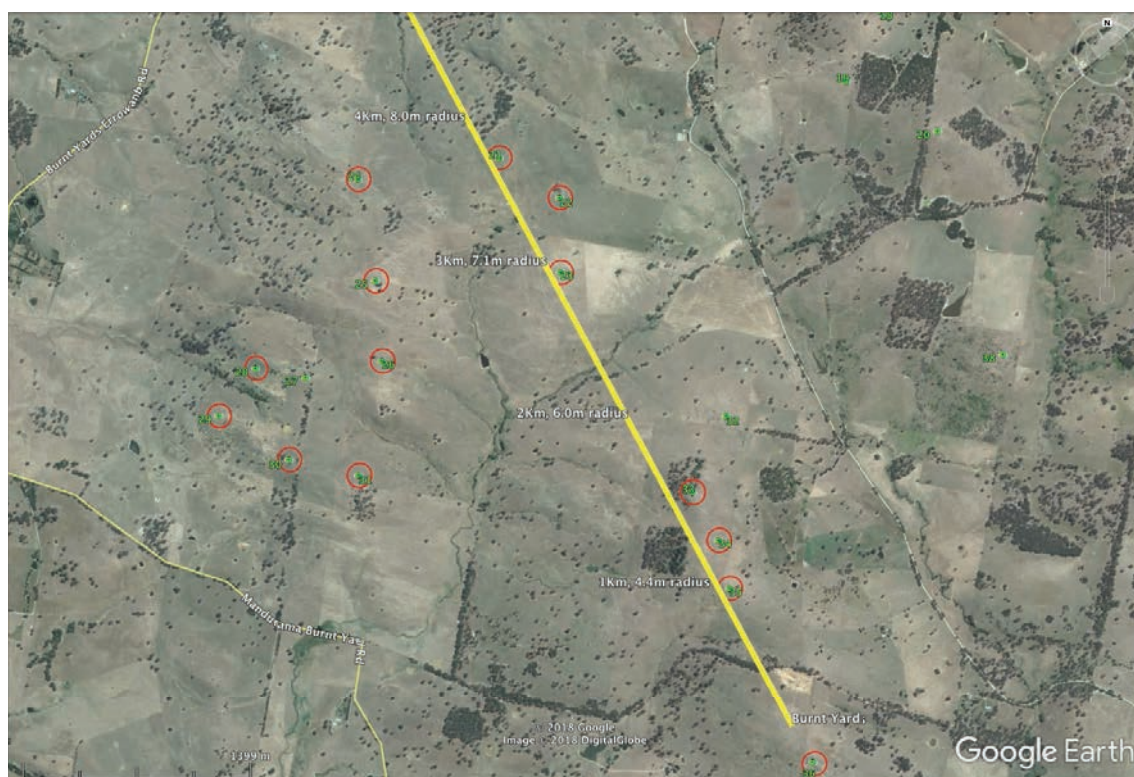


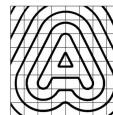
Figure 4-17 Path E - First Fresnel zone shown in yellow. The red circles indicate the area swept by the turbine blades

The calculations in the following tables have been based on the link with the lowest frequency on this path (14.683 GHz), as the lowest frequency has the largest Fresnel zone radius.

The vertical clearance calculations below ignore the horizontal offset of the turbine from the radio path. The horizontal offset is calculated separately.

Location	Ground m AHD	LOS Height m AHD	Refraction (k=1) m	Fresnel (F ₁) m	Blade Tip m AGL	Clearance m
Burnt Yards	885	25				
Turbine 21	856	905	0	8	160	-119 m
Turbine 23	860	906	0	7	160	-121 m
Turbine 33	863	907	0	5	160	-121 m
Turbine 34	901	908	0	5	160	-158 m
Turbine 35	893	908	0	4	160	-121 m
Cadia Road	877	10				

Table 4-5 Clearance for Path E in vertical plane – Modification 4



Location	Distance m	Fresnel (F ₁) m	Blade Tip m	Clearance m
Turbine 21	61	8	70	-17 m
Turbine 23	61	7	70	-16 m
Turbine 33	132	5	70	57 m
Turbine 34	133	5	70	58 m
Turbine 35	60	4	70	-14 m

Table 4-6 Clearance for Path E in horizontal plane – Modification 4

Approved Project

The clearance from each of the turbines is 29 m greater than that shown in in Table 4-6, so none of the turbines infringes the first Fresnel zone.

However, the clearance calculated here is less than the error in topographic data and antenna position data so either a detailed site survey should be performed or additional clearance provided within the micro-siting allowance.

Modification 4

The increased maximum turbine envelope in Modification 4 has been taken into account in Table 4-6. Turbines 21, 23 and 35 have insufficient clearance from Path E in their approved centre point location, however the turbines can be relocated sufficiently within the micro-siting allowance of the existing Project Approval to ensure that sufficient clearance is maintained.



4.2.6 Path F – Burnt Yards to Mt Canobolas



Figure 4-18 Path F – Burnt Yards to Mt Canobolas

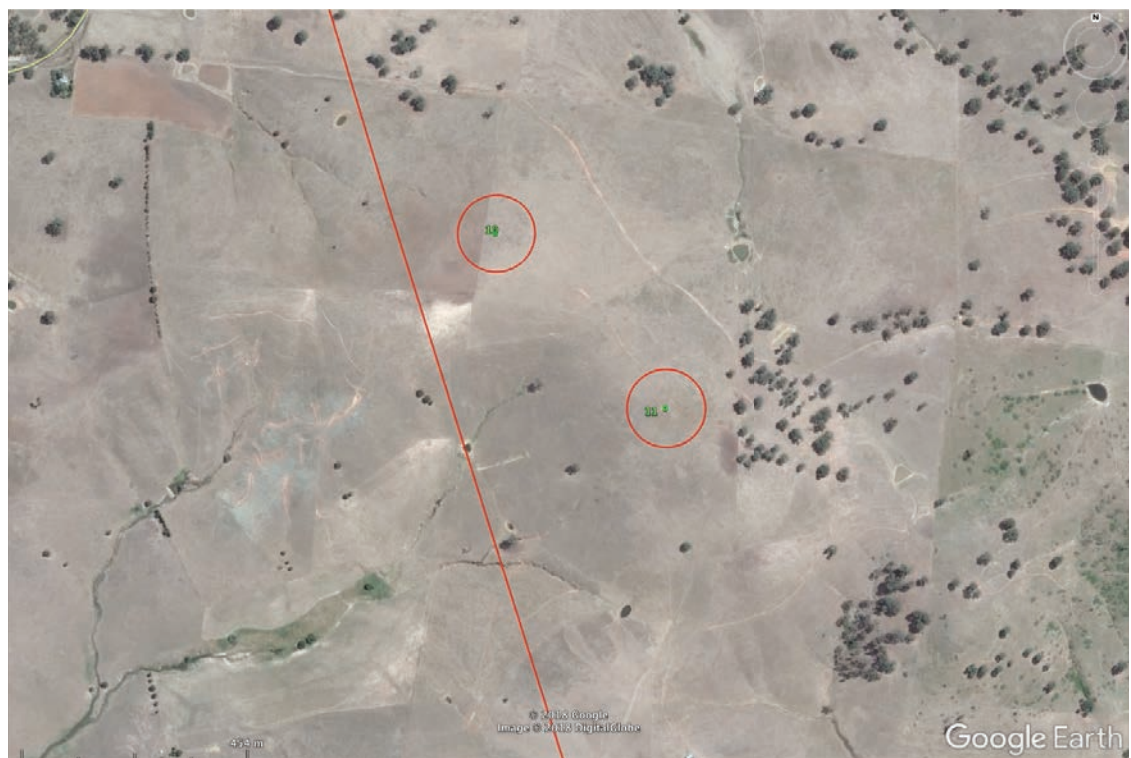


Figure 4-19 Path F – Detail 1



Figure 4-20 Path F – Detail 2

The path travels close to Turbines 10, 32, 33, 34 and 35. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.

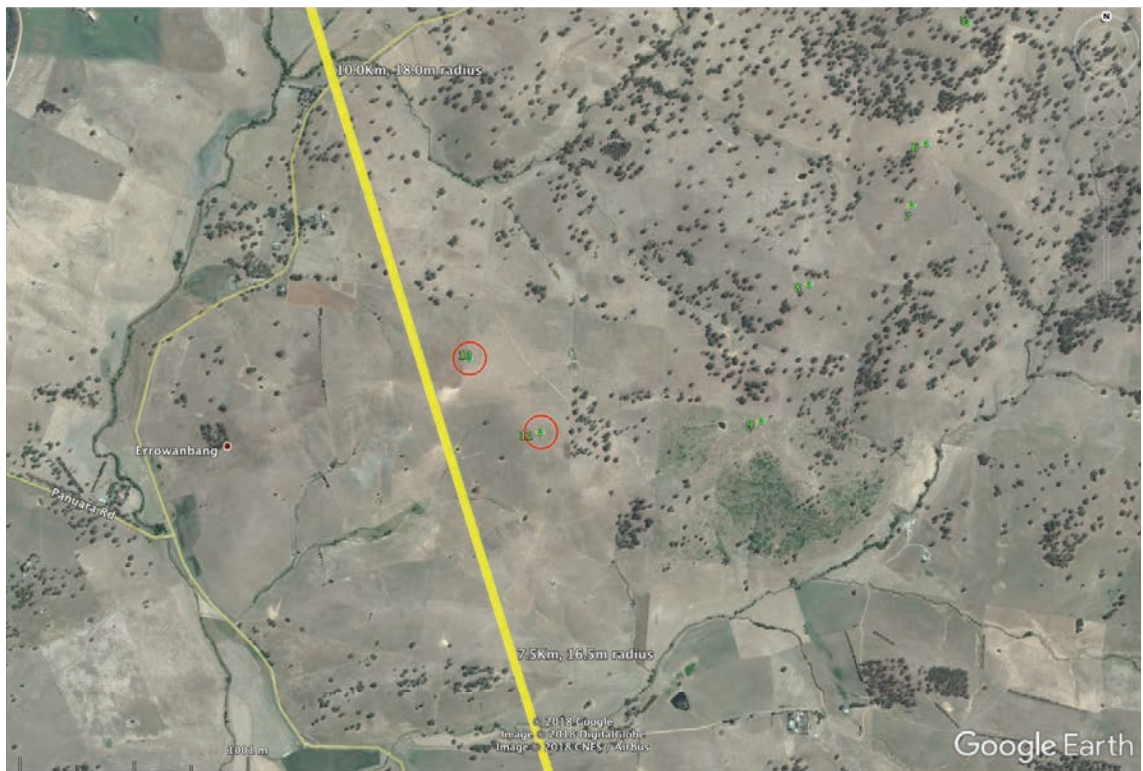


Figure 4-21 Path F - First Fresnel zone shown in yellow – northern portion

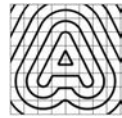


Figure 4-22 Path F - First Fresnel zone shown in yellow – southern portion

The calculations in the following tables have been based on the link with the lowest frequency on this path (6.137925 GHz), as the lowest frequency has the largest Fresnel zone radius.

Location	Distance m	Fresnel (F_1) m	Blade Tip m	Clearance m
Turbine 10	165	18	70	77 m
Turbine 32	176	9	70	97 m
Turbine 33	149	8	70	71 m
Turbine 34	85	8	70	7 m
Turbine 35	104	7	70	27 m

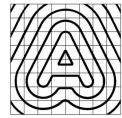
Table 4-7 Clearance for Path F in horizontal plane – Modification 4

Approved Project

The clearance for Path F in the approved project is 29 m greater than that shown in Table 4-7. All turbines have sufficient clearance from the first Fresnel zone, within the accuracy of the map interpolation and available data.

Modification 4

The clearances under Modification 4 are shown in Table 4-7. As in the approved project, Turbines 10, 32 and 33 have sufficient clearance from Path F.



Turbines 34 and 35 are clear of the first Fresnel zone, within the accuracy of the map interpolation and available data.

It is normal practice to provide clearance of twice the first Fresnel Zone at these frequencies, so the location of Turbine 35 should be adjusted from its approved centre point location within the micro-siting conditions of the Project Approval to ensure sufficient clearance is maintained.



4.2.7 Path G – Reece Site, Mt Macquarie to Mt Canobolas

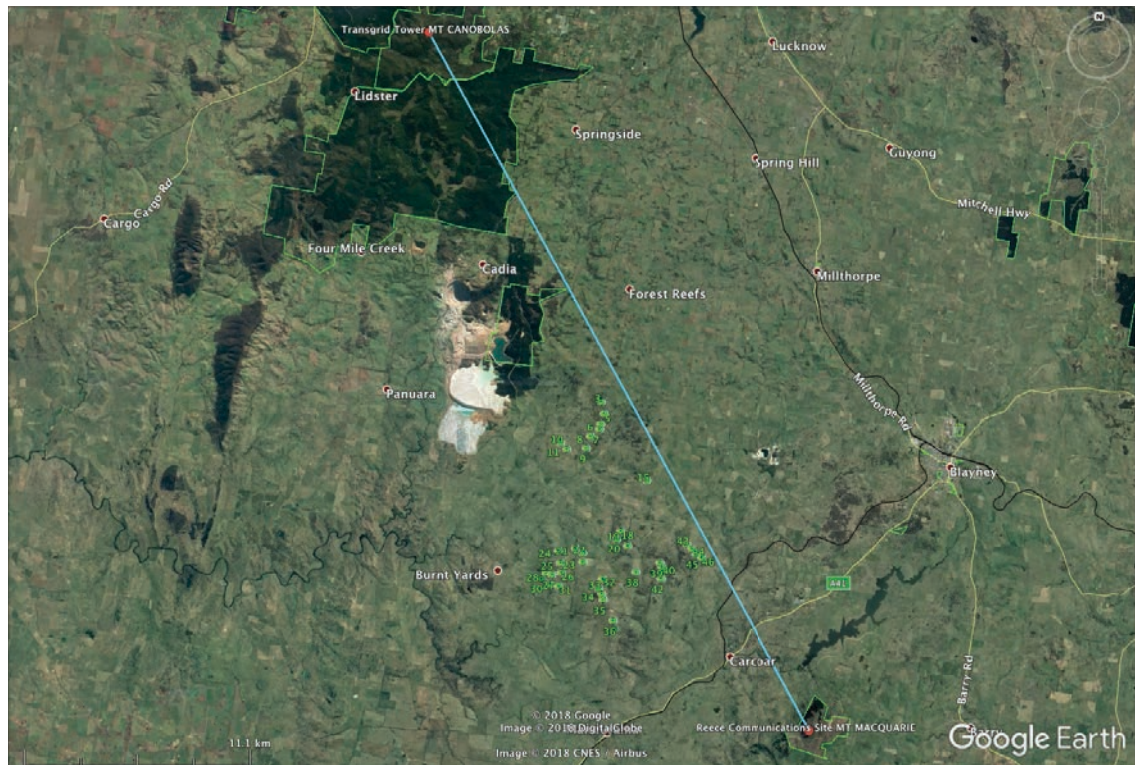


Figure 4-23 Path G – Mt Macquarie to Mt Canobolas



Figure 4-24 Path G – Detail showing locations of turbines 44, 45 and 46



The path travels near Turbines 44, 45 and 46. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.



Figure 4-25 Path G - First Fresnel zone shown in yellow

The diagrams and the calculations in the following table have been based on the link with the lowest frequency on this path (450.6 MHz), as the lowest frequency has the largest Fresnel zone radius.

Location	Distance m	Fresnel (F_1) m	Blade Tip m	Clearance m
Turbine 44	855	70	70	715 m
Turbine 45	809	70	70	669 m
Turbine 46	650	70	70	510 m

Table 4-8 Clearance for Path G in horizontal plane

Approved Project

There is ample clearance from each turbine to Path G.

Modification 4

Path G is not affected by Modification 4.



4.2.8 Path H – Transgrid Site, Mt Macquarie to Mt Canobolas

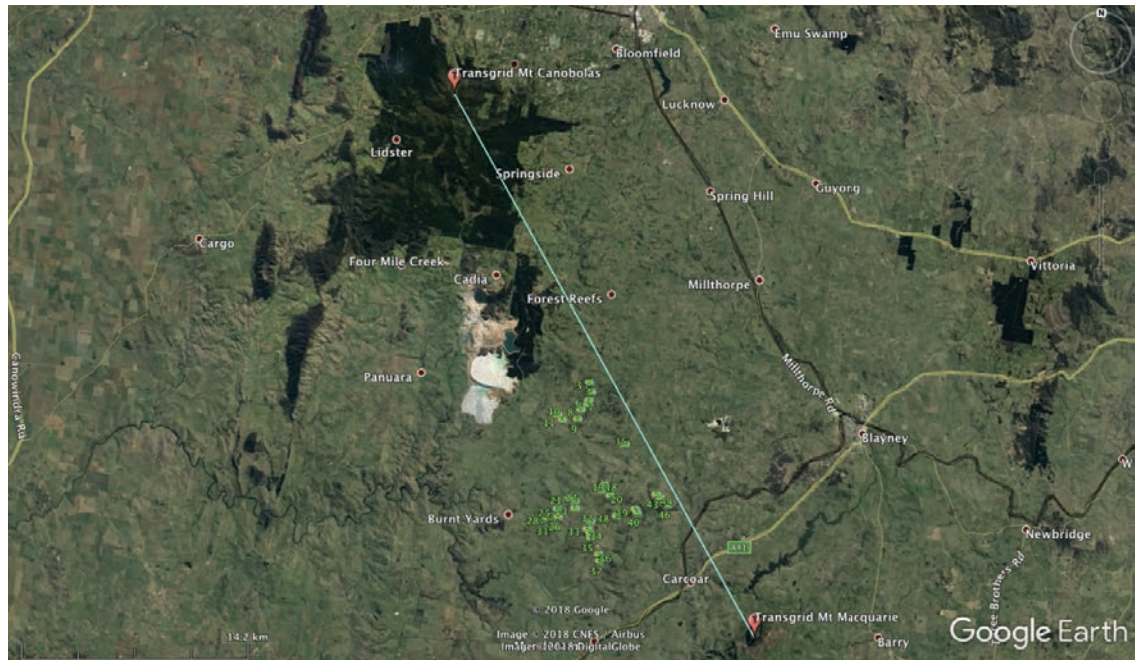


Figure 4-26 Path H – Transgrid Mt Macquarie to Transgrid Mt Canobolas



Figure 4-27 Path H – Detail

The path travels close to Turbines 44, 45 and 46. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.

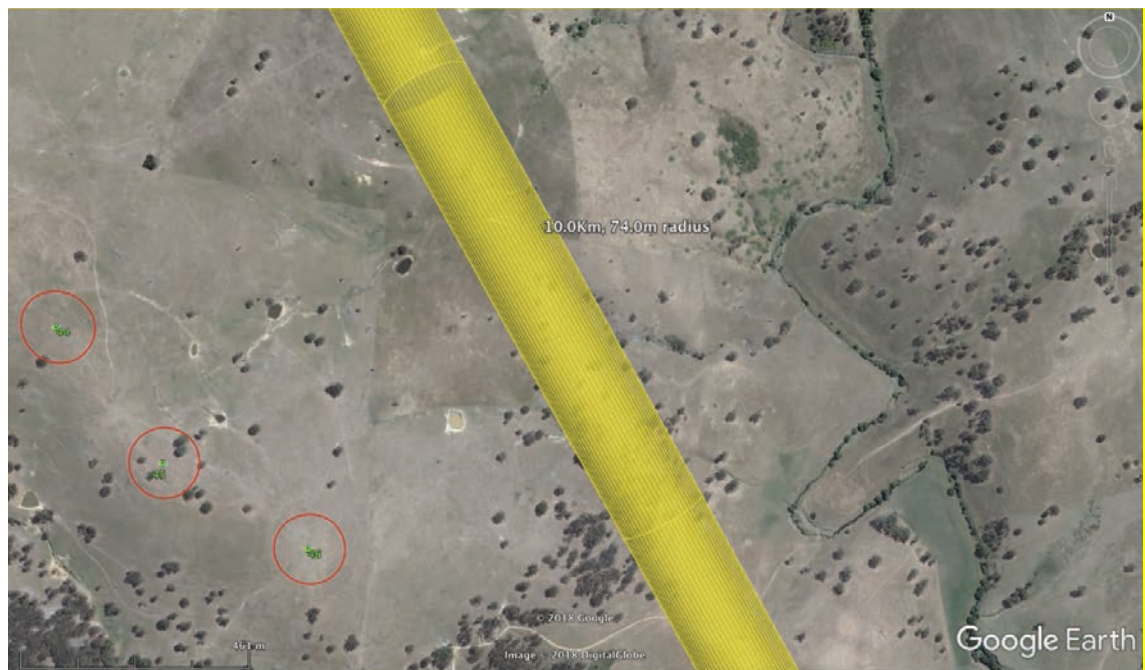


Figure 4-28 Path H - First Fresnel zone shown in yellow

The calculations in the following table have been based on the link with the lowest frequency on this path (404.65 MHz), as the lowest frequency has the largest Fresnel zone radius.

Location	Distance m	Fresnel (F_1) m	Blade Tip m	Clearance m
Turbine 44	850	75	70	705 m
Turbine 45	810	74	70	666 m
Turbine 46	640	74	70	496 m

Table 4-9 Clearance for Path H in horizontal plane

Approved Project

There is ample clearance from each turbine to Path H.

Modification 4

Path H is not affected by Modification 4.



4.2.9 Path I – Burnt Yards to Canowindra

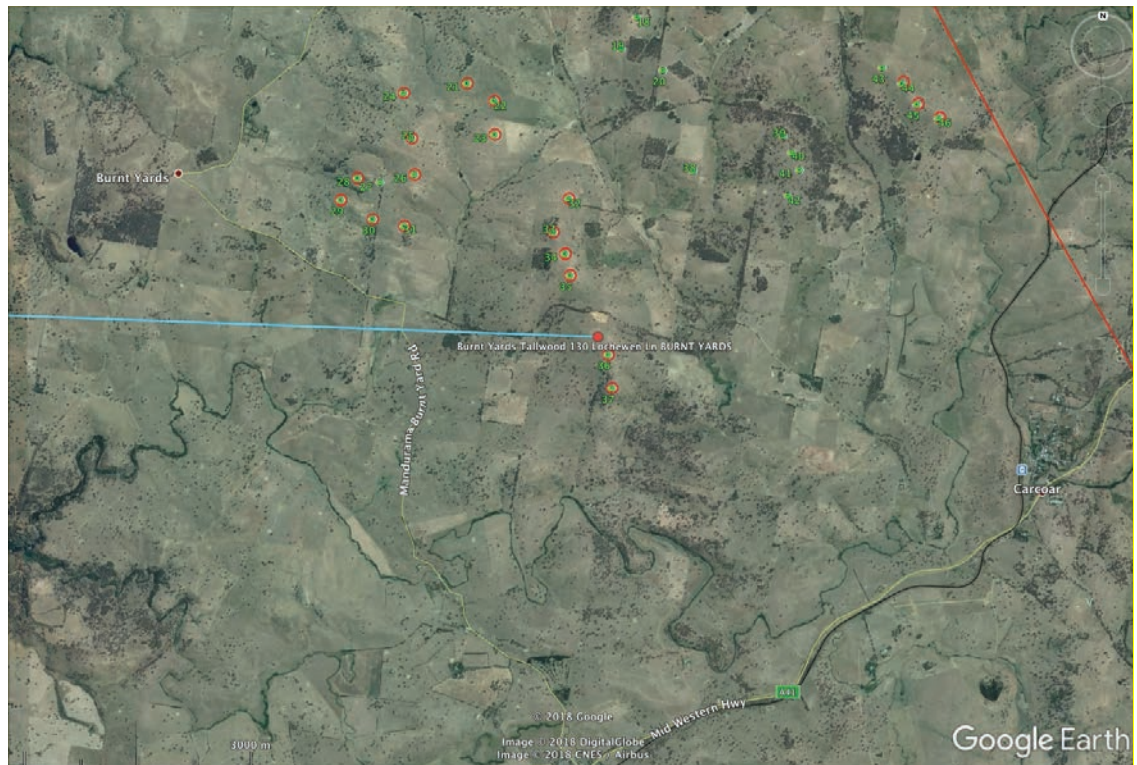


Figure 4-29 Path I – Burnt Yards to Canowindra



Figure 4-30 Path I – Detail

The Burnt Yards site is close to Turbines 35 and 36. The first Fresnel zone around the path is plotted below, showing the relationship with the turbines in this area.

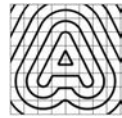


Figure 4-31 Path I - First Fresnel zone shown in yellow

The calculations in the following table have been based on the link with the lowest frequency on this path (7.79 GHz), as the lowest frequency has the largest Fresnel zone radius.

Location	Distance m	Fresnel (F_1) m	Blade Tip m	Clearance m
Turbine 35	780	4	70	706 m
Turbine 36	Behind Path	-	70	Not applicable

Table 4-10 Clearance for Path I in horizontal plane

Approved Design

There is ample clearance from each turbine to Path I.

Modification 4

Path I is not affected by Modification 4.



4.3 CLEARANCE FROM ELECTRICITY TRANSMISSION LINES

The wind farm will connect to the electricity transmission network through a 132 kV transmission line. The transmission line may be constructed overhead or partly overhead and partly underground. For this analysis it is assumed that the line is all overhead and that the pole height is approximately 24 m.

The effect of the transmission line on each of the fixed links is discussed in this section.



Figure 4-32 132 kV Electricity Transmission Line Route



4.3.1 Path C – Clearance from 132 kV Transmission Line

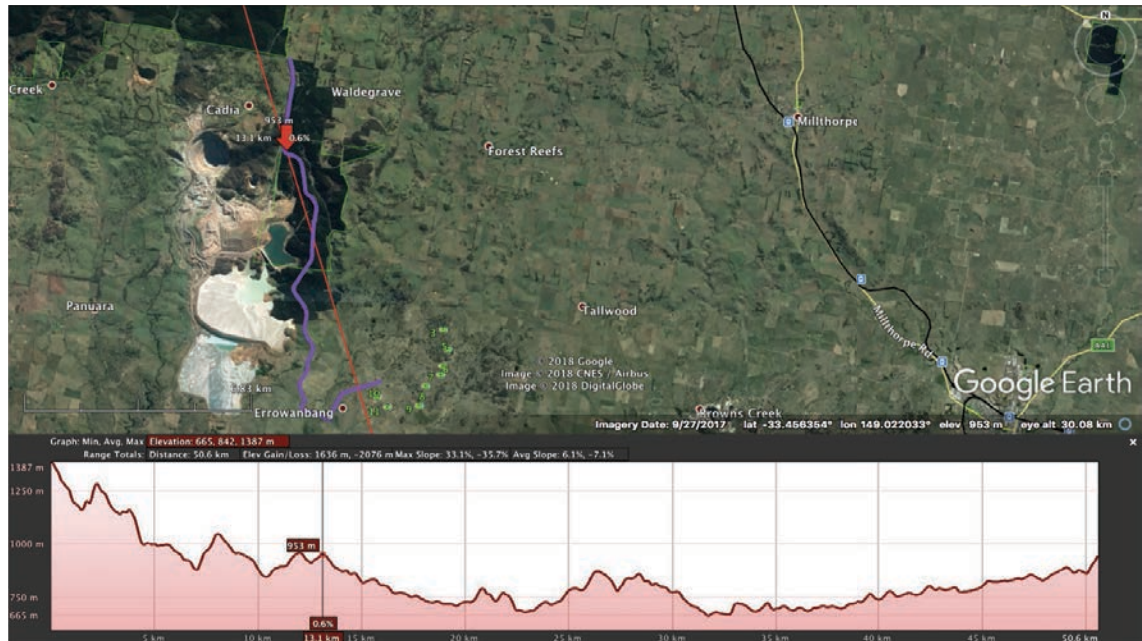


Figure 4-33 Path C - Terrain at 132 kV line crossing

Path C crosses the proposed transmission line at several places. The location with highest terrain and least clearance is at 13.1 km from Mt Canobolas, where the terrain height is 953 m. The ray line at this location is at 1283 m and the first Fresnel zone radius is approximately 80 m. There is ample clearance between the radio path, with a lowest elevation of 1203 m and the top of the pole at approximately 977 m.



Figure 4-34 Path C ray line at 132 kV line crossing

Potential impact of Modification 4

Modification 4 has no impact on Path C.



4.3.2 Path D – Clearance from 132 kV Transmission Line

Path D crosses the proposed transmission line route at two places. The location with the highest terrain is at 16.7 km from Mt Canobolas, where the ground level is 806 m. At this location the radio path is at 1324 m and the first Fresnel zone radius is approximately 70 metres. The clearance to the first Fresnel zone above a 24 m pole is 424 metres.

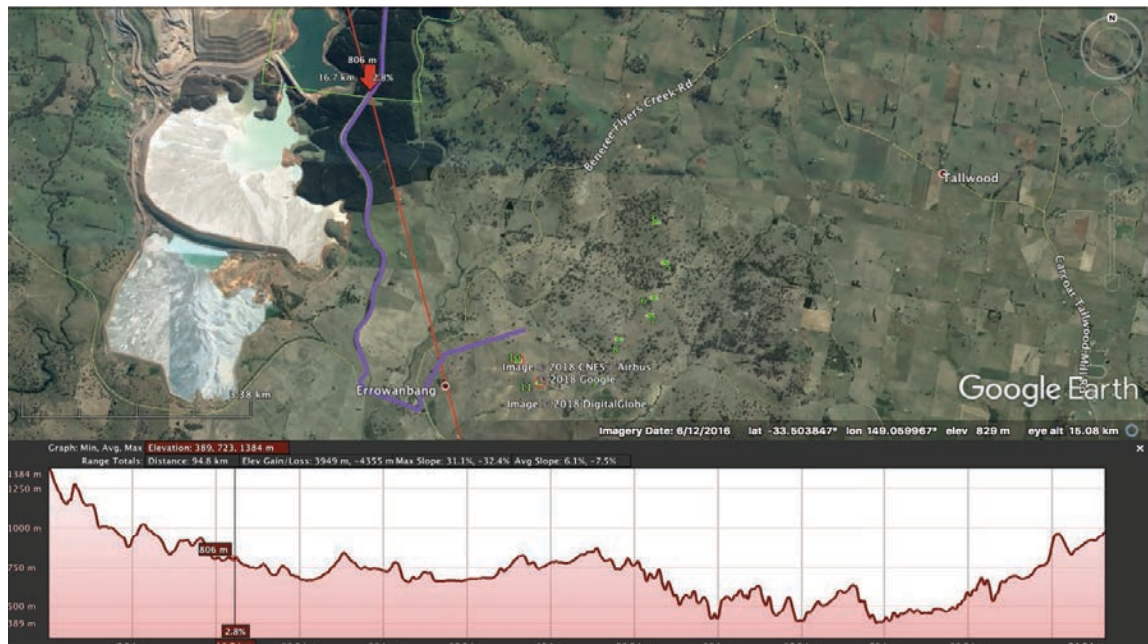


Figure 4-35 Path D - Terrain profile showing northern crossing of 132 kV line

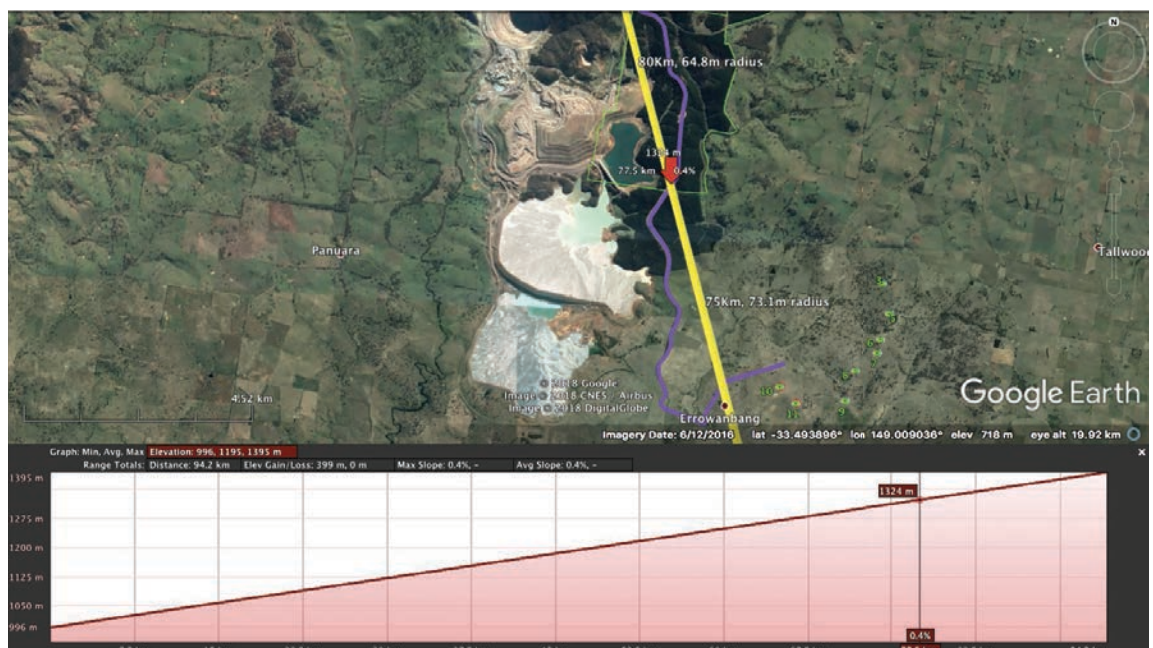


Figure 4-36 Path D - Ray line at northern crossing of 132 kV transmission line

Potential impact of Modification 4

Modification 4 has no impact on Path D.



4.3.3 Path E - Clearance from 132 kV Transmission Line

Path E passes over the proposed transmission line route.

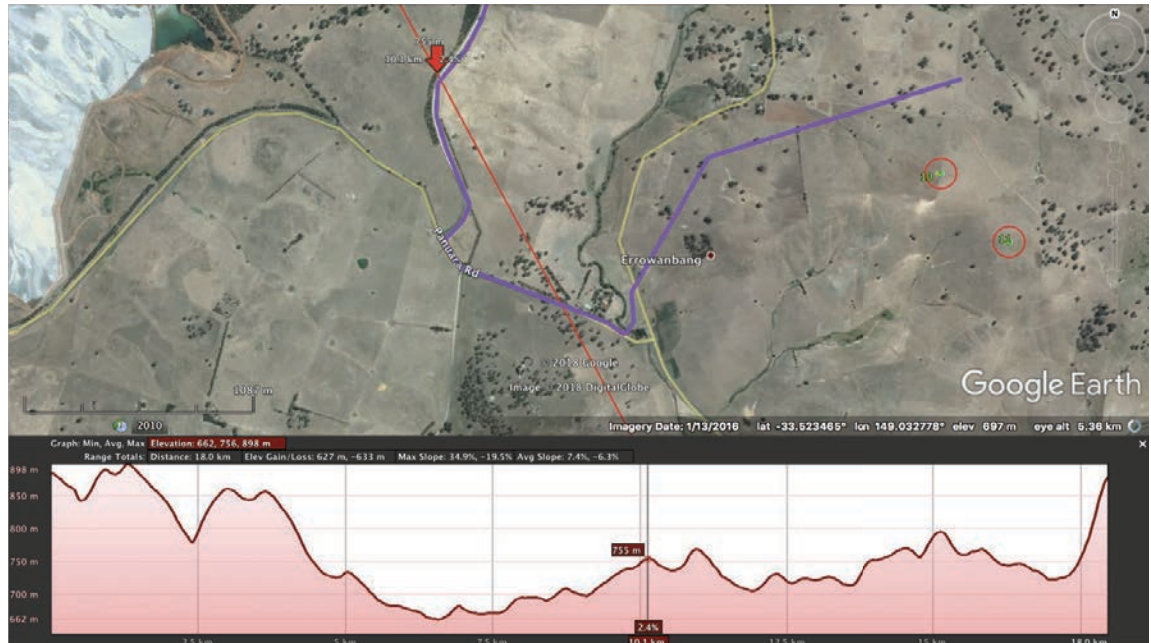


Figure 4-37 Path E - Terrain at the 132 kV transmission line is at 755 m AHD

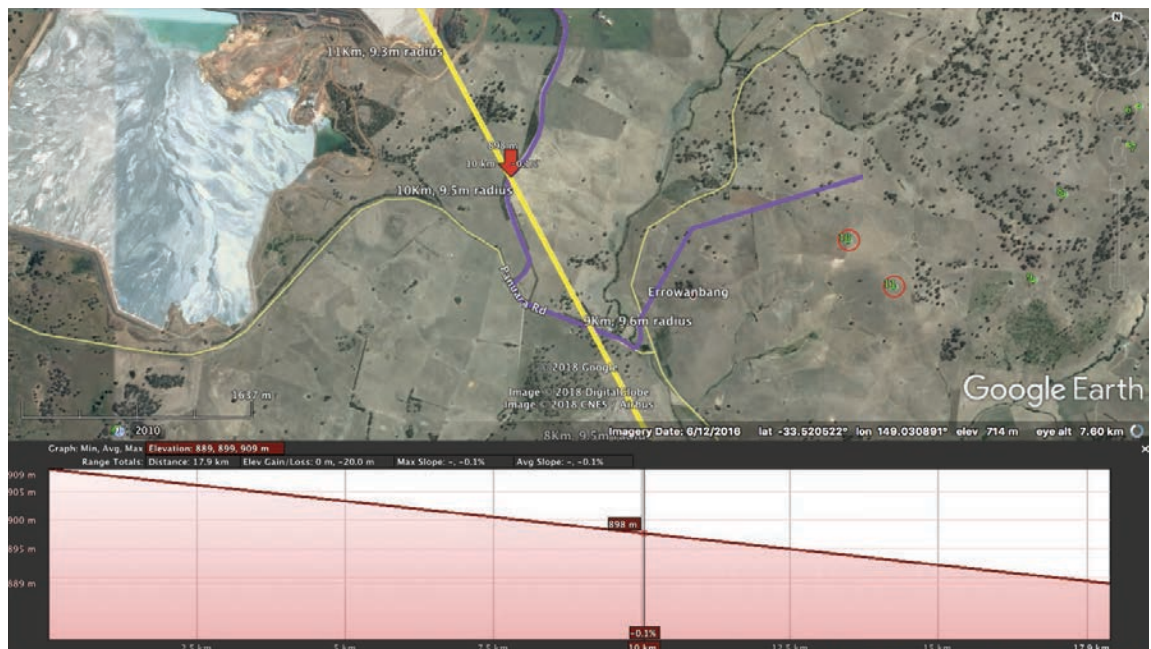


Figure 4-38 Path E - Ray line at the transmission line crossing is at 898 m

The highest point on the terrain at the 132 kV line is marked with a red arrow; the ground level here is 755 m. The radio ray line (centre of beam) is at 898 m at this point, providing 143 m clearance to the centre of the ray line for $k = 1.33$ and the first Fresnel zone radius is 9.5 m at this point. There is ample clearance above the approximate 24 m power line poles. The terrain height is 703 m at the southern crossing of the ray line.



Potential impact of Modification 4

Modification 4 has no impact on Path E.

4.3.4 Path F – Clearance from 132 kV Transmission Line

The ray line for Path F crosses the transmission line at several places. The terrain is highest near Cadia, at 17.6 km from Burnt Yards.

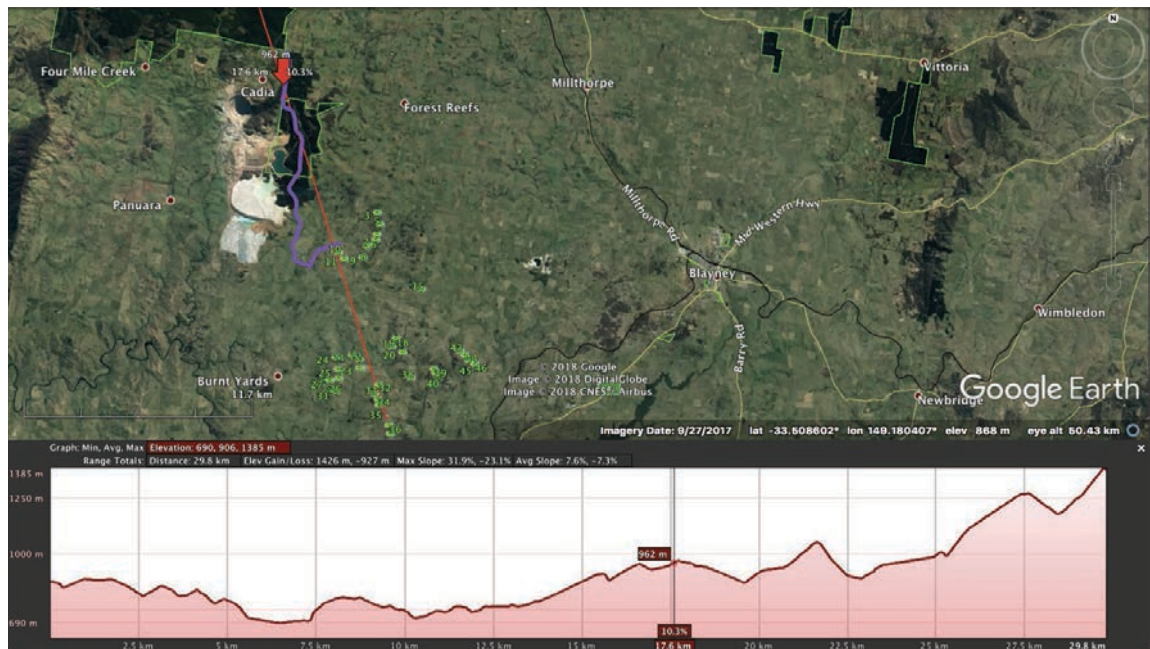


Figure 4-39 Path F crosses the 132 kV transmission line route

At 16.3 km from Burnt Yards the terrain height is 948 m. The ray line is at 1181 m at this point, providing ample clearance above the approximate 24 m power line poles.

Potential impact of Modification 4

Modification 4 has no impact on Path F.



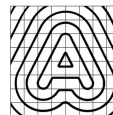
Figure 4-40 Path F Ray line at the northern crossing of Cadia Road

4.4 POINT-TO-MULTIPOINT

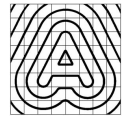


Figure 4-41 Fixed Point to multipoint sites within 30 km radius

There are many point to multipoint services within 30 km radius of the wind farm. The central point of these services is identified in the ACMA database but the remote points are not identified. The services are listed in the table below. Paging services have been included in this category.



Client Name	System	MHz	W	Site Name	Site Id
NSW Rural Fire Service	155113	148.5875	160	Mt Macquarie	10652
NSW Rural Fire Service	121649	148.5875	500	Mt Canobolas	10712
NSW Rural Fire Service	315055	148.5875	500	Clarke Trig	10562
NSW Rural Fire Service	658353	148.5875	165	Mt Macquarie	9004467
Orange City Council	1082254	148.8625	100	Mt Canobolas	10712
NSW Government	134958	148.9875	83	Blayney	10645
NSW Government	134964	148.9875	83	Fire Station Orange	10693
Integrated Agricultural Developments Pty Ltd	190521	450.125	8.4	Cargo Rd Orange	202797
Cadia Holdings	351021	450.275	8.4	Ridgway Mine	9008502
Orange City Council	1082256	461.04375	25	Mt Canobolas	10712
Orange City Council	229756	461.06875	40	Water Plant Orange	10729
Orange City Council	243158	461.10625	8.4	Water Plant Orange	10729
Blayney Shire Council	654712	461.16875	21	Optus Blayney	201534
Essential Energy	177264	461.225	8.4	Mt Canobolas	10712
Central Tablelands County Council	371633	461.30625	8.4	Mt Canobolas	10712
Orange Ex-Services' Club	1905583	461.4875	17	Forest Rd Orange	10008434
Water NSW	1696606	461.525	33	Mt Macquarie	10652
Essential Energy	169421	461.575	8.4	Mt Canobolas	10712
Orange City Council	1082262	461.64375	12.5	Mt Canobolas	10712
Essential Energy	238883	461.75	17	Mt Canobolas	55757
Water NSW	1696611	461.825	33	Mt Canobolas	10712
Essential Energy	169422	461.9	8.4	Mt Canobolas	10712
Cadia Holdings	163711	471.225	8.4	Cadia Mine	402256
Orange City Council	1600485	503.81875	16	Mt Canobolas	10712
Orange City Council	1103113	504.98125	33	Water Plant Orange	10729
TT And CI Reece	222673	519.825	17	Mt Canobolas	55757
Vertical Telecoms	1181225	3610	12	Mt Canobolas	10708



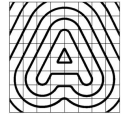
Client Name	System	MHz	W	Site Name	Site Id
Vertical Telecoms	1038992	3625	12	Mt Canobolas	10708

Table 4-11 Point to Multipoint Services

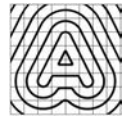
None of these services should be affected by the wind farm development, with the exception of some areas very close to the turbines where there may be local disturbance due to multipath effects. This is similar to the interference experienced when listening to FM radio on a car radio. There are some locations where various reflected signals combine with the wanted signal to make the FM radio reception very noisy. Moving a fraction of a wavelength (less than a metre at these frequencies) is usually sufficient to change the combination of signals and restore normal reception.

Potential impact of Modification 4

Outside the immediate vicinity of the turbines Modification 4 will have no greater impact on point to multipoint reception than the approved project. In the immediate vicinity of the turbines there may be some minor increase in interference. This is not considered to be a significant impact.



Mobile Radio & Cellular



5. MOBILE RADIO & CELLULAR

5.1 MOBILE RADIO AND CELLULAR PLANNING

Mobile radio and cellular telephone systems have defined base station locations and then defined areas of coverage. CB radio repeater stations are provided to assist users of CB radio by extending the range of communication, which would otherwise be limited by the line of sight between users. There is no guarantee of performance or coverage for CB radio.

The performance of the communication systems within their coverage areas is defined statistically, in a similar manner to that of broadcast systems. There is no guarantee of coverage at any particular location but there is a guarantee that there will not be intolerable interference from other sources at any location within the coverage area.

5.2 MOBILE RADIO

Land mobile radio services (two-way radio) are usually designed to cover as wide an area as possible, within the limits of the licensing conditions. The wind farm is not expected to have any significant impact on the identified services. There may be some impact when a mobile unit is very close to a turbine, depending on the orientation of the turbine, the base station and the user. This can be overcome in the normal manner by moving a short distance.



Figure 5-1 Land mobile base station sites within 25 km radius of the wind farm



The closest land mobile services to the wind farm are at the Cadia mine and associated areas. The mobile services covering the general area around the wind farm are at Mt Canobolas and Mt Macquarie. There are 140 services within the area shown, approximately 25 km radius from the wind farm.

Potential impact of Modification 4

Modification 4 will have essentially the same impact as that of the approved project.

5.3 CB RADIO REPEATERS

There are no CB radio repeaters within 25 km of the wind farm.

5.4 SPECTRUM LICENCES

Mobile telephone (cellular services) are licenced to use a specific part of the radio frequency spectrum. The coverage of the mobile services is determined by the operator and may change in response to demand at any time.

The locations of licenced spectrum sites within 15 km of the wind farm are shown in the following figures.



Figure 5-2 Spectrum Licence Sites – 700 MHz and 800 MHz

700 MHz and 800 MHz spectrum is used for mobile telephone services, with the licences all held by Telstra and Optus.

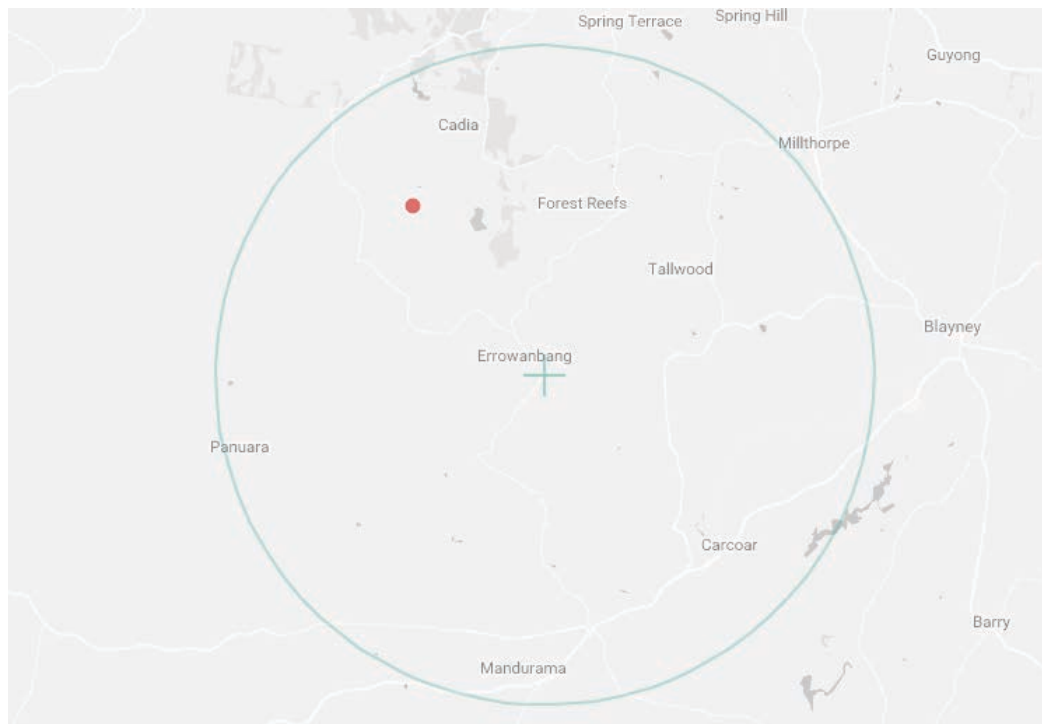
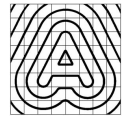


Figure 5-3 Spectrum Licence Sites – 1800 MHz

The 2.3 GHz spectrum licences in the area are all held by the NBN.



Figure 5-4 Spectrum Licence Sites – 2300 MHz



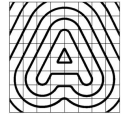
5.5 SUMMARY

Overall mobile radio is unlikely to be affected by the wind farm. There may be some interference within the wind farm lease area, when people are close to the turbines but this will be localised and only affect those directly associated with the wind farm.

Cellular telephone coverage and performance is not expected to be affected by the wind farm. The nature of cellular services is to have a number of base stations covering any particular area, with the mobile unit selecting the base station with best performance. As the number of base stations increases the likelihood of interference will decrease. The planners of cellular services are aware of the wind farm and will design their services and links to avoid interference.

Potential impact of Modification 4

Modification 4 will have essentially the same impact as the approved project.



Radar, Aviation & Defence



6. RADAR, AVIATION & DEFENCE

6.1 AVIATION SERVICES

There are fixed receiving antennas for aviation services at Mt Canobolas (1.09 GHz) and for Orange airport (125.1 MHz). Neither service should be affected by the wind farm.

The wind farm should have no effect on the aeronautical assigned systems shown in Table 6-1.

Client name	System	MHz	Watts	Site name	Site ID
Airservices Australia	77304	135.25	50	Mt Canobolas	10678
Airservices Australia	77306	133.05	100	Mt Canobolas	10678
Airservices Australia	77303	118.5	50	Mt Canobolas	10678
Airservices Australia	77305	122.75	50	Mt Canobolas	10678
Airservices Australia	1786833	127.7	50	Mt Canobolas	10678
Orange City Council	242679	128.8	4	Orange Airport	204422
Orange City Council	176839	119	2.5	Orange Airport	202195
Central West Helicopters	1843258	120.45	6	Mitchell Hwy Orange	9019485
Central West Helicopters	2137225	128.475	9	Mitchell Hwy Orange	10010183
Regional Express	265900	135.55	7	Orange Airport	204422

Table 6-1 Aeronautical Assigned Systems

Potential impact of Modification 4

The potential impact of Modification 4 is the same as that of the approved project. None of the services should be affected.

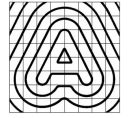
6.2 RADIODETERMINATION (RADAR) SERVICES

The wind farm turbines are not within the coverage area of any aviation radar services.

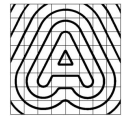
6.3 DEFENCE SERVICES

The public ACMA database does not list any defence radio links in the vicinity of the wind farm. This does not guarantee that there are no defence or security links in the area. There is insufficient information to determine the effect either of the approved project or of Modification 4.

The Department of Defence has been notified of the project and is being consulted as a part of the updated Aviation Impact Assessment.



Emissions from Turbines & Power Lines



7. EMISSIONS FROM TURBINES & POWER LINES

7.1 EMISSIONS FROM TURBINES

The radio communications legislation limits the electromagnetic radiation from wind farm turbines, along with every other electric component of a wind farm. The emissions are limited by the Radiocommunications (Electromagnetic Compatibility) Standard.

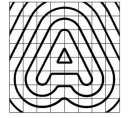
The manufacturer of the turbines and other equipment is required to demonstrate compliance with the Electromagnetic Compatibility Standard and to affix a compliance mark to the equipment.

7.2 EMISSIONS FROM POWER LINES

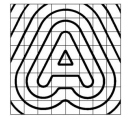
The power transmission lines will be constructed in accordance with the standards and requirements of the state power network operators. There is a requirement to ensure that people and animals are not exposed to hazards due to potential gradients in the earth both under normal operating conditions and under fault conditions. Protection against these hazards is standard engineering practice for power installations.

There is currently no Australian Standard regulating extremely low frequency (power line) electromagnetic fields exposure. The international guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) [4] are generally accepted as best practice and the power line installation should comply with these guidelines.

The potential for interference with radio and television systems is addressed by Australian Standard AS/NZS 2344 [5]. The power installation should be constructed in accordance with this standard.



Conclusions



8. CONCLUSIONS

This assessment has considered the Flyers Creek Wind Farm proposal in Modification 4 and provides an update to the original telecommunications assessment. The changes contemplated in Modification 4 include a 132 kV power transmission line and an increase in the maximum turbine envelope. The turbine positions remain unchanged from the approved locations.

The increased turbine envelope is not expected to have any material effect on television reception. The geometrical relationship of the television transmitter, the television receiver and the reflecting object (turbine) determine whether interference can occur. As there has been no change in the location of the turbines, the reflection mechanisms are unchanged and the potentially affected area remains the same. The amplitude of reflected signals will increase slightly due to the increased reflecting area.

The 132 kV power transmission line proposed in Modification 4 will not affect television reception.

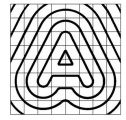
A pre-construction assessment of the existing quality of the television, radio and telephone/internet transmission will be performed at a representative sample of receivers located within five kilometres of any wind turbine, as required by Project Approval condition G3.

As outlined in Project Approval Condition D14, the operators of the various communication services that may be affected should be advised that the wind farm is to be constructed. The parties identified from the ACMA licensing database are:

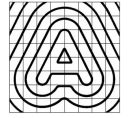
- NBN (which was not in existence at the time of the previous assessment)
- Telstra
- Optus
- Commercial and national television broadcasters,
- Air Services Australia
- Rural Fire Service
- Department of Defence
- NSW Government Telecommunications Authority
- State Emergency Service
- Orange City Council
- Blayney Shire Council
- Essential Energy
- Central Tablelands County Council
- Water NSW
- Essential Energy
- Cadia Holdings
- TT And CI Reece
- Vertical Telecoms.

The communication links operated by these licensees have been reviewed in this analysis. With the exception of Paths E and F Modification 4 has no impact on the operation of the communication links.

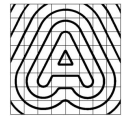
The increased maximum turbine envelope will require micro-siting of Turbines 21, 23 and 35 to maintain clearance on Path E. For Path F, the location of Turbine 34 should be reviewed as the calculated clearance is within the error of topographic map data and antenna location data. The location of Turbine 35 should be adjusted to provide adequate clearance for Path F. These changes can be made within the micro-siting tolerances of the approved project and is not considered a significant impact.



The telecommunications impacts of the project, as modified by Modification 4, will continue to be managed under the conditions of the Project Approval as summarised in section 1.2.2. These conditions remain appropriate to manage telecommunications impacts resulting from Modification 4



References



9. REFERENCES

- [1] *Flyers Creek Wind Farm - investigation of possible impacts on broadcasting and radiocommunication services.* 22nd December 2010 L. J. Derrick, Lawrence Derrick & Associates. Appendix H to the Flyers Creek Wind Farm Environmental Assessment.
- [2] *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia.* Clean Energy Council. Available from cleanenergycouncil.org.au
- [3] *Technical Information and Coordination Process Between Wind Turbines and Radiocommunication and Radar Systems*, published by the Radio Advisory Board of Canada (RABC) & Canadian Wind Energy Association (CanWEA), 2007
- [4] *ICNIRP Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz).* Published in Health Physics 99(6): 818-836; 2010 <http://www.icnirp.org/cms/upload/publications/ICNIRPLFgdl.pdf>
- [5] AS/NZS 2344:1997 (Incorporating Amendment No1). *Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz.*

Appendix I

Aviation Impact Assessment (Aviation Projects)



AVIATION IMPACT ASSESSMENT – MOD 4

FLYERS CREEK WIND FARM

Prepared for Flyers Creek Wind Farm Pty Ltd

DOCUMENT CONTROL

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Reference: 102101-01

Release Date: 06 July 2018

Prepared by: P Davidyuk

Reviewed by: K Tonkin

Released by: K Tonkin

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Revision History

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1.0	Final Report	02 July 2018	Infigen (MR)	03 July 2018
1.1	Final Report with changes	06 July 2018	Infigen (MR)	17 July 2018
1.2	Updated Final Report	18 July 2018	Infigen (MR)	20 July 2018
1.3	Updated Final Report	20 July 2018		

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	VIII
Introduction	viii
Conclusions	ix
Recommendations	xiv
1. INTRODUCTION	1
1.1. Situation	1
1.2. Purpose and Scope	2
1.3. Methodology	3
1.4. Aviation Impact Statement	3
1.5. Report structure	4
1.6. Stakeholders	4
1.7. Material reviewed	5
1.8. References	5
1.9. Triggers for review	6
2. BACKGROUND	7
2.1. Background	7
3. EXTERNAL CONTEXT	8
3.1. Clean Energy Council	8
3.2. Aircraft operations at non-controlled aerodromes	9
3.3. Rules of flight	11
3.4. Aircraft operator characteristics	12
4. INTERNAL CONTEXT	14
4.1. Wind turbine description	14
4.2. Wind monitoring tower description	16
4.3. Power routes grid connections	16
5. CONSULTATION	17
6. AVIATION IMPACT STATEMENT	23
6.1. Nearby registered/certified aerodromes	23
6.2. Bathurst Airport	23
6.3. Cowra Airport	24
6.4. Orange Airport	24
6.5. Obstacles limitation surfaces	25
6.6. Instrument procedures	27
6.7. Nearby aircraft landing areas (ALAs)	30
6.8. Air routes and LSALT	32
6.9. Airspace	34
6.10. Aviation facilities	34
6.11. Radar	34
6.12. Airservices Australia	34
6.13. Summary	34
6.14. Summary	35

7. AIRCRAFT OPERATOR CHARACTERISTICS	36
7.1. Passenger transport operations	36
7.2. Flying training, private, recreational and gliding operations	36
7.3. Aerial application	36
7.4. Aerial fire fighting	38
7.5. Emergency services/RFDS	38
7.6. Summary	38
8. HAZARD LIGHTING AND MARKING	39
8.1. Civil Aviation Safety Authority	39
8.2. International Civil Aviation Organization	41
8.3. Turbine lighting design	43
8.4. Light characteristics	44
8.5. Visual impact of night lighting	46
8.6. Marking of turbines	46
8.7. Wind monitoring towers	47
8.8. Overhead power lines	47
9. ACCIDENT STATISTICS	49
9.1. General aviation operations	49
9.2. ATSB occurrence taxonomy	49
9.3. National aviation occurrence statistics 2006-2015	49
9.4. Worldwide accidents involving wind farms	51
10. RISK ASSESSMENT	57
10.1. Likelihood	57
10.2. Consequence	58
10.3. Risk matrix	59
10.4. Actions required	59
10.5. Risk Identification	60
10.6. Risk Analysis, Evaluation and Treatment	60
10.7. Summary of risks	73
11. CONCLUSIONS	74
11.1. Regulatory requirements	74
11.2. Consultation	74
11.3. Aviation Impact Statement	74
11.4. Aircraft operator characteristics	75
11.5. Hazard lighting and marking	76
11.6. Risk assessment	77
11.7. Conditions of approval	77
12. RECOMMENDATIONS	78
ANNEXURE 1 – WIND TURBINE COORDINATES AND APPROXIMATE HEIGHTS	1

LIST OF FIGURES

Figure 1 Flyers Creek Wind Farm layout	7
Figure 2 Aerodrome standard traffic circuit, showing arrival and joining procedures	10
Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit	11
Figure 4 Approved wind turbines layout and highest wind turbine	14
Figure 5 Burnt Yards Errowanbang Road looking east at the proposed Flyers Creek Wind Farm site.....	15
Figure 6 A view from Carcoar Errowanbang Road.....	15
Figure 7 Flyers Creek Wind Farm in relation to registered/certified aerodromes.....	23
Figure 8 Indicative maximum possible extent of OLS of Bathurst, Cowra and Orange Airports	25
Figure 9 OLS of Orange Airport relative to the WTG 3 of the FCWF Project.....	26
Figure 10 MSA at Bathurst Airport, Cowra Airport and Orange Airport	28
Figure 11 Bathurst, Cowra and Orange Airports 15 nm and 30 nm MSA rings.....	29
Figure 12 Flyers Creek Wind Farm in relation to aircraft landing areas	31
Figure 13 Flyers Creek Wind Farm in relation to aircraft landing area ALA 1 (un-named).....	32
Figure 14 En-Route Chart Low National and air routes within the vicinity of Flyers Creek Wind Farm	33
Figure 15 GA accident and fatal accident rate per million departures	50

LIST OF TABLES

Table 1 Stakeholder consultation details	18
Table 2 Bathurst Airport, Cowra Airport and Orange Airport aerodrome and procedure charts	27
Table 3 Air-route impact analysis	33
Table 4 Number of fatalities by GA sub-category - 2006 to 2015	50
Table 5 Fatal accidents by GA sub-category - 2015.....	51
Table 6 Summary of accidents involving collision with a wind turbine	53
Table 7 Likelihood Descriptors.....	57
Table 8 Consequence Descriptors	58
Table 9 Risk Matrix	59
Table 10 Actions Required	59
Table 11 Summary of Risks	73

ACRONYMS

AAAA	Aerial Agricultural Association of Australia
AGL	above ground level
AHD	Australian Height Datum
AIP	Aeronautical Information Package
ALARP	as low as reasonably practicable
AMSL	above mean sea level
ARP	Aerodrome Reference Point
CAR	Civil Aviation Regulation (1988)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation (1998)
CFIT	controlled flight into terrain
ERSA	En Route Supplement Australia
FCWFPL	Flyers Creek Wind Farm Pty Ltd
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
IMC	instrument meteorological conditions
MOC	minimum obstacle clearance
MOS	Manual of Standards
MSA	minimum sector altitude
OLS	obstacle limitation surface
FCWF	Flyers Creek Wind Farm
PANS-OPS	Procedures for Air Navigation Services - Aircraft Operations
RPT	regular public transport
VFR	visual flight rules
VMC	visual meteorological conditions

UNITS OF MEASUREMENT

ft	feet	(1 ft = 0.3048 m)
km	kilometres	(1 km = 0.5399 nm)
m	metres	(1 m = 3.281 ft)
nm	nautical miles	(1 nm = 1.852 km)

EXECUTIVE SUMMARY

Introduction

Flyers Creek Wind Farm Pty Ltd (FCWFPL) is preparing a modification application (Mod 4) which includes a proposal to increase the tip height at Flyers Creek Wind Farm (FCWF) by 10 m from 150 m to 160 m (525 ft) above ground level (AGL). This also includes changes in rotor diameter and hub height.

Initial project approval for the development application No. MP 08_0252 from the Minister of Planning and Infrastructure NSW was granted on 14 March 2014 and has been subject of three modifications:

- Mod 1 – 13 March 2015;
- Mod 2 – 14 September 2015; and
- Mod 3 – 30 November 2017.

The existing project approval is for up to 38 wind turbine generators (WTGs) at 150 m height and all associated infrastructure (including wind monitoring towers (WMT)) to be developed over the project area. There are two WMTs currently installed on site and existing approval for 3 WMTs.

The FCWF project area is situated within the locality of Forest Reefs, approximately 24 km (13 nm) south of the town of Orange, 15 km (8 nm) south of Orange Airport, 53 km (28.5 nm) south west of Bathurst Airport and 46 km (25 nm) north east of Cowra Airport in the Central Tablelands region of New South Wales.

Flyers Creek Wind Farm Pty Ltd engaged Aviation Projects to prepare an Aviation Impact Assessment for the modification 4 application.

The Aviation Impact Assessment will review potential impacts of proposed Modification 4 to the FCWF on aviation safety in respect of relevant requirements of air safety regulations and procedures and in respect of consultation with relevant regulators.

Project description

- The proposed FCWF will comprise of the following:
 - o up to 38 WTGs, which will be higher than 150 m above ground level (AGL);
 - o maximum overall height (tip height) of the WTG is 160 m (525 ft) AGL with the final height built for each turbine being comprised of the hub height and blade length where the:
 - maximum hub height of the WTG is 92 m AGL; and
 - maximum WTG rotor blade length is 70 m.
 - o highest WTG is WTG20 with ground elevation of 954 m Australian Height Datum (AHD) and overall height of 1114 m AHD (3655 ft) above mean sea level (AMSL).

Conclusions

- The proposed increase in the maximum turbine envelope proposed as part of Modification 4 does not increase the potential impact to aviation from that previously assessed for the Project.

Regulatory requirements

- There is no regulatory requirement for lighting of obstacles lower than 150 m AGL (492 ft AMSL) and that are not within the vicinity of an aerodrome.
- With respect to MOS 139 7.1.5.1, the proposed WTGs and WMTs must be reported to CASA if they will be higher than 110 m AGL.
- With respect to MOS 139 7.1.5.2, the WTGs or WMTs must be regarded as an obstacle if they are higher than 150 m AGL, unless CASA assesses otherwise. Obstacle monitoring includes the PANS OPS surface which extends beyond the OLS of the aerodrome.
- With respect to MOS 139 9.4.1.2 (b), the WTGs or WMTs will need to be lit if they will be outside the OLS and above 110 m AGL, unless an aeronautical study assesses they are of no operational significance.
- **Aviation Projects assesses that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.** Section 10– Risk Assessment of the aeronautical impact assessment concluded no lights were not required for wind turbines or wind monitoring towers.

Consultation

- The following parties were consulted about the proposed planning modification:
 - o Aerial Agricultural Association of Australia;
 - o Airservices Australia;
 - o Department of Defence;
 - o Fred Fahey Aerial Services; and
 - o Orange City Council.

Aviation Impact Statement

- Based on the proposed FCWF layout and overall WTG overall blade tip height limit of 160 m AGL, the blade tip elevation of the highest WTG, which is WTG20, will not exceed 1114 m AHD (3655 ft) and:
 - o will not penetrate any OLS surfaces;
 - o will not penetrate PANS-OPS surfaces;
 - o will not impact on nearby designated air routes;
 - o will not have an impact on prescribed airspace;
 - o is contained within Class G airspace; and

- o is outside the clearance zones associated with aviation navigation aids and communication facilities.
- With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 1114m (3655ft) AHD the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Orange, Cowra or Bathurst Airport, any air route lowest safe altitude (LSALT) and will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

Aircraft operator characteristics

- Aircraft will be required to navigate around the proposed FCWF site in low cloud conditions where aircraft need to fly at 500 ft AGL.
- Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project area.
- Wind turbines are generally not a safety concern to aerial agricultural operators. Wind monitoring towers remain the primary safety concern to aerial agricultural operators, who have expressed a general desire for these towers to be more visible.
- Air operators: There is a relatively low rate of aircraft activity in the vicinity of the wind farm site.
- Aerial fire fighting: There are no known aerial agriculture operations conducted at night in the vicinity of the wind farm site. Any fire-fighting activities in the vicinity of the proposed wind farm by either fixed or rotary wing aircraft would need to be conducted in consideration of the location of the wind turbines and monitoring masts. To this end it is important that the location of the wind turbines and monitoring masts are made available to fire-fighting agencies and aerial agriculture operators.

Notwithstanding that aerial fire-fighting operations will potentially be restricted in the vicinity of the proposed wind farm, there is still a valid (ground-based) means of fighting bushfires on and near the properties on which the wind farm is proposed to be located.

The Country Fire Authority Emergency Management Guidelines for Wind Energy Facilities includes a section on planning, design and development of wind energy facilities and section 2(2.3) stated:

Wind turbines should be located approximately 300 metres apart. This provides adequate distance for aircraft to operate around a Wind Energy Facility given the appropriate weather and terrain conditions. Fire suppression aircraft operate under "Visual Flight Rules". As such, fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Wind turbines, similar to high voltage transmission lines, are part of the landscape and would be considered in the incident action plan.

- Aerial agricultural operators: The proposed wind farm will most likely prevent fixed wing aerial agricultural operations on the wind farm site, whilst the viability of conducting these operations on properties adjacent to the wind farm would have to be assessed on an individual basis.

It is reasonable to conclude that safe aerial application operations would be possible on properties neighbouring the proposed wind farm with some operational or cost impacts, subject to final microsituated turbine locations, and subject to a case by case assessment.

The use of helicopters enables aerial application operations to be conducted in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

Hazard lighting and marking

- With respect to MOS 139 7.1.5.1, the proposed wind turbines must be reported to CASA if they will be higher 110 m AGL. With respect to MOS 139 7.1.5.2, the proposed 160 m wind turbine overall blade tip height must be regarded as obstacles since they are higher than 150 m AGL.
- There are two existing WMTs at a height of 82 m (269 ft), which have been reported to Airservices Australia.
- With respect to MOS 139 9.4.1.2 (b), the wind turbines and WMTs will need to be lit if they are higher than 110 m AGL, unless an aeronautical study assesses they are of no operational significance.
- CASA has advised that it will only review assessments referred to it by a planning authority or agency.
- **Aviation Projects assesses that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.**
- If obstacle lighting is required by the assessment manager, installed lights should be designed according to criteria set out in the applicable regulatory material.
- With respect to marking of turbines, a white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.
- Consultation with Department of Defence regarding lighting has been undertaken during the preparation of the aviation impact assessment. Department of Defence has reviewed the requirement for lighting and has determined that lighting will not be required. If LED lighting is proposed, Department of Defence requests that the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometers, so that the WTGs are visible to pilots using night vision goggles.

If wind monitoring towers are constructed as part of the proposal, Defence notes that the National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers - Paragraph 39 recommends the top 1/3 of wind monitoring towers are painted in alternating contrasting bands of colour in accordance with the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998.

- Although there is no obligation to do so, consideration should be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings (as modified by the guidance in NASF Guideline D).
- With respect to power line route determination (refer to Section 4.3), it is prudent to consider potential adverse impacts on aerial application operations. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Section 8.10 Obstacle Markings; specifically:

8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.

- The transmission line and switching station proposed as part of Modification 4 will not adversely affect aircraft operations.

Conditions of approval

- Conditions of approval D11, D12, D13, D22 and D25 were identified as being relevant to the assessment contained herein.
- In relation to Condition D11 (a), correspondence sent from Orange City Council to FCWFPL advised that there would be no impact on current or future obstacle limitation surfaces of Orange Airport.
- In relation to Condition D11 (b), redesign of the NDB approach at Orange Airport is not required, since the NDB has been decommissioned, and Airservices Australia has advised that there will be no impacts on instrument approach procedures at aerodromes, navigational aids, communications and surveillance facilities.
- In relation to Condition D12, during recent consultation, RAAF AIS advised that all future correspondence should be directed through Airservices Australia. Accordingly, the requirement to notify Royal Australian Air Force – Aeronautical Information Services should be removed from this condition..
- The remainder of Conditions D11, D12, D13, D22 and D25 remain appropriate to managing potential aviation impacts.

Risk Assessment

- A summary of the level of risk associated with the proposed FCWF, under the proposed treatment regime, is provided in Table E1.

Table E1 Risk assessment summary

<i>Risk Element</i>	<i>Consequence</i>	<i>Likelihood</i>	<i>Risk</i>	<i>Actions Required</i>
Aircraft collision with wind turbine	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in En Route Supplement Australia (ERSA) for surrounding aerodromes before, during and following construction.
Aircraft collision with monitoring tower	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Although there is no obligation to do so, consider marking any new wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings, specifically 8.10.2.6 and 8.10.2.8. Communicate details of wind monitoring towers to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes following construction.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Effect on crew	Minor	Possible	5	Acceptable without obstacle lighting (ALARP) Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Visual impact from obstacle lights	Moderate	Likely	7	Acceptable without obstacle lighting (zero risk of visual impact from obstacle lighting). If lights are installed, design to minimise impact.

Recommendations

If the recommendations set out below are implemented, the Project will not adversely affect the safety, operational integrity and efficiency of air services.

Notification and reporting

1. 'As constructed' details of wind turbine coordinates and elevations should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.
2. Any obstacles above 110 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
 - a. The planned operational timeframe and maximum height of the crane; and
 - b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
3. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations. Specifically, details should be provided to the NSW/ACT Regional Airspace and Procedures Advisory Committee for consideration by its members in relation to VFR transit routes in the vicinity of the wind farm.

Operation

4. Although not a mandatory requirement, the Proponent should consider engaging with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.

Marking of turbines

5. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted white, typical of most wind turbines operational in Australia.

Lighting of turbines

6. **Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.**
7. If obstacle lighting was required by the assessment manager, the lighting should have the following characteristics:
 - a. Obstacle lighting should be designed in accordance with the characteristics specified in ICAO Annex 14 Vol 1 Chapter 6 (note that Section 6.2.4 addresses obstacle marking and lighting of wind turbines) and MOS 139 Chapter 9 (note that Section 9.4.3.4A addresses obstacle lighting for a wind farm), while minimising visual impact;
 - b. Department of Defence determined that lighting will not be required. If LED lighting is proposed, the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometers, for night vision devices compatibility; and

- c. To ensure the ongoing operation and availability of obstacle lights (if required) at night and during times of reduced visibility, a monitoring, reporting and maintenance program should be established in accordance with the guidance in MOS 139 Section 9.4.10.

8. Any decision to require or to not require lighting remains with the planning authority to determine.

Marking of wind monitoring towers

- 9. Consideration should be given to marking any new WMTs according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D). Refer to Section 8.6 and O for the detailed description of the marking requirements.

Marking of overhead transmission lines and poles

- 10. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Section 8.10.2.8.

Micrositing

- 11. Alteration to the siting of a turbine will not be more than 100 m and micrositing will address any consequential changes to access tracks and internal power cable routes. The potential micrositing of the turbines has been taken into account in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the nominal turbine position. The micrositing of the turbines is not likely to result in a change in the maximum overall AGL blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this aviation impact assessment would remain the same.

1. INTRODUCTION

1.1. Situation

Flyers Creek Wind Farm Pty Ltd (FCWFPL) is preparing a modification application (Mod 4) which includes a proposal to increase the tip height at Flyers Creek Wind Farm (FCWF) by 10 m from 150 m to 160 m (525 ft) above ground level (AGL). This also includes changes in rotor diameter and hub height.

Initial project approval for the development application No. MP 08_0252 from the Minister of Planning and Infrastructure NSW was granted on 14 March 2014 and has been subject of three modifications:

- Mod 1 – 13 March 2015;
- Mod 2 – 14 September 2015; and
- Mod 3 – 30 November 2017.

The existing project approval is for up to 38 wind turbine generators (WTGs) at 150 m height and all associated infrastructure (including wind monitoring towers (WMT)) to be developed over the project area. There are two existing WMTs on site.

Conditions of approval relevant to this assessment are copied below:

Aviation Obstacles and Hazards

D11. Prior to the commencement of construction, the Proponent shall consult with:

- (a) aerodrome operators that have an aerodrome located within 30 kilometres of the boundaries of the site, to determine any impact on Obstacle Limitation Surfaces at such aerodromes;*
- (b) AirServices Australia, to determine potential impacts on instrument approach procedures at aerodromes, navigational aids, communications and surveillance facilities, inclusive of the redesign of the Non-Directional Beacon Approach (if required);*
- (c) Aerial Agriculture Association Australia, to determine potential hazards to aerial application and related operations; and*
- (d) Rural Fire Service, to determine potential hazards to the aerial fighting of fires. Feasible and reasonable mitigation measures for each of the potential impacts and hazards identified, shall be determined in consultation with the respective groups identified in this condition, prior to the commencement of construction.*

D12. Prior to the commencement of construction, the Proponent shall provide the following information to the Civil Aviation Safety Authority, Airservices Australia, Royal Australian Air Force - Aeronautical Information Services, the Aerial Agricultural Association of Australia, Rural Fire Service as well as all known users of privately owned local airfields:

- (a) coordinates in latitude and longitude of each wind turbine generator;*
- (b) final height of each wind turbine generator in Australian Height Datum; and*
- (c) ground level at the base of each wind turbine generator in Australian Height Datum.*

D13. Should increases to the costs of aerial agricultural spraying on any non-associated property surrounding the site be attributable to the operation of the Project, the Proponent shall fully fund to the affected landowner, the reasonable cost difference between pre-construction aerial agricultural spraying and the increased cost, as agreed between the relevant parties.

Visual Appearance

D22. The Proponent must:

- (a) minimise the off-site visual impacts of the development;*
- (b) ensure the wind turbines are:*
 - painted off white/grey, unless otherwise agreed by the Secretary; and*
 - finished with a surface treatment that minimises the potential for glare and reflection;*
- (c) ensure the visual appearance of all ancillary infrastructure (including paint colours) blends in as far as possible with the surrounding landscape; and*
- (d) not mount any advertising signs or logos on wind turbines or ancillary infrastructure.*

Night Lighting

D25. With the exception of aviation hazard lighting implemented in accordance with the requirements of this condition, no external lighting other than low intensity security night lighting is permitted on site unless otherwise agreed or directed by the Secretary, or required by Civil Aviation Safety Authority. Prior to the commencement of construction, the Proponent shall consult with the Civil Aviation Safety Authority on the need for aviation hazard lighting in relation to the wind turbines. Any aviation hazard lighting shall be implemented in a manner that minimises visual intrusion to surrounding non-associated receivers as far as feasible and reasonable.

The FCWF project area is situated within the locality of Forest Reefs, approximately 24 km (13 nm) south of the town of Orange, 15 km (8 nm) south of Orange Airport, 53 km (28.5 nm) south west of Bathurst Airport and 46 km (25 nm) north east of Cowra Airport in the Central Tablelands region of New South Wales.

The FCWF project area is approximately 14 km (7.5 nm) from the northern extent to the southern extent, and approximately 10 km (5.5 nm) from the eastern extent to the western extent.

Flyers Creek Wind Farm Pty Ltd engaged Aviation Projects to prepare an Aviation Impact Assessment for the modification 4 application.

The Aviation Impact Assessment will review potential impacts of proposed Modification 4 to the FCWF on aviation safety in respect of relevant requirements of air safety regulations and procedures and in respect of consultation with relevant regulators.

1.2. Purpose and Scope

This Aviation Impact Assessment has been prepared to assess the impacts of Proposed Modification 4 to support a modification application proposed to be made under section 4.55 of the Environmental Planning & Assessment Act 1979.

1.3. Methodology

In undertaking this task, Aviation Projects:

1. confirmed the scope and deliverables with Flyers Creek Wind Farm Pty Ltd;
2. reviewed client material;
3. reviewed relevant regulatory requirements and information sources;
4. conducted a site visit to properly investigate aviation safety aspects and identifying existing tall structures within or adjacent to the proposed FCWF project area;
5. prepared a First Draft Aviation Impact Assessment (including Aviation Impact Statement, qualitative risk assessment to determine the need of obstacle lighting and specifications (if obstacle lighting is required)) for client review and consideration by applicable stakeholders;
6. completed the risk assessment following the guidelines in Risk management—Guidelines AS/NZS ISO 31000:2018;
7. consulted with relevant stakeholders, including Airservices Australia, Department of Defence, state and local government authorities, aerodrome operators, aircraft operators, Aerial Agriculture Association of Australia and land owners/leaseholders. Included preparation of correspondence, telephone consultation as applicable and consolidation of responses;
8. finalised the assessment report for client acceptance when responses from relevant stakeholders were received; and
9. finalised the assessment for submission.

1.4. Aviation Impact Statement

The Aviation Impact Statement includes the following specific requirements as advised by Airservices Australia:

Aerodromes:

- Specify all registered/certified aerodromes that are located within 30 nm (55.56 km) of the Site;
- Nominate all instrument approach and landing procedures at these aerodromes;
- Review the potential effect of the Project operations on the operational airspace of the aerodrome(s);

Air Routes:

- Nominate air routes published in ERC-L & ERC-H which are located near/over the Site and review potential impacts of Project operations on aircraft using those air routes;
- Specify two waypoint names located on the routes which are located before and after the obstacles;

Airspace:

- Nominate the airspace classification – A, B, C, D, E, G etc where the Site is located; and

Navigation/Radar:

- Nominate radar navigation systems with coverage overlapping the site.

1.5. Report structure

This report is structured around the following areas of consideration:

- Introduction;
- Background;
- External context
- Internal context;
- Consultation;
- Aviation Impact Statement;
- Aircraft operator characteristics;
- Hazard lighting and marking;
- Accident statistics;
- Risk assessment;
- Conclusions; and
- Recommendations.

1.6. Stakeholders

The following parties were consulted about the proposed planning modification:

- Aerial Agricultural Association of Australia;
- Airservices Australia;
- Department of Defence;
- Fred Fahey Aerial Services; and
- Orange City Council.

Aviation Projects also considered the needs of the following parties:

- aircraft operators;
- Civil Aviation Safety Authority;
- operators of non-regulated aerodromes within the vicinity of the Project; and
- other stakeholders where noted.

1.7. Material reviewed

Material provided by the Proponent for preparation of this assessment included:

- FCWF consolidated project approval (30 November 2017), including project layout and turbine locations;
- Original Environmental Assessment Safety Chapter, May 2011 (including aviation assessment); and
- Consultation correspondence with:
 - o AAAA;
 - o Airservices Australia;
 - o CASA;
 - o Orange Airport; and
 - o Royal Australian Air Force.

1.8. References

References used or consulted in the preparation of this report include:

- Aerial Agricultural Association of Australia, *National Windfarm Operating Protocols*, May 2014;
- Aerial Agricultural Association of Australia, *Powerlines Policy*, dated March 2011;
- Aerial Agricultural Association of Australia, *Windfarm Policy*, dated March 2011;
- Airservices Australia, Aeronautical Information Package; including AIP Book, Departure and Approach Procedures and En Route Supplement Australia, dated 1 March 2018;
- Airservices Australia, *Designated Airspace Handbook*, effective 9 November 2017;
- Aircraft Owners and Pilots Association of Australia (AOPA), *National Airfield Directory 2012*, 15th ed;
- AS/NZS ISO 31000:2018 Risk management—Guidelines, Standards Australia;
- Bureau of Meteorology, NSW/ACT Radar Sites Table and information, http://www.bom.gov.au/australia/radar/nsw_radar_sites_table.shtml
- Clean Energy Council, Best Practice Guidelines – For Implementation of Wind Energy Projects in Australia, 2013, Aircraft Safety;
- Civil Aviation Safety Authority, *Civil Aviation Regulations 1998 (CAR)*, as amended;
- Civil Aviation Safety Authority, *Civil Aviation Safety Regulations 1998 (CASR)*, as amended;
- Civil Aviation Safety Authority, Civil Aviation Advisory Publication (CAAP) 92-1(1): Guidelines for aeroplane landing areas, dated July 1992;
- Civil Aviation Safety Authority, Civil Aviation Advisory Publication (CAAP) 166-1 v4.1 Operations in the vicinity of non-controlled aerodromes, dated April 2017;

- Civil Aviation Safety Authority, *Manual of Standards Part 139 – Aerodromes*, version 1.14: dated January 2017;
- Civil Aviation Safety Authority, *Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design*, version 1.5, dated March 2016;
- Civil Aviation Safety Authority, Advisory Circular (AC) 139-8 (v2.0): Reporting of Tall Structures, dated March 2018;
- Department of Planning and Environment, NSW Government, *NSW Wind Farm Guideline for State significant wind energy development*, December 2016;
- Department of Planning and Environment, NSW State Government, *Wind Energy: Visual Assessment Bulletin – For State significant wind energy development*, December 2016;
- Department of Infrastructure and Regional Development, Australian Government, *National Airport Safeguarding Framework, Guideline D Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*, dated June 2013;
- EUROCONTROL, European Organisation for the safety of air navigation, *EUROCONTROL Guidelines, How to assess the potential impact of wind turbines surveillance sensors*, edition 1.2, ISBN: 978-2-87497-043-6, Reference number: EUROCONTROL-GUID-130, September 2014;
- International Civil Aviation Organization (ICAO), Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS);
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes;
- NSW Government, NSW Legislation, Blayney Shire Council Local Environment Plan 2012, May 2018;
- NSW Government, NSW Legislation, Cowra Council Local Environment Plan 2012, No. 22, January 2013;
- NSW Government, NSW Legislation, Orange Local Environmental Plan 2011, April 2018;
- OzRunways, aeronautical navigation charts (WAC and ERC) extracts, dated 26 April 2018; and
- other references as noted.

1.9. Triggers for review

Triggers for review of this risk assessment are noted below:

- following any significant changes to the context in which the assessment was prepared, including the regulatory framework; and
- following any near miss, incident or accident associated with operations considered in this risk assessment.

2. BACKGROUND

2.1. Background

An overview of the FCWF layout and site area, along Beneree Flyers Creek and Burnt Yards Errowanbang Roads, and between Carcoar Errowanbang Road and Gap Road within the local government area of Blayney Shire Council, NSW, is shown in Figure 1 (Source: FCWFPL, Google Earth, 2018).

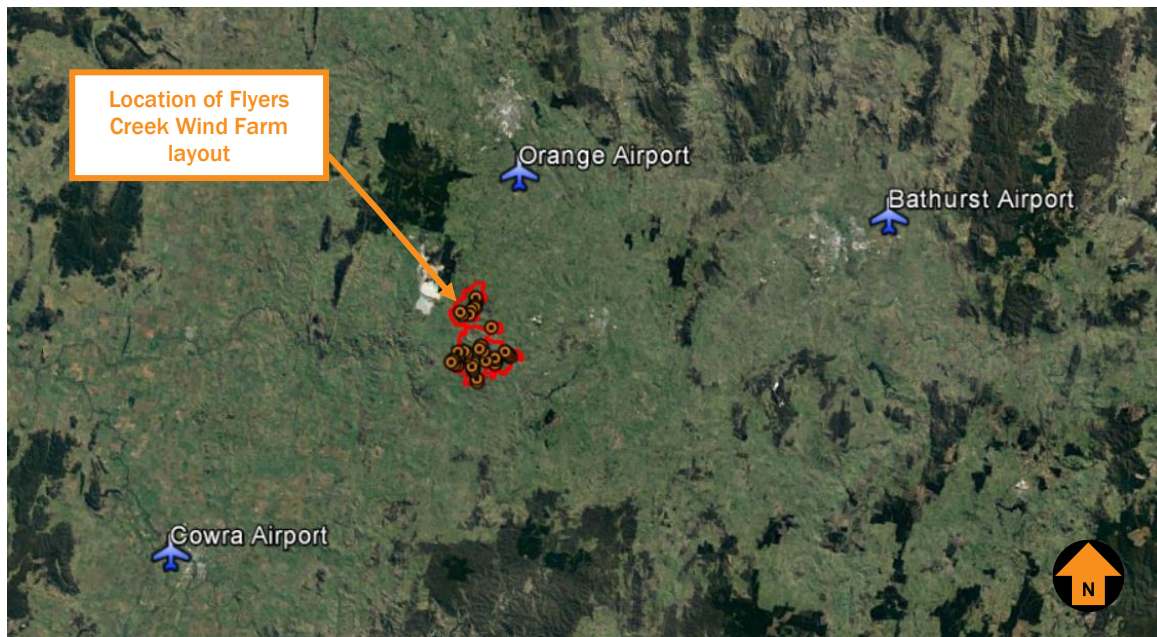


Figure 1 Flyers Creek Wind Farm layout

3. EXTERNAL CONTEXT

3.1. Clean Energy Council

Clean Energy Council has produced a *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*, 2013 version. The guidelines are designed to support the existing wind farm planning and development assessment process and are not mandatory.

Guidance provided under section 3.1.2.8 Aircraft safety state as follows:

Proponents should assess potential for aircraft safety issues by noting the proximity of the site to any major airports, aerodromes or landing strips. Proponents should contact the Civil Aviation Safety Authority, Airservices Australia and the authorities responsible for the operation of such facilities in the vicinity of the proposed site. Advice should be sought on contacting agricultural aviators who may operate in the area.

In addition, proponents should obtain advice from landowners on any farming-related uses of aircraft such as aerial spraying or mustering. In such cases, the district aerodrome supervisor should be contacted for advice on the potential impact of a wind energy development on these activities.

To provide more detailed guidance for wind farm proponents, a National Airports Safeguarding Advisory Group has prepared draft "Guidelines for land use planners and developers to manage the risk to aviation safety of wind turbine installations (wind farms)/wind monitoring towers."

Guidance provided under section 3.1.2.9 Restricted areas state as follows:

Consultation with relevant authorities should be carried out to determine whether any restrictions may apply to the development of a wind farm in the proximity of radar used for aircraft safety.

Guidance provided under section 3.2.4.4 Other agencies state as follows:

Structures such as wind monitoring masts in the vicinity of an airfield or flight area may cause a safety hazard. It is recommended that the proponent contact the Civil Aviation Safety Authority to maximise aircraft safety.

Guidance provided under section 3.3 Detailed assessment, 3.3.2 Environmental considerations, Aircraft safety assessment state as follows:

An assessment of aircraft safety should be completed.

Guidance provided under Appendix 4: Aircraft safety state as follows:

Wind energy projects (including associated wind monitoring masts) need to be sited so as not to cause a hazard to aircraft safety; civil, military, agricultural and industrial.

[NASF Guideline D] provide comprehensive coverage of aviation safety for wind developments and should be the point of reference for wind farm proponents.

The Commonwealth agencies such as the Civil Aviation Safety Authority (CASA), Airservices Australia and Department of Defence must be notified of the locations of all wind monitoring towers and proposed wind farms. It should be noted that where turbine(s) are planned to be over 150 m above ground level or built within 30 km of a certified or registered aerodrome, CASA may be required to provide a formal

assessment of the project. If the wind monitoring tower or wind turbine(s) is within 30 km of a military aerodrome, then extensive consultation will be required with the Department of Defence.

The aviation safety guidelines provide guidance on:

- the notification process for tall structures (wind turbines and wind monitoring masts)
- the need for risk assessment to identify whether the wind turbines or wind monitoring masts will be considered to be hazards
- actions required if a wind turbine(s) or wind monitoring mast is considered to be a hazard – including the possibility that a wind turbine or monitoring mast should not be built.
- marking recommendations for wind monitoring masts

Consultation with aviation stakeholders is strongly encouraged in the early stages of planning for wind farm developments. This should include:

- early identification of any nearby licensed aerodromes
- consultation with any nearby aerodrome owners
- If potential risks to aviation are identified, a preliminary assessment by an aviation consultant of potential issues
- confirmation of the extent of the obstacle limitation surfaces (OLS) for any nearby aerodromes
- registration of all wind monitoring masts on the Airservices Australia's database
- consultation with local agricultural pilots and nearby unlicensed airstrip owners
- consultation with CASA and Airservices
- consultation with the Department of Defence.

3.2. Aircraft operations at non-controlled aerodromes

Civil Aviation Advisory Publications (CAAP) provide guidance, interpretation and explanation on complying with the Civil Aviation Regulations 1988 (CAR) or Civil Aviation Orders (CAO). CAAP 166-1(3) – *Operations in the vicinity of non-controlled aerodromes* – provides guidance with respect to CAR 166. The purpose of this CAAP is to support Common Traffic Advisory Frequency (CTAF) procedures. It provides guidance on a code of conduct (good airmanship) to allow flexibility for pilots when flying at, or in the vicinity of, non-controlled aerodromes.

CAAP 166-1(3) paragraph 3.4 states the following:

3.4 CASA [Civil Aviation Safety Authority] strongly recommends the use of 'standard' traffic circuit and radio broadcast procedures by radio-equipped aircraft at all non-controlled aerodromes. These procedures are described in the Aeronautical Information Publication (AIP) and Visual Flight Rules Guide (VFRG), and discussed in Section 6 of this CAAP (Standard traffic circuit procedures) and Section 7 (Radio broadcasts).

The standard circuit consists of a series of flight paths known as *legs* when departing, arrival or when conducting circuit practice. Illustrations of the standard aerodrome traffic circuit procedures are provided in Figure 2 and Figure 3.

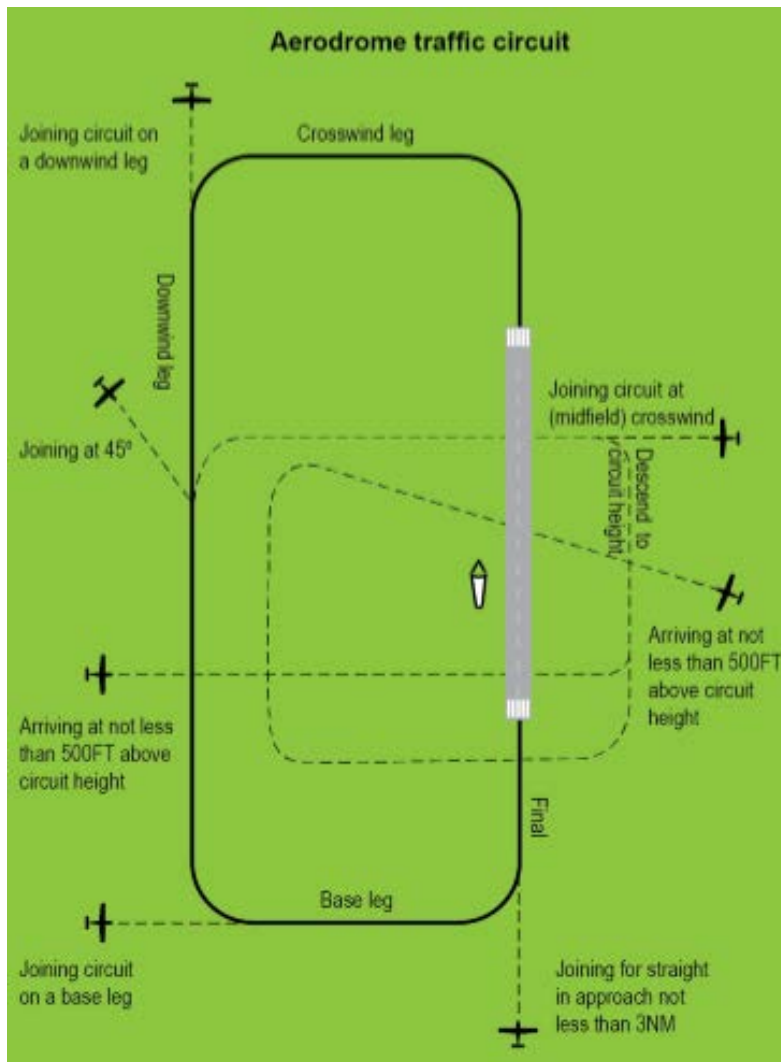


Figure 2 Aerodrome standard traffic circuit, showing arrival and joining procedures

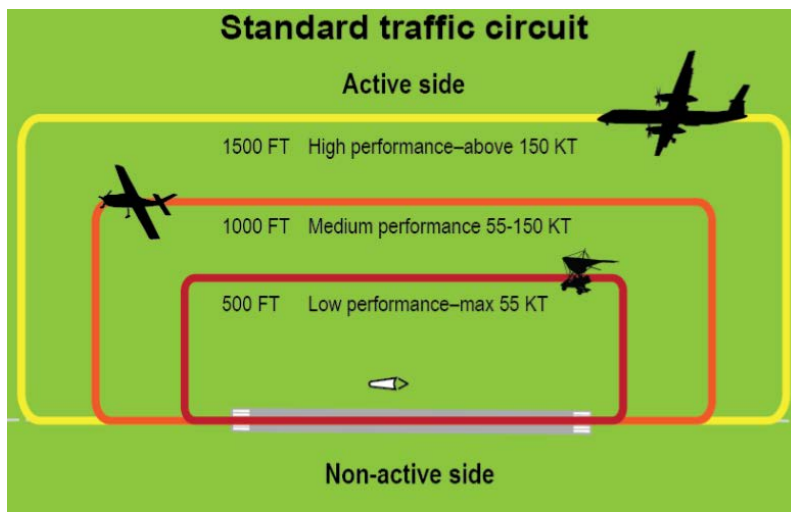


Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

CAAP 166-1(3) paragraph 6.4.1 makes reference to a distance that is “normally” well outside the circuit area and where no traffic conflict exists, which is at least 3 nm (5556 m). The paragraph is copied below:

6.4 Departing the circuit area

6.4.1 Aircraft should depart the aerodrome circuit area by extending one of the standard circuit legs or climbing to depart overhead. However, the aircraft should not execute a turn to fly against the circuit direction unless the aircraft is well outside the circuit area and no traffic conflict exists. This will normally be at least 3 NM from the departure end of the runway, but may be less for aircraft with high climb performance. In all cases, the distance should be based on the pilot’s awareness of traffic and the ability of the aircraft to climb above and clear of the circuit area.

3.3. Rules of flight

3.3.1. Flight under Day Visual Flight Rules (VFR)

According to Aeronautical Information Publication (AIP) the meteorological conditions required for visual flight in the applicable (class G) airspace at or below 3000 ft AMSL or 1000 ft AGL whichever is the higher are: 5000 m visibility, clear of clouds and in sight of ground or water.

Civil Aviation Regulation (1988) 157 (Low flying) prescribes the minimum height for flight. Generally speaking aircraft are restricted to a minimum height of 500 ft AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas, and 1000 ft AGL over built up areas.

These height restrictions do not apply if through stress of weather or any other unavoidable cause it is essential that a lower height be maintained.

Flight below these height restrictions is also permitted in certain other circumstances.

3.3.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Regulations (1988) 174B states as follows:

The pilot in command of an aircraft must not fly the aircraft at night under the V.F.R. at a height of less than 1000 feet above the highest obstacle located within 10 miles of the aircraft in flight if it is not necessary for take-off or landing.

3.3.3. IFR (Day or night)

According to CAR 178, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method. Obstacle lights on structures not within the vicinity of an aerodrome are effectively redundant to an aircraft being operated under the IFR.

3.4. Aircraft operator characteristics

3.4.1. Passenger transport operations

Regular public transport (RPT) and passenger carrying charter operations are generally operated under the IFR.

3.4.2. Private operations

Private operations are generally conducted under day or night VFR, with some IFR. Flight under day VFR is conducted above 500 ft AGL.

3.4.3. Aerial agriculture operations

Aerial agricultural operations including such activities as fertiliser, pest and crop spraying are generally conducted under day VFR below 500 ft AGL; usually between 60 ft (18.3 m) and 100 ft (30.5 m) AGL.

There is a low rate of aerial application operations in the area.

Due to the nature of the operations conducted, aerial agriculture pilots are subject to rigorous training and assessment requirements in order to obtain and maintain their licence to operate under these conditions.

The Aerial Agricultural Association of Australia (AAAA) has a formal risk management program which is recommended for use by its members.

3.4.4. Aerial fire fighting

Aerial fire fighting operations (fire bombing in particular) are conducted in Day VFR, sometimes below 500 ft AGL. Under certain conditions visibility may be reduced/limited by smoke/haze.

Most aerial fire fighting organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained. For example, pilots require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

3.4.5. Emergency services/RFDS

Aeromedical and other emergency services operations are generally conducted under the IFR, except when arriving/departing a destination that is not serviced by instrument approach aids or procedures.

Most emergency aviation services organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

For example, pilots and crew require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

4. INTERNAL CONTEXT

4.1. Wind turbine description

The maximum blade tip height of the wind turbines proposed in Modification 4 will be up to 160 m above ground level (AGL). The maximum ground elevation for the proposed WTG20 wind turbine is 954 m AHD, equating to a maximum overall height of 1114 m AHD (3655ft AMSL).

Figure 4 provides the approved FCWF turbine locations and highlights WTG 20 having the greatest elevation (source: Google Earth, 2018).

Micrositing of turbines means an alteration to the siting of a turbine by not more than 100 m and any consequential changes to access tracks and internal power cable routes. The potential micrositing of the turbines have been taken into account in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the nominal turbine position. The micrositing of the turbines is not likely to result in a change in the maximum overall blade tip height AGL of the Project.

The approved coordinates and approximate ground elevations of the Project wind turbines are listed at Annexure 1.

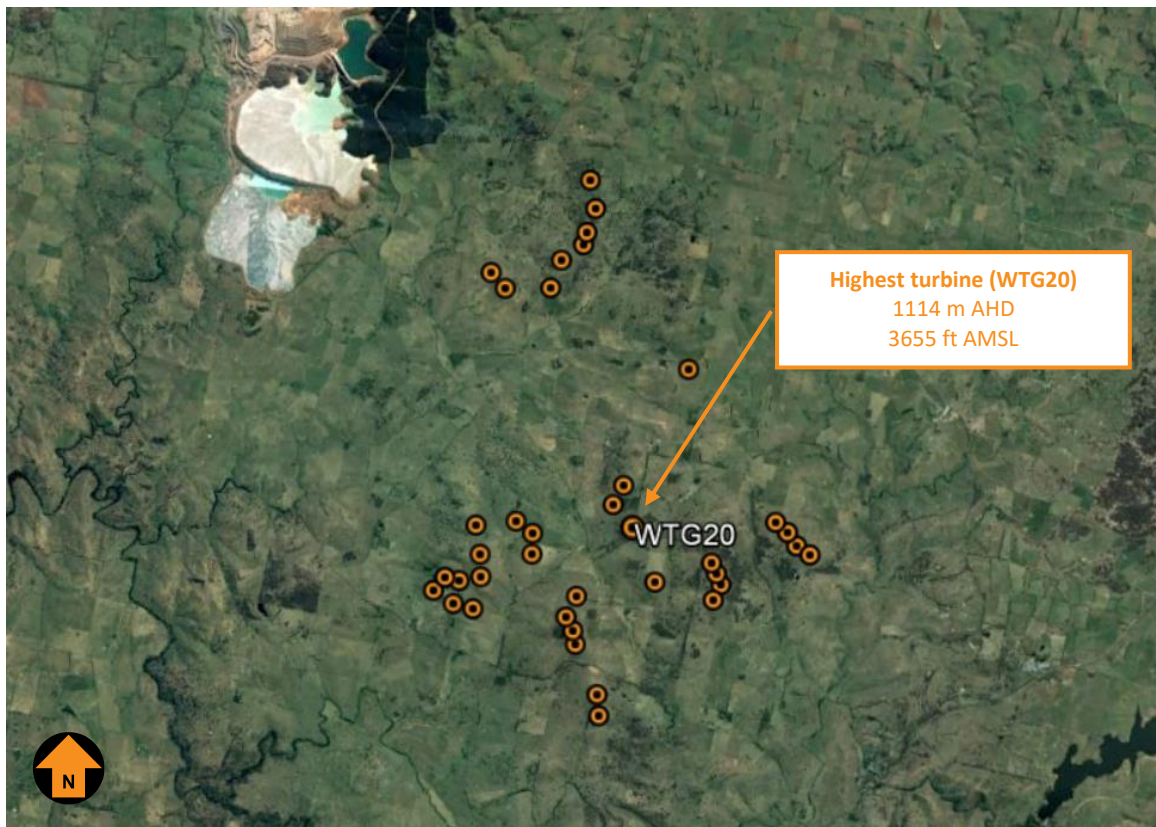


Figure 4 Approved wind turbines layout and highest wind turbine

The wind farm is situated in an area comprised mainly of farming properties on high terrain. Figure 5 shows a view looking east from Burnt Yards Errowanbang Road towards the proposed FCWF site.



Figure 5 Burnt Yards Errowanbang Road looking east at the proposed Flyers Creek Wind Farm site

Figure 6 is taken from Carcoar Errowanbang Road looking north-west to the proposed FCWF site area approximately 3 km north of Mid Western Highway.



Figure 6 A view from Carcoar Errowanbang Road

4.2. Wind monitoring tower description

There are two existing wind monitoring towers (WMTs) installed at the site and existing approval for three WMT's. WMT 1 is located east of WTG 3 and WMT 2 is located between WTG 34 and WTG 35.

FCWFPL is planning to retain the WMTs until construction commences at which point they would either remain or be relocated on the site and may remain throughout the operational phase of the wind farm. The height of WMTs is currently 82 m (269 ft) AGL, however any new met masts which are installed would be up to 92m to correspond to the hub height of the turbines proposed in modification 4.

All future proposed WMTs are subject to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D).

4.3. Power routes grid connections

Planning modification 4 includes a 132 kV grid connection electrical line which will connect the on-site wind farm substation to the wider grid network. The 132 kV line will travel along the Panuara Road and Cadia Road reserves and adjoining land where available. It will be an overhead grid connection line with poles being approximately 24 m in height

5. CONSULTATION

Details and results of the consultation activities are provided in Table 1. The following stakeholders were consulted:

- Aerial Agricultural Association of Australia;
- Airservices Australia;
- aerodrome operators or non-regulated aerodromes within the vicinity of the Project;
- Civil Aviation Safety Authority;
- Department of Defence;
- Orange City Council; and
- other stakeholders where noted.

Table 1 Stakeholder consultation details

<i>Agency/Contact</i>	<i>Activity/Date</i>	<i>Response/ Date</i>	<i>Issues Raised During Consultation</i>	<i>Action Proposed</i>
Aerial Agricultural Association Australia (AAAA)	12 April 2018 Email to Phil Hurst, CEO-AAAA	12 April 2018 Email from Phil Hurst, CEO-AAAA	Information on the proposed planning modification 4 and request for information or comments.	Recommendation has been given to follow National Windfarm Operating Guidelines for Aerial Application for the FCWF Project
Aerial Agricultural Service (Fahey Fred Aerial Services)	14 June 2018 Phone/Email to Fred Fahey	14 June 2018 - Phone; 20 June 2018 – Email, Fred Fahey	Discussed aircraft landing areas in the proximity to the project site to identify which airfields are still used in the area. Mr Fahey requested to send him email with a map showing identified ALAs during the preparation of this AIA. Mr. Fahey marked aircraft landing areas (ALA) in the proximity to the proposed FCWF location. A comparison analysis of provided and previously identified location of ALAs showed that there are no new airstrips in the area of the proposed project.	No further action required at this stage.
Airservices Australia Airport Developments	12 April 2018 Email to Airport Developments	12 April 2018 Email from William Zhao, Advisor Airport Development, Operational Standards & Assurance, Airservices Australia	Information on the proposed planning modification 4 and request for information or comments.	Airservices Australia requested an updated aviation impact assessment report which was duly provided.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
	10 May 2018 Email to Airport Developments	06 June 2018 Email from William Zhao, Advisor Airport Development, Operational Standards & Assurance, Airservices Australia	Airspace Procedures With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 1114m (3655ft) AHD, the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Orange, Cowra or Bathurst Airport. The wind farm will not affect any air route LSALT. Note that procedures not designed by Airservices at Orange, Cowra or Bathurst Airport were not considered in this assessment. Communications/Navigation/Surveillance (CNS) Facilities This wind farm to a maximum height of 1114m (3655ft) AHD will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.	No further action required at this stage.
Civil Aviation Safety Authority	12 April 2018 Email to Matthew Windebank, Aerodrome Engineer, Air Navigation, Airspace & Aerodromes Branch, CASA/Aviation Group	13 April 2018 Email from CASA/Aviation Group	CASA has advised that it will only review assessments referred to it by a planning authority or agency.	Submit aviation impact assessment to NSW Department of Planning and Environment

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
Commonwealth Department of Defence Estate Planning QVT	12 April 2018 Email to Estate Planning Land Planning and Regulation Infrastructure Division and DSRGIDEP.ExecutiveSupport@defence.gov.au	12 April 2018 Email from Debbie Fisher, Distribution Coordinator, Aeronautical Information Service – Air Force	Information on the proposed planning modification 4 and request for information or comments.	Report vertical obstruction information to Airservices Australia.
	10 May 2018 Email to Department of Defence, E&IG Infrastructure EP Exec Support	26 June 2018 Email from Michael Ellis, Land Planning and Regulation, Estate Planning – Infrastructure Division, Department of Defence	Defence has conducted an assessment of the proposed wind farm for potential impacts on the safety of military flying operations as well as possible interference to Defence communications and radar. The proposed 160 metre AGL turbines meet the requirements for reporting of tall structures. There is an ongoing need to obtain and maintain accurate information about tall structures so that this information can be marked on aeronautical charts. Marking tall structures on aeronautical charts assists pilot navigation and enhances flight safety. Airservices Australia (ASA) is responsible for recording the location and height of tall structures. The information is held in a central database managed by ASA and relates to the erection, extension, or dismantling of tall structures, the top of which is above: a. 30 metres AGL, that are within 30 kilometres of an aerodrome; and b. 45 metres AGL elsewhere.	Notify Airservices Australia of ‘as-constructed’ details. Submit an aeronautical risk assessment to CASA. Refer to CASA and the <i>National Airports Safeguarding Framework Guideline D</i> requirements to marking and lighting of wind turbines.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			The proposed structures will meet the above definition of a tall structure. Defence therefore requests that the applicant provide ASA with “as constructed” details. The details can be emailed to ASA at vod@airservicesaustralia.com. Defence notes that the <i>National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers</i> recommends that where a wind turbine 150 metres or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment. It also recommends that the risk assessment be submitted to the Civil Aviation Safety Authority (CASA) to determine whether the proposal is a hazard to aircraft safety and requires approved lighting or marking. Defence supports this requirement and believes that in this instance, it would be prudent for the risk assessment of this proposal to be sent to CASA for consideration. If CASA determines that obstacle lighting is to be provided, it should be compatible with persons using night vision devices. If LED lighting is proposed, the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometres. If wind monitoring towers are constructed as part of the proposal, Defence notes that the <i>National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers</i> - Paragraph 39 recommends the top 1/3 of wind monitoring towers are painted in alternating contrasting bands of colour in accordance with the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998.	

<i>Agency/Contact</i>	<i>Activity/Date</i>	<i>Response/ Date</i>	<i>Issues Raised During Consultation</i>	<i>Action Proposed</i>
			Defence has no objection to the proposed wind farm.	
Orange City Council	12 April 2018 Phone and Email to Tim Mooney, Plant and Depot Manager Orange City Council	12 April 2018 Email from Paul Fitzgerald.	The Orange Airport OLS protection / flight procedures. No impact on OLS.	Confirm that there is no impact on the Orange Airport flight procedures from Airservices Australia – Complete.

6. AVIATION IMPACT STATEMENT

6.1. Nearby registered/certified aerodromes

Bathurst Airport, Cowra Airport and Orange Airport are the certified aerodromes that are located within 30 nm of the FCWF Project site.

Bathurst Airport is located approximately 53 km (28.5 nm) north east of the FCWF site. Cowra Airport is located approximately 46 km (25 nm) south west of the wind farm site, and Orange Airport is located approximately 15 km (8 nm) north of the Project.

The location of the aerodromes relative to the project site are shown in Figure 7 (source: OzRunways, World Aeronautical Chart (WAC), dated 3 May 2018).

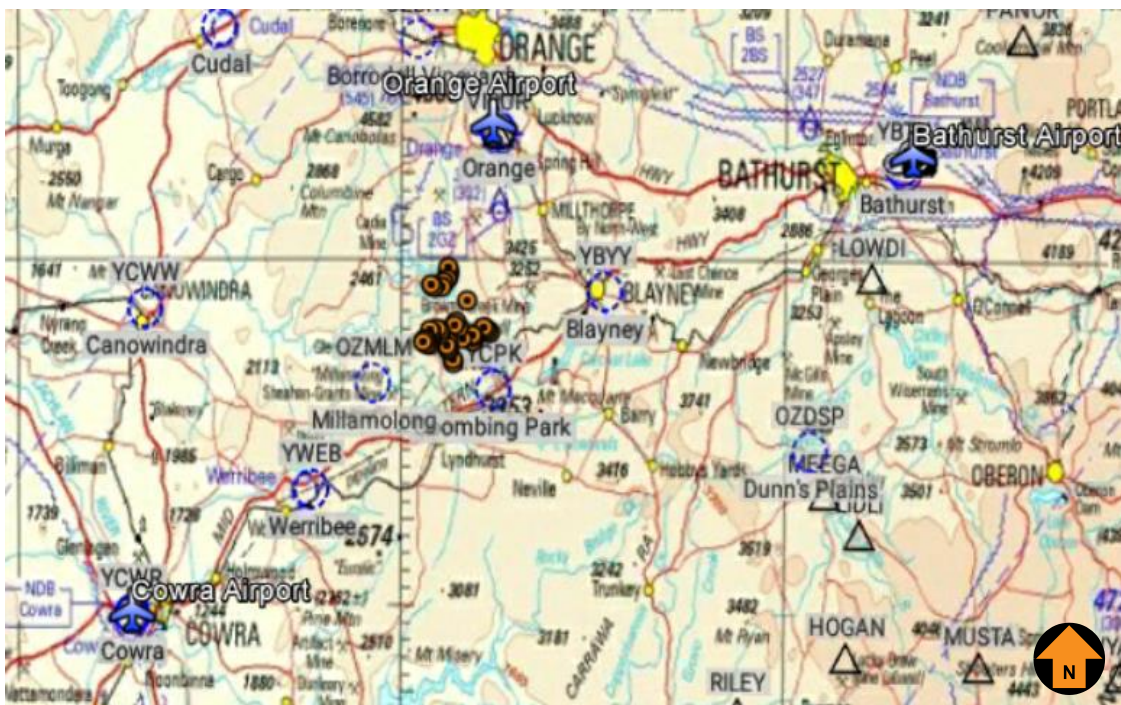


Figure 7 Flyers Creek Wind Farm in relation to registered/certified aerodromes

6.2. Bathurst Airport

Bathurst Airport is an aerodrome identified in this assessment as being a certified airport within 30 nm of the proposed FCWF. This airport is owned and operated by Bathurst Regional Council and is located approximately 7 km (3.8 nm) east from Bathurst city.

Bathurst Airport is a Code 3 certified aerodrome with non-precision approach procedures.

A check of Airservices Australia's Aeronautical Information Package (AIP), dated 1 March 2018, shows that Bathurst Airport (YBTH) has one sealed runway 17/35 and one brown gravel runway 08/26, details as follows:

- 17/35 is 1705 m long and 30 m wide sealed runway with a runway strip of 150 m; and
- 08/26 is 1315 m long and 30 m wide brown gravel runway with a runway strip of 90 m.

Bathurst Airport's aerodrome elevation is 2435 ft (AMSL) (742.2 m AHD).

Bathurst Airport Aerodrome Reference Point (ARP) and Non-Directional Beacon (NDB) published in Airservices Australia's Designated Airspace Handbook (DAH) as follows:

- ARP coordinates are Latitude 33° 24'34"S and Longitude 149° 39'07"E; and
- NDB coordinates are Latitude 33° 24'08"S and Longitude 149° 39'4"E.

6.3. Cowra Airport

Cowra Airport is an aerodrome identified in this assessment as being a certified airport within 30 nm of the proposed FCWF. This airport is owned and operated by Cowra Regional Council and is located approximately 4 km (2.2 nm) west from Cowra town.

Cowra Airport is a Code 3 certified aerodrome with non-precision approach procedures.

A check of Airservices Australia's Aeronautical Information Package (AIP), dated 1 March 2018, shows that Cowra Airport (YCWR) has one sealed runway 15/33 and one grass runway 03/21, details as follows:

- 15/33 is 1630 m long and 30 m wide sealed runway with a runway strip of 90 m; and
- 03/21 is 1166 m long and 30 m wide grass runway with a runway strip of 80 m.

Cowra Airport's aerodrome elevation is 973 ft (AMSL) (297 m AHD).

Cowra Airport Aerodrome Reference Point (ARP) and Non-Directional Beacon (NDB) published in Airservices Australia's Designated Airspace Handbook (DAH) as follows:

- ARP coordinates are Latitude 33° 50'41"S and Longitude 148° 38'56"E; and
- NDB coordinates are Latitude 33° 50'7"S and Longitude 148° 39'2"E.

6.4. Orange Airport

Orange Airport is an aerodrome identified in this assessment as being a certified airport within 30 nm of the proposed FCWF. This airport is owned and operated by Orange City Council and is located approximately 10.5 km (5.7 nm) south from Orange City.

Orange Airport is a Code 4 certified aerodrome with non-precision approach procedures.

A check of Airservices Australia's Aeronautical Information Package (AIP), dated 1 March 2018, shows that Orange Airport (YORG) has one sealed runway 11/29 and one grass runway 04/22, details as follows:

- 11/29 is 2213 m long and 30 m wide sealed runway with a runway strip of 150 m; and
- 04/22 is 723 m long and 30 m wide grass red clay runway with a runway strip of 90 m.

Orange Airport's aerodrome elevation is 3112 ft (AMSL) (949 m AHD).

Orange Airport Aerodrome Reference Point (ARP) published in Airservices Australia's Designated Airspace Handbook (DAH) as follows:

- ARP coordinates are Latitude 33° 22'41"S and Longitude 149° 07'32"E.

6.5. Obstacles limitation surfaces

The NSW Guideline for State significant wind energy development requires assessment to determine if the project height infringes on the Obstacle Limitation Surfaces (OLS) of an aerodrome.

The maximum horizontal distance that an obstacle limitation surface (OLS) may extend for an aerodrome in Australia is 15 km (8.1 nm) from the edge of a runway strip.

The proposed FCWF site is located approximately:

- 53 km (28.5 nm) west of Bathurst Airport;
- 46 km (25 nm) north east of Cowra Airport; and
- 14.8 km (8 nm) south of Orange Airport.

Refer to Figure 8 that shows the maximum possible extent of obstacle limitation surfaces of Bathurst, Cowra and Orange Airports.

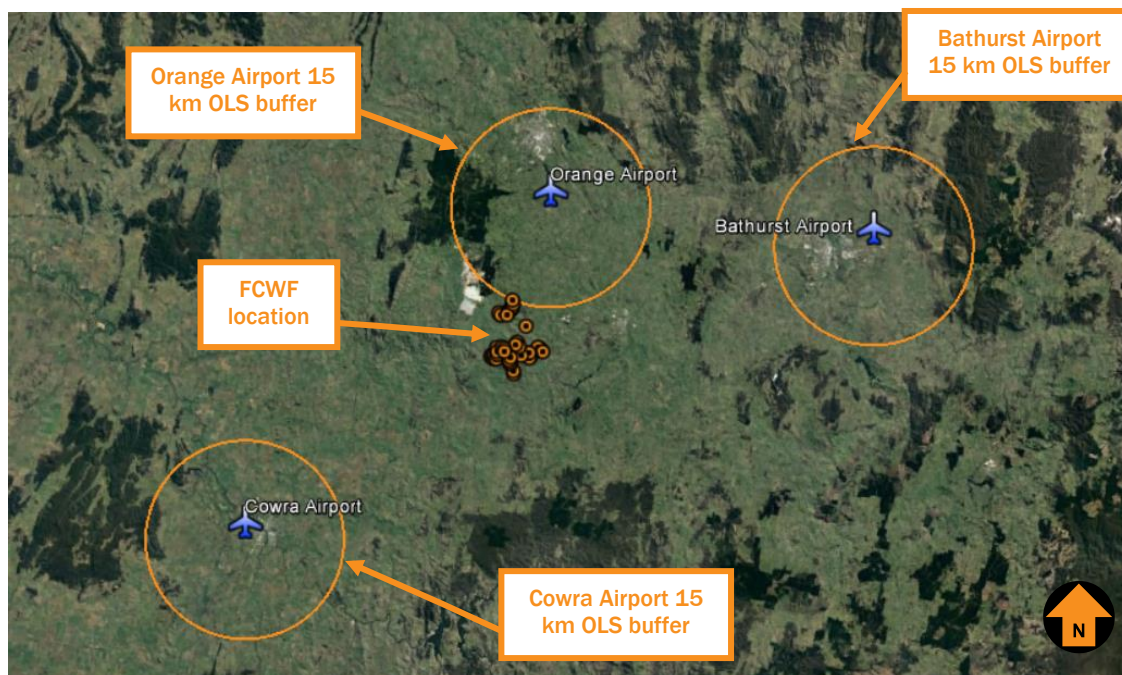


Figure 8 Indicative maximum possible extent of OLS of Bathurst, Cowra and Orange Airports

The OLS of Bathurst and Cowra airports will not be impacted by the proposed development of the FCWF Project.

For the purpose of this report a graphical representation of the OLS of Orange Airport was used from Figure 16.1 'Orange Aerodrome Obstacle Limitation Surface and approaches relative to wind turbine sites' to demonstrate an indicative location of the FCWF site, in particular, WTG3 relative to the maximum possible extent of the OLS of Orange Airport.

Correspondence sent from Orange City Council to FCWFPL noted that a future outer horizontal surface, applicable to precision instrument approaches which are not currently in place, would have a height of 1095.5 m AHD. WTG 3, which is the only turbine within 15 km of the aerodrome reference point, will have an overall height of 1056 m AHD and will not penetrate the outer horizontal surface if it ever becomes operationally applicable. Refer to Figure 9 (FCWFPL, 2011).



Figure 9 OLS of Orange Airport relative to the WTG 3 of the FCWF Project

6.6. Instrument procedures

A check of the AIP via the Airservices Australia website showed that Bathurst Airport, Cowra Airport and Orange Airport are served by non-precision terminal instrument flight procedures as per Table 2 (source: Airservices Australia, 2018).

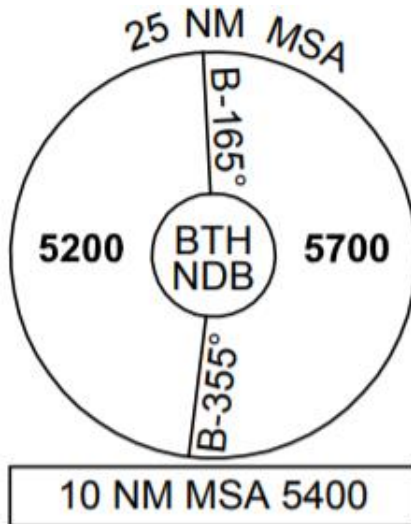
Table 2 Bathurst Airport, Cowra Airport and Orange Airport aerodrome and procedure charts

<i>Chart name (Procedure Designer)</i>	<i>Effective date</i>
Bathurst Airport (YBTH)	
AERODROME CHART (AsA)	25 May 2018 (BTHAD01-151)
RNAV ARRIVAL PAGE 1 (AsA)	25 May 2018 (BTHDG01-151)
RNAV ARRIVAL PAGE 1 (AsA)	25 May 2018 (BTHDG02-151)
NDB RWY 17 (AsA)	25 May 2018 (BTHNB01-151)
RNAV (GNSS) RWY 17 (AsA)	25 May 2018 (BTHGN01-151)
RNAV (GNSS) RWY 35 (AsA)	25 May 2018 (BTHGN02-151)
Cowra Airport (YCWR)	
AERODROME CHART (AsA)	25 May 2017 (CWRAD01-151)
GNSS ARRIVAL (AsA)	25 May 2017 (CWRDG01-151)
NDB RWY 15 (AsA)	25 May 2017 (CWRNB01-151)
RNAV-Z (GNSS) RWY 15 (AsA)	25 May 2017 (CWRGN01-151)
RNAV-Z (GNSS) RWY 33 (AsA)	25 May 2017 (CWRGN02-151)
Orange Airport (YORG)	
AERODROME CHART (AsA)	25 May 2017 (ORGAD01-151)
RNAV-Z (GNSS) RWY 11 (AsA)	25 May 2017 (ORGGN01-151)
RNAV-Z (GNSS) RWY 29 (AsA)	25 May 2017 (ORGGN02-151)

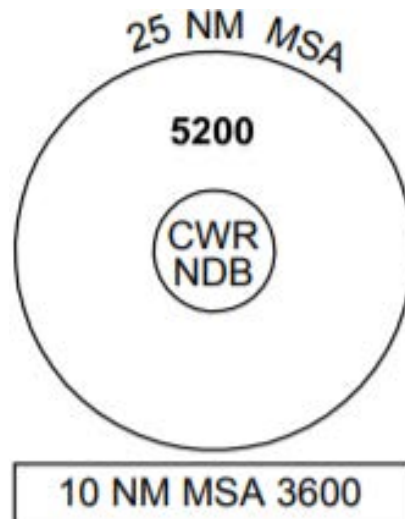
It is noteworthy that the non-directional beacon (NDB) facility that was at Orange Airport has been decommissioned, and hence the issue raised in the Project Approval regarding assessment of the impact on the associated procedures is no longer relevant.

The minimum safe altitude (MSA) is applicable for each instrument approach procedure at Bathurst, Cowra and Orange airports. An image of the MSA published for each airport is shown in Figure 10.

BATHURST, NSW (YBTH)



COWRA, NSW (YCWR)



ORANGE, NSW (YORG)

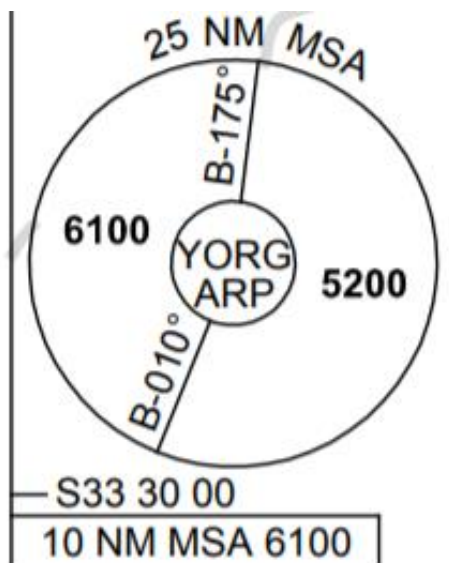


Figure 10 MSA at Bathurst Airport, Cowra Airport and Orange Airport

The *Manual of Standards 173 Standards Applicable to Instrument Flight Procedure Design (MOS 173)*, requires that a minimum obstacle clearance (MOC) of 1000 ft below the published MSA is maintained.

Aircraft are subject to a minimum altitude of 5200 ft AMSL within 30 nm (25 nm MSA + 5 nm buffer) of Bathurst Airport, Cowra Airport and Orange Airport.

At a maximum overall height of approximately 1114 m AHD (3655 ft AMSL) for a wind turbine at 160 m AGL, none of the proposed FCWF turbines and wind monitoring towers are above the Bathurst, Cowra and Orange airports 25 nm MSA MOC.

Within 15 nm (10 nm MSA + 5 nm buffer) of Airport Aerodrome Reference Points (ARP), aircraft are subject to the following minimum safe altitudes:

- 5400 ft AMSL within 15 nm MSA of Bathurst Airport;
- 3600 ft AMSL within 15 nm of Cowra Airport; and
- 6100 ft AMSL within 15 nm MSA of Orange Airport.

Bathurst Airport's and Cowra Airport's 15 nm buffers do not overlay the proposed FCWF Project. Therefore, the MSAs of Bathurst and Cowra airports will not be impacted by the Project. Refer to Figure 11.

Within 10 nm of Orange Airport ARP, aircraft are subject to a minimum safe altitude 6100 ft AMSL. At a maximum overall height of approximately 1114 m AHD (3655 ft AMSL) for a wind turbine at 160 m AGL, none of the proposed FCWF turbines are above the Orange Airport 10 nm MSA MOC and will have no impact on the airport MSA.

Wind turbines of the project will not affect any circling area heights for any of the three airports.

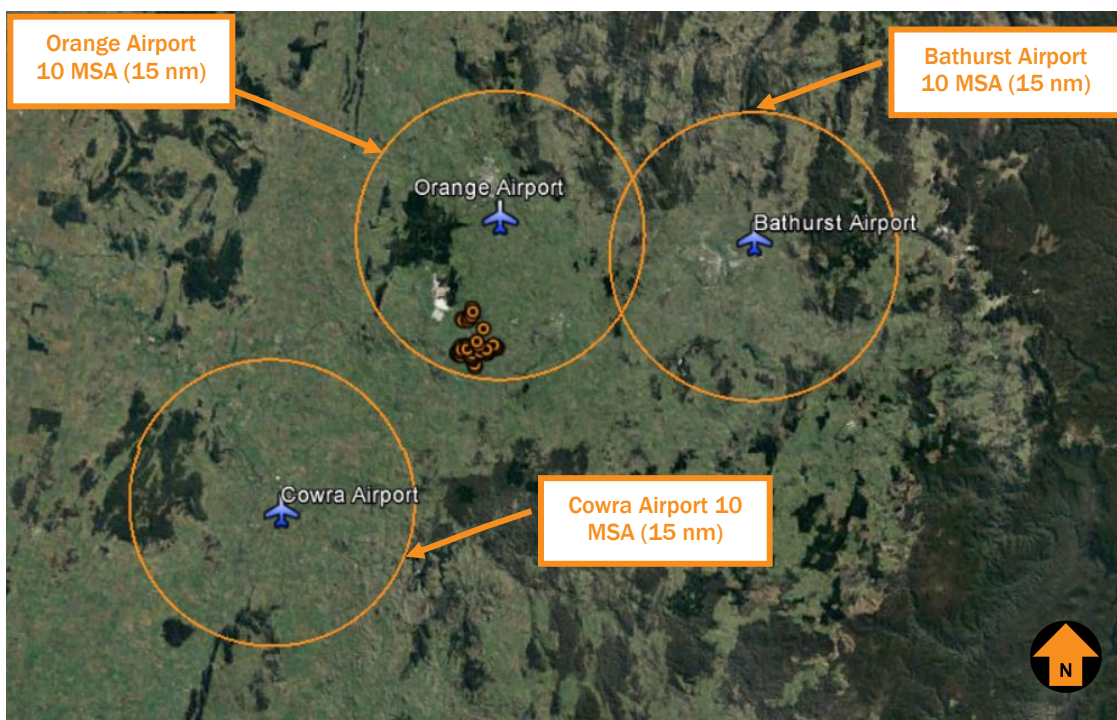


Figure 11 Bathurst, Cowra and Orange Airports 15 nm and 30 nm MSA rings

6.7. Nearby aircraft landing areas (ALAs)

There is only one ALA in close proximity to the proposed FCWF: ALA 1 (un-named) located 5.2 km (2.8 nm) south east from WTG 37.

A Google Earth search also revealed the following ALAs near the FCWF development:

- ALA 2 (un-named) is located approximately 21 km (11.3 nm) south west from the WTG 29;
- ALA 3 (un-named) is located approximately 65.5 km (35.4 nm) south west from the WTG 3; and
- Cudal ALA is located approximately 38 km (21 nm) north west from WTG 3.

Refer to Figure 12 for ALAs location relative to the proposed development of the FCWF Project (source: Google Earth, 2018).

A further search on OzRunways, which sources its data from Airservices Australia (AIP) and AOPA National Airfield Directory datasets, returned no further nearby non-regulated aerodromes. The aeronautical data provided by OzRunways is approved by CASA under Civil Aviation Regulation 233(1)(h).

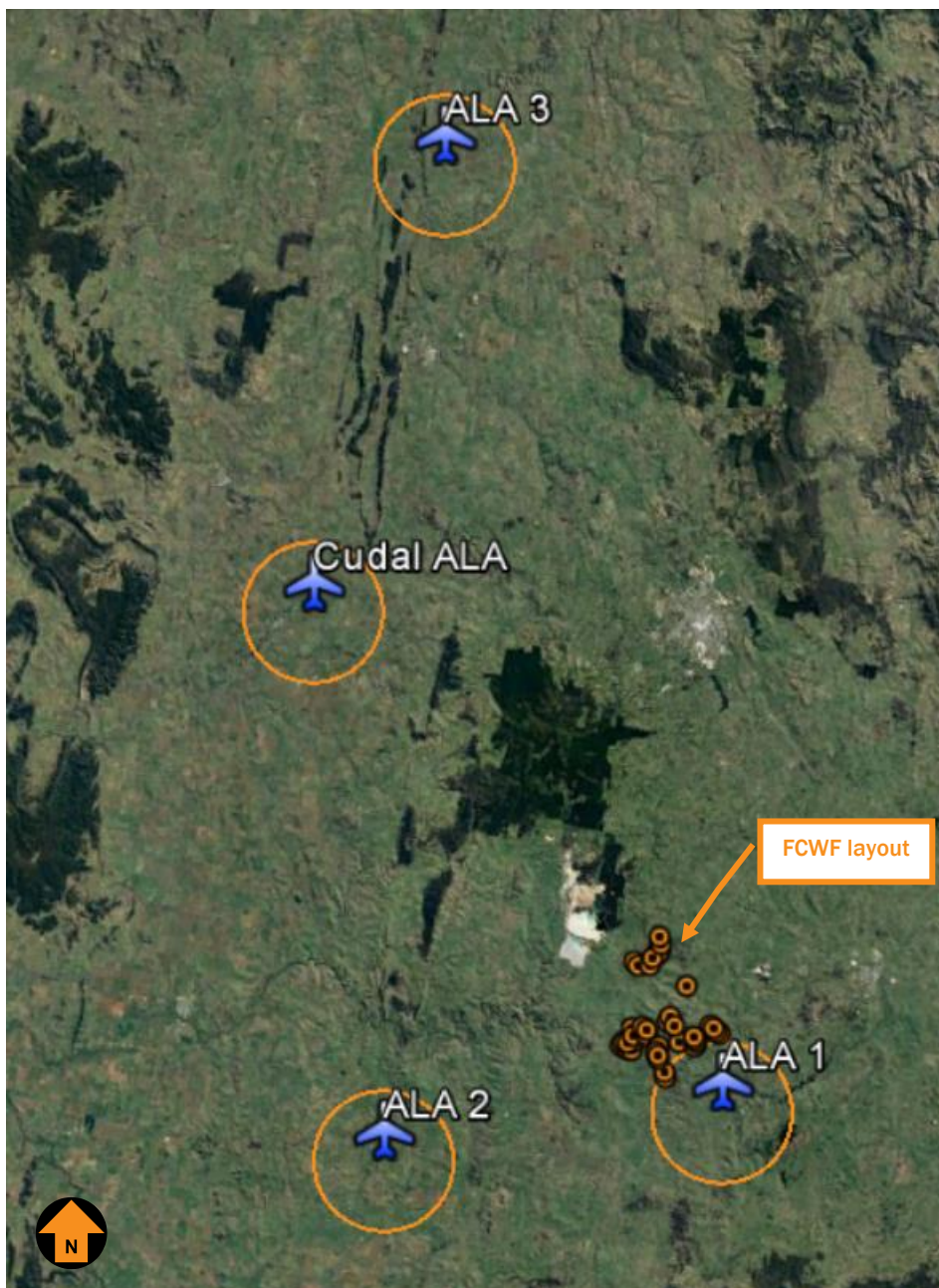


Figure 12 Flyers Creek Wind Farm in relation to aircraft landing areas

ALA 1 (un-named) is located 5.2 km (2.8 nm) and 5.5 km (2.98 nm) south east from wind turbine WTG 37 and WTG 39 respectively. Refer to Figure 13 (source: Google Earth, 2018).

ALA 1 is located south of Mid Western Highway. ALA 1 runway is east-west oriented relative to the FCWF site, which is parallel to wind turbines. Therefore, the proposed development of the FCWF Project will not impact ALA 1 approach and take-off areas.

To maintain acceptable aviation safety for pilots operating at night in ALA 1, including the RFDS, the local traffic procedures at the ALA should be changed to ensure circuits are flown only to the southern side of the runway, particularly at night. This measure addresses the risk of collision and encountering noticeable wake turbulence.

The Project should have no impact on an un-named ALA 1 3 nm OLS in the view of aircraft landing area layout and its flight paths and circuit areas relative to the proposed location of WTG 37 and WTG 39.

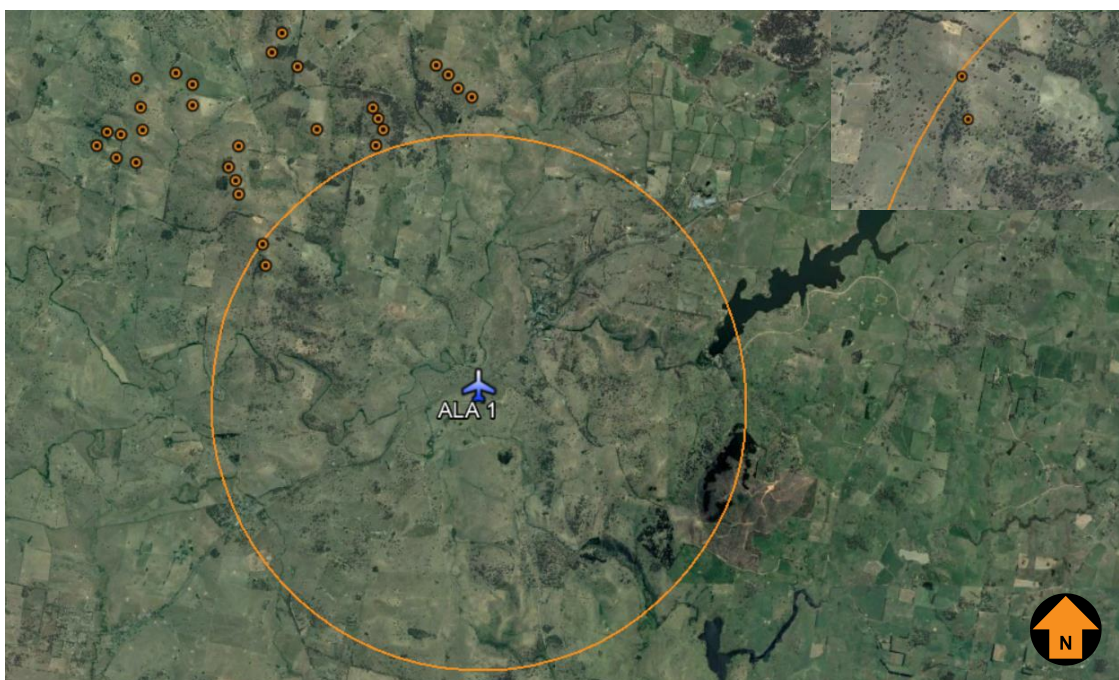


Figure 13 Flyers Creek Wind Farm in relation to aircraft landing area ALA 1 (un-named)

6.8. Air routes and LSALT

Manual of Standards (MOS) Part 173 requires that a minimum obstacle clearance of 1000 ft below the published LSALT is maintained along each air route.

The En Route Chart Low National shows the grid LSALT and the air routes in the vicinity of the Project (source: OzRunways, 2018). Figure 14 provides the En-Route Chart Low National and air routes within the vicinity of FCWF (source: En Route Chart Low National, dated 3 May 2018).



Figure 14 En-Route Chart Low National and air routes within the vicinity of Flyers Creek Wind Farm

An impact analysis of the surrounding air routes is provided at Table 3.

Table 3 Air-route impact analysis

Air route	Waypoint pair	Route LSALT	MOC	Impact on airspace design	Potential solution	Impact on aircraft ops
W440	Parkes and HOGAN	6100 ft AMSL	5100 ft AMSL	Nil	N/A	Nil
W419	Werribee and Bathurst	5400 ft AMSL	4400 ft AMSL	Nil	N/A	Nil
W654	Cowra and VIRUR	5500 ft AMSL	4500 ft AMSL	Nil	N/A	Nil

Note: Minimum obstacle clearance (MOC) is the height above which obstacles would impact on LSALTS or air routes.

The applicable grid LSALT is 5900 ft AMSL, with an MOC of 4900 ft AMSL.

The Project will not impact on route or grid LSALTs.

6.9. Airspace

The project site is located outside controlled airspace (wholly within Class G airspace), and is not located in any Prohibited, Restricted or Danger areas.

6.10. Aviation facilities

The proposed FCWF is not likely to infringe any protection areas associated with aviation facilities.

6.11. Radar

Airservices Australia currently requires an assessment of the potential for wind turbines in a proposed project to affect radar line of sight.

With respect to aviation radar facilities, the closest radar is located at Mt Boyce (approximately 106 km (43 nm) to the north east). This radar facility will not be affected by the proposed wind farm.

6.12. Airservices Australia

With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 1114m (3655ft) AHD the wind farm:

- will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Orange, Cowra or Bathurst Airport;
- will not impact any air route lowest safe altitude (LSALT); and
- will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

Redesign of the NDB approach at Orange Airport mentioned in Condition of Approval D11 (b) is not required, since the NDB has been decommissioned.

6.13. Summary

The proposed increase in the maximum turbine envelope proposed as part of Modification 4 does not increase the potential impact to aviation from that previously assessed for the Project. A list of wind turbines and their coordinates and elevation data that are applicable to this Aviation Impact Statement (AIS) are provided in **Annexure 1**.

6.14. Summary

Based on the proposed wind farm layout and overall turbine overall blade tip height limit of 160 m AGL, the blade tip elevation of the highest WTG, which is WTG20, will not exceed 1114 m AHD (3655 ft AMSL) and:

- will not penetrate any OLS surfaces;
- will not penetrate PANS-OPS surfaces;
- will not have an impact on nearby designated air routes;
- will not have an impact on prescribed airspace;
- is contained within Class G airspace; and
- is outside the clearance zones associated with aviation navigation aids and communication facilities.

The list of FCWF Project wind turbines (obstacles), showing approximate coordinates and elevation data that are applicable to this Aviation Impact Statement (AIS), are provided in **Annexure 1**.

7. AIRCRAFT OPERATOR CHARACTERISTICS

7.1. Passenger transport operations

Regular public transport (RPT) operations are only conducted at registered and certified aerodromes. Thangool Airport is the only certified aerodrome within 30 nm of the Project.

RPT and passenger carrying charter operations are generally operated under the Instrument Flight Rules (IFR). The Aviation Impact Statement provided in Section 6 addresses the matters associated with IFR aircraft operations.

The Project is unlikely to impact on RPT operations.

7.2. Flying training, private, recreational and gliding operations

Flight under day VFR is conducted above 500 ft (152.4 m) above the highest point of the terrain within a 600 m radius (300 m for helicopters), unless the operation is approved to operate below 500 ft above the highest point of the terrain.

It is expected that the wind turbines will be sufficiently visually conspicuous to pilots conducting VFR operations within the vicinity of the Project to enable appropriate obstacle avoidance manoeuvring.

IFR and Night VFR (which are required to conform to IFR applicable altitude requirements) aircraft operations are addressed in Section 3.

7.3. Aerial application

The impact of the proposed turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the Project was assessed.

7.3.1. Aerial Agriculture Association of Australia

In previous consultation with the Aerial Agriculture Association of Australia (AAAA), Aviation Projects has been directed to the AAAA Windfarm Policy (dated March 2011) which states in part:

As a result of the overwhelming safety and economic impact of wind farms and supporting infrastructure on the sector, AAAA opposes all wind farm developments in areas of agricultural production or elevated bushfire risk.

In other areas, AAAA is also opposed to wind farm developments unless the developer is able to clearly demonstrate they have:

- 1. consulted honestly and in detail with local aerial application operators;*
- 2. sought and received an independent aerial application expert opinion on the safety and economic impacts of the proposed development;*
- 3. clearly and fairly identified that there will be no short or long term impact on the aerial application industry from either safety or economic perspectives;*

4. if there is an identified impact on local aerial application operators, provided a legally binding agreement for compensation over a fair period of years for loss of income to the aerial operators affected; and

5. adequately marked any wind farm infrastructure and advised pilots of its presence.

AAAA had developed National Windfarm Operating Protocols (adopted May 2014). These protocols note the following comments:

At the development stage, AAAA remains strongly opposed to all windfarms that are proposed to be built on agricultural land or land that is likely to be affected by bushfire. These areas are of critical safety importance to legitimate and legal low-level operations, such as those encountered during crop protection, pasture fertilisation or firebombing operations.

However, AAAA realises that some wind farm proposals may be approved in areas where aerial application takes place. In those circumstances, AAAA has developed the following national operational protocols to support a consistent approach to aerial application where windfarms are in the operational vicinity.

The protocols list considerations for developers during the design/build stage and also the operational stage, for pilots/aircraft operators during aircraft operations and discusses economic compensation. NASF Guideline D is included as Appendix 1, and AAAA Aerial Application Pilots Manual – excerpts on planning are provided as Appendix II.

7.3.2. Local aerial application operators

Local aerial application operators consulted in previous studies have stated that a wind farm would, in all likelihood, prevent aerial agricultural operations in that particular area, but that properties adjacent to the wind farm would have to be assessed on an individual basis.

Consultation with local aerial application operators has been undertaken during preparation of the impact assessment. These operators generally align their positions with the AAAA policies.

Based on previous studies, and subject to the results of consultation with AAAA and any further consultation with local aerial application operators, it is reasonable to conclude that safe aerial application operations would be possible on properties within the Project site and neighbouring the Project site, subject to final WTG locations, and subject to a case-by-case assessment and by following recommendations provided in this report.

To facilitate the flight planning of aerial application operators, details of the Project, including location and height information of WTGs, WMTs and overhead powerlines should be provided to land owners so that, when asked for hazard information on their property, the land owner may provide the aerial application pilot with all relevant information.

The use of helicopters enables aerial application operations to be conducted in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

7.4. Aerial fire fighting

The Australasian Fire and Emergency Services Council (AFAC) developed a national position on wind turbines: *Wind Farms and Bush Fires Operations*, version 2.0, dated 30 October 2014.

Of specific interest in this document is the paragraph copied below:

Aerial fire fighting operations will treat turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.

7.5. Emergency services/RFDS

Royal Flying Doctor Services and other emergency services operations are generally conducted under the IFR, except when arriving/departing a destination that is not serviced by instrument approach aids or procedures.

Most emergency aviation services organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

For example, pilots and crew require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

7.6. Summary

The proposed increase in the maximum turbine envelope proposed as part of Modification 4 does not increase the potential impact to aviation from that previously assessed for the Project.

8. HAZARD LIGHTING AND MARKING

8.1. Civil Aviation Safety Authority

In considering the need for aviation hazard lighting, the applicable regulatory context was determined.

The Civil Aviation Safety Authority (CASA) regulates aviation activities in Australia. Applicable requirements include the Civil Aviation Regulations 1988 (CAR), Civil Aviation Safety Regulations 1998 (CASR) and associated Manual of Standards (MOS) and other guidance material. Relevant provisions are outlined in further detail in the following section.

8.1.1. Civil Aviation Safety Regulations 1998, Part 139—Aerodromes

In areas remote from an aerodrome, CASR 139.365 requires the owner of a structure (or proponents of a structure) that will be 110 m or more above ground level to inform CASA. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether or not the structure will be hazardous to aircraft operations.

8.1.2. Manual of Standards Part 139—Aerodromes

Chapter 7 of MOS 139 sets out the standards applicable to Obstacle Restriction and Limitation. Section 7.1.5 deals with Objects Outside the OLS:

7.1.5.1 Under CASR Part 139 any object which extends to a height of 110 m or more above local ground level must be notified to CASA.

Note: For instrument runways, obstacle monitoring includes the PANS-OPS surface which extends beyond the OLS of the aerodrome. See MOS 139 paragraph 7.1.1.

7.1.5.2 Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.

Chapter 9 sets out the standards applicable to Visual Aids Provided by Aerodrome Lighting.

Section 9.4.1 provides some general guidance on obstacle lighting:

9.4.1.2 In general, an object in the following situations would require to be provided with obstacle lighting unless CASA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no operational significance:

(b) outside the obstacle limitation surfaces of an aerodrome, if the object is or will be more than 110 m above ground level.

Section 9.4.2 provides guidance on Types of Obstacle Lighting and Their Use:

9.4.2.1 Three types of lights are used for lighting obstacles. These are low intensity, medium intensity and high intensity lights, or a combination of such lights.

9.4.2.2 Low intensity obstacle lights are steady red lights and are to be used on non-extensive objects whose height above the surrounding ground is less than 45 m.

Note: A group of trees or buildings is regarded as an extensive object.

9.4.2.3 Medium intensity obstacle lights are to be used either alone or in combination with low intensity lights, where:

- (a) the object is an extensive one;
- (b) the top of the object is 45 m or more above the surrounding ground; or
- (c) CASA determines that early warning to pilots of the presence of the object is desirable.

9.4.2.4 There are three types of medium intensity obstacle lights:

(a) *Flashing white light.* Likely to be unsuitable for use in environmentally sensitive locations, and near built-up areas. May be used in lieu of obstacle markings during the day to indicate temporary obstacles in the vicinity of an aerodrome, for example construction cranes, etc. and are not to be used in other applications without specific CASA agreement.

(b) *Flashing red light, also known as a hazard beacon.* Is suitable for all applications, and is extensively used to mark terrain obstacles such as high ground.

(c) *Steady red light.* May be used where there is opposition to the use of a flashing red light, for example in environmentally sensitive locations.

9.4.2.5 High intensity obstacle lights are flashing white lights used on obstacles that are in excess of 150 m in height...

Section 9.4.3.4A provides guidance on obstacle lighting specific to wind farms:

9.4.3.4A In the case of a wind farm whose wind turbines must have obstacle lighting, medium intensity lights are to be installed as follows:

(a) if any part of the wind turbine, including the rotating blades, penetrates the obstacle limitation surface (OLS) of an aerodrome, top lights must mark the highest point reached by the rotating blades;

Note: Because it is not practicable to install obstacle lights at the tip of the blades, these lights may be located on a separate structure, adjacent to the wind turbine, at a height that corresponds to the highest point of the rotating blade of the turbine.

(b) if the rotating blades do not penetrate the OLS, the top lights must be placed on top of the generator housing;

(c) obstacle lights must be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, with intervals between lit turbines not exceeding 900 m;

(d) all of the obstacle lights on a wind farm must be synchronised to flash simultaneously;

(e) the downward component of obstacle lighting may be shielded to the extent mentioned in either or both of the following sub-subparagraphs:

(i) so that no more than 5% of the nominal light intensity is emitted at or below 5° below horizontal;

(ii) so that no light is emitted at or below 10° below horizontal;

(f) to prevent obstacle light shielding by the rotating blades, 2 lights must be provided on top of the generator housing in a way that allows at least 1 of the lights to be seen from every angle in azimuth.

CASA recommends that the wind farm is lit with steady red medium intensity lighting at night and recommends a lighting plan consistent with the provisions of Guideline D of the National Airports Safeguarding Framework (NASF).

8.1.3. Advisory Circular 139-08 v2—Reporting of Tall Structures

In Advisory Circular (AC) 139-08 v2—*Reporting of Tall Structures*, CASA provides guidance to those authorities and persons involved in the planning, approval, erection, extension or dismantling of tall structures so that they may understand the vital nature of the information they provide.

Airservices Australia has been assigned the task of maintaining a database of tall structures, the top measurement of which is:

- a) 30 metres or more above ground level—within 30 kilometres of an aerodrome; or
- b) 45 metres or more above ground level elsewhere.

The purpose of notifying Airservices Australia of these structures is to enable their details to be provided in aeronautical information databases and maps/charts etc used by pilots, so that the obstacles can be avoided.

The proposed wind turbines must be reported to Airservices Australia. This action should occur once the final layout after micrositeing is confirmed and prior to construction.

8.2. International Civil Aviation Organization

Australia, as a contracting State to the International Civil Aviation Organization (ICAO) and signatory to the Chicago Convention on International Civil Aviation (the Convention), has an obligation to implement ICAO's standards and recommended practices (SARPs) as published in the various annexes to the Convention.

Annex 14 to the Convention — *Aerodromes, Volume 1*, Section 6.2.4 provides SARPs for the obstacle lighting and marking of wind turbines, which is copied below:

6.2.4 Wind turbines

6.2.4.1 A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.

Note 1.— Additional lighting or markings may be provided where in the opinion of the State such lighting or markings are deemed necessary.

Note 2.— See 4.3.1 and 4.3.2

Markings

6.2.4.2 Recommendation.— The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.

Lighting

6.2.4.3 Recommendation.— When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm should be regarded as an extensive object and the lights should be installed:

- a) to identify the perimeter of the wind farm;
- b) respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;
- c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;
- d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and
- e) at locations prescribed in a), b) and d), respecting the following criteria:
 - i) for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle should be provided;
 - ii) for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and
 - iii) in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note.— The above 6.2.4.3 e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

6.2.4.4 Recommendation.— The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

6.2.4.5 Recommendation.— Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation should be in accordance with 6.2.4.3 e) or as determined by an aeronautical study.

As referenced in Section 6.2.4.3(e)(iii), Section 6.2.1.3 is copied below:

6.2.1.3 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

As referenced in Section 6.2.4.3(b), Section 6.2.3.15 is copied below:

6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and

b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

Section 4.3 Objects outside the obstacle limitation surfaces states the following:

4.3.1 Recommendation.— Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.

4.3.2 Recommendation.— In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation should be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.

Note.— This study may have regard to the nature of operations concerned and may distinguish between day and night operations.

ICAO Doc 9774 Manual on Certification of Airports defines an aeronautical study as:

An aeronautical study is a study of an aeronautical problem to identify potential solutions and select a solution that is acceptable without degrading safety.

Refer to **Section 10** for a detailed assessment of the requirement for obstacle lighting.

8.3. Turbine lighting design

In the event that obstacle lighting is required, a lighting design should be prepared on the basis of the requirements set out in ICAO Annex 14 Vol 1 Chapter 6, MOS 139 Chapter 9.

Turbines proposed to be lit should, wherever possible, be located on the perimeter of the wind farm at appropriate spacing and/or are significantly higher than surrounding turbines.

In addition, the lighting proposal should be based on:

- the specific configuration of the wind farm and its location in relation to surrounding facilities and features (including terrain);
- the relative elevation and proximity of each turbine in relation to others; and
- the position of turbines in relation to falling and rising terrain.

The lighting design should seek to minimise visual impacts by minimising the number of lit wind turbines while achieving the recommendations provided in MOS 139 chapter 9 and ICAO Annex 14 volume 1.

The lighting design should be subject to confirmation of the final turbine layout as any changes proposed could potentially affect which turbines should be lit in accordance with the 900 m interval consideration.

The obstacle lighting (if required) should be operated as per industry standards applicable to aviation obstacle lighting. Obstacle lighting providers may meet the applicable obstacle lighting requirements in various ways using various technology with respect to lighting characteristics and methods of mitigating visual impact. A common method in the industry is to use photoelectric cells in switching mechanisms to switch obstacle lighting on and off based on the level of natural sun light. Additionally, synchronising the flashing of flashing obstacle lighting is commonly achieved with the use of Global Positioning System (GPS) technology.

8.4. Light characteristics

If obstacle lighting is required, installed lights should be designed according to the criteria set out in the applicable regulatory material and taking CASA's recommendations into consideration in the case that CASA has reviewed this risk assessment and provided recommendations.

A summary of generally accepted design characteristics (which reflects the provisions in the regulatory framework) is provided below:

- For wind turbines exceeding 150 m AGL but not exceeding 315 m AGL:
- in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and
- in addition, an intermediate level at half the nacelle height of at least three low-intensity Type E lights (i.e. red flashing) should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B (i.e. red fixed) lights may be used;
 - in any case, the light fixtures should be mounted sufficiently above the surface of the nacelle so that the lights are not obscured by the rotor hub, and at a horizontal separation to ensure an unobstructed view of at least one of the lights by a pilot approaching from any direction; and
 - the characteristics of the obstacle lights should be in accordance with the applicable standards in MOS 139.

The characteristics of low and medium intensity obstacle lights specified in MOS 139, Chapter 9, are provided below:

- MOS 139 section 9.4.6 outlines Characteristics of Low Intensity Obstacle Lights.

9.4.6.1 Low intensity obstacle lights, for general applications, are to have the following characteristics:

- (a) *fixed lights showing red;*
- (b) *a horizontal beam spread that results in 360° coverage around obstacle;*
- (c) *a peak intensity of 100 cd minimum;*
- (d) *a vertical beam spread (to 50% of peak intensity) of 10°;*

(e) a vertical distribution with 100 cd minimum at +6° and +10° above the horizontal; and

(f) not less than 10 cd at all elevation angles between -3° and +90° above the horizontal.

Notes:

1. The intensity level is higher than ICAO standards because in Australia only obstacles assessed as significant to aircraft operations are required to be provided with obstacle lighting.
2. Currently the intensity requirement is normally met by a double-bodied light fitting which also provides a degree of redundancy.
3. Double-bodied light fittings should be orientated so that they show the maximum illuminated surface towards the predominant, or more critical, direction of aircraft approach.
4. For objects that do not infringe the obstacle limitation surfaces, and where CASA has not determined that obstacle lights are required, if the object owner wishes, of their own volition, to provide obstacle lights, it is sufficient for these low intensity obstacle lights to have the following intensity distribution: peak intensity 32 cd minimum, vertical beam spread of 10°, and 32 cd minimum at +6° and +10° elevation.

9.4.6.2 Low intensity obstacle lights, used to indicate taxiway obstacles or unserviceable areas of the movement area, are to have a peak intensity of 10 cd minimum.

MOS 139 section 9.4.7 outlines Characteristics of Medium Intensity Obstacle Lights.

9.4.7.1 Medium intensity obstacle lights are to be flashing or steady red lights or flashing white lights, visible in all directions in azimuth.

9.4.7.2 The frequency of flashes is to be between 20 and 60 flashes per minute.

9.4.7.3 The peak effective intensity is to be 2,000 ± 25% cd with a vertical distribution as follows:

- (a) vertical beam spread is to be 3° minimum (beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity);
- (b) at -1° elevation, the intensity is to be 50% minimum and 75% maximum of lower tolerance value of the peak intensity; and
- (c) at 0° elevation, the intensity is to be 100% minimum of the lower tolerance value of the peak intensity.

9.4.7.4 Where the flashing white light is used in lieu of obstacle marking during the day to indicate temporary obstacles in the vicinity of an aerodrome, in accordance with Paragraph 9.4.2.4(a), the peak effective intensity is to be increased to 20,000 ± 25% cd when the background luminance is 50 cd/m² or greater.

MOS 139 Section 9.4.10 sets out the requirements for ongoing availability of obstacle lights:

9.4.10.4 For obstacles located outside the obstacle limitation surface area of an aerodrome, the owners of the lights need to establish a program to monitor the lights and report light failures. The reporting point for obstacle light failure is normally the nearest CASA office. When an obstacle light is unserviceable, the matter needs to be reported immediately to the relevant CASA office so that a NOTAM warning pilots of the light outage can be initiated.

To ensure the ongoing availability of obstacle lights (if required), a monitoring, reporting and maintenance program will need to be established in accordance with this guidance.

8.5. Visual impact of night lighting

Annex 14 Section 6.2.4 and MOS 139 9.4.3.4A are specifically intended for wind turbines and recommends that medium intensity lighting is installed.

Generally accepted considerations regarding minimisation of visual impact are provided below for consideration in this aeronautical study:

- To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness;
- Shielding may be provided to restrict the downward component of light to either, or both, of the following:
 - such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and
 - such that no light is emitted at or below 10 degrees below horizontal;
- Where two lights are mounted on a nacelle, dynamic shielding or light extinction of one light at a time, for the period that a blade is passing in front of the light, is permissible, providing that at all times at least one light can be seen, without interruption, from every angle of azimuth;
- If flashing obstacle lighting is required, all obstacle lights on a wind farm should be synchronised so that they flash simultaneously; and
- A relatively small area on the back of each blade near the rotor hub may be treated with a different colour or surface treatment, to reduce reflection from the rotor blades of light from the obstacle lights, without compromising the daytime conspicuity of the overall WTG.

8.6. Marking of turbines

ICAO Annex 14 Vol 1 Section 6.2.4.2 recommends that the rotor blades, nacelle and upper 2/3 of the supporting mast of the wind turbines should be painted white, unless otherwise indicated by an aeronautical study.

It is generally accepted that a white colour, typical of most wind turbines operational in Australia, will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.

8.7. Wind monitoring towers

The details of the WMTs were introduced in Section 4.2 of this report.

Consideration could be given to marking any WMTs according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings; specifically:

8.10.2.1 A structure must be marked when more than 150 m higher than the surrounding terrain. Surrounding terrain means the area within 400 m of the structure. Structures above 90 m may need to be marked, and inconspicuous structures 75 m above ground level should also be marked. Fixed objects on the aerodrome movement area, such as ILS buildings, must be marked as obstacles.

8.10.2.6 Masts, poles and towers must be marked in contrasting bands with the darker colour at the top, as shown in Figure 8.10-3. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less.

8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.

NASF Guideline D suggests consideration of the following measures specific to the marking and lighting of WMTs:

- the top 1/3 of wind monitoring towers to painted in alternating contrasting bands of colour. Examples of effective measures can be found in the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998. In areas where aerial agriculture operations take place, marker balls or high visibility flags can be used to increase the visibility of the towers;
- marker balls or high visibility flags or high visibility sleeves placed on the outside guy wires;
- ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground/vegetation; or
- a flashing strobe light during daylight hours.

8.8. Overhead power lines

There is no regulatory requirement to mark or light power poles or overhead transmission lines.

According to the AAAA Powerlines Policy dated March 2011:

Most agricultural land in Australia is crisscrossed with powerlines and aerial application companies and pilots put enormous effort into managing these hazards safely, generally using a risk identification, assessment and management process in line with Australian Standard AS4360/ISO 3[1]000.

The agricultural pilot curriculum mandated by CASA includes training for the safe management of powerlines and AAAA has been active in providing ongoing professional development for application pilots that includes a focus on planning, risk management and a knowledge of human factors relevant to managing powerlines in a low-level aviation environment.

AAAA runs a specific training course for aerial application pilots entitled 'Wire Risk Management' to address these issues.

With respect to power line route determination (refer to Section 4.3), it is prudent to consider potential adverse impacts on aerial application operations. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Section 8.10 Obstacle Markings; specifically: FCWFPL has advised to provide details on the overhead transmission lines prior to finalising this report.

8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.

9. ACCIDENT STATISTICS

9.1. General aviation operations

The general aviation (GA) operation type is considered by the Australian Transport Safety Bureau (ATSB) to be all flying activities that do not involve scheduled (RPT) and non-scheduled (charter) passenger and freight operations. It may involve Australian civil (VH-) registered aircraft, or aircraft registered outside of Australia. General aviation encompasses:

- Aerial work. This includes flying for the purposes of agriculture (spraying and spreading), mustering, search and rescue, fire control, or survey and photography;
- Flying training; and
- Private, business and sports aviation. Sports aviation includes gliding, parachute operations, ballooning, warbird operations, and acrobatics.

9.2. ATSB occurrence taxonomy

The ATSB uses a taxonomy of occurrence sub-type. Of specific relevance to the subject assessment are terms associated with **terrain collision**. Definitions sourced from the ATSB website are provided below:

- **Collision with terrain:** Occurrences involving a collision between an airborne aircraft and the ground or water, where the flight crew were aware of the terrain prior to the collision.
- **Controlled flight into terrain (CFIT):** Occurrences where a serviceable aircraft, under flight crew control, is inadvertently flown into terrain, obstacles, or water without either sufficient or timely awareness by the flight crew to prevent the event.
- **Ground strike:** Occurrences where a part of the aircraft drags on, or strikes, the ground or water while the aircraft is in flight, or during take-off or landing.
- **Wirestrike:** Occurrences where an aircraft strikes a wire, such as a powerline, telephone wire, or guy wire, during normal operations.

9.3. National aviation occurrence statistics 2006-2015

The Australian Transport Safety Bureau recently published a summary of aviation occurrence statistics for the period 2006 to 2015 (AR-2016-122) Final, 11 January 2017.

According to the report, there were no fatalities in high capacity RPT operations, two in low capacity RPT operations and 17 in charter operations during the period 2006-2015.

Of the 360 fatalities recorded in the 10-year period, almost two thirds (231 or 64.17%) occurred in the general aviation segment. On average, there were 1.5 fatalities per aircraft associated with a fatality in this segment. Other than aerial survey and photography (2:1) and private/business (1.725:1), the fatalities to aircraft ratio ranges from 1:1 to 1.5:1. Whilst it can be inferred from the data that the majority of fatal accidents are single person fatalities, it is reasonable to assert that the worst credible effect of an aircraft accident in the general aviation category will be multiple fatalities.

A breakdown of aircraft and fatalities by general aviation sub-categories is provided in Table 4 (source: ATSB).

Table 4 Number of fatalities by GA sub-category - 2006 to 2015

<i>Sub-category</i>	<i>Aircraft assoc. with fatality</i>	<i>Fatalities</i>	<i>Fatalities to aircraft ratio</i>
Agriculture	16	16	1:1
Mustering	13	14	1.08:1
Search and rescue	2	2	1:1
Fire control	3	3	1:1
Survey and photography	8	16	2:1
Other aerial work	6	9	1.5:1
Flying training	8	11	1.375:1
Private/business	80	138	1.725:1
Sport aviation (excluding gliding)	5	5	1:1
Gliding	12	16	1.33:1
Totals	153	230	1.5:1

According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 10-year reporting period ranged between 11.3 in 2012 and 5.9 in 2014. Figure 15 refers (source: ATSB).

Figure 15: General aviation accident and fatal accident rate (per million departures, VH-registered aircraft only), 2006 to 2014

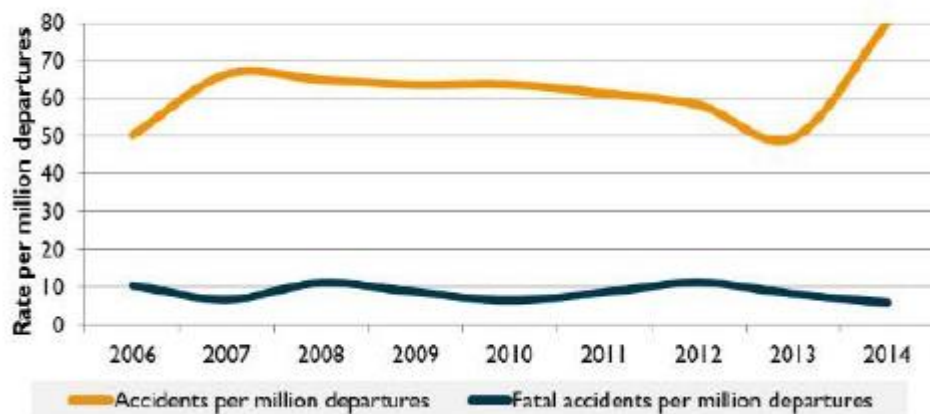


Figure 15 GA accident and fatal accident rate per million departures

In 2014, there were 11 fatal accidents and 19 fatalities involving GA aircraft, resulting in a rate of 5.9 fatal accidents per million departures and 9.3 fatal accidents per million hours flown.

In 2015, there were 1,849,000 departures, and 1,295,000 hours flown by VH-registered general aviation aircraft in Australia, with 13 fatal accidents and 15 fatalities. Based on these results, in 2015 there were 7.0 fatal accidents per million departures and 10.0 fatal accidents per million hours flown. A summary of fatal accidents in 2015 by GA sub-category is provided in Table 5 (source: ATSB).

Table 5 Fatal accidents by GA sub-category - 2015

<i>Sub-category</i>	<i>Fatal accidents</i>	<i>Fatalities</i>
Aerial work	3	3
Aerial agriculture	1	1
Aerial mustering	2	2
Search and rescue	0	0
Fire control	0	0
Survey and photography	0	0
Flying training	1	1
Private/business	5	7
Sports	1	1
Foreign registered	0	0
Totals	13	15

Over the 10-year period, there were 16,689,000 general aviation departures in Australia, during which time no aircraft collided with a wind turbine or a wind monitoring tower.

Of the 3,761 incidents and accidents in GA operations in the 10-year period, 994 (26.4%) were terrain collisions.

There is an underlying fatality rate for GA operations that is considered tolerable within Australia's regulatory and social context.

9.4. Worldwide accidents involving wind farms

To provide some perspective on the likelihood of a VFR aircraft colliding with a wind turbine, a summary of the four accidents that involved an aircraft colliding with a wind turbine, and the relevant factors applicable to this assessment, is incorporated in this section.

Note that there are no recorded accidents involving an aircraft colliding with a wind turbine in Australia.

Global Wind Energy Council reports on its website there were 314,000 wind turbines operating around the world at the end of 2015.

Australia's Clean Energy Council reports on its website there were 2062 wind turbines in Australia at the end of 2015.

Aviation Projects has researched public sources of information, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia,

Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

Of the four known accidents, one was caused by inflight separation of the majority of the right canard and all of the right elevator resulting from a failure of the builder to balance the elevators per the kit manufacturer's instructions. The accident occurred overhead a wind farm, and the aircraft struck a wind turbine on its descent. This accident is not applicable to the circumstances under consideration.

There have been two accidents involving collision with a wind turbine during the day (in 2008 and 2017), and one at night (in 2014).

Only one of these (Melle, Germany 2017) resulted in a single fatality, as the result of a collision with a wind turbine steel lattice mast at a very low altitude during the day with good visibility and no cloud.

In the other case (Plouguin, France, 2008), the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was in conditions of significantly reduced horizontal visibility in fog where the top of the turbine was obscured by cloud. The turbines became visible too late for avoidance manoeuvring and the aircraft made contact with two turbines. The aircraft was damaged but landed safely.

In both cases, is difficult to conclude that obstacle lighting would have prevented the accident.

The other fatal accident occurred at night in IMC.

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group, which suggests a Cessna 182 collided with a wind turbine near Baraboo, Wisconsin, on 29 July 2000. The NTSB database records details of an accident involving a Cessna 182 that occurred on 28 July 2000 in the same area, but suggests that the accident was caused by IFR flight into IMC encountered by the pilot and exceeding the design limits of the aircraft. A factor was flight to a destination alternate not performed by the pilot. No mention is made of wind turbines or a wind farm.

A summary of the four accidents is provided in Table 6.

Table 6 Summary of accidents involving collision with a wind turbine

<i>ID</i>	<i>Description</i>	<i>Date</i>	<i>Location</i>	<i>Fatalities</i>	<i>Flight rules</i>	<i>Turbine height</i>	<i>Obstacle lighting</i>	<i>Cause of accident</i>	<i>Relevant to obstacle lighting at night</i>
1	Diamond DA320-A1 D-EJAR Collided with a wind turbine approximately 20 m above the ground, during the day in good visibility. The mast was grey steel lattice, rather than white, although the blades were painted in white and red bands.	02 Feb 2017	Melle, Germany	1	Day VFR No cloud and good visibility	Not specified	Not specified	Not specified	Not applicable

ID	Description	Date	Location	Fatalities	Flight rules	Turbine height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
2	The Piper PA-32R-300, N8700E, was destroyed during an impact with the blades of a wind turbine tower, at night in IMC. The wind turbine farm was not marked on either sectional chart covering the accident location; however, the pilot was reportedly aware of the presence of the wind farm.	27 Apr 2014	10 miles south of Highmore, South Dakota	4	Night IMC Low cloud and rain	420 ft AGL overall	Fitted but reportedly not operational on the wind turbine that was struck	The NTSB determined the probable cause(s) of this accident to be the pilot's decision to continue the flight into known deteriorating weather conditions at a low altitude and his subsequent failure to remain clear of an unlit wind turbine. Contributing to the accident was the inoperative obstruction light on the wind turbine, which prevented the pilot from visually identifying the wind turbine.	An operational obstacle light may have prevented the accident

3	Beechcraft B55 The pilot was attempting to remain in VMC by descending the aircraft through a break in the clouds. The pilot, distracted by trying to visually locate the aerodrome, flew into an area of known wind turbines. After sighting the turbines, he was unable to avoid them. The tip of the left wing struck the first turbine blade, followed by the tip of the right wing striking the second turbine. The pilot was able to maintain control of the aircraft and landed safely.	04 Apr 2008	Plougin, France	0	Day VFR The weather in the area of the wind turbines had deteriorated to an overcast of stratus cloud, with a base between 100 ft to 350 ft and tops of 500 ft.	328 ft AGL hub height, 393 ft AGL overall	Not specified	This pilot reported having been distracted by a troubling personal matter which he had learned of before departing for the flight. The wind farm was annotated on aeronautical charts.	Not applicable
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<i>ID</i>	<i>Description</i>	<i>Date</i>	<i>Location</i>	<i>Fatalities</i>	<i>Flight rules</i>	<i>Turbine height</i>	<i>Obstacle lighting</i>	<i>Cause of accident</i>	<i>Relevant to obstacle lighting at night</i>
4	VariEze N25063 The aircraft collided with a wind turbine following in-flight separation of the majority of the right canard and all of the right elevator	20 July 2001	Palm Springs, USA	2	Day VFR	N/A	N/A	The failure of the builder to balance the elevators per the kit manufacturer's instructions	Not applicable

10. RISK ASSESSMENT

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects has been developed in consideration of AS/NZS ISO 31000:2018 *Risk management— Guidelines* and the guidance provided by CASA in its SMS for Aviation guidance material, which is aligned with the guidance provided by the International Civil Aviation Organization (ICAO) in Doc 9589 *Safety Management Manual*, Third Edition, 2013. Doc 9589 is intended to provide States (including Australia) with guidance on the development and implementation of a State safety programme (SSP), in accordance with the International Standards and Recommended Practices (SARPs), and is therefore adopted as the primary reference for aviation safety risk management in the context of the subject assessment.

Section 2.1 *The concept of safety* defines safety as follows [author's underlining]:

2.1.1 Within the context of aviation, safety is “the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management.”

10.1. Likelihood

Likelihood is defined in AS/NZS ISO 3100:2018 as the chance of something happening. Likelihood descriptors used in this report are as indicated in Table 7.

Table 7 Likelihood Descriptors

No	Descriptor	Description
1	Rare	It is almost inconceivable that this event will occur
2	Unlikely	The event is very unlikely to occur (not known to have occurred)
3	Possible	The event is unlikely to occur, but possible (has occurred rarely)
4	Likely	The event is likely to occur sometimes (has occurred infrequently)
5	Almost certain	The event is likely to occur many times (has occurred frequently)

10.2. Consequence

Consequence is defined as the outcome of an event affecting objectives, which in this case is the safe and efficient operation of aircraft, and the visual amenity and enjoyment of local residents.

Consequence descriptors used in this report are as indicated in Table 8.

Table 8 Consequence Descriptors

No	Descriptor	People Safety	Property/Equipment	Effect on Crew	Environment
1	Insignificant	Minor injury – first aid treatment	Superficial damage	Nuisance	No effects or effects below level of perception
2	Minor	Significant injury – outpatient treatment	Moderate repairable damage – property still performs intended functions	Operations limitation imposed. Emergency procedures used.	Minimal site impact – easily controlled. Effects raised as local issues, unlikely to influence decision making. May enhance design and mitigation measures.
3	Moderate	Serious injury - hospitalisation	Major repairable damage – property performs intended functions with some short term rectifications	Significant reduction in safety margins. Reduced capability of aircraft/crew to cope with conditions. High workload/stress on crew. Critical incident stress on crew.	Moderate site impact, minimal local impact, and important consideration at local or regional level, possible long term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences.
4	Major	Permanent injury	Major damage rendering property ineffective in achieving design functions without major repairs	Large reduction in safety margins. Crew workload increased to point of performance decrement. Serious injury to small number of occupants. Intense critical incident stress.	High site impact, moderate local impact, important consideration at state level. Minor long term cumulative effect. Design and mitigation measures unlikely to remove all effects.
5	Catastrophic	Multiple Fatalities	Damaged beyond repair	Conditions preventing continued safe flight and landing. Multiple deaths with loss of aircraft	Catastrophic site impact, high local impact, national importance. Serious long term cumulative effect. Mitigation measures unlikely to remove effects.

10.3. Risk matrix

The risk matrix, which correlates likelihood and consequence to determine a level of risk, used in this report is shown in Table 9.

Table 9 Risk Matrix

		CONSEQUENCE				
		INSIGNIFICANT 1	MINOR 2	MODERATE 3	MAJOR 4	CATASTROPHIC
LIKELIHOOD	ALMOST CERTAIN 5	6	7	8	9	10
	LIKELY 4	5	6	7	8	9
	POSSIBLE 3	4	5	6	7	8
	UNLIKELY 2	3	4	5	6	7
	RARE 1	2	3	4	5	6

10.4. Actions required

Actions required according to the derived level of risk are shown in Table 10.

Table 10 Actions Required

8-10	Unacceptable Risk -	Immediate action required by either treating or avoiding risk. Refer to executive management.
5-7	Tolerable Risk -	Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.
0-4/5	Broadly Acceptable Risk -	Managed by routine procedures, and can be accepted with no action.

10.5. Risk Identification

The primary risk being assessed is that of aviation safety. Based on an extensive review of occurrence data and input from stakeholders, the significant risks that are manifested by the Project have been identified for further assessment:

- there is potential for an aircraft to collide with a wind turbine (CFIT);
- there is potential for an aircraft to collide with a wind monitoring tower (CFIT);
- there is potential for a pilot to initiate manoeuvring in order to avoid colliding with a wind turbine or monitoring tower resulting in collision with terrain; and
- there is potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew.

It should be noted that according to guidance provided by the Commonwealth Department of Infrastructure and Regional Development, and in line with generally accepted practice, the risk to be assessed should primarily be associated with passenger transport services. The risk being assessed herein is primarily associated with smaller aircraft likely to be flying under the VFR, and so the maximum number of passengers exposed to the nominated consequences is likely to be limited.

The secondary risk being assessed is the visual impact that obstacle lights (if fitted) will have on the surrounding residents.

10.6. Risk Analysis, Evaluation and Treatment

For the purpose of considering applicable consequences, the concept of worst credible effect has been used. Untreated risk is first evaluated, then, if the resulting level of risk is unacceptable, further treatments are identified to reduce the level of risk to an acceptable level.

Each of the five risk events are considered in separate tables in the following pages.

Risk ID:	1. Aircraft collision with wind turbine
Discussion An aircraft collision with a wind turbine would result in harm to people and damage to property. Property could include the aircraft itself, as well as the wind turbine. There have been four reported occurrences worldwide of aircraft collisions with a component of a wind turbine structure since the year 2000. These reports show a range of situations where pilots were conducting various flying operations at low level and in the vicinity of wind farms in both IMC and VMC. No reports of aircraft collisions with wind farms in Australia have been found. In consideration of the circumstances that would lead to a collision with a wind turbine: - GA VFR aircraft operators generally don't individually fly a significant number of hours in total, let alone in the area in question; - There is a very small chance that a pilot, suffering the stress of weather, will continue into poor weather conditions (contrary to the rules of flight) rather than divert away from it, is not aware of the wind farm, will not consider it or will not be able to accurately navigate around it; and - If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a wind turbine. Refer to the discussion of worldwide accidents at Section 9.4. There are no known aerial agriculture operations conducted at night in the vicinity of the Project. Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.	
Consequence If an aircraft collided with a wind turbine, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.	
	Consequence Catastrophic
Untreated Likelihood There have been four reports of aircraft collisions with wind turbines worldwide, which have resulted in a range of consequences, where aircraft occupants sustained minor injury in some cases and fatal injuries in others. Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents resulted from structural failure of the aircraft before the collision. Only two relevant accidents occurred during the day, and only one resulted in a single fatality. It is assessed that collision with a wind turbine resulting in multiple fatalities and damage beyond repair is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.	
	Untreated Likelihood Possible
Current Treatments (without lighting) - The Project is clear of the obstacle limitation surfaces of any aerodrome. - Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. The proposed turbines will be a maximum of 160 m	

(523 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 7 m (23 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines. • If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective. • Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The wind turbines are typically coloured white, typical of most wind turbines operational in Australia, so they should be visible during the day. • The as constructed details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. • Because the turbines are above 110 m AGL, there is a statutory requirement to report the towers to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of an unacceptable consequence is 8.	
Current Level of Risk	8 – Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Proposed Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Details of the Project should be communicated to local and regional aircraft operators prior to, during and following construction to heighten their awareness of its location and so that they can plan their operations accordingly. Specifically: • Provide the details to the NSW/ACT Regional Airspace and Procedures Advisory Committee for consideration by its members in relation to VFR transit routes in the vicinity of the wind farm. • Engage with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project area. • Arrangements should be made to publish details of the wind farm in ERSAs (En Route Supplement Australia) for surrounding aerodromes	

Residual Risk

With the additional recommended treatments, the likelihood of an aircraft collision with a wind turbine resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 - Tolerable.

It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified.

In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP).

It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.

<i>Residual Risk</i>	7 - Tolerable
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Risk ID:	2. Aircraft collision with a wind monitoring tower
Discussion An aircraft collision with a wind monitoring tower (WMT) would result in harm to people and damage to property. FCWFPL advises there are two existing WMTs at 82 m (269 ft) AGL. WMT locations shall be advised to Airservices Australia. The proposed WMTs shall have high visibility aviation marker balls up on the top level guy wires. The location of the proposed WMTs location and other applicable details shall be advised to Airservices Australia. The towers shall be steel lattice masts (at or below the wind turbine hub height) and shall be installed at different locations the site. There are a few instances of aircraft colliding with a WMT, but they were all during the day with good visibility, and none was in Australia. There is a relatively low rate of aircraft activity in the vicinity of the wind farm. There are no known aerial agriculture operations conducted at night in the vicinity of the wind farm. For objects at a height of 110 m AGL or more and outside the OLS of an aerodrome, CASA must be notified. Obstacle lighting may be required unless CASA, in an aeronautical study, assesses it as being shielded by another lit object or that it is of no obstacle significance. Any object that extends to a height of 150 m or more above local ground level must be regarded as an obstacle unless it is assessed by CASA to be otherwise.	
Consequence If an aircraft collided with a WMT, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.	
	Consequence Catastrophic
Untreated Likelihood There are a few occurrences of an aircraft colliding with a WMT, but all were during the day with good visibility when obstacle lighting would arguably be of no effect, and none was in Australia. It is assessed that collision with a WMT without obstacle lighting that would be effective in alerting the pilot to its presence may only occur in exceptional circumstances, which is classified as Rare.	
	Untreated Likelihood Rare
Current Treatments (without lighting) - The existing wind monitoring towers at FCWF are 82 m (269 ft) high, and do not require lighting. Their location and other applicable details shall be advised to Airservices Australia. - Aircraft are restricted to a minimum height of 152.4 m (500 ft) AGL above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. The highest WMT is at a maximum height of 82 m (269 ft) AGL, leading to no intrusion above the minimum height of 500 ft AGL for an aircraft flying at this height.	

• In the event that descending cloud forces an aircraft lower than 152.4 m AGL (500 ft), the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of the tower. • Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). • Aircraft authorised to intentionally fly below 152.4 m (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The towers are constructed from grey steel. • Since the existing towers are not higher than 110 m AGL, there is no a statutory requirement to report them to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 - Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Proposed Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Details of any WMTs when they are constructed should be advised to Airservices Australia. • Although there is no obligation to do so, consideration could be given to marking any WMTs according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings (as modified by the guidance in NASF Guideline D); specifically: 8.10.2.6 Masts, poles and towers must be marked in contrasting bands with the darker colour at the top, as shown in Figure 8.10-3. The bands must be perpendicular to the longest dimension and have a width approximately 1/7 of the longest dimension or 30 m, whichever is less. 8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart. • Ensure details of any additional WMTs on the Project site have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction.	

Residual Risk

With the additional recommended treatments, the likelihood of an aircraft collision with a WMT resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable.

It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified, other than if the WMT exceeds 150 m AGL in height and is not in relatively close proximity to a wind turbine.

In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP).

It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with the WMTs, without obstacle lighting on the turbines of the Project.

<i>Residual Risk</i>	7 - Tolerable
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Risk ID:	3. Harsh manoeuvring leads to controlled flight into terrain (CFIT)	
Discussion An aircraft colliding with terrain as a result of manoeuvring to avoid colliding with a wind turbine would result in harm to people and damage to property. There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day.		
Consequence If an aircraft collided with terrain, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.		
Consequence		Catastrophic
Untreated Likelihood There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day. It is assessed that a ground collision accident following manoeuvring to avoid a wind turbine is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.		
Untreated Likelihood		Possible
Current Treatments (without lighting) - The Project is clear of the obstacle limitation surfaces of any aerodrome. - Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. - Wind turbines will be a maximum of 160 m (523 ft) at the top of the blade tip, so the rotor blade at its maximum height will be approximately 7 m (23 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). - Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines. - If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective. - Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). - Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. - The wind turbines are typically coloured white, typical of most wind turbines operational in Australia, so they should be visible during the day. - The ‘as constructed’ details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. - Since the turbines will be higher than 110 m AGL, there is a statutory requirement to report the turbines to CASA.		

Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 – Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Proposed Treatments The following treatments which can be implemented at little cost will provide an acceptable level of safety: • Ensure details of the Project have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction; and • Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project area.	
Residual Risk With the additional recommended treatments, the likelihood of ground collision resulting from manoeuvring to avoid a wind turbine resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 – Tolerable. It is considered that the significant cost of obstacle lighting (which is not a preventative control), may only slightly reduce the likelihood of a collision given that the pilot is already in a highly undesirable situation (and not in all situations – such as where the obstacle light may be obscured by cloud) and hence is not justified. In the circumstances, the level of risk under the proposed treatment plan is considered as low as reasonably practicable (ALARP). It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for ground collision resulting from manoeuvring to avoid a wind turbine, without obstacle lighting on the turbines of the Project.	
Residual Risk	7 - Tolerable

Risk ID:	4. Effect of the Project on operating crew	
Discussion Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew. There are no known aerial agriculture operations conducted at night in the vicinity of the Project.		
Consequence The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.		
Consequence		Minor
Untreated Likelihood The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.		
Untreated Likelihood		Possible
Current Treatments (without lighting) - The Project is clear of the obstacle limitation surfaces of any aerodrome. - Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 600 m (or 300 m for helicopters) in visual flight during the day when not in the vicinity of built up areas. - Wind turbines will be a maximum of 160 m (523 ft) at the top of the blade tip, so the rotor blade at its maximum height will be approximately 7 m (23 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). - In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines. - Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of wind turbines. - If cloud descends below the turbine hub, obstacle lighting would be obscured and therefore ineffective. - Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night). - Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.		

- The wind turbines are typically coloured white, so they should be visible during the day. - The 'as constructed' details of wind turbines are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. - Since the WMTs are not higher than 110 m AGL, there is no a statutory requirement to report the turbines to CASA.	
Level of Risk The level of risk associated with a Possible likelihood of a Minor consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 5 is classified as Tolerable: Treatment action possibly required to achieve ALARP - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.	
Risk Decision	Accept, conduct cost benefit analysis
Proposed Treatments Given the current treatments and the limited scale and scope of flying operations conducted within the vicinity of the Project, there is likely to be little additional safety benefit to be gained by installing obstacle lighting, other than if a WMT exceeds 150 m AGL in height and is not in relatively close proximity to a wind turbine. However, the following treatments, which can be implemented at little cost, will provide an additional margin of safety: - Ensure details of the Project have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators before, during and following construction. - Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for such aircraft operations in the vicinity of the Project	
Residual Risk Notwithstanding the current level of risk is considered tolerable, the additional recommended treatments will enhance aviation safety. The likelihood remains Possible, and consequence remains Moderate. In the circumstances, the risk level of 5 is considered as low as reasonably practicable (ALARP). It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for operational limitations to affect aircraft operating crew, without obstacle lighting on the turbines of the Project.	
Residual Risk	5 - Tolerable

Risk ID:	5. Effect of obstacle lighting on neighbours	
Discussion This scenario discusses the consequential impact of a decision to install obstacle lighting on the wind farm. Installation and operation of obstacle lighting on wind turbines or WMT can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions. If the wind turbines or WMT will be higher than 150 m AGL (492 ft), the wind turbines must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 110 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.		
Consequence The worst credible effect of obstacle lighting specifically at night in good visibility conditions would be: Moderate site impact, minimal local impact, important consideration at local or regional level, possible long term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences. This would be a Moderate consequence.		
Consequence		Moderate
Untreated Likelihood The likelihood of moderate site impact, minimal local impact is Almost certain - the event is likely to occur many times (has occurred frequently).		
Untreated Likelihood		Almost certain
Current Treatments If the wind turbines or WMT will be higher than 150 m AGL (492 ft), they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 110 m would require obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.		
Level of Risk The level of risk associated with a Likely likelihood of a Moderate consequence is 8.		
Current Level of Risk		8 - Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.		
Risk Decision		Unacceptable

Proposed Treatments

Not installing obstacle lighting would completely remove the source of the impact.

If lighting is required, there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including:

- reducing the number of wind turbines with obstacle lights;
- specifying an obstacle light that minimises light intensity at ground level;
- specifying an obstacle light that matches light intensity to meteorological visibility; and
- mitigating light glare from obstacle lighting through measures such as baffling.

There are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to those on the ground.

Consideration may be given to activating the obstacle lighting via a pilot activated lighting system.

An option is to consider using Aircraft Detection Lighting Systems (referred in the United States Federal Aviation Administration Advisory Circular AC70/7460-1L CHG1 – Obstruction Marking and Lighting). Such a system would only activate the lights when an aircraft is detected in the near vicinity and deactivate the lighting once the aircraft has passed. This technology reduces the impact of night lighting on nearby communities and migratory birds and extends the life expectancy of obstruction lights.

Residual Risk

Not installing obstacle lights would clearly be an acceptable outcome to those affected by visual impact.

Consideration of visual impact in the lighting design should enable installation of lighting that produces an acceptable impact to neighbours, which reduces the likelihood of a Moderate consequence to Likely – The event is likely to occur sometimes (has occurred infrequently), resulting in a risk level of 7 – Tolerable.

It is our assessment that visual impact from obstacle lights can be negated if they are not installed, but if obstacle lights are to be installed, they can be designed so that there is an acceptable risk of visual impact to neighbours.

Residual Risk 7 - Tolerable

10.7. Summary of risks

The proposed 10 m increase in the maximum turbine tip height proposed as part of Modification 4 does not increase the potential impact to aviation from that previously assessed for the Project.

A summary of the level of risk associated with the proposed FCWF Project, under the proposed treatment regime, is provided in Table 11.

Table 11 Summary of Risks

<i>Risk Element</i>	<i>Consequence</i>	<i>Likelihood</i>	<i>Risk</i>	<i>Actions Required</i>
Aircraft collision with wind turbine	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in En Route Supplement Australia (ERSA) for surrounding aerodromes before, during and following construction.
Aircraft collision with monitoring tower	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Although there is no obligation to do so, consider marking any new wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings, specifically 8.10.2.6 and 8.10.2.8. Communicate details of wind monitoring towers to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes following construction.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Effect on crew	Minor	Possible	5	Acceptable without obstacle lighting (ALARP). Communicate details of the Project to local and regional operators and make arrangements to publish details in ERSA for surrounding aerodromes before, during and following construction.
Visual impact from obstacle lights	Moderate	Likely	7	Acceptable without obstacle lighting (zero risk of visual impact from obstacle lighting). If lights are installed, design to minimise impact.

11. CONCLUSIONS

The results of this study are summarised as follows:

- The proposed increase in the maximum turbine envelope proposed as part of Modification 4 does not increase the potential impact to aviation from that previously assessed for the Project.

11.1. Regulatory requirements

- There is no regulatory requirement for lighting of obstacles lower than 150 m AGL (492 ft) and that are not within the vicinity of an aerodrome.
- With respect to MOS 139 7.1.5.1, the proposed wind turbines and WMTs must be reported to CASA if they will be higher than 110 m AGL.
- With respect to MOS 139 7.1.5.2, the wind turbines or WMTs must be regarded as an obstacle if they are higher than 150 m AGL, unless CASA assesses otherwise. Obstacle monitoring includes the PANS OPS surface which extends beyond the OLS of the aerodrome.
- With respect to MOS 139 9.4.1.2 (b), the wind turbines or WMTs will need to be lit if they will be outside the OLS and above 110 m AGL, unless an aeronautical study assesses they are of no operational significance.
- **Aviation Projects assesses that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.** Section 10– Risk Assessment of the aeronautical impact assessment concluded no lights were not required for wind turbines or wind monitoring towers.

11.2. Consultation

- The following parties were consulted about the proposed planning modification:
 - o Aerial Agricultural Association of Australia;
 - o Airservices Australia;
 - o Department of Defence;
 - o Fred Fahey Aerial Services; and
 - o Orange City Council.

11.3. Aviation Impact Statement

- Based on the proposed FCWF layout and overall WTG overall blade tip height limit of 160 m AGL, the blade tip elevation of the highest WTG, which is WTG20, will not exceed 1114 m AHD (3655 ft AMSL) and:
 - will not penetrate any OLS surfaces;
 - will not penetrate PANS-OPS surfaces;

- will not have an impact on nearby designated air route or grid lowest safe altitudes;
- will not have an impact on prescribed airspace;
- is contained within Class G airspace; and
- is outside the clearance zones associated with aviation navigation aids and communication facilities.
- With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 1114m (3655ft) AHD the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at Orange, Cowra or Bathurst Airport, any air route lowest safe altitude (LSALT) and will not adversely impact the performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

11.4. Aircraft operator characteristics

- Aircraft will be required to navigate around the Project site in low cloud conditions where aircraft need to fly at 500 ft AGL.
- Although there is no requirement to do so, the Proponent may consider engaging with local aerial agricultural and aerial firefighting operators to develop procedures for their safe operation within the Project area.
- Wind turbines are generally not a safety concern to aerial agricultural operators. Wind monitoring towers remain the primary safety concern to aerial agricultural operators, who have expressed a general desire for these towers to be more visible.
- Air operators: There is a relatively low rate of aircraft activity in the vicinity of the wind farm site.
- Aerial fire fighting: There are no known aerial agriculture operations conducted at night in the vicinity of the wind farm site. Any fire-fighting activities in the vicinity of the proposed wind farm by either fixed or rotary wing aircraft would need to be conducted in consideration of the location of the wind turbines and monitoring masts. To this end it is important that the location of the wind turbines and monitoring masts are made available to fire-fighting agencies and aerial agriculture operators.

Notwithstanding that aerial fire-fighting operations will potentially be restricted in the vicinity of the proposed wind farm, there is still a valid (ground-based) means of fighting bushfires on and near the properties on which the wind farm is proposed to be located.

The Country Fire Authority Emergency Management Guidelines for Wind Energy Facilities includes a section on planning, design and development of wind energy facilities and section 2(2.3) stated:

Wind turbines should be located approximately 300 metres apart. This provides adequate distance for aircraft to operate around a Wind Energy Facility given the appropriate weather and terrain conditions. Fire suppression aircraft operate under "Visual Flight Rules". As such, fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Wind turbines, similar to high voltage transmission lines, are part of the landscape and would be considered in the incident action plan.

- Aerial agricultural operators: The proposed wind farm will most likely prevent fixed wing aerial agricultural operations on the wind farm site, whilst the viability of conducting these operations on properties adjacent to the wind farm would have to be assessed on an individual basis.

It is reasonable to conclude that safe aerial application operations would be possible on properties neighbouring the proposed wind farm with some operational or cost impacts, subject to final microsituated turbine locations, and subject to a case by case assessment.

The use of helicopters enables aerial application operations to be conducted in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

11.5. Hazard lighting and marking

- With respect to MOS 139 7.1.5.1, the proposed wind turbines must be reported to CASA if they will be higher 110 m AGL. With respect to MOS 139 7.1.5.2, the proposed 160 m wind turbine overall blade tip height must be regarded as obstacles since they are higher than 150 m AGL.
- There are two existing WMTs at a height of 82 m (269 ft), which have been reported to Airservices Australia.
- With respect to MOS 139 9.4.1.2 (b), the wind turbines and WMTs will need to be lit if they are higher than 110 m AGL, unless an aeronautical study assesses they are of no operational significance.
- CASA has advised that it will only review assessments referred to it by a planning authority or agency.
- **Aviation Projects assesses that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a wind turbine, without obstacle lighting on the turbines of the Project.**
- If obstacle lighting is required by the assessment manager, installed lights should be designed according to criteria set out in the applicable regulatory material.
- With respect to marking of turbines, a white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.
- Consultation with Department of Defence regarding lighting has been undertaken during the preparation of the aviation impact assessment. Department of Defence has reviewed the requirement for lighting and has determined that lighting will not be required. If LED lighting is proposed, Department of Defence requests that the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometers, so that the WTGs are visible to pilots using night vision goggles.

If wind monitoring towers are constructed as part of the proposal, Defence notes that the National Airports Safeguarding Framework Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers - Paragraph 39 recommends the top 1/3 of wind monitoring towers are painted in alternating contrasting bands of colour in accordance with the Manual of Standards for Part 139 of the Civil Aviation Safety Regulations 1998.

- Although there is no obligation to do so, consideration should be given to marking any wind monitoring towers according to the requirements set out in MOS 139 Section 8.10 Obstacle Markings (as modified by the guidance in NASF Guideline D).

- With respect to power line route determination (refer to Section 4.3), it is prudent to consider potential adverse impacts on aerial application operations. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Section 8.10 Obstacle Markings; specifically:

8.10.2.8 Wires or cable obstacles must be marked using three-dimensional coloured objects such as spheres and pyramids, etc; of a size equivalent to a cube with 600 mm sides, spaced 30 m apart.

- The transmission line and switching station proposed as part of Modification 4 will not adversely affect aircraft operations.

11.6. Risk assessment

A summary of the level of risk associated with the Project under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 11 of Section 10.

11.7. Conditions of approval

- Conditions of approval D11, D12, D13, D22 and D25 were identified as being relevant to the assessment contained herein.
- In relation to Condition D11 (a), correspondence sent from Orange City Council to FCWFPL advised that there would be no impact on current or future obstacle limitation surfaces of Orange Airport.
- In relation to Condition D11 (b), redesign of the NDB approach at Orange Airport is not required, since the NDB has been decommissioned, and Airservices Australia has advised that there will be no impacts on instrument approach procedures at aerodromes, navigational aids, communications and surveillance facilities.
- In relation to Condition D12, during recent consultation, RAAF AIS advised that all future correspondence should be directed through Airservices Australia. Accordingly, the requirement to notify Royal Australian Air Force – Aeronautical Information Services should be removed from this condition.
- The remainder of Conditions D11, D12, D13, D22 and D25 remain appropriate to managing potential aviation impacts.

12. RECOMMENDATIONS

If the recommendations set out below are implemented, the Project will not adversely affect the safety, operational integrity and efficiency of air services.

Notification and reporting

1. 'As constructed' details of wind turbine and WMT coordinates and elevations should be provided to Airservices Australia, using the following email address: vod@airservicesaustralia.com.
2. Any obstacles above 110 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:
 - a. The planned operational timeframe and maximum height of the crane; and
 - b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.
3. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations. Specifically, details should be provided to the NSW/ACT Regional Airspace and Procedures Advisory Committee for consideration by its members in relation to VFR transit routes in the vicinity of the wind farm.

Operation

4. Although not a mandatory requirement, the Proponent should consider engaging with local aerial agricultural operators and aerial firefighting operators in developing procedures for such aircraft operations in the vicinity of the Project.

Marking of turbines

5. The rotor blades, nacelle and the supporting mast of the wind turbines should be painted a white colour, typical of most wind turbines operational in Australia.

Lighting of turbines

6. **Aviation Projects has assessed that the Project will not require obstacle lighting to maintain an acceptable level of safety to aircraft.**
7. If obstacle lighting was required by the assessment manager, the lighting should have the following characteristics:
 - a. Obstacle lighting should be designed in accordance with the characteristics specified in ICAO Annex 14 Vol 1 Chapter 6 (note that Section 6.2.4 addresses obstacle marking and lighting of wind turbines) and MOS 139 Chapter 9 (note that Section 9.4.3.4A addresses obstacle lighting for a wind farm), while minimising visual impact;
 - b. Department of Defence determined that lighting will not be required. If LED lighting is proposed, the frequency range of the LED light emitted should be within the range of wavelengths 665 to 930 nanometres for night vision devices compatibility; and

- c. To ensure the ongoing operation and availability of obstacle lights (if required) at night and during times of reduced visibility, a monitoring, reporting and maintenance program should be established in accordance with the guidance in MOS 139 Section 9.4.10.

8. Any decision to require or to not require lighting remains with the planning authority to determine.

Marking of wind monitoring towers

9. Consideration should be given to marking any new WMTs according to the requirements set out in MOS 139 Section 8.10 (as modified by the guidance in NASF Guideline D).

Marking of overhead transmission lines and poles

10. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with MOS 139 Section 8.10.2.8.

Micrositing

11. Alteration to the siting of a turbine or WMTs will not be more than 100 m and micrositing will address any consequential changes to access tracks and internal power cable routes. The potential micrositing of the turbines has been taken into account in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the nominal turbine position. The micrositing of the turbines is not likely to result in a change in the maximum overall AGL blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this aviation impact assessment would remain the same.

ANNEXURE 1 – WIND TURBINE COORDINATES AND APPROXIMATE HEIGHTS

A1.1 Wind turbine generator centre point coordinates and approximate heights

Note, the turbine positions have not changed from the approved locations (Project Approval, November 2017).

WTG ID	Easting (m)	Northing (m)	Base Elevation (m AHD)	Tip Height for WTG (m AGL)	Tip Height for WTG (m AHD)
WTG3	692487	6290959	896	160	1056
WTG5	692610	6290375	900	160	1060
WTG6	692438	6289879	867	160	1027
WTG7	692375	6289621	856	160	1016
WTG8	691922	6289293	869	160	1029
WTG9	691710	6288716	855	160	1015
WTG10	690463	6289008	826	160	986
WTG11	690764	6288686	833	160	993
WTG15	694616	6287092	899	160	1059
WTG18	693315	6284663	919	160	1079
WTG19	693106	6284262	922	160	1082
WTG20	693633	6283962	954	160	1114
WTG21	691091	6283878	856	160	1016
WTG22	691440	6283635	876	160	1036
WTG23	691436	6283205	863	160	1023
WTG24	690258	6283778	822	160	982
WTG25	690357	6283178	860	160	1020
WTG26	690381	6282714	840	160	1000
WTG27	689933	6282625	841	160	1001
WTG28	689635	6282686	819	160	979
WTG29	689403	6282413	792	160	952
WTG30	689820	6282149	817	160	977
WTG31	690231	6282050	835	160	995
WTG32	692382	6282353	878	160	1038

WTG33	692173	6281920	915	160	1075
WTG34	692320	6281639	901	160	1061
WTG35	692379	6281358	894	160	1054
WTG36	692852	6280328	884	160	1044
WTG37	692897	6279893	826	160	986
WTG38	694007	6282678	881	160	1041
WTG39	695178	6283099	922	160	1082
WTG40	695285	6282880	919	160	1079
WTG41	695383	6282655	911	160	1071
WTG42	695229	6282331	898	160	1058
WTG43	696494	6283966	943	160	1103
WTG44	696745	6283761	922	160	1082
WTG45	696940	6283488	902	160	1062
WTG46	697221	6283308	882	160	1042



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Appendix J

Biodiversity Assessment (NGH Environmental)

Biodiversity Assessment

FLYERS CREEK WIND FARM PLANNING MODIFICATION 4



JULY 2018



Document Verification



Project Title: Flyers Creek Wind Farm Planning Modification 4

Project Number: 18-310

Project File Name: Flyer's Creek Transmission Line biodiversity assessment

Revision	Date	Prepared by (name)	Reviewed by (name)	Approved by (name)
V1.1	24/07/18	J Gooding / J Murphy	Nick Graham-Higgs	Nick Graham-Higgs

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CONTENTS

1	EXECUTIVE SUMMARY	1
2	INTRODUCTION AND BACKGROUND	2
2.1	PROJECT DESCRIPTION	2
2.1.1	Location of the activity	2
2.2	SCOPE OF THE REPORT.....	2
2.3	THE TRANSMISSION LINE	4
2.4	PROJECT APPROVAL CONDITIONS	4
2.5	STUDY AREA	4
3	STATUTORY CONSIDERATIONS.....	5
3.1	NSW BIODIVERSITY CONSERVATION ACT 2016	5
3.2	NSW BIOSECURITY ACT 2015	5
3.3	NSW FISHERIES MANAGEMENT (FM) ACT 1994	6
3.4	STATE ENVIRONMENTAL PLANNING POLICY NO. 44 – KOALA HABITAT PROTECTION.....	7
3.5	ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION (EPBC) ACT 1999 (CWTH)	7
4	METHODS	8
4.1	BACKGROUND REVIEW	8
4.1.1	Database searches	8
4.1.2	Literature review	8
4.2	FIELD SURVEYS	9
4.2.1	Flora survey methods	9
4.2.2	Fauna survey methods.....	9
4.2.3	Limitations	10
5	RESULTS.....	11
5.1	FLORA.....	11
5.1.1	Existing environment	11
5.1.2	Priority Weeds	12
5.2	PLANT COMMUNITY TYPES.....	12
5.3	PLANT SPECIES AND COMMUNITIES OF CONSERVATION SIGNIFICANCE	21
5.3.1	Endangered ecological communities	21
5.3.2	Threatened species.....	22
5.4	FAUNA.....	29
5.4.1	Fauna habitat.....	29

5.4.2	Threatened species.....	29
5.5	EPBC MATTERS OF NATIONAL SIGNIFICANCE.....	32
6	ASSESSMENT OF IMPACTS	34
6.1	NATIVE VEGETATION.....	34
6.2	THREATENED ENTITIES.....	34
6.3	WEEDS, PESTS AND PATHOGENS.....	35
6.4	CONSTRUCTION DISTURBANCE.....	36
6.5	REGIONAL AND CUMULATIVE IMPACTS	36
7	MITIGATION MEASURES.....	36
8	CONCLUSION	37
9	REFERENCES.....	38
APPENDIX A	BACKGROUND SEARCHES	A-I
APPENDIX B	FIELD SURVEY RESULTS	B-II
APPENDIX C	THREATENED SPECIES EVALUATIONS.....	C-I
APPENDIX D	THREATENED SPECIES ASSESSMENTS OF SIGNIFICANCE	D-I
APPENDIX E	HOLLOW BEARING TREE INVENTORY.....	E-I
APPENDIX F	NSW HERBARIUM CORRESPONDENCE.....	F-I

TABLES

Table 2-1	Biosecurity Act 2015 toolset for weed management (Department of Primary Industries, 2016)..	6
Table 3-1	Databases searches for the Biodiversity Assessment.	8
Table 3-2	Weather conditions during field survey at nearest Bureau of Meteorology weather station, Orange NSW (063303).	9
Table 4-1	Vegetation extent within the study area.	11
Table 4-2	Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands bioregion.	14
Table 4-3	Long-leaved Box - Red Box - Red Stringybark mixed open forests on hills and hillslopes in the NSW South Western Slopes bioregion.	17
Table 5-1	Impacts to vegetation	34

FIGURES

Figure 1-1 Proposal Location.	3
Figure 4-1 Blackberry (priority weed) along the roadside within the study area.....	12
Figure 4-2 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in good condition along Panuara Road.	15
Figure 4-3 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in moderate condition in private property.	15
Figure 4-4 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in good condition along Cadia Road.	16
Figure 4-5 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in low condition along Cadia Road.	16
Figure 4-6 Example of Long-leaved Box – Red Box – Red Stringybark mixed open forest along Cadia Road.	18
Figure 4-7 Example of planted vegetation along Cadia Road.	19
Figure 4-8 Example of exotic pine plantation along Cadia Road.	20
Figure 4-9 Example of exotic vegetation in grazed paddocks.....	20
Figure 4-10 Example of exotic vegetation along Cadia Road.....	21
Figure 4-11 Suspected Silver-leaf Candlebark (E. canobolensis) within pine plantation.....	22
Figure 4-12 Vegetation Map - Map 1.....	23
Figure 4-13 Vegetation Map - Map 2.....	24
Figure 4-14 Vegetation Map - Map 3.....	25
Figure 4-15 Vegetation Map - Map 4.....	26
Figure 4-16 Vegetation Map - Map 5.....	27
Figure 4-17 Vegetation Map - Map 6.....	28
Figure 4-18 Example of rocky outcrop.....	29

ACRONYMS AND ABBREVIATIONS

BA	Biodiversity Assessment
BC Act	<i>Biodiversity Conservation Act 2016 (NSW)</i>
Biosecurity Act	<i>Biosecurity Act 2015 (NSW)</i>
Cwth	Commonwealth
CEEC	Critically Endangered Ecological Community
DEE	Department of Environment and Energy (Cwth)
DECC or DECCW	Refer to OEH
DGR	Director-General's Requirements
DoE	Department of Energy (Cwth) (refer to DEE)
DPI	Department of Planning and Infrastructure (NSW)
EEC	Endangered ecological community
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999 (Cwth)</i>
FM Act	<i>Fisheries Management Act 1994 (NSW)</i>
ha	hectares
IBRA	Interim Biogeographic Regionalisation for Australia
km	kilometres
KTP	Key Threatening Process
LGA	Local Government Area
m	metres
NES	Matters of National environmental significance under the EPBC Act (<i>c.f.</i>)
NPWA Act	<i>National Parks and Wildlife Act 1974 (NSW)</i>
NSW	New South Wales
OEH	Office of Environment and Heritage (NSW)
PCT	Plant Community Type
SEPP	State Environmental Planning Policy (NSW)
sp/spp	Species/multiple species
SPRAT	Species Profile and Threats Database (DEE)
TEC	Threatened Ecological Community
VIS	Vegetation Information System

1 EXECUTIVE SUMMARY

Flyers Creek Wind Farm (Pty Ltd) is planning for the construction and operation of the Flyers Creek Wind Farm, 21km South of Orange. Planning Modification 4 includes the reinstatement of a 132 kilovolt (kV) transmission line from the on-site substation to connection point on the Orange North to Cadia transmission line to the north of the site. The proposed 132 kV transmission line will be approximately 14 kilometres (km) in length and have a total expected easement width of 45metres (m).

A biodiversity assessment was undertaken by NGH Environment on behalf of Flyers Creek Wind Farm Pty Ltd (Proponent). The aim of the biodiversity assessment was to determine the vegetation communities present, undertake flora and fauna surveys and assess the likely impacts of the proposal.

Field Surveys of the study area identified two plant community types (PCTs). Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (PCT 1330) and Long-leaved Box – Red Box – Red stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion (PCT 287). PCT1330 forms part of the Endangered Ecological Community (EEC), White Box, Yellow Box Blakely’s Red Gum Woodland listed under the NSW Biodiversity Conservation Act (BC Act). Sections of the community along Cadia Road meet the criteria for the EEC listed under the federal Environment Protection and Biodiversity Conservation Act (EPBC Act).

An assessment of threatened flora under the BC Act and EPBC Act was undertaken. One threatened tree – Silver-leaf Candlebark (*Eucalyptus canobolensis*) is known to occur within 10km of the study area. Two trees within the study area were suspected to be the threatened tree but were unable to be confirmed by the National Herbarium of NSW due to the timing of the survey. These trees would be avoided by the proposal. Two other threatened flora species, Small Purple-pea (*Swainsona recta*) and Silky Swainson-pea (*Swainsona sericea*) are considered to have the potential to occur within the study area. These plants lie dormant over Autumn and early winter and would not have been visible during the site surveys. No other threatened flora were considered to occur within the study area.

An assessment of threatened fauna under the BC Act and EPBC Act was undertaken. One threatened mammal carcus, the Grey headed flying fox (*Pteropus poliocephalus*) was recorded within the study area. 24 birds species, 12 mammals, one amphibian and two reptiles were also considered to have the potential to occur within the study area. Assessments of significance were carried out for these threatened entities. No significant impact is considered likely for any of these BC or EPBC listed species.

Consideration has been given to avoid and minimise impacts to native vegetation and threatened species where possible. Where impacts are unavoidable, up to 6.8ha of native vegetation and 1.4ha of planted native vegetation would be removed by the proposal, however the final amount will be determined following detailed design. Mitigation and management measures will be put in place to adequately address direct and indirect impacts associated with the proposal. Broadly, these would include but are not limited to, clearly marking and protecting hollow bearing trees and the suspected *Eucalyptus canobolensis* trees, Pre-clearance surveys for the threatened flora species (*Swainsona recta* and *Swainsona sericea*), implement a hollow bearing tree clearing protocol and incorporate the control of priority weeds into a weed management plan.

Prior to the commencement of construction, the proponent will update the baseline mapping of the vegetation within the final disturbance area, and calculate the biodiversity offset credit liability in accordance with the *NSW Biodiversity Offset Policy for Major Projects*.

2 INTRODUCTION AND BACKGROUND

This Biodiversity Assessment (BA) has been prepared to provide a specialist assessment of the construction of a 132 kV transmission line as part of the Flyers Creek Wind Farm planning modification 4.

2.1 PROJECT DESCRIPTION

2.1.1 Location of the activity

The proposal site is described as the area around Flyers Creek, along Cadia Road and Panuara Road, 21 kilometres (km) south of Orange and 15 km west of Millthorpe (Figure 1-1).

The following terms are used for the different spatial scales in this assessment:

- Project footprint: 45m wide cleared easement required for the construction and operation of the transmission line. This is wholly contained within the study area.
- Study area: 100m wide corridor including project footprint and immediate surrounds
- Locality: proposal area and 10 km radius

The study area is within the South-Eastern Highlands IBRA bioregion, in the Orange subregion. The bioregion is dominated by a temperate climate with warm summers and no dry season. The geology of the bioregion is part of the Lachlan fold belt, comprising a complex series of metamorphosed Ordovician to Devonian sandstones, shales, and volcanic rocks with granite intrusions. The dominant topographical features are plateau remnants, granite basins with prominent ridges, and the western ramp, with deeply entrenched streams and narrow valleys with little Quaternary sediment. Diverse vegetation communities occur across the bioregion, including those consisting of Yellow Box *Eucalyptus melliodora*, Red Box *Eucalyptus polyanthemos*, and Blakely's Red Gum *Eucalyptus blakelyi*, with areas of White Box *Eucalyptus albens* in lower areas.

2.2 SCOPE OF THE REPORT

The scope of this assessment includes:

- Desktop assessment of local biodiversity and vegetation communities;
- Detailed flora and fauna survey and general habitat assessment; and
- Assessment of likely impacts of the proposal.

This assessment forms part of a planning modification for Flyers Creek Wind Farm. This planning modification that is being prepared by Flyers Creek Wind Farm Pty Ltd (Proponent) considers the following key items:

1. Reinstatement of the 132 kilovolt (kV) transmission line from the on-site substation to connection point on the Orange North to Cadia transmission line to the north of the site; and
2. An increase in the wind turbine envelope so as to accommodate the newer, more efficient turbine models now available. This assessment only assesses the ecological impacts associated with the reinstatement of the transmission line. The bird and bat impacts of the proposed increase of the turbine envelope have been separately assessed by Brett Lane and Associates and are reported on in a separate report.

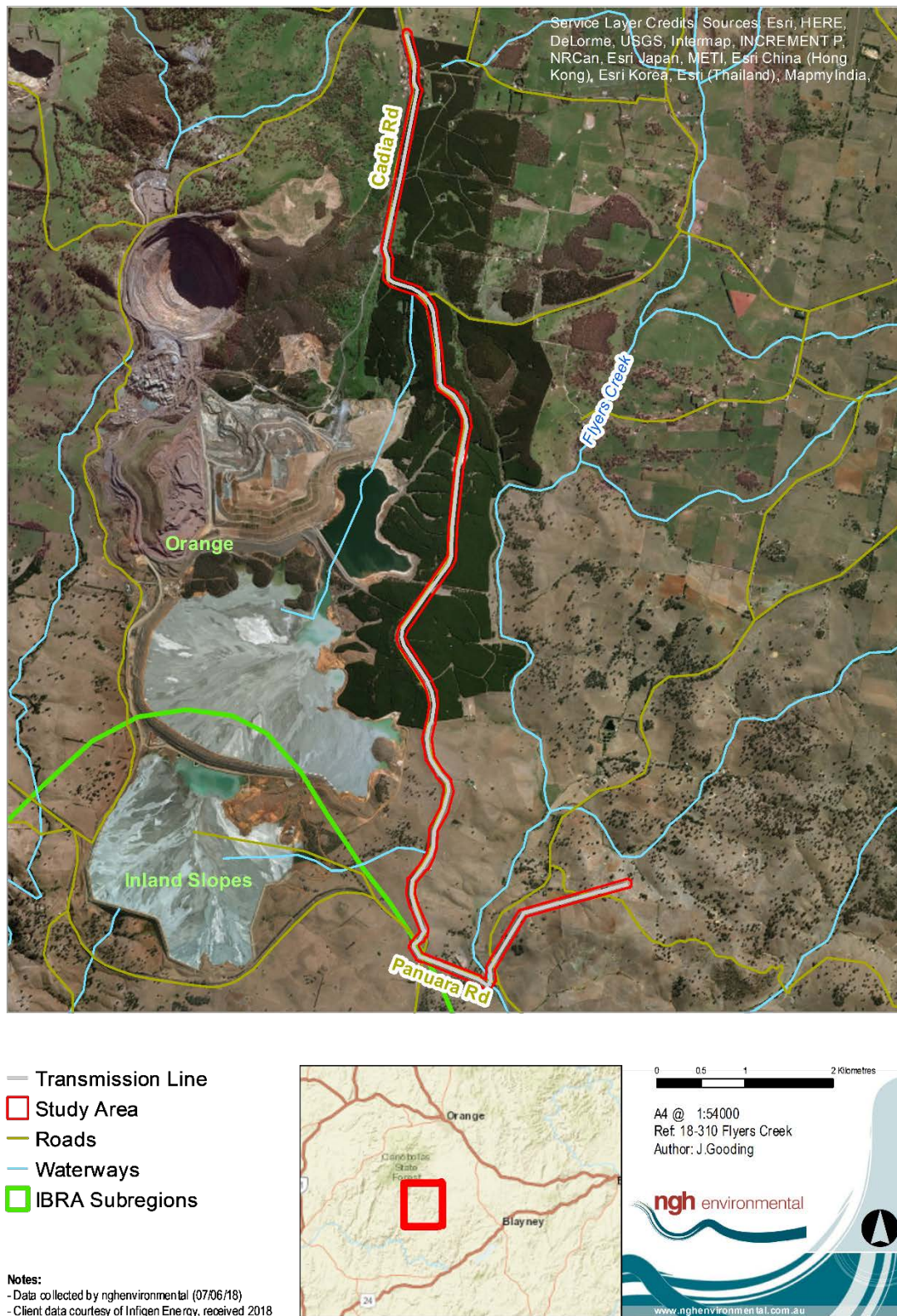


Figure 1-1 Proposal Location.

2.3 THE TRANSMISSION LINE

The proposed 132 kV transmission line;

- Will be approximately 14km in length
- Have poles approximately 24 metres in height
- Have a total expected easement width of 45 metres

The route of the transmission line will travel across farmland from the proposed substation westwards, traverse Errowanbang Rd and then travel along Panuara Rd reserve before heading north along Cadia Rd reserve before travelling alongside the road in NSW Forestry Corporation state forest.

It should be noted that a transmission line was previously approved as part of the original project approval and then removed at Modification 2 due to land access issues. The approved route is slightly different to that being proposed in this Modification.

2.4 PROJECT APPROVAL CONDITIONS

The Project Approval, as currently modified, contains a number of conditions regulating biodiversity matters. These include conditions D1, D2, D3, D4, D5, D6 and F21(f). These are summarised below.

- D1. The proponent must ensure that:
 - a. No EEC is cleared for the project unless the Secretary agrees otherwise,
 - b. Minimise the clearing of native woodland vegetation, scattered paddock trees and fauna habitat (Including rocky outcrops) within the approved disturbance footprint.
- D2. Tree trunks and major branches from cleared trees should be used to the fullest extent practicable, to enhance habitat in rehabilitated areas or derived native grasslands and details included in the Construction Flora and Fauna Management Plan.
- D3. No more than 10 hollow bearing trees should be removed unless the secretary agrees otherwise
- D4. Prior to the commencement of construction, the proponent shall prepare and submit for the approval of the secretary a Bird and Bat Adaptive Management Plan.
- D5. Prior to the commencement of construction, the proponent must
 - a. Update the baseline mapping of the vegetation and key habitat within the final disturbance area, and
 - b. Calculate the biodiversity offset credit liability in accordance with the *NSW Biodiversity Offset Policy for Major Projects*
- D6. Within two years of the commencement of construction, the proponent must retire the required biodiversity credits to the satisfaction of OEH. The retirement of the credits must be carried out in accordance with the NSW Biodiversity Offsets policy for Major Projects.
- F21(f): A construction flora and fauna management plan to detail how construction impacts on ecology will be minimised and managed.

2.5 STUDY AREA

The assessment focussed on the transmission line study area that includes an easement 100 metre wide.

The project footprint would be 45 metres wide (22.5 metres either side of the centre of the transmission line), and this would be the maximum width of clearing. The project footprint would occur within the overall 100m wide study area that was assessed. The final disturbance footprint would be identified prior to construction and assessment of the biodiversity offset credit liability. The extent of clearing would be less in sections of the route pass through treeless areas.

The biodiversity assessment was only undertaken within the transmission line project area. The area of the windfarm and wind turbines has previously been assessed for biodiversity impacts and the location of the wind turbines has not changed with this modification to the Flyers Creek Wind Farm.

3 STATUTORY CONSIDERATIONS

3.1 NSW BIODIVERSITY CONSERVATION ACT 2016

The *Biodiversity Conservation Act 2016 (NSW)* (BC Act) aims to maintain a healthy, productive and resilient environment for the greatest wellbeing of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act includes listing of Key Threatening Processes (KTPs), threatened species and threatened ecological communities. The BC Act also includes a five-part test of significance, which is used to determine if a proposed development is likely to have a significant impact on threatened species, ecological communities or their habitats.

In addition, Division 4 of Part 7 of the BC Act requires that consent authorities take into consideration the likely impact of the proposed development on biodiversity values protected by the BC Act as assessed in a biodiversity development assessment report when determining certain planning applications under the EP&A Act. In particular, section 4.17 of the BC Act requires consideration of a biodiversity development assessment report for modification applications under the EP&A Act where Division 4 of Part 7 "applies in relation to the original development as proposed to be modified". However, as the Flyers Creek Wind Farm was originally approved under Part 3A of the EP&A Act and Division 4 of Part 7 of the BC Act does not apply to Part 3A projects, a biodiversity development assessment report is not required for Modification 4.

This assessment considers the potential for the proposal to impact on threatened species and ecological communities listed under the BC Act.

3.2 NSW BIOSECURITY ACT 2015

The *Biosecurity Act 2015* (BA Act) guides the management of weeds at the regional level throughout NSW. Under the BA Act, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant who knows or ought to know of any biosecurity risk has a duty to ensure the risk is prevented, eliminated or minimised, as far as it reasonably practicable. Individuals landholders and managers are required under the BA Act to control priority weeds for their area according to the relevant biosecurity toolset (Table 2-1).

Table 2-1 *Biosecurity Act 2015* toolset for weed management (Department of Primary Industries, 2016).

Outcome category	Biosecurity toolset
<i>Weeds excluded from entering state</i>	Prohibited Matter: Declaration and management of significant weeds not present I NSW or part of NSW.
<i>Weeds to be eradicated</i>	Control Order: Management of weeds that are the targets of approved eradication programs. Although a Control Order is for a five-year period, this can be renewed for longer eradication programs.
<i>Weeds to be effectively managed to reduce spread on regional basis</i>	Biosecurity Zone: Weeds subject to ongoing 'strategic' regional management.
<i>All Weeds</i>	General Biosecurity Duty: Requires any person dealing with biosecurity matter or a carrier of biosecurity matter and who knows or ought to know of the biosecurity risks associated with that activity to take measures to prevent, minimise or eliminate the risk as far as is reasonably practicable. Specific measures to reduce the risk will be detailed in regional weeds plans for priority weeds. Note however, that the General Biosecurity Duty exists for all weeds that present a biosecurity risk.
<i>Other Biosecurity tools</i>	Mandatory Measures Regulation: May require persons to take specific actions with respect to weeds or carriers of weeds. Emergency Order: To respond to a current or imminent biosecurity risk that may have a significant impact. Biosecurity Direction: An enforceable instruction to a person or class of persons to take action to: - Prevent, eliminate or minimise a biosecurity risk - Prevent, manage or control a biosecurity impact - Enforce any instrument under the Act. Biosecurity Undertaking: An authorised officer may accept in writing an undertaking by a person that sets out the measures a person has agreed to implement to remedy a contravention, a likely contravention, or suspected contravention of the Act.

A vegetation assessment was undertaken at the proposal area. One priority weeds listed under the Biosecurity Act were present. Weed control measures are discussed in Section 4.1.2.

3.3 NSW FISHERIES MANAGEMENT (FM) ACT 1994

This Act provides for conservation of fishes and their habitats and outlines approval processes for activities that may impact on threatened species and habitats. No work in aquatic habitat will be undertaken, and fish passage would not be affected. No permits or licences are required under the FM Act.

3.4 STATE ENVIRONMENTAL PLANNING POLICY NO. 44 – KOALA HABITAT PROTECTION

SEPP 44 encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure that permanent, free-living populations will be maintained over their present range.

The study area is within Blayney Local Government Area (LGA) and Cabonne LGA. These are listed as LGAs to which SEPP 44 applies. SEPP 44 aims to identify areas of potential and core Koala Habitat. These are described as follows:

- *Core Koala Habitat* is defined as an area of land with a resident population of Koalas, evidenced by attributes such as breeding females, and recent and historical records of a population.
- *Potential Koala Habitat* is defined as areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

In Schedule 2 of the SEPP 44, Ribbon Gum *Eucalyptus viminalis* is listed as a feed tree species. Under the NSW Koala Recovery Plan (DECC 2008) under the section *Koala Management Area 5: Central and Southern Tablelands*, eucalypt species are prescribed as Koala feed trees. Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi* are secondary feed trees, and Red Stringybark *E. macrorhyncha* is a supplementary species. The survey looked for and this assessment considers the presence of core and potential Koala habitat at the site.

3.5 ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION (EPBC) ACT 1999 (CWTH)

The EPBC Act protects nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of National Environmental Significance (NES).

Matters of NES relevant to biodiversity are:

- Wetlands of international importance
- Nationally threatened species and ecological communities
- Migratory species
- Commonwealth marine areas

Significance of impacts is determined in accordance with the *Significance impact guidelines 1.1 – matters of national environmental significance* (DoE 2013).

Where a proposal is likely to have a significant impact on a matter of NES, the proposal is referred to the Commonwealth Environment Minister via the Department of the Environment (DoE). The Minister then determines whether the proposal is a 'controlled action'. If a proposal is declared a controlled action, an assessment of the action is carried out and the Minister decides to approve, approve with conditions, or not approve the proposed action.

This assessment considers the potential for the proposal to impact on matters of NES relevant to biodiversity.

4 METHODS

4.1 BACKGROUND REVIEW

4.1.1 Database searches

Database searches done for this assessment included threatened species databases and weed databases (Table 3-1). The results of the database searches for threatened species, populations and ecological communities are provided in Table 3-1. These results informed the focus for the field surveys.

Table 3-1 Databases searches for the Biodiversity Assessment.

Resource	Target	Search Area	Date
Office of Environment and Heritage (OEH) BioNet	Threatened populations	flora, fauna and 10 km radius of proposal site	5 June 2018
OEH	Threatened populations	flora, fauna and Inland slopes IBRA subregion and Western Slopes Grassy Woodland	12 June 2018
OEH VIS Mapping	Vegetation Mapping	Proposal site	5 June 2018
EPBC Protected Matters Search Tool	Threatened endangered populations and ecological communities, and migratory species	flora and fauna, 10 km radius of proposal site	12 June 2018
NSW WeedWise	Priority weeds	Central Region Tablelands	5 June 2018

4.1.2 Literature review

Documentation and literature relevant to this assessment was reviewed, including:

- NSW OEH Threatened Species Profiles
- Department of Environment and Energy (DEE) EPBC Act Species Profiles and Threats Database (SPRAT)
- Construction Methodology and concept designs from Proponent
- NSW OEH Vegetation Information System (VIS) Map Catalogue
- BioNet Vegetation Classification Database
- Threatened Species Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (DEC 2004)
- NSW WeedWise database (NSW DPI)
- Satellite imagery

4.2 FIELD SURVEYS

A field survey was completed by ecologists Julie Gooding (BAM Assessor Accreditation No. BAAS18074) and Jess Murphy on 6 and 7 June 2018. A survey area of a 50 m radius surrounding the transmission line route was assessed for this report. Survey conditions are documented in Table 3-2.

Table 3-2 Weather conditions during field survey at nearest Bureau of Meteorology weather station, Orange NSW (063303).

Dates	Temperature (minimum °C)	Temperature (maximum °C)	Rainfall (mm)	Windspeed (9:00am km/hr)	Cloud (9:00 am)
6 June 2018	5.0	13.8	0	19	0
7 June 2018	5.4	14.1	2.2	17	1

4.2.1 Flora survey methods

The aims of the flora surveys were to:

- Determine all vegetation communities present within the study area, their condition and extent.
- Identify potential Endangered Ecological Communities (EECs) within the study area and determine their condition and extent.
- Identify whether threatened flora species are present within the study area, and whether it is likely that any have the potential to occur within the habitats present.

Species and vegetation communities identified from the background research as potentially occurring in the study area were targeted during the surveys.

The entire length of the study area was surveyed using a random meander method (informal transects) in accordance with Cropper (1993). All observed vascular plant species were identified to species level or otherwise as accurately as possible. The random meander method provides comprehensiveness in terms of the number of species recorded and variation within vegetation types. It is used to maximise the coverage of threatened species habitat and the encounter rate of different species (SoQ, 2014). During the random meander dominant species, physical structure of the vegetation, and species composition were also recorded and used to identify vegetation types. A comprehensive species list is provided in Appendix B.1.

Vegetation communities in the study area have been categorised on the basis of their structure and formation with reference to PCTs from the OEH VIS Classification Database (OEH, 2017).

4.2.2 Fauna survey methods

The aims of the terrestrial fauna surveys were to:

- Assess the fauna habitat types available and their quality and suitability as threatened species habitat (e.g. hollow-bearing trees (HBTs), important foraging resources, vegetation structural complexity)
- Determine which fauna are present or likely to be present within the study area using appropriate survey techniques

- Collect data on the habitat usage and abundance of threatened fauna observed in the study area, in order to determine the potential impacts of the proposal on these species

An assessment of habitat types available and their quality and suitability as threatened species habitat was conducted across the study area. Factors such as hollow-bearing trees (HBTs), coarse woody debris (CWD), leaf litter, vegetation structure, connectivity and disturbance were noted.

Ten bird surveys of at least 20-minute duration were done across the proposal area, targeting impact areas and different vegetation types. Incidental sightings of fauna and their traces (e.g. scats, tracks, scratches) made while present on the site were also recorded.

4.2.3 *Limitations*

Fauna surveys were conducted over brief periods of time to obtain an indicative assessment of the proposal area. Survey results may vary during different seasons and if conducted over longer periods of time.

There is some potential for some flora species to not be recorded during the survey due to the timing of the survey in early winter. Some ephemeral or short-lived species such as grasses, orchids and lilies, have a limited growing season and would only be identifiable during spring and early summer.

The calculation of HBTs, in particular the size and number of hollows, is as accurate as could be determined from ground level. There is potential for some hollows to be present that were not visible from ground level, which may result in underestimates of the number of hollows (Gibbons and Lindenmayer, 2000). Where it was deemed likely for hollows to be present but not visible from ground level, these were noted.

5 RESULTS

5.1 FLORA

5.1.1 Existing environment

The vegetation within the study area is a mix of remnant native woodlands, forestry plantations, exotic pastures with scattered paddock trees. The extent of each of these areas is shown in Table 4-1.

A large proportion of the transmission line corridor is owned by State Forest and is comprised of Radiata Pine plantations. Remnant native woodlands occur along the road reserve of Cadia Road and Panuara Road and small sections within the pine plantation. This native woodland vegetation is comprised of a mix of Eucalypts such as Apple Box (*Eucalyptus bridgessiana*), Broad-leaved Peppermint (*Eucalyptus dives*), Long-leaf Box (*Eucalyptus goniacalyx*), Red Stringybark (*Eucalyptus macrorhyncha*) and Yellow Box (*Eucalyptus melliodora*). Along the road reserves, where no overstory canopy of Eucalypts occur, the groundcover is dominated by exotic grasses and forbs such as Phalaris (**Phalaris aquatica*), Fleabane (**Conyza* sp.), Vervain (**Salvia verbenacea*) and saffron thistle (**Carthamus lanatus*).

The majority of the Southern section of the transmission line runs through private property. This area has been extensively cleared for grazing of sheep and cattle. Some scattered trees of Yellow Box and Blakely's Red Gum remain within the paddocks as isolated paddock trees or small patches within the paddock. Planted corridors of native vegetation, comprising local trees and shrubs such as Yellow Box, Long-leaf Box and Acacia species occur alongside Cadia Road in the Southern sections of the transmission line route.

Flyers Creek runs through the study area in the Southern End. The riparian vegetation along the banks of Flyers Creek is dominated by exotic vegetation such as Willows (**Salix* sp.), Blackberry (**Rubus fruticosus*) and exotic annuals.

A total of 65 flora species were recorded during the site surveys, comprising 33 native species and 32 exotic species. One threatened species, Silver-leaf Candlebark (*Eucalyptus canobolensis*) was assumed to occur within the study area (refer to Section 4.3.2). A complete list of all species recorded is provided in Appendix B.

Table 4-1 Vegetation extent within the study area.

Vegetation Type	Area (ha) In Study Area)
Native Woodland	17.4
Pine Plantation	58.5
Planted Native Vegetation	7.2
Exotic Vegetation	47.4
Bare Earth	1.8

5.1.2 Priority Weeds

One priority weed, was detected within the study area, Blackberry (*Rubus fruticosus*). Blackberry was observed in patches along the transmission line route, such as along Flyers Creek in the South of the Transmission Line and smaller drainage lines within the study area.

Blackberry is a scrambling shrub with prickly stems that spreads vegetatively and by seed. Blackberry has a General Biosecurity Duty for NSW, which means any person who deals with this plant has a duty to ensure the biosecurity risk is prevented, eliminated or minimised so far as reasonably practicable. Within the Central Tablelands Local Landservices Area, Blackberry has a regional recommended measure that land managers should mitigate spread from their land to protect conservation areas, natural environments and primary production lands that are free of Blackberry (DPI, 2018).

The locations of the priority weeds are shown in Figure 4-11 to Figure 4-16.



Figure 4-1 Blackberry (priority weed) along the roadside within the study area.

5.2 PLANT COMMUNITY TYPES

Two plant community types were detected within the study area.

- PCT 1330: Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion
- PCT 287: Long-leaved Box – Red Box – Red stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion.

These PCTs are described in Table 4-2 and Table 4-3.

A large proportion of the native vegetation along Cadia Rd did not align closely with any listed PCT in the IBRA region. The mapping of native vegetation in the Central West Catchment (DEC, 2006) showed patches of remnant vegetation along Cadia Rd and surrounds as Yellow Box – Blakely’s Red Gum Grassy woodland on the tablelands. Mature Yellow Box and Blakely’s Red Gum were absent from most of the patches of native vegetation along Cadia Rd, with the dominant species being Apple Box, Broad-leafed Peppermint, Long Leaf Box and occasional Red Stringybark, Ribbon Gum (*Eucalyptus viminalis*) and juvenile Yellow Box. Although Yellow Box and Blakely’s Red Gum were not dominant species in these patches of native vegetation, PCT 1330 was identified as the most suitable vegetation community, based on the Eucalypt species present also being associated in this community, the landscape position and existing vegetation mapping (DEC, 2006). The native vegetation in the southern portion of the transmission line route, was dominated by Yellow Box and Blakely’s Red Gum and clearly aligned with PCT 1330.

Plant community types were categorised into two condition classes based on the framework for biodiversity assessment. Under the methodology, native woody vegetation is in low condition if:

- The over-storey per cent foliage is <25% of the lower value of the over-storey per cent foliage cover benchmark for that vegetation type, AND
- <50% of vegetation in the ground layer is indigenous species or >90% ploughed or fallow.

Native grassland or herbfield is in low condition if:

- <50% of vegetation in the ground layer is indigenous species or >90% ploughed or fallow.

If native vegetation is not in low condition, then it is considered to be in moderate to good condition.

Three NGH Environmental condition classes were applied to provide greater detail regarding the condition of the vegetation across the study area. These were assigned according to the definitions below.

Good	Native overstorey present greater than 25% of the benchmark overstorey foliage cover for the particular vegetation type. Numerous native species present in the midstorey and/or ground cover.
Moderate	Native overstorey present greater than 25% of the benchmark overstorey foliage cover for the particular vegetation type). Understorey dominated by exotic species.
Low	Native overstorey present less than 25% of the benchmark overstorey foliage cover (mostly cleared). Numerous exotic species present and low diversity of natives and/or large areas of bare ground with no vegetative cover. Disturbance generally moderate to high.

Table 4-2 Yellow Box - Blakely's Red Gum Grassy Woodland on the tablelands, South Eastern Highlands bioregion.

Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (1330)		
Vegetation formation	Grassy Woodlands	
Vegetation class	Southern Tablelands Grassy Woodlands	
Vegetation type	Plant Community Type (PCT) ID	1330
	Common Community Name	Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (1330)
Approximate extent within study area	14.7 ha	
Condition	1.7 ha Good Condition 10.4 ha Moderate Condition 2.6 ha Low Condition	
Conservation Status	This vegetation community forms part of the TEC – White Box – Yellow Box – Blakely’s Red Gum Woodland listed under the BC Act. The vegetation community is listed as Critically Endangered under the EPBC Act.	
Estimate of percent cleared	94%	
Threatened plant species habitat	This community can provide potential habitat for the Small Purple-pea (<i>Swainsona recta</i>) and Silky Swainson-Pea (<i>Swainsona sericea</i>).	
Fauna Habitat	Woodland can provide foraging and nesting habitat for arboreal birds and mammals. Hollow bearing trees provide nesting resources for threatened fauna such as Superb Parrot, Gang-Gang Cockatoo, Squirrel Glider and microbats.	

Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (1330)

Examples



Figure 4-2 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in good condition along Panuara Road.



Figure 4-3 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in moderate condition in private property.

Yellow Box – Blakely's Red Gum grassy woodland on the tablelands, South Eastern Highlands Bioregion (1330)



Figure 4-4 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in good condition along Cadia Road.



Figure 4-5 Example of Yellow Box - Blakely's Red Gum Grassy Woodland in low condition along Cadia Road.

Table 4-3 Long-leaved Box - Red Box - Red Stringybark mixed open forests on hills and hillslopes in the NSW South Western Slopes bioregion.

Long-leaved Box – Red Box – Red stringybark mixed open forests on hills and hillslopes in the NSW South Western Slopes Bioregion (287).		
Vegetation formation	Dry Sclerophyll forest (shrubby sub-formation)	
Vegetation class	Western Slopes dry sclerophyll forests	
Vegetation type	Plant Community Type (PCT) ID	287
	Common Community Name	Long-leaved Box – Red Box – Red Stringybark mixed open forest on hills and hillslopes.
Approximate extent within study area	2.7 ha	
Condition	2.7 ha Moderate to Good Condition	
Conservation Status	This community does not form part of a TEC.	
Estimate of percent cleared	67%	
Threatened plant species habitat	This community can provide potential habitat for the Small Purple-pea (<i>Swainsona recta</i>) and Silky Swainson-Pea (<i>Swainsona sericea</i>).	
Fauna Habitat	Woodland can provide foraging and nesting habitat for arboreal birds and mammals. Hollow bearing trees provide nesting resources for threatened fauna such as Superb Parrot, Gang-Gang Cockatoo, Squirrel Glider and microbats.	

Long-leaved Box – Red Box – Red stringybark mixed open forests on hills and hillslopes in the NSW South Western Slopes Bioregion (287).

Examples



Figure 4-6 Example of Long-leaved Box – Red Box – Red Stringybark mixed open forest along Cadia Road.

Planted Native Vegetation

7.6 ha of planted native vegetation occurred in linear strips within the study area (Figure 4-7). These areas are comprised of planted native species local to the area such as Mixed Eucalypts (Yellow Box, Long Leaf Box, Large-leaf Peppermint) and mixed Acacia shrubs (*Acacia paradoxa*, *Acacia implexa* and *Acacia dealbata*).



Figure 4-7 Example of planted vegetation along Cadia Road.

Exotic Vegetation

The majority of the study area is comprised of exotic vegetation. 106 ha of the study area was considered to be comprised of non-native vegetation. The majority of the Northern section of the transmission line route is a Pine Plantation, comprised of dense plantings of Radiata Pine (**Pinus radiata*) (Figure 4-8). The understory is mostly covered by pine needles, however there are some patches of Blackberry (**Rubus fruticosus*) occurring throughout the plantation.

The majority of the Southern section of the transmission line, runs through grazing pastures (Figure 4-9). These areas were heavily grazed at the time of survey. The paddocks are dominated by exotic pasture species such as Phalaris, Clover (**Trifolium* sp) and Medics (**Medicago* sp.) and exotic weeds such as Sheep Sorrel (**Acetosa vulgaris*), Variegated Thistle (**Silybum marianum*) and Lambs Tongue (**Plantago lanceolata*). Along the road reserves in the South of Cadia Road, the groundcover is dominated by exotic grasses and forbs such as Phalaris (**Phalaris aquatica*), Fleabane (**Conyza* sp.), Vervain (**Salvia verbenacea*) and Saffron Thistle (**Carthamus lanatus*) (Figure 4-10).



Figure 4-8 Example of exotic pine plantation along Cadia Road.



Figure 4-9 Example of exotic vegetation in grazed paddocks.



Figure 4-10 Example of exotic vegetation along Cadia Road.

5.3 PLANT SPECIES AND COMMUNITIES OF CONSERVATION SIGNIFICANCE

5.3.1 *Endangered ecological communities*

Background searches identified six EECs that could occur within the study area (Appendix A).

Of these, one EEC occurred within the study area – White Box – Yellow Box – Blakely’s Rd Gum Woodland (Box-Gum Woodland). This community is listed as Endangered under the Biodiversity Conservation Act and also listed as a Critically Endangered ecological community under the EPBC Act.

This community is identified by the presence of Yellow Box (*Eucalyptus melliodora*), White Box (*Eucalyptus albens*) or Blakely’s Red Gum (*Eucalyptus blakelyi*). Yellow Box and Blakely’s Red Gum are the dominant tree species along Panuara Road, remnant paddock trees in the private property and some sections along Cadia Road.

Although a large proportion of the vegetation along Cadia Road is mapped as Yellow Box - Blakely’s Red Gum Woodland, these areas were dominated by the presence of Apple Box (*Eucalyptus bridgesiana*) and large leaf Peppermint (*Eucalyptus dives*). Very few of the characteristic trees species of this EEC were present within this vegetation and it is not considered to meet the criteria of the listed Box-Gum Woodland EEC.

The location of the Box-Gum Woodland EEC is shown in Figure 4-12 to Figure 4-17.

5.3.2 Threatened species

Background searches, identified twelve threatened plants that could occur in the study area (Appendix A)

One threatened tree – Silver-leaf Candlebark (*Eucalyptus canobolensis*) is known to occur within 10km of the study area. This tree is predominantly found on Mount Canobolas – 8 km to the north of the study area but a few isolated Silver-leaf Candlebark trees have been located in the surrounding pine plantations.

Two Eucalyptus trees, located in a drainage line within the pine plantation are suspected to be the threatened tree, Silver-leaf Candlebark (Figure 4-11). A sample was sent to the National Herbarium of New South Wales for confirmation. The herbarium was unable to confirm the species as being *E. canobolensis* without juvenile leaves. No juvenile leaves were present on the tree at the time of survey. For the purposes of this assessment, the trees are assumed to be *E. canobolensis*. The location of these trees is shown in Figure 4-12.

Based on the results of the initial field survey and habitat evaluation in Appendix C.1, two additional threatened flora species are considered to have the potential to occur within the study area that may not have been identified during the surveys:

- Small Purple-pea (*Swainsona recta*) – E BC
- Silky Swainson-pea (*Swainsona sericea*) – V BC

These two forbs could occur within the good condition woodland with a native understory. These plants lie dormant over Autumn and early winter and would not have been visible during the site surveys.



Figure 4-11 Suspected Silver-leaf Candlebark (*E. canobolensis*) in pine plantation.

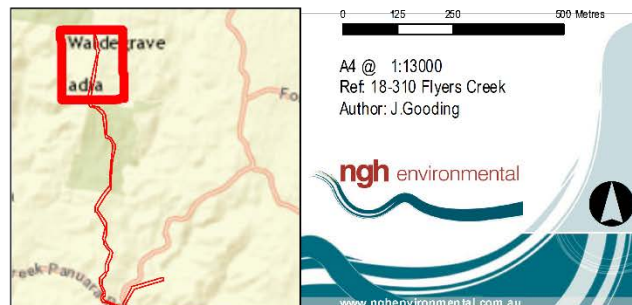
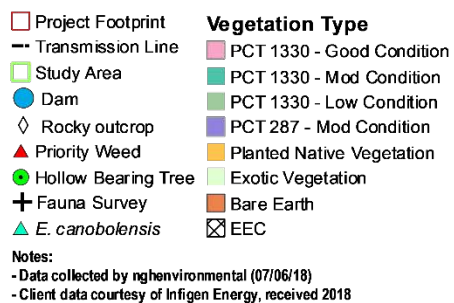


Figure 4-12 Vegetation Map - Map 1.

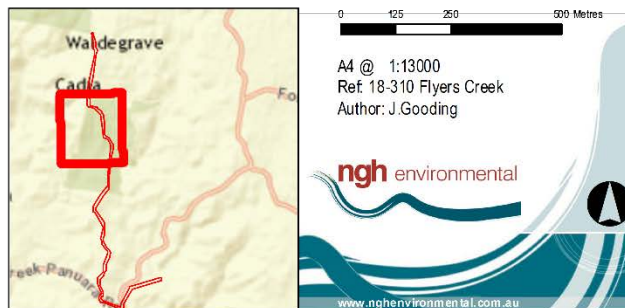
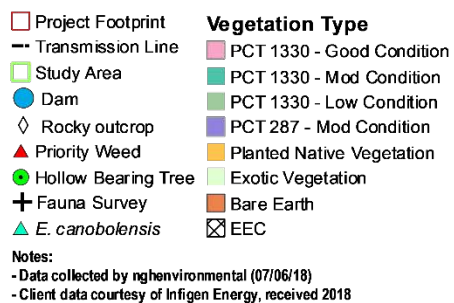


Figure 4-13 Vegetation Map - Map 2.

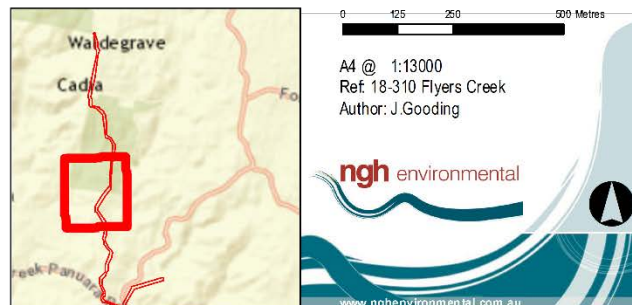
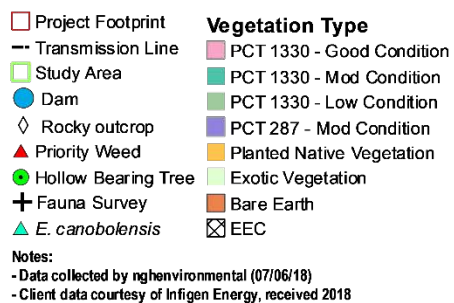


Figure 4-14 Vegetation Map - Map 3.

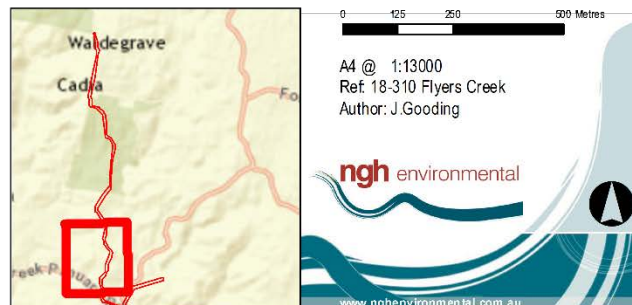
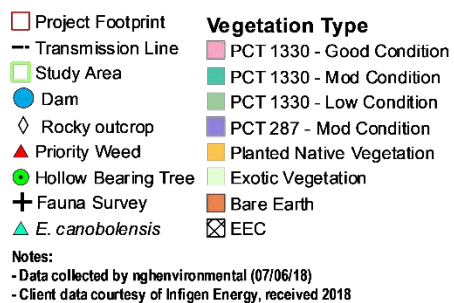


Figure 4-15 Vegetation Map - Map 4.

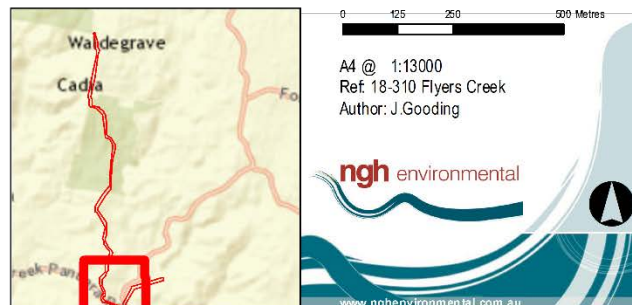
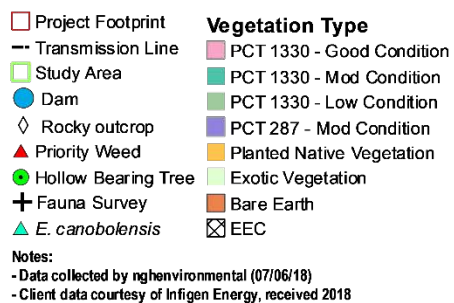
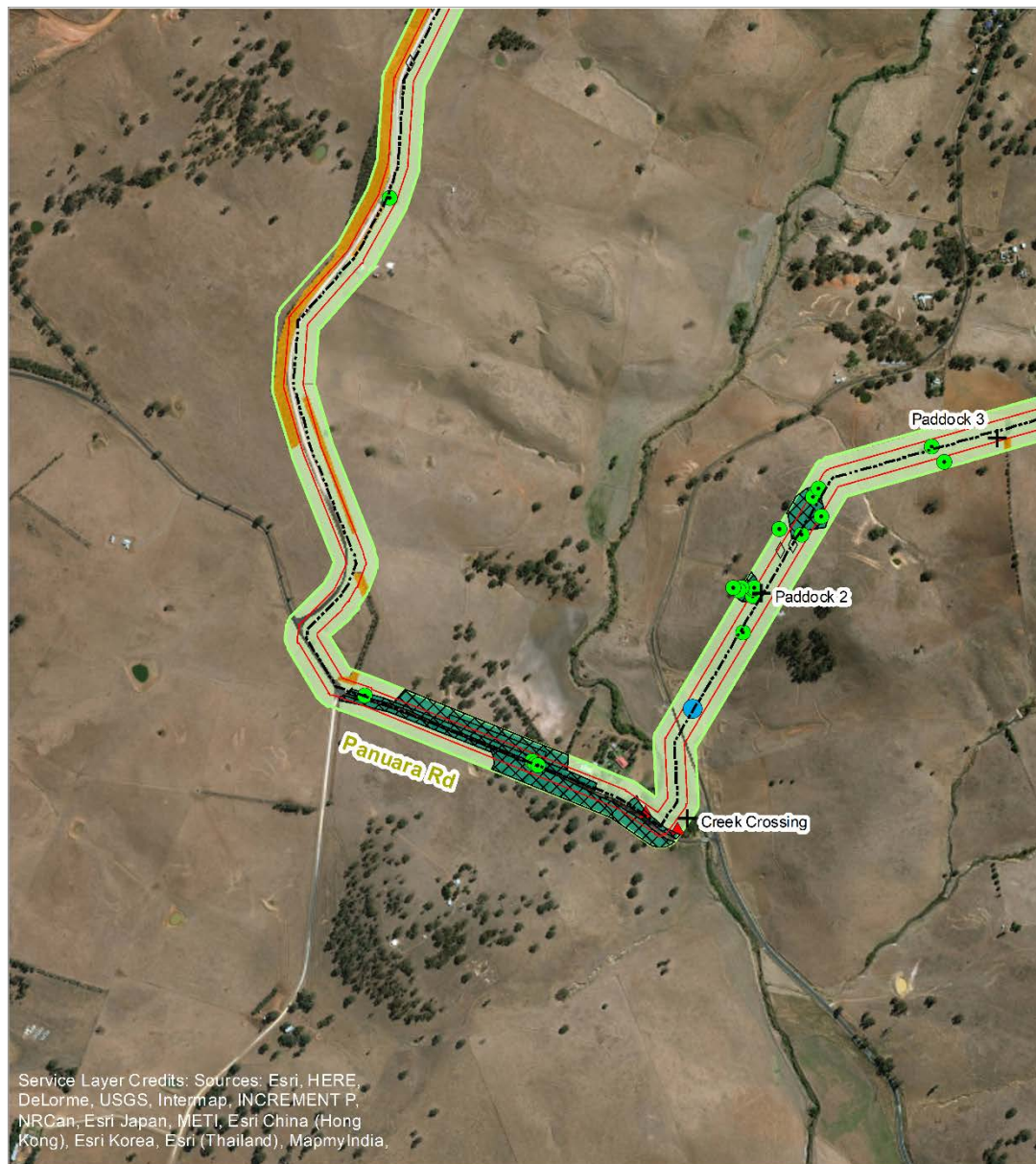


Figure 4-16 Vegetation Map - Map 5.

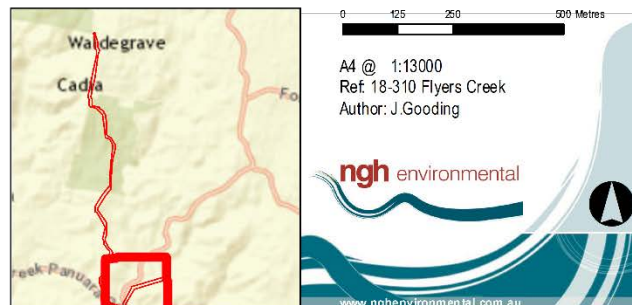
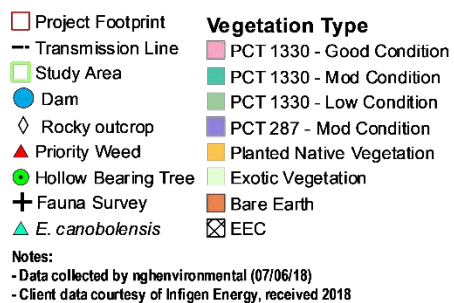


Figure 4-17 Vegetation Map - Map 6.

5.4 FAUNA

A complete list of all species recorded during the field survey is provided in Appendix B.2.

5.4.1 Fauna habitat

In addition to the vegetation types described in Section 4.2, the following habitat features were recorded in the study area:

- 28 hollow-bearing trees
- 8 rock outcrops (Figure 4-18)
- Scattered fallen timber



Figure 4-18 Example of rocky outcrop.

5.4.2 Threatened species

One threatened species of fauna was recorded during the field survey, Grey-headed Flying-fox *Pteropus poliocephalus* (V BC, V EPBC).

Database searches identified threatened fauna species that have been recorded or are predicted to occur within 10 km of the study area, including 24 birds, 14 mammals including 6 bats, 3 reptiles, 4 amphibians, and 2 fishes. Based on the habitats present at the site and the proximity of nearest records, threatened fauna species that are most likely to occur within the study area and use the habitats on site include:

Ground/understorey birds:

- Diamond Firetail *Stagonopleura guttata* – V BC
- Scarlet Robin *Petroica boodang* – V BC
- Flame Robin *Petroica phoenicea* – V BC
- Hooded Robin *Melanodryas cucullata* – V BC
- White-fronted Chat *Epthianura albifrons* – V BC
- Grey-crowned Babbler *Pomatostomus temporalis* – V BC
- Bush Stone-curlew *Burhinus grallarius* – E BC

Canopy/aerial birds:

- Raptors
 - o Little Eagle *Hieraaetus morphnoides* – V BC
 - o Spotted Harrier *Circus assimilis* – V BC
 - o Square-tailed Kite *Lophoictinia isura* – V BC
- Owls
 - o Barking Owl *Ninox connivens* – V BC
 - o Powerful Owl *Ninox strenua* – V BC
- Small passerines
 - o Varied Sittella *Daphoenositta chrysoptera* – V BC
 - o Dusky Woodswallow *Artamus cyanopterus* – V BC
 - o Regent Honeyeater *Anthochaera phrygia* – CE BC, CE EPBC
 - o Painted Honeyeater *Grantiella picta* – V BC, V EPBC
 - o Pied Honeyeater *Certhionyx variegatus* – V BC
 - o Black-chinned Honeyeater *Melithreptus gularis gularis* – V BC
 - o Brown Treecreeper *Climacteris picumnus victoriae* – V BC
- Parrots
 - o Swift Parrot *Lathamus discolor* – E BC, CE EPBC
 - o Superb Parrot *Polytelis swainsonii* – V BC, V EPBC
 - o Turquoise Parrot *Neophema pulchella* – V BC
 - o Gang-gang Cockatoo *Callocephalon fimbriatum* – V BC
 - o Little Lorikeet *Glossopsitta pusilla* – V BC

Arboreal mammals:

- Spotted-tailed Quoll *Dasyurus maculatus* – V BC, E EPBC
- Squirrel Glider *Petaurus norfolcensis* – V BC
- Eastern Pygmy-possum *Cercartetus nanus* – V BC
- Brush-tailed Phascogale *Phascogale tapoatafa* – V BC
- Koala *Phascolarctos cinereus* – V BC, V EPBC
- Greater Glider *Petaurus volans* – V EPBC

Bats:

- Large-eared Pied Bat *Chalinolobus dwyeri* – V BC, V EPBC
- Corben's Long-eared Bat *Nyctophilus corbeni* – V BC, V EPBC
- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* – V BC
- Southern Myotis *Myotis macropus* – V BC
- Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* – V BC

- Grey-headed Flying-fox *Pteropus poliocephalus* – V BC, V EPBC

Amphibians:

- Booroolong Frog *Litoria booroolongensis* – E BC, E EPBC

Reptiles:

- Pink-tailed Legless Lizard *Aprasia parapulchella* – V BC, V EPBC
- Striped Legless Lizard *Delma impar* – V BC, V EPBC

Open woodland and exotic-dominated grassland with scattered fallen timber occurs in the study area. This provides potential foraging and roosting habitat for the ground/understorey birds Diamond Firetail, Scarlet Robin, Flame Robin, Hooded Robin, White-fronted Chat, Grey-crowned Babbler and Bush Stone-curlew, and would be removed by the proposal. None of these ground/understorey birds were detected during the field survey, but Varied Sittella, Dusky Woodswallow, Diamond Firetail and Scarlet Robin have been recorded in the locality.

Potential foraging habitat for Little Eagle and Square-tailed Kite (open woodland) and potential foraging and breeding habitat for Spotted Harrier (grassland and open woodland with mature trees) occur in the proposal area and would be removed by the proposal. Surveys did not detect these species or signs such as nests.

Potential foraging habitat (open woodland) with HBTs providing potential roosting habitat for Barking Owl and Powerful Owl occur in the proposal area and would be removed by the proposal. Surveys did not detect any sign such as pellets.

Small woodland passerines including Varied Sittella, Dusky Woodswallow, Regent Honeyeater, Painted Honeyeater, Pied Honeyeater, Black-chinned Honeyeater and Brown Treecreeper were not detected during the field survey. Potential foraging habitat (open woodland) and breeding habitat including HBTs occurs in the proposal area and would be removed by the proposal.

Potential foraging habitat for Swift Parrot, Superb Parrot, Turquoise Parrot, Gang-gang Cockatoo and Little Lorikeet and HBTs providing potential breeding habitat for Superb Parrot, Turquoise Parrot, Gang-gang Cockatoo and Little Lorikeet occur in the proposal area and would be removed by the proposal. Swift Parrot breeds only in Tasmania, and the proposal would therefore not impact on any potential breeding habitat. Surveys did not detect these species or any signs that they have recently used the study area, but Superb Parrot has been recorded in the locality.

Potential foraging habitat for Koala including preferred feed trees and potential foraging and breeding habitat for Spotted-tailed Quoll, Squirrel Glider, Greater Glider, Eastern Pygmy-possum and Brush-tailed Phascogale occur in the proposal area and would be removed by the proposal. Surveys did not detect these species or signs such as scats or scratches on trees that would indicate that the site has been recently used by these species, but Squirrel Glider has been recorded in the locality.

Potential foraging habitat for Large-eared Pied Bat, Eastern Bentwing-bat and Grey-headed Flying-fox and HBTs providing roosting and breeding habitat for Corben's Long-eared Bat, Southern Myotis and Yellow-bellied Sheath-tail-bat occurs in the proposal area and would be removed by the proposal. Surveys were not completed for these species, so it is assumed that they could occur in the study area.

A permanent stream (Flyers Creek) and several farm dams providing potential foraging and breeding habitat for Booroolong Frog occurs in the study area and would be impacted by the proposal. Targeted surveys were not completed for this species, so it is assumed that it could occur in the study area. However, there will be only minimal indirect impacts on this habitat.

Grassland and rocky outcrops that provide potential foraging and breeding habitat for these species occur in the study area and would be removed by the proposal. Surveys did not detect these species or any signs that would indicate that the site has recently been used by these species.

5.5 EPBC MATTERS OF NATIONAL SIGNIFICANCE

An EPBC Protected Matters Search found that three EECs, 8 threatened plants, 9 threatened birds, two threatened fishes, two threatened frogs, 7 threatened mammals including three bats, two threatened reptiles, and 11 migratory birds listed under the EPBC Act could occur in the study area (Appendix A.2). A habitat assessment was completed for these species (Appendix C).

Endangered Ecological Communities

Based on the presence of Yellow Box and Blakely's Red Gum in the south of the study area, one EEC, *White Box – Yellow Box – Blakely's Red Gum woodland and Derived Native Grassland* (Box-Gum Grassy Woodland) could occur in the study area. Box-Gum Grassy Woodland is listed as a Critically Endangered ecological community under the EPBC Act.

An assessment of the condition thresholds (DEH, 2006) for the EPBC listed community was undertaken. The Box-Gum Grassy woodlands in the private property in the South of the transmission line route and along Panuara Rd, were not considered to form part of the EPBC listed community, based on the predominantly exotic understory of exotic perennial species such as *Phalaris*.

The patch of good condition Yellow-Box-Blakely's Red Gum Woodland along Cadia Rd has a predominantly native understory. It meets the condition threshold for the EPBC listed community as the patch size is greater than 2ha and there is natural regeneration of the overstorey eucalypts.

The remaining vegetation along Cadia Rd was not considered to form part of the EPBC listed community as Yellow Box, White Box or Blakely's Red Gum were not the dominant overstorey species.

Threatened Flora

One Eucalypt species observed during the field survey was suspected to be the threatened tree – Silver leaf Candlebark (*E. canobolenis*). Silver leaf Candlebark is listed as Endangered under the EPBC Act. Its distribution is limited to the high altitudes of Mount Canobolas.

Two suspected trees were located within the study area, in a drainage line within the pine plantation (Figure 4-12). Samples were sent to the National herbarium of NSW for identification. The samples were unable to be confirmed however were considered that they could be the threatened species (Botanic Garden communication). These trees are presumed to be *E. canobolenis* for the purposes of this assessment.

Based on the habitats present at the site and the results of the field surveys, one additional threatened flora species is considered to have the potential to occur within the study area that may not have been identified during the surveys:

- Small Purple-pea (*Swainsona recta*) - E

This forb could occur within the good condition woodland with a native understory. This species lies dormant over Autumn and early winter and would not have been visible during the site surveys.

Threatened Fauna

Based on the habitats present at the site and the proximity of nearest records, threatened fauna species that are most likely to occur within the study area and use the habitats on site include:

Birds:

- Swift Parrot *Lathamus discolor* – CE
- Painted Honeyeater *Grantilla picta* – V
- Superb Parrot *Polytelis swainsonii* – V
- Fork-tailed Swift *Apus pacificus* – M
- White-throated Needletail *Hirundapus caudacutus* – M
- Yellow Wagtail *Motacilla flava* – M
- Satin Flycatcher *Myiagra cyanoaleuca* – V

Mammals:

- Spotted-tailed Quoll *Dasyurus maculatus* – E
- Large-eared Pied Bat *Chalinolobus dwyeri* – V
- Corben's Long-eared Bat *Nyctophilus corbeni* – V
- Grey-headed Flying-fox *Pteropus poliocephalus* – V
- Greater Glider *Petaurus volans* – V
- Koala *Phascolarctos cinereus* – V

Amphibians:

- Booroolong Frog *Litoria booroolongensis* – E

Reptiles:

- Pink-tailed Legless Lizard *Aprasia parapulchella* – V
- Striped Legless-lizard *Delma impar* – V

Open grassland provides potential foraging habitat for Fork-tailed Swift, and open woodland provides potential foraging habitat for White-throated Needletail. These would be impacted by the proposal. Surveys did not detect these species, but given their wide-ranging life habits, it is possible that they use the habitat in the study area on occasion.

Grassland near a permanent stream and dams provide potential foraging habitat for Yellow Wagtail, and open woodland provides potential foraging and roosting habitat for Satin Flycatcher. These would be impacted by the proposal. Surveys did not detect these species, but it is possible that they could use the study area on occasion.

Threatened species habitats are discussed in Section 4.4.2.

6 ASSESSMENT OF IMPACTS

6.1 NATIVE VEGETATION

The proposal would have a direct impact on vegetation within the study area through removal for construction. Based on a 45 metre wide power line easement up to 6.8 ha of remnant native woodland vegetation and 1.4 ha of planted native vegetation would be removed by the proposal within the Project Footprint. This is considered a worse-case scenario and includes the maximum potential impact. Native vegetation and threatened species would be avoided wherever possible. The quantity of each vegetation type to be impacted is provided in Table 5-1. These values will be finalised based on the final design of the power line within the corridor.

Table 5-1 Impacts to vegetation

Vegetation Type	Condition	EEC	Area (Ha) In Study Area)	Assessed Area of impact (Ha)
Yellow Box – Blakely’s Red Gum Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands (PCT 1330)	Moderate - Good	Yes: White Box – Yellow Box – Blakely’s Red Gum woodland	8.2	4.0
Yellow Box – Blakely’s Red Gum Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands (PCT 1330)	Moderate - Good	No (Characteristic tree species not dominant).	3.8	0.5
Yellow Box – Blakely’s Red Gum Yellow Box – Blakely’s Red Gum grassy woodland on the tablelands (PCT 1330)	Low	No	2.6	1.2
Long-leaved Box – Red Box – Red stringybark mixed open forest on hills and hillslopes in the NSW South Western Slopes Bioregion (PCT 287)	Moderate – Good	No	2.7	1.1
Planted Native Vegetation	-	No	7.2	1.4
Non-native Vegetation	-	No	107.7	52.8

6.2 THREATENED ENTITIES

Threatened Ecological Communities

Approximately 4.0ha of White Box – Yellow Box – Blakely’s Red Gum woodland (Box-gum woodland) listed under the BC Act would be impacted by the proposal. An Assessment of Significance under the BC Act was carried out for this community (Appendix D) and concluded there is unlikely to be a significant impact on the EEC due to the following reasons.

1. The amount of habitat to be removed or disturbed by the proposal is relatively small in the local context

2. The majority of the Box-Gum woodland within the proposal area has a degraded understory.
3. No fragmentation or isolation of habitat would occur.

A small section of the Box-Gum woodland EEC along Cadia Rd has a higher quality groundcover and is considered to meet the condition threshold of the CEEC under the EPBC Act. 0.8ha of the EPBC listed community would be impacted by the proposal. An EPBC assessment of significance was undertaken for this community and concluded there is unlikely to be a significant impact on this CEEC.

The proposal is not likely to have a significant impact on any TEC's protected by the BC or EPBC Act

Threatened Flora

The threatened tree, *Eucalyptus canobolensis* is considered to occur within the study area. Two suspected trees are present within a small drainage line in the pine plantation (Figure 4-11). These trees fall outside the 45 m wide clearing easement and would not be removed by the proposal. None were recorded within the project footprint (impact zone), but any identified during detailed surveys or suspected would be clearly marked prior to construction to ensure they would not be impacted.

Two other threatened flora species have the potential to occur within the good condition woodland, Small Purple-Pea and Silky Swainson-pea. These forbs are associated with Yellow Box – Blakley's Red Gum Woodland. 1.6 ha of good condition woodland would be impacted by the proposal.

These species lie dormant over the Autumn and early winter months and would not have been visible during the site surveys. As it is not known if the species occur within the development footprint, mitigation measures would be implemented to conduct pre-clearance surveys in Spring for the Small Purple-pea and Silky Swainson-pea to determine if they are present on site. If these species are detected, further assessment would be undertaken and any subsequent requirements implemented before work commenced.

Threatened Fauna

Assessments of significance under the BC Act and EPBC Act were undertaken for the threatened fauna species considered likely to use the habitats in the study area that would be impacted by the proposal (Appendix D). It was concluded that a significant impact would be unlikely, based on the following:

4. The amount of habitat to be removed or disturbed by the proposal is relatively small in the local context and is relatively disturbed and fragmented.
5. No fragmentation or isolation of habitat would occur.
6. No substantial contribution to any key threatening process would be expected.
7. Mitigation measures would be implemented to prevent disruptions to the life cycle or harm to individual animals of these species.

Biodiversity impacts can be adequately managed under the controls contained in the existing conditions of the Project Approval. The proposal is not likely to have a significant impact on any fauna species protected by the BC or EPBC Act.

6.3 WEEDS, PESTS AND PATHOGENS

The proposal has the potential to spread weeds, pests and pathogens during vegetation removal and through the movement of vehicles and machinery into or out of the site. These are easily transported via seeds, propagules, or soil on machinery brought to the site. Equally, they can be carried away to other

areas from the site or spread within it. If not controlled prior to work commencing, then there is the potential for spread throughout the site during and following construction.

The cleared transmission line easement created through the pine plantation could result in the establishment of priority weeds such as Blackberry, that is found growing in nearby areas. Mitigation measures to maintain the easement for priority weeds would limit the establishment of weeds within the easement.

Rehabilitation of disturbed areas and ongoing control after the completion of construction activities would limit the establishment and spread of weeds, pests and pathogens during operation.

6.4 CONSTRUCTION DISTURBANCE

There may be some short-term noise, light, and vibration disturbance during construction, which could temporary impact on fauna around the proposal area. However, the proposed work would be in an area which is already disturbed. Any impact is likely to be temporary and limited in extent.

6.5 REGIONAL AND CUMULATIVE IMPACTS

The clearing of native vegetation, which is a key threatening process at both State and Commonwealth level, is considered a major factor in the loss of biological diversity. Cumulative impacts are considered best addressed by avoiding and minimising vegetation and habitat loss. The proposal largely avoids impacts to native vegetation and threatened species habitat and the cumulative contribution of the proposal to biodiversity impacts is considered to be low.

7 MITIGATION MEASURES

The following measures are recommended to minimise impacts to biodiversity;

Prior to construction

- Incorporate the following safeguards into the Construction Flora and Fauna Management Plan:
 - Clearly mark and protect hollow-bearing trees and other habitat features that are to be avoided. Exclusion areas would extend to the dripline of the trees to be retained (the area directly under the tree branches) or as far from the trunk as possible.
 - Clearly mark the limit of works prior to commencing works.
 - Where suspected Silver-leaf Candlebark (*E. canobolensis*) trees occur within the development easement, or potential impact zone clearly mark and protect these trees to ensure impact to them is avoided.
- Carry out Spring Flora surveys to confirm vegetation mapping and determine the presence of Small Purple-pea (*Swainsona recta*) and Silky Swainson Pea (*Swainsona sericea*)
- Prior to commencement of construction Calculate the biodiversity offset credit liability in accordance with the *NSW Biodiversity Offset Policy for Major Projects*

During construction

The following mitigation measures would be incorporated into the Construction Fauna and Flora Management Plan.

- Works would be confined to within the defined clearing limit.
- Clearing of hollow-bearing trees would not be undertaken during the breeding season of threatened hollow-dependent species.
- A hollow-bearing tree clearing protocol would be developed
- Large native trees with hollows and surface rock would be relocated to the edge of the easement. Replaced items would not be placed on top of existing habitat features.
- Declared priority weeds such as Blackberry would be managed according to the requirements stipulated by the local control authority.

After construction

- Post-construction management of priority weeds such as Blackberry would be incorporated into a weed management plan.

8 CONCLUSION

NGH Environmental has prepared this biodiversity assessment for the construction of a 132kv transmission line as part of Flyers Creek Wind Farm planning Modification 4. Biodiversity impacts have been assessed and concluded that;

- The proposal would result in the removal of up to 6.8ha of native vegetation and 1.4ha of planted native vegetation.
- The proposal would not have a significant impact on any threatened species of ecological communities in the study area
- Mitigation measures have been recommended to avoid or minimise any potential impacts.
- Spring flora surveys have been recommended to determine the presence of threatened flora, (*Swainsona recta* and *Swainsona Sericea*)
- Prior to the commencement of construction, the proponent will calculate the biodiversity offset credit liability in accordance with the *NSW Biodiversity Offset Policy for Major Projects*.

9 REFERENCES

- DEC (2006) 'Reconstructed and extant distribution of native vegetation in the Central West Catchment.' NSW Department of Environment and Conservation, Dubbo. (VIS_3815)
- DECC (2008) Recovery Plan for the Koala (*Phascolarctos cinereus*). Accessed at <http://www.environment.nsw.gov.au/research-and-publications/publications-search/recovery-plan-for-the-koala-phascolarctos-cinereus>
- DEH (2006) 'White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grasslands), Australian Government
- DoE (2013) Matters of National Significance: Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.
- DPI (2018) NSW Weedwise – Priority Weeds for the Central Tablelands. Accessed at <http://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=1>
- Gibbons, P & Lindenmayer, D (2002) *Tree Hollows and Wildlife Conservation in Australia*, CSIRO.
- OEH (2018) BIONET accessed at www.bionet.nsw.gov.au

APPENDIX A BACKGROUND SEARCHES

A.1 BIONET

Result of all threatened or commonwealth listed Entities within 10km radius of proposal area. (55H 688482 6295165 UTM)

Kingdom	Class Name	Family Name	Scientific Name	Common Name	NSW Status	C'wealth Status	DateLast	Accuracy
Fauna	Aves	Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle	V,P		1/02/2018	20
Fauna	Aves	Psittacidae	<i>Polytelis swainsonii</i>	Superb Parrot	V,P,3	V	13/12/2002	1000
Fauna	Aves	Psittacidae	<i>Polytelis swainsonii</i>	Superb Parrot	V,P,3	V	1/02/2018	20
Fauna	Aves	Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella	V,P		6/12/2002	1000
Fauna	Aves	Artamidae	<i>Artamus cyanopterus</i>	Dusky Woodswallow	V,P		11/03/1999	10000
Fauna	Aves	Artamidae	<i>Artamus cyanopterus</i>	Dusky Woodswallow	V,P		16/03/1999	10000
Fauna	Aves	Petroicidae	<i>Petroica boodang</i>	Scarlet Robin	V,P		25/08/2013	10
Fauna	Aves	Estrildidae	<i>Stagonopleura guttata</i>	Diamond Firetail	V,P		1/02/2018	20
Fauna	Mammalia	Petauridae	<i>Petaurus norfolcensis</i>	Squirrel Glider	V,P		6/12/2002	1000
Flora	Flora	Myrtaceae	<i>Eucalyptus canobolensis</i>	Silver-Leaf Candlebark	V,P	E	8/03/2017	5
Flora	Flora	Myrtaceae	<i>Eucalyptus canobolensis</i>	Silver-Leaf Candlebark	V,P	E	8/03/2017	5
Flora	Flora	Myrtaceae	<i>Eucalyptus canobolensis</i>	Silver-Leaf Candlebark	V,P	E	8/03/2017	10
Flora	Flora	Myrtaceae	<i>Eucalyptus canobolensis</i>	Silver-Leaf Candlebark	V,P	E	8/03/2017	10

A.2 PROTECTED MATTERS SEARCH TOOL



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 12/06/18 13:14:21

[Summary](#)

[Details](#)

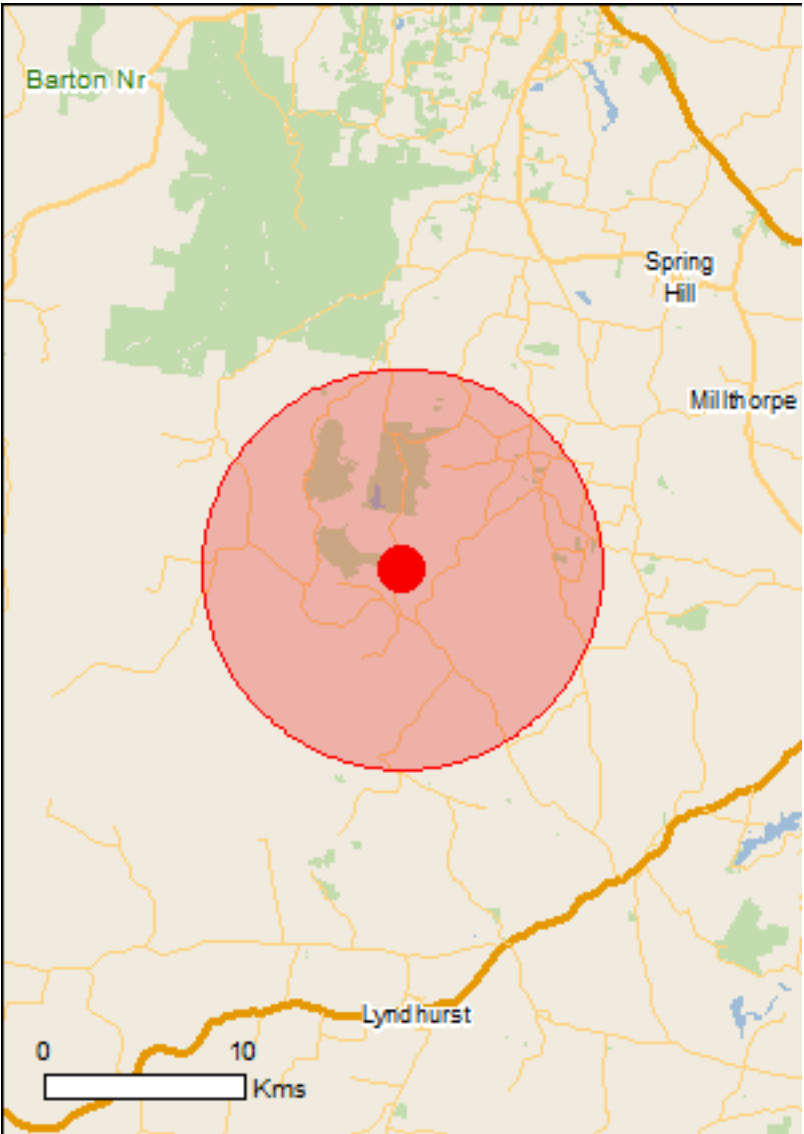
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

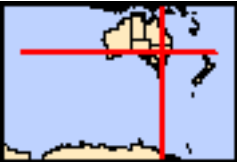
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 10.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	30
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

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

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

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	31
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Banrock station wetland complex	700 - 800km upstream	
Hattah-kulkyne lakes	600 - 700km upstream	
Riverland	700 - 800km upstream	
The coorong, and lakes alexandrina and albert wetland	800 - 900km upstream	

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

Name	Status	Type of Presence
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Natural Temperate Grassland of the South Eastern Highlands	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species	[Resource Information]
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Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
Frogs		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat may occur within area
Litoria castanea Yellow-spotted Tree Frog, Yellow-spotted Bell Frog [1848]	Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Plants		
Ammobium craspedioides Yass Daisy [20758]	Vulnerable	Species or species habitat may occur within area
Eucalyptus aggregata Black Gum [20890]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus canobolensis Silver-leaf Candlebark, Mt Canobolas Candlebark [64896]	Endangered	Species or species habitat may occur within area
Eucalyptus pulverulenta Silver-leaved Mountain Gum, Silver-leaved Gum [21537]	Vulnerable	Species or species habitat likely to occur within area
Leucochrysum albicans var. tricolor Hoary Sunray, Grassland Paper-daisy [56204]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Prasophyllum petilum Tarengo Leek Orchid [55144]	Endangered	Species or species habitat may occur within area
Swainsona recta Small Purple-pea, Mountain Swainson-pea, Small Purple Pea [7580]	Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Delma impar Striped Legless Lizard [1649]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[Resource Information]

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

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species

[Resource Information]

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

Name	Threatened	Type of Presence
Birds		

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Alauda arvensis Skylark [656]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Nassella trichotoma Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884]		Species or species habitat likely to occur

Name	Status	Type of Presence
Pinus radiata		within area
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Ulex europaeus		
Gorse, Furze [7693]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-33.50845 149.02897

Acknowledgements

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

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

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

Please feel free to provide feedback via the [Contact Us](#) page.

APPENDIX B FIELD SURVEY RESULTS

B.1 FLORA

The relative cover/abundance of species is based on visual estimates of foliage cover (Carnahan 1976), and is scored using a six level Braun-Blanquet scale:

Braun-Blanquet cover-abundance scale	
1	Few (0-15), <5% cover
2	Numerous/scattered, <5% cover
3	5 - 25% cover
4	25- 50% cover
5	50 - 75% cover
6	75 - 100% cover

Cover/abundance scores relate to general abundance over this site, not to representative quadrats.

Where uncertainty exists due to the unavailability of reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only. Species of conservation significance are bolded. Introduced species are denoted by an asterisk. Priority or significant environmental weeds are indicated with a 'Δ' symbol. Scientific nomenclature follows Harden (1990-2002) and the Sydney Royal Botanic Gardens PlantNet website

Family	Scientific Name	Common Name	PCT 1330					PCT 287	Planted		Exotic		Flyers Creek
			Good Cadia Rd	Mod McKenzie	Mod Panuara Rd	Mod Cadia Rd	Low Cadia Rd	Mod Cadia Rd	Native Vegetation	Pine Plantation	Paddock/ Roadside		
TREES													
Myrtaceae	<i>Eucalyptus blakelyi</i>	Blakely's Red Gum	3	2	3								
Myrtaceae	<i>Eucalyptus bridgesiana</i>	Apple Box	3		1	3	1						
Myrtaceae	<i>Eucalyptus dives</i>	Broad-leaved Peppermint				2				3			
Myrtaceae	<i>Eucalyptus goniocalyx</i>	Long-leaf Box	2			3			3	3			
Myrtaceae	<i>Eucalyptus macrorhyncha</i>	Red Stringybark							3				
Myrtaceae	<i>Eucalyptus melliodora</i>	Yellow Box	3	3	3	1	1	3		3			
Myrtaceae	<i>Eucalyptus (canobolensis?)</i>	Silver leaf Candlebark				1							
Myrtaceae	<i>Eucalyptus viminalis</i>	Ribbon Gum				1							
Pinaceae	* <i>Pinus radiata</i>	Radiata Pine				2					6		
Salicaceae	* <i>Salix spp.</i>												4
SHRUBS													
Fabaceae (Mimosoideae)	<i>Acacia cultriformis</i>	Knife-leaved Wattle								3			
Fabaceae (Mimosoideae)	<i>Acacia dealbata</i>	Silver Wattle				1				3			
Fabaceae (Mimosoideae)	<i>Acacia implexa</i>	Hickory Wattle	1					1		3			
Fabaceae (Mimosoideae)	<i>Acacia paradoxa</i>	Kangaroo Thorn								3			
Asteraceae	<i>Cassinia arcuata</i>	Sifton Bush	4			4	4	3				1	
Fabaceae (Faboideae)	* <i>Genista spp.</i>					1							
Rosaceae	* <i>Rosa rubiginosa</i>	Sweet Briar						2					2

Family	Scientific Name	Common Name	PCT 1330					PCT 287	Planted		Exotic	
			Good	Mod	Mod	Mod	Low	Mod	Native	Pine	Paddock/	Flyers Creek
Rosaceae	*Δ <i>Rubus fruticosus sp. agg.</i>	Blackberry complex	2			3	3	2		2		3
FORBS												
Rosaceae	<i>Acaena novae-zelandiae</i>	Bidgee-widgee	2		2	2		2				
Polygonaceae	* <i>Acetosella vulgaris</i>	Sheep Sorrel	3	2		2					3	
Rubiaceae	<i>Asperula spp.</i>	Woodruff				1						
Asteraceae	* <i>Carthamus lanatus</i>	Saffron Thistle		1							2	2
Asteraceae	* <i>Chondrilla juncea</i>	Skeleton Weed									2	
Asteraceae	* <i>Cirsium vulgare</i>	Spear Thistle	2	1		2	2				2	3
Asteraceae	* <i>Conyza spp.</i>	A Fleabane				2	2				2	
Chenopodiaceae	<i>Dysphania pumilio</i>	Small Crumbweed		1								
Chenopodiaceae	<i>Einadia nutans</i>	Climbing Saltbush		1								
Onagraceae	<i>Epilobium billardierianum</i>		2									
Geraniaceae	* <i>Geranium molle subsp. molle</i>	Cranesbill Geranium	2	2			2					
Haloragaceae	<i>Gonocarpus spp.</i>	Raspwort				1						
Asteraceae	* <i>Helminthotheca echioides</i>	Ox-tongue					2					
Clusiaceae	<i>Hypericum gramineum</i>	Small St John's Wort	2					2				
Asteraceae	* <i>Hypochaeris radicata</i>	Catsear			2	2						
Asteraceae	* <i>Lactuca serriola</i>	Prickly Lettuce									2	
Malvaceae	* <i>Malva parviflora</i>	Small-flowered Mallow		3		2					2	
Fabaceae (Faboideae)	* <i>Medicago spp.</i>	A Medic	2	3							3	
Oxalidaceae	<i>Oxalis perennans</i>				2	2						
Plantaginaceae	* <i>Plantago lanceolata</i>	Lamb's Tongues			3		2				3	3

Family		Scientific Name	Common Name	PCT 1330					PCT 287	Planted		Exotic	
				Good	Mod	Mod	Mod	Low	Mod	Native	Pine	Paddock/	Flyers Creek
Polygonaceae	*	<i>Rumex crispus</i>	Curled Dock										1
Lamiaceae	*	<i>Salvia verbenaca</i>	Vervain									3	
Rosaceae	*	<i>Sanguisorba minor subsp. muricata</i>	Sheep's Burnet					2	1				
Asteraceae		<i>Senecio quadridentatus</i>	Cotton Fireweed				2						
Asteraceae	*	<i>Senecio spp.</i>	Groundsel, Fireweed					2	2				
Asteraceae	*	<i>Silybum marianum</i>	Variegated Thistle		2				2			2	
Asteraceae	*	<i>Sonchus oleraceus</i>	Common Sowthistle						2				
Caryophyllaceae	*	<i>Stellaria media</i>	Common Chickweed						2				
Asteraceae	*	<i>Taraxacum officinale</i>	Dandelion						2				
Fabaceae (Faboideae)	*	<i>Trifolium spp.</i>	A Clover		3	3	2					4	3
Urticaceae		<i>Urtica incisa</i>	Stinging Nettle						2				
Campanulaceae		<i>Wahlenbergia spp.</i>	Bluebell			1							
Cucurbitaceae	*	<i>Citrullus lanatus var. lanatus</i>	Wild Melon, Camel Melon, Bitter		1								
Echi plan	*	<i>Echium plantagineum</i>	Patterson's Curse								1		
GRASSES													
Poaceae		<i>Austrostipa sp</i>	Spear Grass	2		3							
Poaceae		<i>Bothriochloa macra</i>	Red Grass				2						
Poaceae	*	<i>Briza maxima</i>	Quaking Grass					2					
Poaceae	*	<i>Cynosurus echinatus</i>	Rough Dog's Tail				2						
Poaceae	*	<i>Lolium perenne</i>	Perennial Ryegrass				2					3	
Poaceae		<i>Microlaena stipoides</i>	Weeping Grass	3			2	2	3		1		
Poaceae	*	<i>Phalaris aquatica</i>	Phalaris	2	3	3	4	4	1	4		5	4
Poaceae		<i>Themeda triandra</i>	Kangaroo Grass				1						
GRAMINOIDS													
Cyperaceae		<i>Carex spp.</i>											

Family	Scientific Name	Common Name	PCT 1330					PCT 287	Planted		Exotic	
			Good	Mod	Mod	Mod	Low	Mod	Native	Pine	Paddock/	Flyers Creek
Juncaceae	<i>Juncus spp.</i>	A Rush					2					
Lomandraceae	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush					1					
Lomandraceae	<i>Lomandra spp.</i>	Mat-rush			1							
OTHER												
Loranthaceae	<i>Amyema miquelii</i>	Box Mistletoe		2	2	2						

B.2 FAUNA

Common Name	Scientific Name	Status (BC/EPBC)	Paddock 1	Paddock 2	Paddock 3	Forest 1	Forest 2	Clearing 6	Clearing 7	Clearing 8	Planting	Creek Crossing	Opportunistic
BIRDS													
<i>Egretta novaehollandiae</i>	White-faced Heron	Not listed											X
<i>Anas superciliosa</i>	Pacific Black Duck	Not listed					X						
<i>Anas castanea</i>	Chestnut Teal	Not listed					X						
<i>Vanellus miles</i>	Spur-winged Plover	Not listed		X									
<i>Falco cenchroides</i>	Nankeen Kestrel	Not listed											X
<i>Ocyphaps lophotes</i>	Crested Pigeon	Not listed			X							X	
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	Not listed		X	X								
<i>Cacatua</i> sp.	Corella sp.	Not listed											X
<i>Eolophus roseicapilla</i>	Galah	Not listed	X	X	X			X			X	X	
<i>Platycercus eximius</i>	Eastern Rosella	Not listed	X										
<i>Platycercus elegans</i>	Crimson Rosella	Not listed		X		X	X	X	X	X		X	
<i>Psephotus haemotonomus</i>	Red-rumped Parrot	Not listed	X	X									
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Not listed											X
<i>Hirundo neoxena</i>	Welcome Swallow	Not listed		X								X	
<i>Rhipidura leucophris</i>	Willy Wagtail	Not listed		X		X				X			
<i>Malurus</i> sp.	Blue Wren sp.	Not listed				X	X	X				X	
<i>Sericornis frontalis</i>	White-browed Scrubwren	Not listed				X		X		X			
<i>Pardalotus striatus</i>	Striated Pardalote	Not listed	X	X								X	
<i>Anthochaera carunculata</i>	Red Wattlebird	Not listed		X			X						
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	Not listed		X								X	

Common Name	Scientific Name	Status (BC/EPBC)	Paddock 1	Paddock 2	Paddock 3	Forest 1	Forest 2	Clearing 6	Clearing 7	Clearing 8	Planting	Creek Crossing	Opportunistic
<i>Manorina melanoccephala</i>	Noisy Miner	Not listed											X
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	Not listed			X								
<i>Acanthiza lineata</i>	Striated Thornbill	Not listed					X			X			
<i>Grallina cyanoleuca</i>	Peewee	Not listed				X	X						
<i>Cracticus tibicen</i>	Australian Magpie	Not listed	X			X	X	X		X	X	X	
<i>Cracticus nigrogularis</i>	Pied Butcherbird	Not listed											X
<i>Corvus coronoides</i>	Australian Raven	Not listed	X		X	X	X				X		
<i>Strepera graculina</i>	Pied Currawong	Not listed				X		X	X				
<i>Corcorax melanorhamphos</i>	White-winged Chough	Not listed											X
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	Not listed		X									
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	Not listed				X	X	X	X				
<i>Pachycephala rufiventris</i>	Rufous Whistler	Not listed				X							
<i>Cormobates leucophaea</i>	White-throated Treecreeper	Not listed				X	X						
<i>Eopsaltria australis</i>	Eastern Yellow Robin	Not listed				X							
<i>Sternus vulgaris</i>	Starling	Not listed	X				X						
<i>Turdus merula</i>	Blackbird	Not listed				X			X				
MAMMALS													
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox Dead animal tangled in barbed wire fence.	V BC V EPBC											X - E688458.829 N 6290501.318 GDA94 Z55
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	Not listed					X	X					
<i>Oryctolagus cuniculus</i>	Rabbit	Not listed		X									
AMPHIBIANS													
<i>Crinia signifera</i>	Common Froglet	Not listed										X	

APPENDIX C THREATENED SPECIES EVALUATIONS

The tables in this appendix present the habitat evaluation for threatened species, ecological communities and endangered populations listed in the locality of Flyers Creek in the *Atlas of NSW Wildlife*¹ and those identified as potentially occurring in the area according to the Commonwealth EPBC *Protected Matters Search Tool*².

The likelihood of occurrence is based on presence of habitat, proximity of nearest records and mobility of the species (where relevant). The assessment of potential impact is based on the nature of the proposal, the ecology of the species and its likelihood of occurrence. The following classifications are used:

Presence of habitat:

Present: Potential or known habitat is present within the study area

Absent: No potential or known habitat is present within the study area

Likelihood of occurrence

Unlikely: Species known or predicted within the locality but unlikely to occur in the study area

Possible: Species could occur in the study area

Present: Species was recorded during the field investigations

Possible to be impacted

No: The proposal would not impact this species or its habitats. No Assessment of Significance (AoS) is necessary for this species

Yes: The proposal could impact this species or its habitats. An AoS has been applied to these entities.

¹ The *Atlas of NSW Wildlife* is administered by NSW OEH and is an online database of fauna and flora records that contains over four million recorded sightings.

² This online tool is designed for the public to search for matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is managed by the Commonwealth Department of the Environment and Energy.

C.1 EVALUATION OF THE LIKELIHOOD AND EXTENT OF IMPACT ON THREATENED FLORA SPECIES

Species	Description of habitat ³	Presence of habitat	Likelihood of occurrence	Possible impact?
Trees				
Silver-leaf Candlebark <i>Eucalyptus canobolensis</i> E EPBC V BC	Undulating low to steep hills; soils shallow skeletal sands and loams on steep slopes; vegetation sub-alpine woodland.	Present Sub-alpine woodland on relatively steep hills in study area.	Likely Recorded in locality (BioNet). Plant sample sent to NSW Herbarium for identification thought to be <i>E. canobolensis</i> .	Yes Assessment of Significance completed. (AoS)
Black Gum <i>Eucalyptus aggregata</i> V EPBC V BC	Lowest parts of the landscape on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, in an open woodland formation with a grassy groundlayer but few shrubs. Also occurs as isolated paddock trees in modified native or exotic pastures.	Present Open woodland with grassy groundlayer and few shrubs.	Unlikely Known in subregion. Conspicuous tree not detected in site survey.	No Not detected in study area.
Silver-leafed Mountain Gum <i>Eucalyptus pulverulenta</i> V EPBC V BC	Shallow soils as an understorey plant in open forest, typically dominated by Brittle Gum, Red Stringybark, Broad-leafed Peppermint, Silvertop Ash and Apple Box.	Present Apple Box, Broad-leafed Peppermint and Red Stringybark in study area.	Unlikely Conspicuous tree not detected in site survey.	No Not detected in study area.

³ Information sourced from species profiles on NSW OEH's threatened species database or the Australian Government's Species Profiles and Threats database (SPRAT) unless otherwise stated.

OEH threatened species database: <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>

SPRAT: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Species	Description of habitat ³	Presence of habitat	Likelihood of occurrence	Possible impact?
Robertson's Peppermint <i>Eucalyptus robertsonii</i> subsp. <i>hemisphaerica</i> V BC	Locally frequent in grassy or dry sclerophyll woodland or forest, on lighter soils and often on granite. Usually found in closed grassy woodlands in locally sheltered sites. Habitats include quartzite ridges, upper slopes and a slight rise of shallow clay over volcanics.	Present Open eucalypt woodland.	Unlikely Known in subregion. Conspicuous tree not detected in site survey.	No Not detected in study area.
Shrubs				
<i>Acacia meiantha</i> E BC	Found in three populations: Clarence, Mullions Range, and Aaron's Pass.	Absent No associated vegetation types in study area.	Unlikely Study area not in known population. Conspicuous shrub not detected in site survey.	No Not detected in study area.
<i>Prostanthera gilesii</i> CE BC	Only known from Mt Canobolas State Conservation Area.	Absent Study area outside Mount Canobolas SCA.	Unlikely Study area not within known population. Conspicuous shrub not detected in site survey.	No Not detected in study area.
Herbs & Forbs				
Small Purple-pea <i>Swainsona recta</i> E EPBC E BC	Grassy woodlands, and sometimes grassy open forest, usually with tree cover including Blakely's Red Gum, Yellow Box, and White Box.	Present Associated vegetation types in study area.	Possible Would not have been visible during site surveys. Native understory present in remnant woodland. Nearest known record over 100 km in Wellington.	Surveys for this species to be undertaken in spring in remnant woodland.

Species	Description of habitat ³	Presence of habitat	Likelihood of occurrence	Possible impact?
Silky Swainson-pea <i>Swainsona sericea</i> V BC	Natural temperate grassland and snowgum woodland on the Monaro. Box-Gum woodland in the southern tablelands and South West slopes.	Present Associated vegetation types in study area.	Possible Would not have been visible during site surveys. Native understory present in remnant woodland. Nearest recent record in 35 km away in roadside reserve in Cudal.	Surveys for this species to be undertaken in spring in remnant woodland.
Yass Daisy <i>Ammobium craspediodes</i> V EPBC	Moist or dry forest communities, Box-Gum Woodland and grasslands derived from clearing of these communities. Grows in association with a large range of eucalypts.	Present Associated vegetation types in study area.	Unlikely Not known to occur in subregion.	No Unlikely to occur in study area.
Hoary Sunray <i>Leucochrysum albicans</i> var. <i>tricolor</i> E EPBC	Wide variety of grassland, woodland and forest habitat generally on relatively heavy soils. Can occur in modified habitats such as roadsides and semi-urban areas. Highly dependent on the presence of bare ground for germination.	Present Associated vegetation types in study area.	Unlikely Not known to occur in subregion.	No Unlikely to occur in study area.
Austral Toadflax <i>Thesium C-IVagitta</i> V EPBC	Grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass.	Present Grassy woodland present in study area.	Absent Not known to occur in subregion.	No Unlikely to occur in study area.
Orchids				
Tarengo Leek Orchid <i>Prasophyllum petilum</i> E EPBC	Relatively fertile soils in grassy woodland or natural grassland. Flat or gently sloping sites on plains and rolling hills. Soils usually loams, clay loams, or sandy clays. Often relatively moist areas.	Present Grassy woodland present in study area.	Absent Not known to occur in subregion.	No Unlikely to occur in study area.

Species	Description of habitat ³	Presence of habitat	Likelihood of occurrence	Possible impact?
EECs				
White Box – Yellow Box – Blakely's Red Gum Woodland EEC BC CE EPBC	Tablelands and western slopes of NSW, usually on lower fertile parts of the landscape where resources such as water and nutrients are abundant.	Present Tablelands of NSW in fertile landscape.	Present Yellow Box and Blakely's Red Gum in study area.	Yes AoS completed.
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Penepplain, Nandewar and Brigalow Belt South Bioregions EEC BC	Drier edge of temperate grassy woodland belt (375 – 700 mm rainfall) ranging from central NSW through northern and central Victoria into South Australia. Flat to undulating landscapes, such as plains, low slopes and rises, or occasionally in drainage depressions. Patches tend to occur on relatively productive soils.	Present Open woodland in central NSW.	Unlikely No Grey Box in study area.	No No areas of EEC in proposal area.
Mt Canobolas Xanthoparmelia Lichen Community EEC BC	Rock faces and soils of the Mt Canobolas Tertiary volcanic complex.	Absent Outside distribution of EEC.	Unlikely Known in subregion at site outside locality.	No No areas of EEC in proposal area.
Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC BC	Loam or clay soils associated with basalt or, less commonly, alluvium, fine-grained sedimentary rocks, granites, and similar substrates that produce relatively fertile soils. Altitudes from approximately 600 m to 900 m above sea level, usually on undulating or hilly terrain.	Present Hilly terrain 600 - 900 m above sea level.	Unlikely <i>E. radiata</i> , <i>E. viminalis</i> , <i>E. dalrympleana</i> , <i>E. pauciflora</i> not dominant in study area.	No No areas of EEC in proposal area.
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South Western Slopes Bioregions EEC BC	Characterised by presence of Snow Gum, Candlebark, Ribbon Gum and/or Black Sallee trees. Remnants may occur on lower, more fertile parts of the landscape where resources such as water and nutrients are abundant; sites on midslope situations where resources are scarcer are more common.	Absent No Snow Gum, Ribbon Gum or Black Sallee trees in study area.	Unlikely Snow Gum, Ribbon Gum, Candlebark or Black Sallee trees not dominant in study area.	No No areas of EEC in proposal area.

Species	Description of habitat ³	Presence of habitat	Likelihood of occurrence	Possible impact?
Grey Box (<i>Eucalyptus macrocarpa</i>) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia E EPBC	Low-relief landscapes, often on productive soils derived from alluvial or colluvial materials. Drier sites within belt of grassy woodlands in south-eastern Australia, in rainfall range of 375 – 700 mm per year.	Present Open woodlands in south-eastern Australia.	Unlikely No Grey Box in study area.	No No areas of EEC in proposal area.
Natural Temperate Grassland of the South Eastern Highlands CE EPBC	Range of topographic positions from 250 m to 1200 m on soils derived from variety of substrates, including granites, basalts, sediments, colluvium and alluvium.	Absent Study area not in distribution of EEC.	Unlikely Study area not in distribution of EEC.	No No areas of EEC in proposal area.

E BC = listed as Endangered under Schedule 1 of the NSW *Biodiversity Conservation Act 2016*.

E EPBC = listed as Endangered under the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999*.

V BC = listed as Vulnerable under Schedule 1 of the NSW *BC Act 2016*.

V EPBC = listed as Vulnerable under the Commonwealth *EPBC Act 1999*.

EEC BC = Endangered Ecological Community listed under Schedule 2 of the NSW *BC Act 2016*.

CE EPBC = listed as Critically Endangered under the Commonwealth *EPBC Act 1999*.

C.2 EVALUATION OF THE LIKELIHOOD AND EXTENT OF IMPACT ON THREATENED FAUNA

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Aves				
Little Eagle <i>Hieraetus morphnoides</i> V BC	Open eucalypt forest, woodland, or open woodland, and Sheoak or Acacia woodlands and riparian woodlands in interior NSW, where they nest in tall living trees within a remnant patch.	Present Open eucalypt woodland in study area.	Likely Recorded in locality (BioNet).	Yes AoS completed.
Spotted Harrier <i>Circus assimilis</i> V BC	Grassy open woodland including acacia and Mallee remnants, inland riparian woodland, grassland and shrub steppe. Most commonly found in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands.	Present Grassy open woodland with acacias and agricultural land in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Square-tailed Kite <i>Lophoictinia isura</i> V BC	Timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland.	Present Timbered habitat in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Barking Owl <i>Ninox connivens</i> V BC	Woodland and open forest, including fragmented remnants and partly cleared farmland.	Present Woodland and partly cleared farmland in study area.	Possible Known to occur in subregion.	Yes AoS completed.

⁴ Information sourced from species profiles on NSW OEH's threatened species database or the Australian Government's *Species Profiles and Threats* database (SPRAT) unless otherwise stated.

OEH threatened species database: <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>

SPRAT: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Powerful Owl <i>Ninox strenua</i> V BC	Range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well.	Present Fragmented woodland in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Varied Sittella <i>Daphoenositta chrysoptera</i> V BC	Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, Mallee and Acacia woodland.	Present Eucalypt woodland in study area.	Likely Recorded in locality (BioNet).	Yes AoS completed.
Dusky Woodswallow <i>Artamus cyanopterus</i> V BC	Woodlands and dry open sclerophyll forests, usually dominated by eucalypts including Mallee. Understorey typically open with sparse eucalypt saplings, acacias, and other shrubs. Ground cover may consist of grasses, sedges, or open ground, often with coarse woody debris. Also observed in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber.	Present Dry eucalypt woodland and farmland in study area.	Likely Recorded in locality (BioNet).	Yes AoS completed.
Diamond Firetail <i>Stagonopleura guttata</i> V BC	Grassy eucalypt woodlands, including box-gum woodlands and Snow Gum <i>Eucalyptus pauciflora</i> woodlands. Also occur in open forest, Mallee, Natural Temperate Grassland, in secondary grassland derived from other communities, in riparian areas, and in lightly wooded farmland.	Present Grassy eucalypt woodland in study area.	Likely Recorded in locality (BioNet).	Yes AoS completed.
Scarlet Robin <i>Petroica boodang</i> V BC	Dry eucalypt forests and woodlands. Understorey usually open and grassy with a few scattered shrubs. Both mature and regrowth vegetation, usually with abundant logs and fallen timber. In autumn and winter, many live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees.	Present Dry eucalypt woodland and grassland with fallen timber in study area.	Likely Recorded in locality (BioNet).	Yes AoS completed.
Flame Robin <i>Petroica phoenicea</i> V BC	Breed in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, where they prefer clearings or areas with open understoreys. Groundlayer dominated by native grasses and shrubs. Occasionally occur in temperate rainforest, herbfields, healthlands, shrublands, and sedgeland at high altitudes. In winter, drier and more open habitats in lowlands, including dry forests, open woodlands, and pastures and native grasslands with or without scattered trees.	Present Upland eucalypt woodland with open understorey in study area.	Possible Known to occur in subregion.	Yes AoS completed.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Hooded Robin <i>Melanodryas cucullata cucullata</i> V BC	Lightly wooded country, usually open eucalypt woodland, Acacia scrub and Mallee, often in or near clearings or open areas. Structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs, and ground layer of tall native grasses.	Present Open eucalypt woodland and lightly wooded farmland in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Regent Honeyeater <i>Anthochaera phrygia</i> CE EPBC CE BC	Temperate woodlands and open forests of the inland slopes of south-east Australia. Dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak, particularly those with mature trees, high canopy cover, abundant mistletoe, and a shrubby understorey.	Present Dry temperate woodland with HBTs in study area.	Possible Known to occur in subregion and considered likely to occur in locality.	Yes AoS completed.
Painted Honeyeater <i>Grantiella picta</i> V EPBC V BC	Boree/Weeping Myall, Brigalow, and Box-Gum Woodlands and Box-Ironbark Forests.	Present Box-Gum woodland in study area.	Possible Known to occur in subregion and considered likely to occur in locality.	Yes AoS completed.
Pied Honeyeater <i>Certhionyx variegatus</i> V BC	Wattle shrub, primarily mulga, mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering. Feeds on nectar, predominantly from various species of emu-bushes, also from mistletoes and other shrubs.	Present Eucalypt woodland in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Black-chinned Honeyeater <i>Melithreptus gularis gularis</i> V BC	Upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark <i>Eucalyptus sideroxylon</i> , White Box <i>E. albens</i> , Inland Grey Box <i>E. microcarpa</i> , Yellow Box <i>E. melliodora</i> , Blakely's Red Gum <i>E. blakelyi</i> , and Forest Red Gum <i>E. tereticornis</i> , and open forests of smooth-barked gums, Stringybarks, ironbarks, tea trees, and river sheoaks (nesting habitat).	Present Dry open woodland with 17.1ha in study area.	Possible Known to occur in subregion.	Yes AoS completed.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Brown Treecreeper <i>Climacteris picumnus victoriae</i> V BC	Eucalypt woodlands (including box-gum woodland) and dry open forest of the inland slopes and plains west of the Great Dividing Range, mainly in woodlands dominated by Stringybarks or other rough-barked eucalypts, usually with an open grassy understorey and sometimes with one or more shrub species. Also, Mallee and River Red Gum forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses. Fallen timber important for foraging, and hollows in standing dead or live trees and tree stumps essential for nesting.	Present Eucalypt woodland with fallen timber and HBTs in study area.	Possible Known to occur in subregion.	Yes AoS completed.
White-fronted Chat <i>Epthianura albifrons</i> V BC	Bare or grassy ground in wetland areas, samphire flats, damp paddocks, low shrublands, and grasslands.	Present Grassland in study area.	Possible Predicted to occur in subregion.	Yes AoS completed.
Grey-crowned Babbler <i>Pomatostomus temporalis temporalis</i> V BC	Open box-gum woodlands on the slopes, and box-cypress and open box woodlands on alluvial plains. Generally unable to cross large open areas.	Present Open box-gum woodland in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Bush Stone-curlew <i>Burhinus grallarius</i> E BC	Open forests and woodlands with sparse grassy ground layer and fallen timber.	Present Open grassy woodland with fallen timber in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Swift Parrot <i>Lathamus discolor</i> CE EPBC E BC	Areas where eucalypts are flowering profusely or where there are abundant infestations of lerp (from sap-sucking bugs). Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box. Commonly used lerp infested trees include Grey Box and Blackbutt.	Present Box-Gum woodland with 17.1ha in study area.	Possible Predicted to occur in subregion and considered likely to occur in locality.	Yes AoS completed.
Superb Parrot <i>Polytelis swainsonii</i> V EPBC V BC	Box-Gum, Box-Cypress, and Boree Woodlands and River Red Gum Forests. Nest in hollows of large trees in tall open forest or woodland.	Present Box-Gum woodland with HBTs in study area.	Likely Recorded in locality (BioNet; PMST).	Yes AoS completed.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Turquoise Parrot <i>Neophema pulchella</i> V BC	Edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Nests in tree hollows, logs or posts.	Present Eucalypt woodland in farmland with creek in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> V BC	In spring and summer, tall mountain forests and woodland, particularly heavily timbered and mature wet sclerophyll forests. In autumn and winter, lower altitudes in drier, more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages. Favours old growth forest and woodland attributes for nesting and roosting.	Present Highland eucalypt woodland with HBTs in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Little Lorikeet <i>Glossopsitta pusilla</i> V BC	Open <i>Eucalyptus</i> forest and woodland, finding food in <i>Angophora</i> , <i>Melaleuca</i> and other tree species. Riparian habitats particularly used due to greater productivity. Isolated flowering trees in open country, including paddocks, roadside remnants, and urban trees also used. Nesting hollows in the limbs and trunks of smooth-barked eucalypts, often in riparian areas.	Present Open eucalypt woodland and isolated flowering trees in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Fork-tailed Swift <i>Apus pacificus</i> M EPBC	Open habitat including semi-arid areas, coasts, islands, and occasionally forests and cities.	Present Open agricultural and woodland habitat in study area.	Possible Considered likely to occur in locality.	Yes AoS completed.
White-throated Needletail <i>Hirundapus caudacutus</i> M EPBC	Wooded areas including open forest and rainforest, and less commonly above woodland.	Present Open woodland habitat in study area.	Possible Considered likely to occur in locality.	Yes AoS completed.
Yellow Wagtail <i>Motacilla flava</i> M EPBC	Flat, open, grassy area near water, which may include grasslands, air strips, pastures, sports fields, and edges of wetlands, rivers, and dams.	Present Grassy agricultural land along stream in study area.	Possible May occur in locality.	Yes AoS completed.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Satin Flycatcher <i>Myiagra cyanoleuca</i> M EPBC	Eucalypt forest and woodland, especially tall, wet sclerophyll forests along gullies and water courses, and open, grassy areas of woodland.	Present Open grassy woodland in study area.	Possible Known to occur in locality.	Yes AoS completed.
Speckled Warbler <i>Chthonicola sagittata</i> V BC	Wide range of eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants required for species to persist.	Absent No large remnants of eucalypt communities in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Australasian Bittern <i>Botaurus poiciloptilus</i> E EPBC	Along coast and in Murray-Darling Basin, notably in floodplain wetlands of Murrumbidgee, Lachlan, Macquarie and Gwydir Rivers. Occurs in permanent freshwater wetlands with tall, dense vegetation. Favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds or cutting grass growing over muddy or peaty substrate.	Absent No permanent wetlands in study area.	Possible Predicted to occur in subregion and may occur in locality.	No No suitable habitat in study area.
Australian Painted Snipe <i>Rostratula australis</i> E EPBC	Fringes of swamps, dams and nearby marshy areas with cover of grasses, low scrub or open timber. Permanent and ephemeral shallow (<50 cm) wetlands and waterbodies or inundated grassland and paddocks.	Absent No wetlands in study area.	Possible Predicted to occur in subregion and may occur in locality.	No No suitable habitat in study area.
Curlew Sandpiper <i>Calidris ferruginea</i> CE M EPBC	Littoral and estuarine habitats, and intertidal mudflats of sheltered coasts. Forages on edge of shallow water, exposed algal mats or banks of beach cast seagrass or seaweed.	Absent No littoral or estuarine habitat in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Eastern Curlew <i>Numenius madagascariensis</i> CE M EPBC	Large intertidal mudflats often with seagrass beds along sheltered coasts including in estuaries, bays, harbours, inlets, lagoons, and among saltmarshes and mangroves.	Absent No mudflats or coastal habitat in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Blue-billed Duck <i>Oxyura australis</i> V BC	Deep water in large permanent wetlands and swamps with dense aquatic vegetation.	Absent No permanent wetlands in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Freckled Duck <i>Stictonetta naevosa</i> V BC	Permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum, or Tea Tree. During drier times, move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams, and sewage ponds.	Absent No permanent wetlands in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Glossy Black-Cockatoo <i>Calyptorhynchus lathami</i> V BC	Open forest and woodland of the coast and Great Dividing Range where stands of Sheoak occur. Inland populations feed on wide range of sheoaks, including Drooping Sheoak <i>Allocasuarina diminuta</i> , <i>A. gymnathera</i> , and Belah <i>Casuarina cristata</i> . In the Riverina, associated with hills and rocky rises supporting Drooping Sheoak, and open woodlands dominated by Belah. Dependent on large hollow-bearing eucalypts for nesting.	Absent No sheoak in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Black Falcon <i>Falco subniger</i> V BC	Tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas.	Absent No tree-lined watercourses or isolated woodlands in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
White-bellied Sea-eagle <i>Haliaeetus leucogaster</i> V BC	Coastal habitats and around terrestrial wetlands in tropical and temperate regions of Australia. Habitat characterised by large open areas of water. Has been recorded in or over a variety of terrestrial habitats.	Absent No large open areas of water in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Malleefowl <i>Leipoa cuminat</i> V EPBC	Semi-arid to arid shrublands and low woodlands, especially dominated by Mallee and/or Acacia which are tall, dense, and floristically rich. May use Mallee with spinifex understorey, but usually at lower densities than areas with shrub understorey. Sandy to sandy-loam substrate and abundance of leaf litter are required for breeding.	Absent No arid or semi-arid shrublands or low woodlands in study area.	Possible Known to occur in locality.	No No suitable habitat in study area.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Rufous Fantail <i>Rhipidura rufifrons</i> M EPBC	In east and south-east Australia, wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood, Mountain Grey Gum, Narrow-leaved Peppermint, Mountain Ash, Alpine Ash, Blackbutt or Red Mahogany; usually with a dense shrubby understorey often including ferns. Also subtropical and temperate rainforests. Occasionally secondary regrowth, following logging or disturbance in forests or rainforests. When on passage, sometimes drier sclerophyll forests and woodlands, including Spotted Gum, Yellow Box, ironbarks or stringybarks, often with a shrubby or heath understorey.	Absent No wet sclerophyll forest or rainforest in study area.	Possible Considered likely to occur in locality.	No No suitable habitat in study area.
Common Sandpiper <i>Actitis hypoleucos</i> M EPBC	Coastal wetland and some inland wetlands, mostly around muddy margins or rocky shores and rarely on mudflats. Also, estuaries, deltas, banks further upstream, around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties.	Absent No wetlands in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Sharp-tailed Sandpiper <i>Calidris acuminata</i> M EPBC	Muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh, or other low vegetation. Includes dams, waterholes, soaks, bore drains and bore swamps, saltpans, and hypersaline salt lakes inland. Will use ephemeral wetlands when filled.	Absent No wetlands in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Pectoral Sandpiper <i>Calidris melanotos</i> M EPBC	Shallow fresh to saline wetlands with open fringing mudflats and low emergent or fringing vegetation. Usually coastal or near-coastal habitat, but occasionally inland.	Absent No wetlands in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Latham's Snipe <i>Gallinago hardwickii</i> M EPBC	Permanent and ephemeral wetlands, usually open freshwater wetlands with low, dense vegetation such as swamps, flooded grasslands or heathlands, and bogs, but also in saline or brackish water bodies, and in both modified and artificial habitats.	Absent No wetlands in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Black-tailed Godwit <i>Limosa limosa</i> V BC	Primarily coastal. Sheltered bays, estuaries and lagoons with large intertidal flats and/or sandflats. Further inland, mudflats and water less than 10 cm deep, around muddy lakes and swamps.	Absent No coastal or mudflat habitat in study area.	Possible Predicted to occur in subregion.	No No suitable habitat in study area.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Fishes				
Murray Cod <i>Maccullochella peelii</i> V EPBC	Slow flowing, turbid water in streams and rivers, favouring deeper water around boulders, undercut banks, overhanging vegetation and logs.	Absent No deep rivers or streams in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Macquarie Perch <i>Macquaria australasica</i> E EPBC	Rivers, in clear, deep, rocky holes with plenty of cover including aquatic vegetation, large boulders, large woody debris, and overhanging banks.	Absent No deep rivers in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Mammals				
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> V EPBC V BC	Roosts in caves, crevices in cliffs, old mine workings and disused bottle-shaped mudnests of the Fairy Martin, frequenting low to mid-elevation dry open forest and woodland close to those features.	Present Dry open woodland in study area.	Possible Predicted to occur in subregion and considered likely to occur in locality.	Yes AoS completed.
Corben's Long-eared Bat <i>Nyctophilus corbeni</i> V EPBC V BC	Variety of vegetation types, most commonly Mallee, Bulloke, and Box-dominated communities, but are most common in vegetation which has a distinct canopy and dense understorey. They roost in tree hollows, crevices, and under loose bark.	Present Woodland with Box species and HBTs in study area.	Possible Considered likely to occur in locality.	Yes AoS completed.
Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i> V BC	Caves are primary roosting habitat, also derelict mines, stormwater tunnels, buildings, and other man-made structures.	Present Roosting habitat present in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Southern Myotis <i>Myotis macropus</i> V BC	Often roost close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges, and in dense foliage. Forage over streams and pools.	Present Roosting habitat including HBTs and small stream in study area.	Possible Known to occur in subregion.	Yes AoS completed.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i> V BC	Most forested and cleared habitats, roosting in tree hollows and buildings, or in mammal burrows in cleared areas.	Present Roosting habitat including HBTs present in study area.	Possible Known to occur in subregion.	Yes AoS completed.
Grey-headed Flying-fox <i>Pteropus poliocephalus</i> V EPBC V BC	Roost and forage in a range of vegetation communities including rainforest, open forest, and closed and open woodland. Roost sites are usually near water, including lakes, rivers, and coastlines.	Present Open woodland in study area.	Known Recorded during field survey.	Yes AoS completed.
Spotted-tailed Quoll <i>Dasyurus maculatus</i> E EPBC V BC	Range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from sub-alpine zone to coastline. Hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky cliff faces as den sites.	Present Woodland with HBTs and fallen timber in study area.	Possible Known to occur in subregion and may occur in locality.	Yes AoS completed.
Squirrel Glider <i>Petaurus norfolcensis</i> V BC	Old growth box, box-ironbark woodlands, and River Red Gum forests west of the Great Dividing Range, and prefer mixed species stands with a shrubby or Acacia understorey. Abundant tree hollows are required for refuge and nesting.	Present Box woodland with HBTs in study area.	Likely Recorded in locality (BioNet).	Yes AoS completed.
Greater Glider <i>Petauroides volans</i> V EPBC	Eucalypt forests and woodlands. Taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. Diversity of eucalypt species.	Present Eucalypt woodland with HBTs in study area.	Possible May occur in locality.	Yes AoS completed.
Eastern Pygmy-possum <i>Cercartetus nanus</i> V BC	Broad range of habitat from rainforest through sclerophyll (including box-ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned nests, Ringtail Possum dreys or thickets of vegetation.	Present Sclerophyll woodland with HBTs in study area.	Possible Predicted to occur in subregion.	Yes AoS completed.

Species and Status		Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Brush-tailed Phascogale <i>Phascogale tapoatafa</i> V BC		Dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. Nest and shelter in tree hollows.	Present Sclerophyll woodland with HBTs in study area.	Possible Predicted to occur in subregion.	Yes AoS completed.
Koala <i>Phascolarctos cinereus</i> V EPBC V BC		Range of eucalypt forest and woodland communities, including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains.	Present Eucalypt woodland in study area.	Possible Known to occur in subregion and may occur in locality.	Yes AoS completed.
Yellow-bellied Glider <i>Petaurus australis</i> V BC		Tall mature eucalypt forest generally in areas with high rainfall and nutrient-rich soils. Mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south.	Absent No high-rainfall tall mature eucalypt forest in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Brush-tailed wallaby <i>Petrogale penicillata</i> V EPBC	Rock-	Rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.	Absent No complex rock features in study area.	Possible May occur in locality.	No No suitable habitat in study area.
Amphibians					
Booroolong Frog <i>Litoria booroolongensis</i> E EPBC E BC		Along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses.	Present Small permanent stream with fringing vegetation in study area.	Possible Predicted to occur in subregion and may occur in locality.	Yes AoS completed.
Yellow-spotted Frog <i>Litoria castanea</i> E EPBC CE EPBC	Tree	Only known population near Yass. Large permanent ponds or slow-flowing chain-of-ponds streams with abundant emergent vegetation such as bulrushes and aquatic vegetation.	Absent No large permanent ponds or chain-of-ponds in study area.	Unlikely Study area outside known population distribution.	No No suitable habitat in study area.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
Green and Golden Bell Frog <i>Litoria aurea</i> E BC	Marshes, dams and stream-sides, particularly those containing bulrushes or spikerushes. Optimally, water bodies that are unshaded, free of predatory fishes such as Plague Minnow, have a grassy area nearby and diurnal sheltering sites available.	Absent No unshaded marshes, dams or streams with bulrushes or spikerushes in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Southern Bell Frog <i>Litoria raniformis</i> E BC	Only known to occur in isolated populations in Coleambally Irrigation Area, Lowbidgee floodplain, and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps or billabongs along floodplains and river valleys, and in irrigated rice crops where there is no available natural habitat.	Absent No swamps, billabongs, or irrigated crops in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.
Reptiles				
Pink-tailed Legless Lizard <i>Aprasia parapulchella</i> V EPBC V BC	Sloping open woodland areas with groundcover dominated by native grasses, typically those which are well-drained with rocky outcrops or scattered, partly-buried rocks.	Present Sloping open woodland with native grasses and scattered rocks in study area.	Possible Predicted to occur in subregion and may occur in locality.	Yes AoS completed.
Striped Legless Lizard <i>Delma impar</i> V EPBC V BC	Mainly Natural Temperate Grasslands, but also grasslands with high exotic component, in secondary grassland near Temperate Natural Grassland, and open Box-Gum Woodland. Grassland dominated by perennial, tussock-forming grasses such as Kangaroo Grass <i>Themeda australis</i> , spear-grasses <i>Austrostipa</i> spp., poa tussocks <i>Poa</i> spp., and occasionally wallaby grasses <i>Austrodanthonia</i> spp. Sometimes found in grasslands with significant amounts of surface rocks, used for shelter.	Present Woodland with native grasses and scattered rocks in study area.	Possible May occur in locality.	Yes AoS completed.
Rosenberg's Goanna <i>Varanus rosenbergi</i> V BC	Heath, open forest and woodland. Associated with termites, the mounds of which this species nests in. Termite mounds and a critical habitat component. Individuals require large areas of habitat.	Absent No large areas of habitat with termite mounds in study area.	Possible Known to occur in subregion.	No No suitable habitat in study area.

Species and Status	Description of habitat ⁴	Presence of habitat	Likelihood of occurrence	Potential for impact?
E TSC = listed as Endangered under Schedule 1 of the NSW <i>Biodiversity Conservation Act 2016</i>. E EPBC = listed as Endangered under the Commonwealth <i>Environment Protection & Biodiversity Conservation Act 1999</i>. V TSC = listed as Vulnerable under Schedule 1 of the NSW <i>BC Act 2016</i>. V EPBC = listed as Vulnerable under the Commonwealth <i>EPBC Act 1999</i>. M EPBC = listed as Migratory under the Commonwealth <i>EPBC Act 1999</i>. CE BC = listed as Critically Endangered under the NSW <i>BC Act 2016</i>. CE EPBC = listed as Critically Endangered under the Commonwealth <i>Environment Protection & Biodiversity Conservation Act 1999</i>.				

APPENDIX D THREATENED SPECIES ASSESSMENTS OF SIGNIFICANCE

D.1 BIODIVERSITY CONSERVATION ACT FIVE-PART TEST

Section 7.3 of the BC Act specifies five factors to be taken into account in deciding whether a development is likely to significantly affect threatened species or ecological communities, or their habitats, listed at the state level under the BC Act.

This *Five-part Test* characterises the significance of likely impacts associated with the proposal on the following species:

- FLORA
 - Silver-leaf Candlebark (*Eucalyptus canobolensis*) - V
- EECs:
 - White Box -Yellow Box – Blakely’s Red Gum Woodland (Box Gum Woodland) – EEC
- Ground/Understorey Birds:
 - Diamond Firetail *Stagonopleura guttata* – V, Scarlet Robin *Petroica boodang* – V, Flame Robin *Petroica phoenicea* – V, Hooded Robin *Melanodryas cucullata cucullata* – V, White-fronted Chat *Epthianura albifrons* – V, Grey-crowned Babbler *Pomatostomus temporalis temporalis* – V, Bush Stone-curlew *Burhinus grallarius* – E
- Canopy/Aerial Birds:
 - Raptors: Little Eagle *Hieraaetus morphnoides* – V, Spotted Harrier *Circus assimilis* – V, Square-tailed Kite *Lophoictinia isura* – V
 - Owls: Barking Owl *Ninox connivens* – V, Powerful Owl *Ninox strenua* – V
 - Small passerines: Varied Sittella *Daphoenositta chrysoptera* – V, Dusky Woodswallow *Artamus cyanopterus cyanopterus* – V, Regent Honeyeater *Anthochaera phrygia* – CE, Painted Honeyeater *Grantiella picta* – V, Pied Honeyeater *Certhionyx variegatus* – V, Black-chinned Honeyeater *Melithreptus gularis gularis* – V, Brown Treecreeper *Climacteris picumnus victoriae* – V
 - Parrots: Swift Parrot *Lathamus discolor* – E, Superb Parrot *Polytelis swainsonii* – V, Turquoise Parrot *Neophema pulchella* – V, Gang-gang Cockatoo *Callocephalon fimbriatum* – V, Little Lorikeet *Glossopsitta pusilla* – V
- Arboreal Mammals:
 - Spotted-tailed Quoll *Dasyurus maculatus* – V, Squirrel Glider *Petaurus norfolcensis* – V, Eastern Pygmy-possum *Cercartetus nanus* – V, Brush-tailed Phascogale *Phascogale tapoatafa* – V, Koala *Phascolarctos cinereus* - V
- Bats:
 - Large-eared Pied Bat *Chalinolobus dwyeri* – V, Corben’s Long-eared Bat *Nyctophilus corbeni* – V, Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* – V, Southern Myotis *Myotis macropus* – V, Yellow-bellied Sheath-tail-bat *Saccolaimus flaviventris* – V, Grey-headed Flying-fox *Pteropus poliocephalus* – V
- Amphibians:
 - Booroolong Frog *Litoria booroolongensis* – E
- Reptiles:

- o Pink-tailed Legless Lizard *Aprasia parapulchella* – V, Striped Legless Lizard *Delma impar* – V

a) In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Flora

Two suspected *E. canobolensis* were present within the study area. These trees fall outside the 45m clearing easement and would not be impacted by the proposal. No impacts to the lifecycle of these species would occur. Mitigation measures to clearing mark these trees prior to construction would avoid any impacts to the life cycle of the species. The local population is unlikely to be placed at risk of extinction.

EECs

Not applicable.

Ground/understorey birds

Potential foraging and roosting habitat for Diamond Firetail, Scarlet Robin, Flame Robin, Hooded Robin, White-fronted Chat, Grey-crowned Babbler and Bush Stone-curlew occurs within the proposal area and would be removed by the proposal. Surveys did not detect these species or signs such as nests that would indicate that the site has recently been used by these species, and so the study area is not considered known habitat.

The proposal would involve the removal of around 61 ha of highly modified, relatively disturbed and fragmented habitat. This would include 18.1 ha of exotic grassland, 31.6 ha of pine plantation, 6.8 ha of native remnant woodland, 1.4 ha of planted vegetation, 2.0 ha of other exotic habitat, and 1.1 ha of bare ground. The habitat to be removed is similar to the habitat in the rest of the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction.

Raptors

Potential foraging habitat for Little Eagle and Square-tailed Kite and potential foraging and breeding habitat for Spotted Harrier occur in the proposal area and would be removed by the proposal. Surveys did not detect these species or signs such as nests that would indicate that the site has been recently used by these species, and so the study area is not considered known habitat.

The proposal would involve the removal of around 29 ha of relatively disturbed and fragmented habitat. This would include 18.1 ha of exotic grassland, 6.8 ha of native remnant woodland, 1.4 ha of planted vegetation, 2.0 ha of other exotic habitat, and 1.1 ha of bare ground. The habitat to be removed is similar to the habitat in the rest of the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction.

Owls

Potential foraging habitat and HBTs which provide potential roosting habitat for Barking Owl and Powerful Owl occur in the proposal area and would be removed by the proposal. Surveys did not detect any sign such as pellets that would indicate that the site has been recently used by these species, and so the study area is not considered known habitat.

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the life cycle of these species such that a viable

local population is likely to be placed at risk of extinction. Mitigation measures have been recommended to mitigate the potential for injury or mortality to breeding owls.

Small passerines

Potential foraging and breeding habitat for these species occurs in the proposal area and would be removed by the proposal. Surveys did not detect these species or signs such as nests that would indicate that the site has recently been used by these species, and so the study area is not considered known habitat.

The proposal would involve the removal of around 61 ha of highly modified, relatively disturbed and fragmented habitat. This would include 6.8 ha of native remnant woodland including 14 HBTs, 1.4 ha of planted vegetation and 31.6 ha of pine plantation. The habitat to be removed is similar to the habitat in the rest of the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction. Mitigation measures have been recommended to mitigate the potential for injury or mortality to hollow-nesting birds.

Parrots

Potential foraging habitat for these species and HBTs which provide potential breeding habitat for Superb Parrot, Turquoise Parrot, Gang-gang Cockatoo and Little Lorikeet occur in the proposal area and would be removed by the proposal. Swift Parrot breeds only in Tasmania, and the proposal would therefore not impact on any potential breeding habitat. Surveys did not detect these species or any signs that they have recently used the study area, and so the study area is not considered known habitat.

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction. Mitigation measures have been recommended to mitigate the potential for injury or mortality to breeding parrots.

Arboreal mammals

Potential foraging habitat for Koala including preferred feed trees and potential foraging and breeding habitat for Spotted-tailed Quoll, Squirrel Glider, Eastern Pygmy-possum and Brush-tailed Phascogale occur in the proposal area and would be removed by the proposal. Surveys did not detect these species or signs such as scats or scratches on trees that would indicate that the site has been recently used by these species, and so the study area is not considered known habitat.

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction. Mitigation measures have been recommended to mitigate the potential for injury or mortality to hollow-breeding mammals.

Bats

Potential foraging and roosting habitat for these species occurs in the proposal area and would be removed by the proposal. Surveys were not completed for these species, so it is assumed that they could occur in the study area.

The proposal would involve the removal of around 29 ha of relatively disturbed and fragmented habitat. This would include 6.8 ha of native remnant woodland which contains 14 HBTs and 1.4 ha of planted vegetation. The habitat to be removed is similar to the habitat in the rest of the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to

have an adverse effect on the life cycle of these species such that a viable local population is likely to be placed at risk of extinction. Mitigation measures have been recommended to mitigate the potential for injury or mortality to hollow-roosting bats.

Amphibians

Potential foraging and breeding habitat for Booroolong Frog occurs in the study area and would be impacted by the proposal. Targeted surveys were not completed for this species, so it is assumed that it could occur in the study area.

The proposal would involve indirect construction impacts on the relatively disturbed Flyer's Creek and several farm dams. The indirect disturbance of a small area of low quality habitat is considered unlikely to have an adverse effect on the life cycle of this species such that a viable local population is likely to be placed at risk of extinction.

Reptiles

Grassland and rocky outcrops that provide potential foraging and breeding habitat for these species occur in the study area and would be removed by the proposal. Surveys did not detect these species or any signs that would indicate that the site has recently been used by these species, and so the study area is not considered known habitat.

The proposal would involve the removal of a small amounts of surface rocks and an area of around 43 ha of exotic-dominated grassland. The habitat to be removed is similar to the habitat in the rest of the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect of the life cycle of the species such that a viable local population is likely to be placed at risk of extinction. Mitigation measures have been recommended to mitigate the potential for habitat loss for these species.

b) In the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
- ii. Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Flora

Not applicable.

EECs

Four patches of Box Gum woodland occur within the study area. The proposal would reduce the extent of the community by around 4 ha. OEH VIS mapping estimates 180 ha of Yellow Box – Blakely's Red Gum woodland community within 1 km of the study area. Most of these areas are connected to the community in the proposal area and are considered part of the local occurrence. The total reduction of the local occurrence by 4 ha is unlikely to place it at risk of extinction.

The composition and structure of the vegetation within the study area is already substantially and adversely modified. Areas surrounding the proposal area are actively utilised for agricultural purposes and have been subject to varying levels of degradation. In this context, further modification is expected to be minimal and is unlikely to place the local occurrence of the community at risk of extinction.

Ground/understorey birds

Not applicable.

Raptors
Not applicable.
Owls
Not applicable.
Small passerines
Not applicable.
Parrots
Not applicable.
Arboreal mammals
Not applicable.
Bats
Not applicable.
Amphibians
Not applicable.
Reptiles
Not applicable.

c) In relation to the habitat of a threatened species or ecological community:

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
- iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Flora

Two suspected *E. canobolensis* trees are present within the study area. Samples sent to the herbarium were unable to be confirmed and these trees are presumed to be *E. canobolensis* until juvenile leaves are present for identification.

- I. The two trees fall outside the clearing easement and would not be removed by the proposal. Habitat for these trees species would remain. No known habitat is likely to be removed or modified.
- II. The two trees are isolated from other known records of this species. The nearest known recording occurs 1km away on the same drainage line. The majority of the population of this species, occur on Mount Canobolas, 8km North of the study area. The two trees are already isolated from other known populations and the proposal would not cause further fragmentation or isolation of habitat.
- III. As the trees would be avoided by the proposal, no known habitat for this species is to be removed or modified. Thus, no impacts to the long term survival of the species is considered to occur.

EEC

- I. The proposal would result in the removal of 4.0 ha of Box-Gum Woodland.
- II. The proposal would result in the clearing of a narrow, linear strip 45 m wide. The proposal area occurs near an existing roadway that has already contributed to fragmentation of the community to a minor degree relative to the surrounding highly cleared agricultural landscape. The proposal would

marginally increase this fragmentation; however, it would not result in isolation of the community from adjacent areas of habitat.

- III. The majority of the Box-Gum woodland within the proposal area has a degraded understory. The groundlayer degradation is due to the invasion of exotic species. These degraded areas are not likely to contain any important habitat for the long-term survival of the community in the locality, although it does assist with connectivity in the landscape. The area of good condition Box-Gum woodland has a diverse structure and is showing signs of natural recruitment and regeneration of overstory species. This area is considered important for maintaining the species composition of community. This patch comprises an area of about 6 ha on the Eastern side of Cadia Rd. 0.8 ha of this patch would be impacted, so 4.4 ha would remain to provide a seed supply and contribute to the long-term survival of the species. Further, given the large extent of the community estimated to occur in the locality (180 ha), it is unlikely that the habitat to be removed is important to the long-term survival of the community.

Ground/understorey birds

- IV. The proposal would result in the removal of around 61 ha of habitat for these species. This would include around 18 ha of exotic grassland, 31.6 ha of pine plantation, 1.4 ha of native remnant woodland, 1.4 ha of planted vegetation, 2 ha of other exotic vegetation, and 1.1 ha of bare ground.
- V. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- VI. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Raptors

- I. The proposal would result in the removal of around 61 ha of habitat for these species. This would include around 18 ha of exotic grassland, 31.6 ha of pine plantation, 1.4 ha of native remnant woodland with 14 HBTs, 1.4 ha of planted vegetation, 2 ha of other exotic vegetation, and 1.1 ha of bare ground.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Owls

- I. The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential roosting sites for these species.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Small passerines

- I. The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential roosting sites for these species.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat

to be removed is not considered to be important to the long-term survival of these species in the locality.

Parrots

- I. The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential roosting sites for these species.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Arboreal mammals

- I. The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential roosting sites for hollow-roosting species and preferred feed trees.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Bats

- I. The proposal would result in the removal of around 61 ha of habitat for these species. This would include around 18 ha of exotic grassland, 31.6 ha of pine plantation, 1.4 ha of native remnant woodland with 14 HBTs, 1.4 ha of planted vegetation, 2 ha of other exotic vegetation, and 1.1 ha of bare ground.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Amphibians

- I. The proposal would result in the indirect disturbance of a small area of aquatic habitat where the transmission line would cross Flyer's Creek and near farm dams.
- II. The proposal would not disrupt movement along the stream, and so would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the surrounding aquatic habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

Reptiles

- I. The proposal would result in the removal of small amounts of surface rocks and an area of around 43 ha of exotic-dominated grassland.
- II. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal would not result in the fragmentation or isolation of any of this habitat.
- III. The habitat within the study area is not known habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the habitat in the rest of the locality. The habitat to be removed is not considered to be important to the long-term survival of these species in the locality.

d) Whether the action proposed is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).

No areas of outstanding biodiversity value occur within the proposal area. There will be no direct or indirect adverse effects on any declared areas of outstanding biodiversity value.

e) Whether the action constitutes or is part of a key threatening process or is likely to increase the impact of a key threatening process.

Key Threatening Processes (KTPs) relevant to the proposal include the following:

i. Clearing of native vegetation

The clearing of native vegetation is considered a major contributor to the loss of biodiversity. In the Scientific Committee's determination, it was found that 'clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity.' Clearing can lead to direct habitat loss, habitat fragmentation and associated genetic impacts, habitat degradation and off-site impacts such as downstream sedimentation. Around 6.8 ha of remnant native woodland including 14 HBTs and around 1.4 ha of planted native vegetation would be cleared as a result of the proposal. The proposal has the potential to increase the impact of this KTP. However, the contribution of this proposal would be relatively minor given the minimal amount of habitat to be removed and the extent of habitat that would remain in the study area.

ii. Loss of hollow-bearing trees

The proposal would result in the removal of 14 HBTs. The removal of these trees would contribute to this KTP, but only at a relatively small scale given the amount of habitat that would remain.

iii. Invasion and establishment of exotic vines and scramblers

The proposal has the potential to contribute to the spread of exotic species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is likely to make only a minor contribution to this KTP.

iv. Invasion of native plant communities by exotic perennial grasses

The proposal has the potential to contribute to the introduction or spread of exotic perennial grasses to the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is likely to make only a minor contribution to this KTP.

v. Removal of dead wood and dead trees

Dead trees and dead wood that occur in the proposal area in the form of stags and fallen timber could be relocated as part of the proposal. This would have the potential to impact species through the loss of roosting, perching, hunting, and breeding habitat. As part of the mitigation measures, it has been recommended that dead wood is retained and placed in adjacent areas instead of being taken off site. With the implementation of this measure, the proposal is unlikely to contribute to this KTP.

Conclusion

The impacts of the proposal on the assessed threatened species and ecological community listed under the BC Act are considered to be manageable. A significant impact is considered unlikely based on the following conclusions:

1. The amount of habitat to be removed or disturbed by the proposal is relatively small in the local context and is relatively disturbed and fragmented.
2. No fragmentation or isolation of habitat would occur.
3. No substantial contribution to any key threatening process would be expected.

4. Mitigation measures would be implemented to prevent disruptions to the life cycle or harm to individual animals of these species (Section 6).

D.2 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT PRINCIPAL SIGNIFICANT IMPACT ASSESSMENT

The *Environment Protection and Biodiversity Conservation Act* 1999 specifies factors to be taken into account in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level.

The following assessment assesses the significance of the likely impacts associated with the proposed works on the following endangered and critically endangered species:

- Arboreal species:
 - Swift Parrot *Lathamus discolor* – CE, Spotted-tailed Quoll *Dasyurus maculatus* – E
- Booroolong Frog *Litoria booroolongensis* – E
- Silver-leaf Candlebark *Eucalyptus canobolensis* - E

a) Will the action lead to a long-term decrease in the size of a population of a species?

Arboreal species

Potential foraging habitat for Swift Parrot and potential foraging and breeding habitat for the Spotted-tailed Quoll occurs within the proposal area and would be removed by the proposal, including HBTs.

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the species such that it would lead to a long-term decrease in the size of a population. Mitigation measures have been recommended to mitigate the potential for injury or mortality to breeding or roosting animals.

Booroolong Frog

Potential foraging and breeding habitat for Booroolong Frog occurs in the study area and would be impacted by the proposal.

The proposal would involve indirect construction impacts on the relatively disturbed Flyer's Creek and farm dams. The indirect disturbance of a small area of low quality habitat is considered unlikely to have an adverse effect on the life cycle of this species such that it would lead to a long-term decrease in the size of a population.

Silver-leaf Candlebark

Two suspected *E. canobolensis* trees are present within the study area. Samples sent to the herbarium were unable to be confirmed and these trees are presumed to be *E. canobolensis* until juvenile leaves are present for identification.

The two trees fall outside the clearing easement and would be avoided by the proposal. The action would not lead to a long-term decrease to the size of the population of this species.

b) Will the action reduce the area of occupancy of the species?

Arboreal species

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, the removal of a relatively small area of habitat as a result of the proposal is considered unlikely to reduce the area of occupancy of these species.

Booroolong Frog

The proposal would result in the indirect disturbance of a small area of aquatic habitat where the transmission line would cross Flyer's Creek and near farm dams. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the rest of the aquatic habitat in the rest of the locality. In this context, the disturbance of a relatively small area of habitat as a result of the proposal is considered unlikely to reduce the area of occupancy of this species.

Silver-leaf Candlebark

Two suspected *E. canobolensis* trees are present within the study area. Samples sent to the herbarium were unable to be confirmed and these trees are presumed to be *E. canobolensis* until juvenile leaves are present for identification.

The two trees fall outside the clearing easement and would be avoided by the proposal. No juvenile trees were present. The action would not reduce the area of occupancy of this species.

c) Will the action fragment and existing population into two or more populations?

Arboreal species

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential roosting sites for these species. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat, so the proposal would not fragment an existing population into two or more populations.

Booroolong Frog

The proposal would result in the indirect disturbance of a small area of aquatic habitat where the transmission line would cross Flyer's Creek and near farm dams. The proposal would not disrupt movement along the stream or within dams, and so the proposal would not fragment an existing population into two or more populations.

Silver-leaf Candlebark

Two suspected *E. canobolensis* trees are present within the study area. Samples sent to the herbarium were unable to be confirmed and these trees are presumed to be *E. canobolensis* until juvenile leaves are present for identification.

The two trees fall outside the clearing easement and would be avoided by the proposal. The two trees are isolated from other known records of this species. The nearest known recording occurs 1km away on the same drainage line. The two trees are already isolated from other known populations, the action would not cause further fragmentation of the population.

d) Will the action adversely affect habitat critical to the survival of a species?

Arboreal species

No areas of critical habitat have been declared for these species.

Booroolong Frog

No areas of critical habitat have been declared for this species.

Silver-leaf Candlebark

No areas of critical habitat have been declared for this species.

e) Will the action disrupt the breeding cycle of a population?

Arboreal species

Swift Parrots breed in Tasmania during spring and summer. Given that the proposal area is not in Tasmania, it is not likely that the action will disrupt the breeding cycle of a population of this species.

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential breeding sites for the Spotted-tailed Quoll. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, it is not likely that the action will disrupt the breeding cycle of a population of this species.

Booroolong Frog

The proposal would result in the indirect disturbance of a small area of aquatic habitat where the transmission line would cross Flyer's Creek and near farm dams. The habitat within the study area is not known habitat and is relatively disturbed. In this context, it is not likely that the action will disrupt the breeding cycle of a population of this species.

Silver-leaf Candlebark

Two suspected *E. canobolensis* trees are present within the study area. Samples sent to the herbarium were unable to be confirmed and these trees are presumed to be *E. canobolensis* until juvenile leaves are present for identification.

The two trees fall outside the clearing easement and would be avoided by the proposal. Flowering and pollination of this species would continue in its current state. The action would not disrupt the breeding cycle of the population.

f) Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Arboreal species

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. In this context, the removal and disturbance of a relatively small area of habitat as a result of the proposal is considered unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Booroolong Frog

The proposal would result in the indirect disturbance of a small area of aquatic habitat where the transmission line would cross Flyer's Creek and near farm dams which could decrease the quality of some habitat. The habitat to be removed is a relatively small area of disturbed habitat, and is similar to the rest of the aquatic habitat in the rest of the locality. In this context, the removal and disturbance of a relatively small area of habitat as a result of the proposal is considered unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Silver-leaf Candlebark

Two suspected *E. canobolensis* trees are present within the study area. Samples sent to the herbarium were unable to be confirmed and these trees are presumed to be *E. canobolensis* until juvenile leaves are present for identification.

The two trees fall outside the clearing easement and would be avoided by the proposal. The action is considered unlikely to destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

g) Will the action result in invasive species that are harmful to a critically endangered or endangered/vulnerable species becoming established in the endangered / critically endangered /vulnerable species habitat?

The proposal has the potential to contribute to the spread of invasive species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is therefore unlikely to result in invasive species that are harmful to these species becoming established in their potential habitat.

h) Will the action introduce disease that may cause the species to decline?

There is a risk that pathogens could be established or spread in the proposal area via machinery during construction. However, with the recommended mitigation measures, the action is unlikely to introduce any disease which may cause the species to decline.

i) Will the action interfere with the recovery of the species?

Swift Parrot

The National Recovery Plan for the Swift Parrot lists the following objectives:

1. To identify and prioritise habitats and sites used by the species across its range, on all land tenures.
2. To implement management strategies to protect and improve habitats and sites on all land tenures.
3. To monitor and manage the incidence of collisions, competition and Beak and Feather Disease (BFD).
4. To monitor population trends and distribution throughout the range.

The proposal would not interfere with any of these objectives.

Spotted-tailed Quoll

The National Recovery Plan for the Spotted-tailed Quoll lists the following objectives:

1. Determine the distribution and status of Spotted-tailed Quoll populations throughout the range and identify key threats and implement threat abatement management practices.
2. Investigate key aspects of the biology and ecology of the Spotted-tailed Quoll to acquire targeted information to aid recovery.
3. Reduce the rate of habitat loss and fragmentation on private land.
4. Evaluate and manage the risk posed by silvicultural practices.
5. Determine and manage the threat posed by introduced predators (foxes, cats, wild dogs) and of predator control practices on Spotted-tailed Quoll populations.
6. Determine and manage the impact of fire regimes on Spotted-tailed Quoll populations.
7. Reduce deliberate killings of Spotted-tailed Quolls.
8. Reduce the frequency of Spotted-tailed Quoll road mortality.
9. Assess the threat Cane Toads pose to Spotted-tailed Quolls and develop threat abatement actions if necessary.
10. Determine the likely impact of climate change on Spotted-tailed Quoll populations.
11. Increase community awareness of the Spotted-tailed Quoll and involvement in the Recovery Program.

Booroolong Frog

The National Recovery Plan for the Booroolong Frog lists the following objectives:

1. Determine the species distribution in areas that have not been the focus of targeted surveys.
2. Determine the taxonomic status of northern and southern Booroolong Frog populations, and identify further genetic sub-division within these populations.
3. Reduce the impact of known or perceived threats contributing to the ongoing decline of the Booroolong Frog.
4. Determine population trends across the species range, and in areas subject to different management regimes.
5. Identify the potential impacts of climate change, and determine management responses to reduce these impacts.

6. Identify other potentially threatening processes.
7. Increase community awareness and involvement in the Booroolong Frog recovery program.
8. Achieve the effective implementation of the recovery plan.

Silver-leaf Candlebark

No recovery plan has been adopted or made for this species.

The *Environment Protection and Biodiversity Conservation Act 1999* specifies factors to be taken into account in deciding whether a development is likely to significantly affect Endangered Ecological Communities, threatened species and migratory species, listed at the Commonwealth level. The following assessment assesses the significance of the likely impacts associated with the proposed works on the following vulnerable species:

- Canopy birds: Painted Honeyeater *Grantilla picta*, Superb Parrot *Polytelis swainsonii*
- Bats: Large-eared Pied Bat *Chalinolobus dwyeri*, Corben's Long-eared Bat *Nyctophilus corbeni*, Grey-headed Flying-fox *Pteropus poliocephalus*
- Arboreal mammals: Greater Glider *Petaurus volans*, Koala *Phascolarctos cinereus*
- Reptiles: Pink-tailed Legless Lizard *Aprasia parapulchella*, Striped Legless-lizard *Delma impar*

a) Will the action lead to a long-term decrease in the size of an important population of a species?

Canopy birds

Potential foraging and breeding habitat for Painted Honeyeater and Superb Parrot occurs in the proposal area and would be removed by the proposal, including HBTs.

The proposal would involve the removal of around 6.8 ha of native remnant woodland including 14 HBTs. The habitat to be removed is similar to the habitat in the rest of the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the species such that it would lead to a long-term decrease in the size of an important population. Mitigation measures have been recommended to mitigate the potential for injury or mortality to hollow-nesting birds.

Bats

Potential foraging and roosting habitat for these species occurs in the proposal area and would be removed by the proposal, including HBTs.

The proposal would involve the removal of around 61 ha of relatively disturbed and fragmented habitat. This would include 6.8 ha of native remnant woodland including 14 HBTs, 1.4 ha of planted vegetation and 31.6 ha of pine plantation. The habitat to be removed is similar to the habitat in the rest of the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the species such that it would lead to a long-term decrease in the size of an important population. Mitigation measures have been recommended to mitigate the potential for injury or mortality to hollow-roosting bats.

Arboreal mammals

Potential foraging habitat for Koala including preferred feed trees and potential foraging and breeding habitat for Greater Glider occur in the proposal area and would be removed by the proposal.

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the species such that it would lead to a long-term decrease in the size of an important population. Mitigation measures have been recommended to mitigate the potential for injury or mortality to hollow-breeding Greater Gliders.

Reptiles

Potential foraging and breeding habitat for these species occur in the study area and would be removed by the proposal.

The proposal would involve the removal of a small amounts of surface rocks and an area of around 18.1 ha of exotic-dominated grassland. The habitat to be removed is similar to the habitat in the rest of the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of potential habitat as a result of the proposal is considered unlikely to have an adverse effect on the species such that it would lead to a long-term decrease in the size of an important population. Mitigation measures have been recommended to mitigate the potential for habitat loss for these species.

b) Will the action reduce the area of occupancy of an important population of a species?

Canopy birds

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of habitat as a result of the proposal is considered unlikely to reduce the area of occupancy of an important population of these species.

Bats

The proposal would involve the removal of around 61 ha of relatively disturbed and fragmented habitat. This would include 6.8 ha of native remnant woodland including 14 HBTs, 1.4 ha of planted vegetation and 31.6 ha of pine plantation. The habitat to be removed is similar to the habitat in the rest of the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of habitat as a result of the proposal is considered unlikely to reduce the area of occupancy of an important population of these species.

Arboreal mammals

The proposal would involve the removal of an area of around 6.8 ha of native remnant woodland, including 14 HBTs. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of habitat as a result of the proposal is considered unlikely to reduce the area of occupancy of an important population of these species.

Reptiles

The proposal would involve the removal of a small amounts of surface rocks and an area of around 18.1 ha of exotic-dominated grassland. The habitat to be removed is similar to the habitat in the rest of the locality. The proposal area is not located in a known important population of these species. In this context, the removal of a relatively small area of habitat as a result of the proposal is considered unlikely to reduce the area of occupancy of an important population of these species.

c) Will the action fragment an existing important population into two or more populations?

Canopy birds

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential roosting sites for these species. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal area is not located in a known important population of these species. The proposal would not fragment an existing important population into two or more populations.

Bats

The proposal would involve the removal of around 61 ha of relatively disturbed and fragmented habitat, including 6.8 ha of native remnant woodland including 14 HBTs, 1.4 ha of planted vegetation and 31.6 ha of pine plantation. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal area is not located in a known important population of these species. The proposal would not fragment an existing important population into two or more populations.

Arboreal mammals

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including preferred feed trees for Koala and HBTs which provide potential roosting sites for Greater Glider. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal area is not located in a known important population of these species. The proposal would not fragment an existing important population into two or more populations.

Reptiles

The proposal would involve the removal of a small amounts of surface rocks and an area of around 18.1 ha of exotic-dominated grassland. The proposal would result in the clearing of a narrow, linear strip of relatively disturbed habitat. The proposal area is not located in a known important population of these species. The proposal would not fragment an existing important population into two or more populations.

d) Will the action adversely affect habitat critical to the survival of a species?

Canopy birds

No areas of critical habitat have been declared for these species.

Bats

No areas of critical habitat have been declared for these species.

Arboreal mammals

No areas of critical habitat have been declared for these species.

Reptiles

No areas of critical habitat have been declared for these species.

e) Will the action disrupt the breeding cycle of an important population?

Canopy birds

6.8 ha of native remnant woodland including 14 HBTs providing potential breeding habitat for Regent Honeyeater and Superb Parrot occur in the proposal area and would be removed by the proposal. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, it is not likely that the action will disrupt the breeding cycle of an important population of these species. Mitigation measures have been recommended to mitigate the potential for injury or mortality to breeding birds.

Bats

The proposal would involve the removal of around 61 ha of relatively disturbed and fragmented habitat, including 6.8 ha of native remnant woodland including 14 HBTs that provide potential breeding habitat, 1.4 ha of planted vegetation and 31.6 ha of pine plantation. This habitat is relatively disturbed and fragmented,

and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, it is not likely that the action will disrupt the breeding cycle of an important population of these species. Mitigation measures have been recommended to mitigate the potential for injury or mortality to breeding bats.

Arboreal mammals

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs which provide potential breeding sites for these species. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, it is not likely that the action will disrupt the breeding cycle of a population of these species.

Reptiles

The proposal would involve the removal of a small amounts of surface rocks and an area of around 18.1 ha of exotic-dominated grassland. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, it is not likely that the action will disrupt the breeding cycle of a population of these species.

f) Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Canopy birds

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal and disturbance of a relatively small area of habitat as a result of the proposal is considered unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Bats

The proposal would involve the removal of around 61 ha of relatively disturbed and fragmented habitat, including 6.8 ha of native remnant woodland including 14 HBTs, 1.4 ha of planted vegetation and 31.6 ha of pine plantation. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal and disturbance of a relatively small area of habitat as a result of the proposal is considered unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Arboreal mammals

The proposal would result in the removal of around 6.8 ha of remnant native woodland, including 14 HBTs. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal and disturbance of a relatively small area of habitat as a result of the proposal is considered unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Reptiles

The proposal would involve the removal of a small amounts of surface rocks and an area of around 18.1 ha of exotic-dominated grassland. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in a known important population of these species. In this context, the removal and disturbance

of a relatively small area of habitat as a result of the proposal is considered unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

g) Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

The proposal has the potential to contribute to the spread of invasive species in the proposal area through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal is therefore unlikely to result in invasive species that are harmful to these species becoming established in their potential habitat.

h) Will the action introduce disease that may cause the species to decline?

There is a risk that pathogens could be established or spread in the proposal area via machinery during construction. However, with the recommended mitigation measures, the action is unlikely to introduce any disease which may cause the species to decline.

i) Will the action interfere substantially with the recovery of the species?

Canopy birds

The National Recovery Plan for Superb Parrot lists the following specific objectives:

1. Determine population trends in the Superb Parrot.
2. Increase the level of knowledge of the Superb Parrot's ecological requirements.
3. Develop and implement threat abatement strategies.
4. Increase community involvement in and awareness of the Superb Parrot recovery program.

The proposal would not interfere with any of these objectives.

No recovery plan has been prepared for Painted Honeyeater.

Bats

The National Recovery Plan for the Large-eared Pied Bat lists the following objectives:

1. Identify priority roost and maternity sites for protection
2. Implement conservation and management strategies for priority sites
3. Educate the community and industry to understand and participate in the conservation of the large-eared pied bat

The proposal would not interfere with any of these objectives.

The draft National Recovery Plan for Grey-headed Flying Fox lists the following overall objectives:

1. Improve the Grey-headed Flying Foxes national population trend by reducing the impact of threatening processes on Grey-headed Flying Foxes through habitat identification, protection, restoration, and monitoring.
2. Assist communities and Grey-headed Flying Foxes to coexist through better education, stakeholder engagement, research, policy and continued support to fruit growers.

The proposal would not interfere with any of these objectives.

No recovery plan has been prepared for Corben's Long-eared Bat.

Arboreal mammals

No recovery plan has been prepared for Greater Glider.

The overall objective of the National Recovery Plan for the Koala is to reverse the decline of the koala in NSW, to ensure adequate protection, management and restoration of koala habitat, and to maintain healthy breeding populations of koalas throughout their current range. The proposal would not interfere with any of these objectives.

Reptiles

The National Recovery Plan for Striped Legless Lizard lists the following specific objectives:

1. Establish and maintain national forums for the discussion and organisation of the conservation of *D. impar* across its natural distribution.

2. Determine the distribution of potential *D. impar* habitat.
3. Determine the current distribution and abundance of *D. impar* in Victoria, NSW, the ACT and South Australia.
4. Establish a series of reserves and other managed areas across the natural distribution of the species.
5. Determine the habitat use and ecological requirements of *D. impar*.
6. Identify the nature and extent of threatening processes affecting *D. impar*.
7. Undertake a program of monitoring to provide a basis for adaptive management of *D. impar*.
8. Increase community awareness and involve the community in aspects of the recovery program.
9. Assess the need for salvage and translocation, determine their feasibilities, develop protocols and undertake a trial translocation if appropriate.
10. Ensure that captive population(s) are used to support education and research elements of the Recovery Plan.

The proposal would not interfere with any of these objectives.

No recovery plan has been prepared for Pink-tailed Legless Lizard.

The following assessment assesses the significance of the likely impacts associated with the proposed works on these migratory species:

- Aerial birds:
 - Fork-tailed Swift *Apus pacificus*, White-throated Needletail *Hirundapus caudacutus*
- Ground/Understorey birds:
 - Yellow Wagtail *Motacilla flava*, Satin Flycatcher *Myiagra cyanoleuca*

a) Will the action substantially modify (including by fragmenting, alerting fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?

Aerial birds

The proposal would involve the removal of around 31.6 ha of pine plantation, 6.8 ha of native remnant woodland and 1.4 ha of planted vegetation that form part of the above-canopy habitat for these species. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in an area of known important habitat for these species. In this context, the action is not likely to substantially modify, destroy, or isolate any area of important habitat for these migratory species.

Ground/understorey birds

The proposal would involve the removal of around 61 ha of relatively disturbed and fragmented habitat foraging. This would include 18.1 ha of exotic grassland, 31.6 ha of pine plantation, 6.8 ha of native remnant woodland, 1.4 ha of planted vegetation, 2 ha of other exotic habitat, and 1.1 ha of bare ground. There would also be some disturbance associated with construction and operation of the proposal which could decrease the quality of some habitat. This habitat is relatively disturbed and fragmented, and is similar to the habitat that would remain in the locality. The proposal area is not located in an area of known important habitat for these species. In this context, the action is not likely to substantially modify, destroy, or isolate any area of important habitat for these migratory species.

b) Will the action result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?

Aerial birds

The proposal has the potential to contribute to the spread of invasive species in the proposal site through the transfer and introduction of plant material and soil on machinery. However, they are not likely to be harmful to these species as they are only likely to use the proposal area for foraging above the canopy on occasion. Mitigation measures have also been recommended to prevent the spread of weeds on site. The proposal area is not located in a known area of important habitat for these species. The proposal is therefore unlikely to result in invasive species that are harmful to these species becoming established in an area of important habitat.

Ground/understorey birds

The proposal has the potential to contribute to the spread of invasive species in the proposal site through the transfer and introduction of plant material and soil on machinery. Mitigation measures have been recommended to prevent the spread of weeds on site. The proposal area is not located in a known area of important habitat for these species. The proposal is therefore unlikely to result in harmful invasive species becoming established in an area of important habitat.

c) Will the action seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?

Aerial birds

These species occur in the region and could potentially occur in the vicinity of the proposed action. However, given the low number of records of these species in the region, and the minimal footprint of the proposal which is unlikely to be an ecologically significant proportion of habitat for these wide-ranging species, the proposal is not likely to seriously disrupt the life cycle of an ecologically significant proportion of the populations of these migratory species.

Ground/understorey birds

These species occur in the region and could potentially occur in the vicinity of the proposed action. However, given the low number of records, and the minimal footprint of the proposal which is unlikely to be an ecologically significant proportion of habitat for these wide-ranging species, the proposal is not likely to seriously disrupt the life cycle of an ecologically significant proportion of these populations.

ENDANGERED ECOLOGICAL COMMUNITY

The following assesses the significance of the likely impacts associated with the proposed works on the Endangered Ecological Community (EEC);

- o White Box – Yellow Box – Blakely’s Red Gum Grassy Woodlands and derived native grasslands (Box-Gum Grassy Woodlands) - CEEC

a) Will the action lead to a reduction in the extent of an ecological community?

Box-Gum Grassy Woodland

One 6 ha patch of EPBC listed Box-Gum Grassy Woodland occurs along Cadia Rd. The action would impact 0.8 ha of this community through the construction of a transmission line. This is unlikely to substantially reduce the extent of this EEC.

b) Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?

Box-Gum Grassy Woodland

The proposal would result in the removal of 0.8 ha of Box-Gum Woodland. The proposal would result in the clearing of a narrow, linear strip 45 m wide for a transmission line. The proposal area occurs near an existing roadway that has already contributed to fragmentation of the community to a minor degree relative to the surrounding highly cleared agricultural landscape. The proposal would marginally increase this fragmentation; however, it would not result in isolation of the community from adjacent areas of habitat.

c) Will the action adversely affect habitat critical to the survival of an ecological community?

Box-Gum Grassy Woodland

The majority of the Box-Gum woodland within the proposal area has a degraded understory. The groundlayer degradation is due to the invasion of exotic species. These degraded areas are not likely to contain any important habitat for the long-term survival of the community in the locality, although it does assist with connectivity in the landscape. The area of good condition Box-Gum woodland has a diverse structure and is showing signs of natural recruitment and regeneration of overstory species. This area is considered important for maintaining the species composition of community. This patch comprises an area of about 6 ha on the Eastern side of Cadia Rd. 0.8 ha of this patch would be impacted, so 4.4 ha would remain to provide a seed supply and contribute to the long-term survival of the species. Further, given the large extent of the community estimated to occur in the locality (180 ha), it is unlikely that the habitat to be removed is important to the long-term survival of the community.

d) Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns?

Box-Gum Grassy Woodland

During construction, the proposal would have a short-term impact upon soils and possibly surface water flow, within discrete areas. These impacts are manageable with the implementation of erosion and sediment controls and would be unlikely to further degrade the community in the long-term. The actions associated with the proposal are not considered likely to substantially alter hydrological patterns necessary for the community's survival.

e) Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?

Box-Gum Grassy Woodland

The composition and structure of the vegetation within the study area is already substantially and adversely modified. Areas surrounding the proposal area are actively utilised for agricultural purposes and have been subject to varying levels of degradation. In this context, further modification is expected to be minimal and is unlikely to place the local occurrence of the community at risk of extinction.

- f) Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:**
- a. Assisting invasive species, that are harmful to the listed ecological community, to become established; or**
 - b. Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?**

Box-Gum Grassy Woodland

There is a risk that invasive weeds could be established in the proposal area via seeds or plant parts on machinery during construction. These impacts can be readily managed and minimised with the implementation of a weed management procedure.

The proposal does not involve the introduction of any fertilisers, herbicides or other chemicals or pollutants. With the recommended hygiene measures implemented, the likelihood of the proposal resulting in invasive species or introduction of pollutants that are harmful to the EEC is minimal.

- g) Will the action interfere with the recovery of an ecological community?**

Box-Gum Grassy Woodland

The objective of the

The National Recovery Plan for this EEC lists the objective of minimising the risk of extinction of the ecological community through:

1. Achieving no net loss in extent and condition of the ecological community throughout its geographic distribution;
2. Increasing protection of sites with high recovery potential;
3. Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
4. Increasing transitional areas around remnants and linkages between remnants; and
5. Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

The proposal would not interfere with any of these objectives.

Conclusion

The impacts of the proposal on the assessed threatened and migratory species and EECs listed under the EPBC Act are considered to be manageable. A significant impact is considered unlikely based on the following conclusions:

1. The amount of habitat to be removed or disturbed by the proposal is relatively small in the local context and is already relatively disturbed and fragmented.
2. No fragmentation or isolation of habitat would occur.
3. No substantial contribution to any key threatening process would be expected.
4. Mitigation measures would be implemented to prevent disruptions to the life cycle or harm to individual animals of these species.

APPENDIX E HOLLOW BEARING TREE INVENTORY

Hollow bearing trees that would be impacted are highlighted in Grey.

ID	Latitude	Longitude	Species	DBH (cm)	Small Limb	Small Trunk	Med Liimb	Med Trunk	Large Limb	Large Trunk	Fissure	Other
1	149.048311	-33.518579	Stag	80	1	0	0	0	0	0	0	
2	149.048547	-33.518776	Blakelys Red Gum	40	0	0	0	1	0	0	0	
3	149.049041	-33.518421	Blakelys Red Gum	65	0	0	1	0	0	0	0	
4	149.049085	-33.518378	Yellow Box	75	0	1	0	0	0	0	0	
5	149.037076	-33.524188	Stag	100	1	1	2	1	0	0	0	
6	149.03731	-33.523404	Yellow Box	100	1	0	0	0	0	0	0	
7	149.037323	-33.523256	Yellow Box	90	0	0	2	0	0	0	0	
8	149.037333	-33.523235	Yellow Box	90	3	0	0	0	0	0	0	
9	149.037034	-33.523222	Yellow Box	100	2	0	0	0	0	0	0	
10	149.03694	-33.523298	Yellow Box	100	2	0	0	0	0	0	0	
11	149.036801	-33.523224	Yellow Box	100	2	0	1	0	0	0	0	
12	149.038507	-33.522083	Yellow Box	200	2	0	0	0	0	0	0	
13	149.039016	-33.521671	Yellow Box	100	0	0	0	2	0	0	0	
14	149.038786	-33.521265	Yellow Box	80	3	0	0	0	0	0	0	Galah scar
15	149.038923	-33.521088	Yellow Box	75	2	0	0	0	0	0	0	
16	149.037948	-33.521955	Stag	80	0	0	0	1	0	0	0	
17	149.041786	-33.520151	Blakelys Red Gum	89	2	0	2	0	0	0	0	Galah scar - two Galahs
18	149.042098	-33.52046	Stag	100	5	0	0	1	0	0	0	
19	149.023227	-33.433654	Apple Box	0	2	0	0	0	0	0	0	
20	149.023523	-33.436594	Stag	0	1	0	0	1	0	0	0	
21	149.023574	-33.436664	Stag	10	0	0	0	0	0	0	0	
22	149.023562	-33.438013	Apple Box	0	0	0	0	0	0	0	1	
23	149.022577	-33.442706	Long-leaved Box	60	2	0	0	0	0	0	0	
24	149.027856	-33.515056	Blakelys Red Gum	100	0	0	0	0	0	0	0	
25	149.027465	-33.525676	Yellow Box	100	0	1	1	0	0	0	0	
26	149.031776	-33.527023	Yellow Box	80	0	0	1	0	0	0	0	
27	149.031838	-33.527054	Yellow Box	70	0	0	1	0	0	0	0	
28	149.031927	-33.527097	Yellow Box	60	0	0	0	1	0	0	0	

APPENDIX F NSW HERBARIUM CORRESPONDENCE



National Herbarium of New South Wales

Julie GOODING
nghenvironmental
Suite 1
39 Fitzmaurice Street
Wagga Wagga, NSW 2650
AUSTRALIA

Enquiry No: 20639
Botanical.Is@rbgsyd.nsw.gov.au
Fax No: (02) 9251 1952
Ph. No: (02) 9231 8111
Date: 13 June 2018

Dear Julie GOODING,

Thank you for your enquiry of 13-Jun-18. We are happy to provide the following information:

“I think this is *Eucalyptus canobolensis* although it did not key out using EUCLID as the valves should be exerted in this species.” Det S.F. McCune 12 June 2018. This species is listed as NSW BCA: Vulnerable.

We will be showing your specimen to other eucalypt experts in the herbarium for confirmation (and a second opinion).

Thank you for your enquiry.

Yours sincerely

Barbara Wiecek
Identification Botanist
Botanical Information Service



Go to our online Botanical Information Services at plantnet.rbgsyd.nsw.gov.au to find out more about plants of New South Wales



Office of
Environment
& Heritage

The Botanical Information Email address is Botanical.Is@rbgsyd.nsw.gov.au
Mrs Macquaries Road Sydney NSW 2000 Australia • Telephone (02) 9231 8111 • Fax (02) 9251 1952

Appendix K

Aboriginal and Historical Heritage Impact Assessment (NSW Archaeology)

**Flyer Creek Wind Farm
Modification 4**
Aboriginal and Historical Heritage Assessment

Date: 20 July 2018
Author: Dr Julie Dibden
Proponent: Flyers Creek Wind Farm Pty Ltd



TABLE OF CONTENTS

1 INTRODUCTION	1
2. MODIFICATION 4	3
3. AHIMS DATABASE SEARCH AND LANDSCAPE ASSESSMENT	4
3.1 AHIMS SITE SEARCH RESULTS	4
4. IMPACT ASSESSMENT	7
4.1 PROPOSED IMPACTS	7
4.2 IMPACT ASSESSMENT	7
5. LEGISLATION	8
6. CONCLUSIONS AND RECOMMENDATIONS	9
7. REFERENCES.....	10
APPENDIX 1 – AHIMS DATABASE SEARCH	11

TABLE OF FIGURES

Figure 1 Location of Aboriginal object sites as per AHIMS site search.	6
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LIST OF TABLES

Table 1 The AHIMS sites as per search #355155. Datum has been changed where relevant.	4
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1 INTRODUCTION

The Flyers Creek Wind Farm was granted development approval in 2014. Flyers Creek Wind Farm Pty Ltd is currently seeking a modification (Modification 4) to that approval.

NSW Archaeology Pty Ltd has been engaged to conduct an assessment of the Modification as it relates to the 132 kV transmission line. This report will form an Appendix to the Modification application documentation.

Modification 4 contemplates:

1. increase the wind turbine envelope so as to accommodate the newer, more efficient turbine models now available; and
2. reinstatement of the 132 kilovolt (kV) transmission line from the on-site substation to connection point on the Essential Energy (EE) transmission line to the north of the site (Figure 1).

The following heritage assessments of the project have been conducted previously:

- o Austral Archaeology May 2011 Flyers Creek Wind Farm Project Aboriginal Archaeological & Cultural Heritage Assessment Combined Desktop and Field Assessment Report.
- o Austral Archaeology April 2015 Transmission & Substation, Flyers Creek Wind Farm, Cadia, New South Wales. Aboriginal Archaeological Report.
- o Austral Archaeology July 2015 Transmission & Substation, Flyers Creek Wind Farm, Cadia, NSW. Aboriginal Archaeological Report. Volume 2: Panuara Road, Errowanbang Road and Gap Road Access track.
- o NSW Archaeology Pty Ltd 2016 Flyers Creek Wind Farm Modification 3 Addendum Report.

The current report is conducted in respect of the proposed 132 kilovolt (kV) transmission line which would extend from the on-site substation to a connection point on the existing Orange North to Cadia transmission line to the north of the site.

A process of Aboriginal community consultation has previously been undertaken by Austral Archaeology Pty Ltd. The process of consultation and Registered Aboriginal Parties for the project have been documented in the previous Austral Archaeology reports. During planning modification 3, additional consultation was undertaken. The results of previous modification assessments have been provided to the Registered Aboriginal Parties and no responses were received. Given no Aboriginal objects are expected to be impacted as a result of the current

modification, no further consultation has been undertaken at this stage. Detailed consultation will be carried out as part of the development of the Construction Heritage Management Plan which will be developed pre-construction.

The assessment has been based on a desktop review. A desktop assessment has been considered appropriate given the high levels of previous disturbance in the proposed activity area and the generally low archaeological potential of the area as defined during previous assessments conducted for the Flyers Creek Wind Farm project. It is also noted that the section of line from the on-site substation to the junction of Panuara Road and Cadia Road (~3.2km) has been subject to previous on site survey.

As a result of the assessment, the following conclusions are made:

1. No previously recorded Aboriginal sites are located in the 132 kilovolt (kV) transmission line route corridor (100 metres).
2. The 132 kilovolt (kV) transmission line is assessed to be highly disturbed as a result of previous impacts including road works and forestry operations.
3. It is concluded that the impact area is of low archaeological sensitivity and potential.
4. There are no Aboriginal or historic heritage constraints in regard to the proposed 132 kilovolt (kV) transmission line route corridor.
5. No further heritage assessment is required in respect of the Modification 4 application.

2. MODIFICATION 4

Planning Modification 4 contemplates the changes outlined in section 1 of this report. This assessment considers the potential impacts to aboriginal heritage from the construction and operation of the proposed 132kV transmission line.

The proposed 132kV transmission line would extend from the on-site substation to a connection point via a switching station on the existing Orange North to Cadia transmission line.

The transmission route corridor is 100 m wide, however the final impact area would be up to 45m wide. The 132 kV line would be installed in either road corridors or the edge of a pine plantation. The majority of the line is proposed to be overhead, but there are some small sections where the line may be undergrounded. Limited surface disturbance is expected for overhead sections with some narrow trenches expected for any underground sections.

3. AHIMS DATABASE SEARCH AND LANDSCAPE ASSESSMENT

3.1 AHIMS Site Search Results

A search of the NSW OEH Aboriginal Heritage Information Management System (AHIMS) has been undertaken in respect of this modification assessment (Search #355155). The search covered an area of 165 square kilometres, encompassed by Eastings: 685000 – 692000 and Northings: 6287000 – 6299000, with a buffer of 50 metres (see Appendix 1; Table 1).

A total of 18 Aboriginal object sites are listed on AHIMS for the search area (Figure 1).

No Aboriginal sites or places are listed on AHIMS as being recorded in the proposed activity area.

Searches have been conducted of the NSW State Heritage Inventory and the Australian Heritage Database. No Aboriginal heritage sites are listed on these as being in the subject area.

It is noted that for the purposes of Due Diligence, the AHIMS search results may be relied on for 12 months.

Table 1 The AHIMS sites as per search #355155. Datum has been changed where relevant.

Site ID	Site name	Datum	Easting GDA	Northing GDA	Site features
44-5-0126	FCWF-IF-03	GDA	690131	6289577	Artefact : -
44-5-0128	FCWF-PAD-02	GDA	690238	6289870	Potential Archaeological Deposit (PAD) : -
44-5-0132	FCWF-S-04	GDA	691021	6288725	Artefact : -
44-1-0014	Cadia 1	AGD	686858	6298311	Modified Tree (Carved or Scarred) : -
44-1-0017	CA/1, Cadia 1	AGD	685483	6297784	Artefact : -
44-1-0025	CC-OS-1 (Cudal)	AGD	685313	6296784	Artefact : -
44-1-0134	HOARE'S CREEK	AGD	685363	6296934	Artefact : 1
44-1-0135	CCIF1	GDA	685859	6297095	Artefact : 1
44-1-0136	CCIF2	GDA	685189	6296724	Artefact : 1
44-2-0158	WOODVILLE ROAD PAD	GDA	688529	6295504	Potential Archaeological Deposit (PAD) : 1
44-2-0159	WOODVILLE ROAD 3	AGD	688643	6295670	Artefact : 1
44-2-0160	WOODVILLE ROAD 2	AGD	688652	6295715	Artefact : 1
44-5-0133	Rodds Creek South PAD 7	GDA	686789	6289318	Potential Archaeological Deposit (PAD) : 1

Site ID	Site name	Datum	Easting GDA	Northing GDA	Site features
44-1-0130	CCIF3	GDA	685472	6297899	Artefact : 1
44-1-0131	CCIF4	GDA	685437	6297582	Artefact : 1
44-1-0132	CCIF5	GDA	685305	6297644	Artefact : 1
44-1-0133	CCIF6	GDA	685536	6294536	Artefact : 1
44-1-0038	C-OS-1	AGD	685383	6295714	Artefact : -

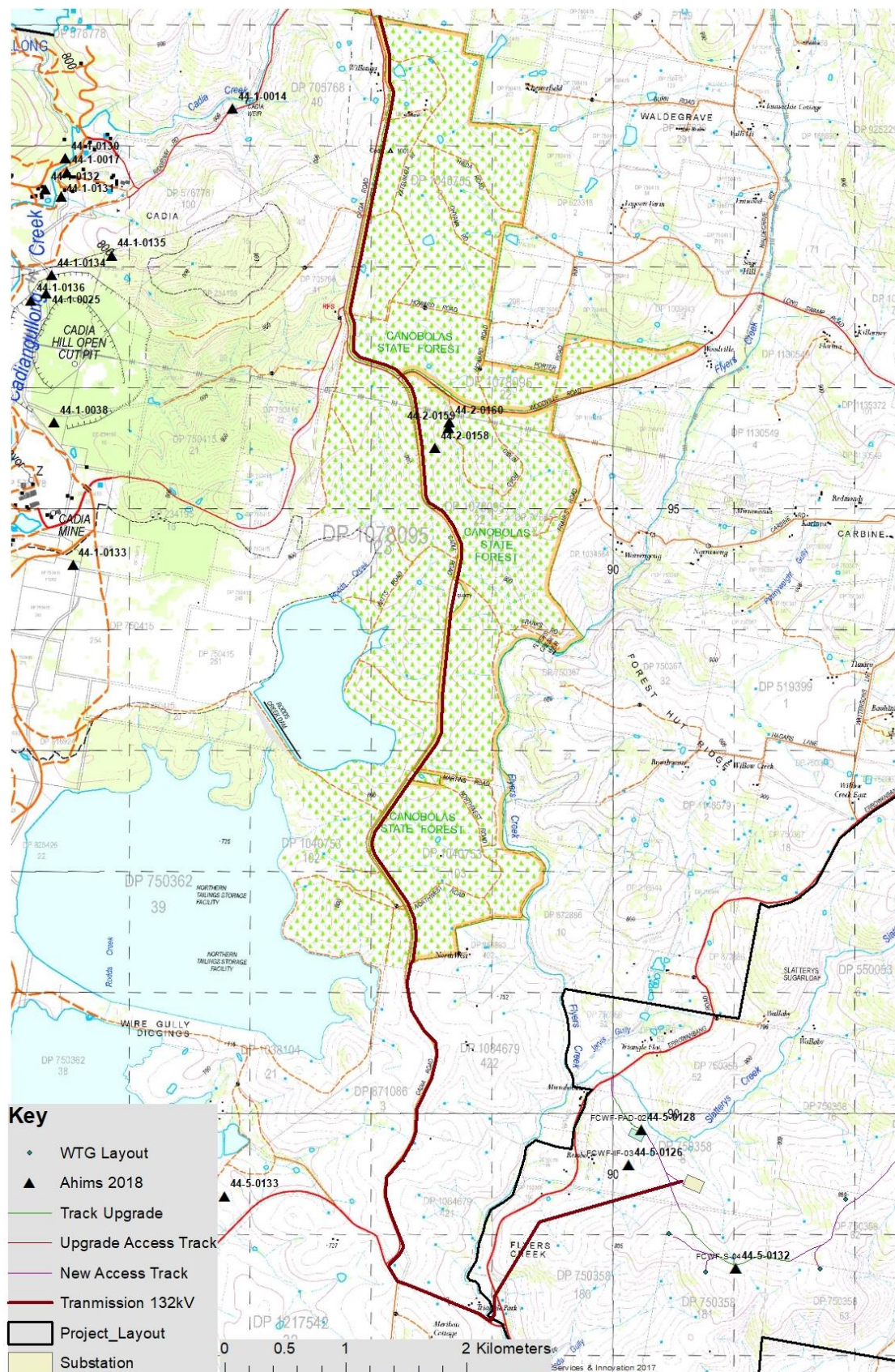


Figure 1 Location of Aboriginal object sites as per AHIMS site search.

4. IMPACT ASSESSMENT

4.1 Proposed Impacts

The route of the 132kV is shown in Figure 1. The transmission route corridor is 100 m wide. The 132kv line will:

- o be approximately 14.5 km in length;
- o travel across open farmland from the substation westwards, cross Errowanbang Rd (public road) and then travel along Panuara Rd reserve before heading north on Cadia Rd reserve before travelling alongside the road/in NSW Forestry Corporation state forest.
- o The power poles will likely be approximately 24 m high and the easement corridor will be 45 m wide within a 100 m wide route corridor.

4.2 Impact Assessment

The transmission route corridor is 100 m wide, however the final impact area would be up to 45m wide. The 132 kV line would be installed in either road corridors or the edge of a pine plantation. The majority of the line is proposed to be overhead, but there are some small sections where the line may be underground. Limited surface disturbance is expected for overhead sections with some narrow trenches expected for any underground sections.

The proposed activity area has already experienced significant prior ground disturbance from original clearance, road construction and forestry operations.

Given previous clearing, there is low potential for the proposed activity to disturb any culturally modified trees.

The landscape is assessed to be of generally low archaeological potential. Numerous assessments have been conducted in respect of the Flyers Creek Wind Farm and all have concluded that the landscape is of low sensitivity. Two previous studies of alternative transmission line routes in the local area have failed to record Aboriginal sites (Austral Archaeology 2016a and 2015b).

It is concluded that there are no known Aboriginal sites and there is a low probability of objects occurring in the proposed activity area.

5. LEGISLATION

The National Parks and Wildlife Act 1974 (NPW Act) is the primary legislation for the protection of some aspects of Aboriginal cultural heritage in NSW. One of the objectives of the NPW Act is:

... the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including but not limited to: (i) places, objects and features of significance to Aboriginal people ... (s.2A(1)(b))

Part 6 of the NPW Act is administered by the NSW Office of Environment and Heritage (NSW OEH) and provides specific protection for Aboriginal objects and declared Aboriginal places by establishing offences of harm. Harm is defined to mean destroying, defacing or damaging an Aboriginal object or declared Aboriginal place, or moving an object from the land.

Section 86 of the NPW Act, *Harming or desecrating Aboriginal objects and Aboriginal places*, sets out the penalties for harming an Aboriginal object. For an individual, the penalty for harming an object the person knows is an Aboriginal object, is imprisonment for up to 2 years and a significant fine (>\$200,000).

Anyone proposing to carry out an activity that may harm an Aboriginal object or declared Aboriginal place must investigate, assess and report on harm that may be caused by the activity they propose. An Aboriginal Heritage Impact Permit (AHIP) may be required if harm to Aboriginal objects and declared Aboriginal places is proposed. When this is the case, an Aboriginal Cultural Heritage Assessment Report (ACHAR) is required to support the AHIP application. No Aboriginal objects are known to be present in the activity area and it is assessed to be of low archaeological sensitivity. Based on the current assessment it is concluded that an AHIP is not required.

Further archaeological investigations such as test excavations can be undertaken to provide a more informed assessment. Such work can be done within the provisions of the NSW DECCW (2010b) Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (the Code of Practice). Test Excavation undertaken in accordance with the Code of Practice, allows harm to Aboriginal objects to occur (during excavation) without the need for an AHIP. Such work would normally only take place if the assessment concluded that further archaeological works were necessary. In this case, that conclusion has not been reached.

6. CONCLUSIONS AND RECOMMENDATIONS

The assessment has concluded that based on the extent of previous impacts and the nature of the landscape, the activity area is not archaeologically sensitive. It is also noted that the proposed impacts are relatively minor in scope. No Aboriginal objects are known to be present.

Accordingly, no further archaeological assessment is required, and it is concluded that there are no Aboriginal or historic heritage constraints in regard to the modification.

The existing conditions of Project Approval require a Construction Heritage Management Plan to be implemented to manage any potential impacts to Aboriginal and Historic heritage. This condition remains appropriate to manage any potential heritage impacts resulting from Modification 4.

7. REFERENCES

- Austral Archaeology Pty Ltd May 2011 Flyers Creek Wind Farm Project Aboriginal Archaeological & Cultural Heritage Assessment Combined Desktop and Field Assessment Report.
- Austral Archaeology Pty Ltd April 2015a Transmission & Substation, Flyers Creek Wind Farm, Cadia, New South Wales. Aboriginal Archaeological Report.
- Austral Archaeology Pty Ltd July 2015b Transmission & Substation, Flyers Creek Wind Farm, Cadia, NSW. Aboriginal Archaeological Report. Volume 2: Panuara Road, Errowanbang Road and Gap Road Access track.
- NSW Archaeology Pty Ltd 2016 Flyers Creek Wind Farm Modification 3 Addendum Report.

APPENDIX 1 – AHIMS DATABASE SEARCH



Office of
Environment
& Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Flyers Ck

Client Service ID : 355155

SiteID	SiteName	Datum	Zone	Eastng	Northing	Contact	Site Status	SiteFeatures	SiteTypes	Reports
44-5-0126	FCWVF-IF-03	GDA	SS	690131	6289577	Open site	Valid	Aresfact: -		102269
	Contact	Recorders	Austral Archaeology Pty Ltd-Mr-Alan Hay					Permits		
44-5-0128	FCWVF-PAD-02	GDA	SS	690238	6289870	Open site	Valid	Potential Archaeological Deposit (PAD): -		102269
	Contact	Recorders	Austral Archaeology Pty Ltd-Mr-Alan Hay					Permits		
44-5-0132	FCWVF-S-04	GDA	SS	691021	6288725	Open site	Valid	Aresfact: -		102269
	Contact	Recorders	Austral Archaeology Pty Ltd-Mr-Alan Hay					Permits		
44-1-0014	Cadia 1	AGD	SS	688745	6298127	Open site	Valid	Modified Tree (Carved or Scarred): -	Scarred Tree	630
	Contact	Recorders	Andrew Ross					Permits		
44-1-0017	CA/1, Cadia 1	AGD	SS	688370	6297600	Open site	Valid	Aresfact: -	Open Camp Site	2326
	Contact	Recorders	Jim Kohen					Permits		
44-1-0025	CC-OS-1 (Cudal)	AGD	SS	688200	6296600	Open site	Valid	Aresfact: -	Open Camp Site	
	Contact	Recorders	Bill Allen					Permits		
44-1-0134	HOARE'S CREEK	AGD	SS	688250	6296750	Open site	Valid	Aresfact: 1		
	Contact	Recorders	Jim Kohen					Permits		
44-1-0135	CCIF1	GDA	SS	688559	6297095	Open site	Valid	Aresfact: 1		
	Contact	Recorders	Jim Kohen					Permits		
44-1-0136	CCIF2	GDA	SS	688189	6296724	Open site	Valid	Aresfact: 1		
	Contact	Recorders	Jim Kohen					Permits		
44-2-0158	WOODYVILLE ROAD PAD	GDA	SS	688529	6295504	Open site	Valid	Potential Archaeological Deposit (PAD): 1		
	Contact	Recorders	Kayanda Archaeological Services					Permits		
44-2-0159	WOODYVILLE ROAD 3	AGD	SS	688530	6295486	Open site	Valid	Aresfact: 1		
	Contact	Recorders	Kayanda Archaeological Services					Permits		
44-2-0160	WOODYVILLE ROAD 2	AGD	SS	688539	6295531	Open site	Valid	Aresfact: 1		
	Contact	Recorders	Kayanda Archaeological Services					Permits		
44-5-0133	Rodds Creek South PAD 7	GDA	SS	686789	6299318	Open site	Valid	Potential Archaeological Deposit (PAD): 1		
	Contact	Recorders	Doctor Colin Pardoe					Permits		
44-1-0130	CCIF3	GDA	SS	685472	6297899	Open site	Valid	Aresfact: 1		
	Contact	Recorders	Jim Kohen					Permits		
44-1-0131	CCIF4	GDA	SS	685437	6297582	Open site	Valid	Aresfact: 1		

Report generated by AHIMS Web Service on 03/07/2018 for Julie Didden for the following area at Datum: GDA, Zone: SS, Eastings: 688000 - 692000, Northings: 6287000 - 6299000 with a Buffer of 50 meters. Additional Info : Archaeological assessment. Number of Aboriginal sites and Aboriginal objects found is 18
This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.




AHIMS Web Services (AWS)
 Extensive search - Site list report

Your Ref/PO Number : Flyers Ck
 Client Service ID : 355155

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
44-1-0132	Contact CCIF5	Recorders GDA	Jim Kohlen 55	685305	6297644	Open site	Valid	Artefact : 1	Permits	
44-1-0133	Contact CCIF6	Recorders GDA	Jim Kohlen 55	685536	6294536	Open site	Valid	Artefact : 1	Permits	
44-1-0038	Contact C-OS-1	Recorders AGD	Jim Kohlen 55	685270	6295530	Open site	Valid	Artefact : -	Permits	
	Contact	Recorders	Central West Archaeological and Heritage Services Pty Ltd			Open Camp Site	Valid	Artefact : -	Permits	

Report generated by AHIMS Web Service on 03/07/2018 for Julie Didden for the following area at Datum :GDA, Zone : 55, Eastings : 685000 - 692000, Northings : 6287000 - 6299000 with a Buffer of 50 meters. Additional Info : Archaeological assessment. Number of Aboriginal sites and Aboriginal objects found is 18
This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

Appendix L

Community Newsletter (July 2018)

Flyers Creek Wind Farm Newsletter

July 2018



Welcome to the latest Flyers Creek Wind Farm project newsletter.

Project Update

Flyers Creek Wind Farm is located near Errowanbang Road, Blayney Shire Council. It was granted Project Approval by the NSW Government Planning Assessment Commission (PAC) in March 2014.

Infigen has been preparing a planning modification application for the project to increase the wind turbine maximum tip height by 10 metres (m) from 150m to 160m and to install a 132kV transmission line to connect the wind farm to the electricity network. No changes to the location of wind turbines or project infrastructure is included in the modification application. The project layout showing the location of the 132kV can be viewed on the next page of this newsletter.

The modification will be lodged with the NSW Department of Planning and Environment in July 2018 and will be available to view on the Department’s major projects web page.

Community

The Flyers Creek Wind Farm Community Consultation Committee (CCC) continues to meet on a quarterly basis to discuss the project. The latest meeting was on 16th May 2018. Minutes of the meetings are available on the Infigen website: www.infigenenergy.com/flyers-creek

Mailing List

If you would like to be added to the Flyers Creek Wind Farm mailing list or update your details please contact megan.richardson@infigenenergy.com

CENREC

Infigen is grateful for the support of the Central NSW Renewable Energy Co-operative (CENREC). This community-led co-operative was formed in October 2012 with a primary purpose to enable community investment in the local area, including the Flyers Creek Wind Farm project. More information is available at:

www.cenrec.com.au



Infigen was pleased to sponsor part of the Carcoar Annual Show in October 2017.

Number of Wind Turbines		38
Approximate installed capacity		140 - 155 MW
Maximum wind turbine tip height		160 m
Estimated annual generation		~ 430 GWh
Equivalent number of houses powered per annum		~ 58,000

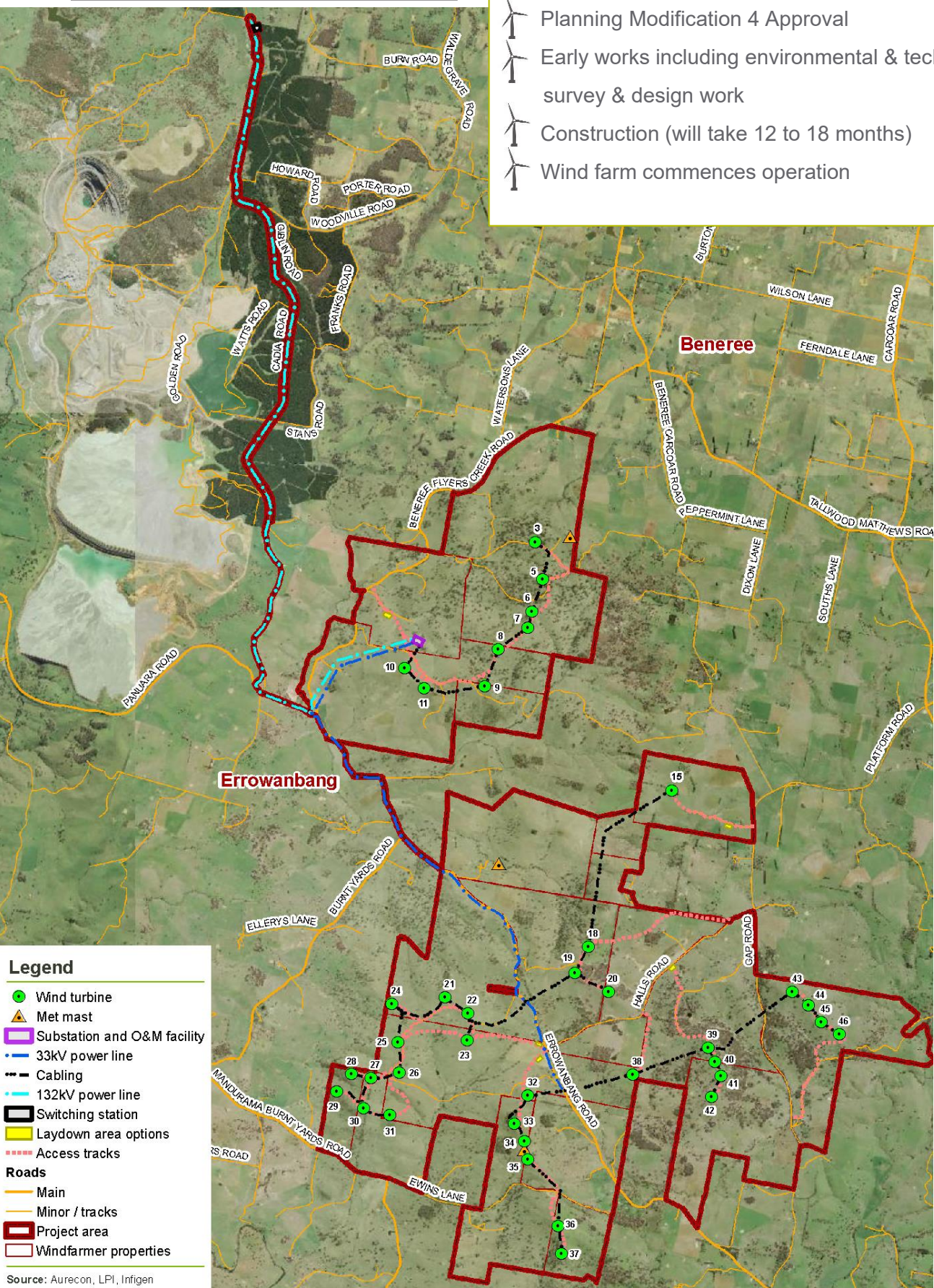
Our generation, your future

Flyers Creek Wind Farm

Project Milestones



- Planning Modification 4 Approval
- Early works including environmental & technical survey & design work
- Construction (will take 12 to 18 months)
- Wind farm commences operation



Please contact us if you have any questions or would like to meet to discuss the project.

Ph: 02-8031-9900

E: megan.richardson@infigenenergy.com

W: www.infigenenergy.com

Our generation, your future