

Crookwell 2 Wind Farm Modification 2

VISUAL IMPACT ASSESSMENT

Prepared for:



Prepared by:

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Table 1 Glossary

Term	Definition
Cumulative effects	The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.
Magnitude	A combination of the scale, extent and duration of an effect.
Mitigation	Measures, including any processes, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development project.
Residual visual effect	Observable difference between the approved Crookwell 2 Wind Farm project and the proposed Crookwell 2 Modification 2 amendments.
Sensitivity	Susceptibility of a receiver to a specific type of change.
Swept area	Circular area defined by the rotational path of the rotor blades.
Visibility	A relative determination at which the proposal can be clearly discerned and described.
Visual amenity	The value of a particular area or view in terms of what is seen.
Visual envelope	Extent of potential visibility to or from a specific area or feature.
Visual Impact Assessment	A process of applied professional and methodical techniques to assess and determine the extent and nature of change to the composition of existing views that may result from a development.
View location	A place or situation from which a proposed development may be visible.
Visual receiver	Individual and/or defined groups of people who have the potential to be affected by a proposal.
Visual significance	A measure of the importance or gravity of the visual effect culminating from the degree of magnitude and receiver sensitivity.
Zone of Theoretical Visibility (ZTV; sometimes Zone of Visual Influence)	A map, usually digitally produced, showing areas of land within which a development is theoretically visible.

Executive summary

Green Bean Design Pty Ltd (GBD) has been commissioned by Union Fenosa Wind Australia Pty Ltd on behalf of Crookwell Development Pty Ltd (the Proponent) to prepare a Visual Impact Assessment (VIA) report for the Crookwell 2 Wind Farm (C2WF) proposed Modification-2 Application (Mod-2). The Application is for an amendment of development consent in accordance with section 75W of the Environment Planning and Assessment Act 1979.

This VIA has been prepared to assess the potential visual effect of the C2WF proposed Mod-2 amendments to increase tip height to a maximum 160m against the approved C2WF Modification-1 Application (Mod-1). The C2WF Mod-1 development consent (dated 29th June 2009) permits the construction and operation of up to 46 wind turbines to a maximum of 128 metre tip height.

The Zone of Theoretical Visibility (ZTV) Diagrams **Figures 2** and **3** illustrate that the area of land within which the C2WF Mod-1 and Mod-2 would be theoretically visible (as well as number of wind turbines being visible), would be very similar.

This VIA included an assessment of ninety four residential dwellings within 5 km of a C2WF proposed Mod-2 wind turbine. The overall assessment of visual effects associated with the C2WF proposed Mod-2 wind turbines is summarised as Low to Negligible. The C2WF Mod-2 wind turbine is not considered to be of a magnitude that would significantly increase visual effects associated with the approved C2WF Mod-1 development. Key differences in the approved C2WF Mod-1 and proposed Mod-2 are illustrated in **Figures 4, 5** and **6**.

The installation of ancillary wind farm infrastructure, including the proposed TransGrid tower, would not result in unacceptable levels of visual impact from surrounding key receiver locations.

This VIA incorporates a summary of the Shadow Flicker and Blade Glint Assessment. This VIA also determined that no non-associated residential dwellings surrounding the C2WF Mod-2 wind turbines would experience shadow flicker. This assessment also determined that blade glint would not be an issue subject to the correct surface treatment of wind turbine structures.

Eight photomontages have been prepared to illustrate the location and extent of wind turbines within the approved C2WF Mod-1 and Mod-2 wind turbine layouts. The photomontages have not been prepared to reflect those presented in the C2WF original and Mod-1 applications as these photomontages now differ from best practice or advice within contemporary guidelines for the preparation and presentation of photomontages

As proposed amendments to the approved C2WF Mod-1 are considered to result in low level visual effects, and introduce elements which are neither prominent or out of character with the approved C2WF Mod-1, the potential for the proposed Mod-2 wind turbines to result in any additional significant cumulative visual effects is considered to be low.

The overall area from which the C2WF Mod-2 obstacle lighting may be visible is not expected to extend extensively beyond the influence of obstacle lighting associated with the approved C2WF Mod-1.

1 Introduction

1.1 Introduction

The NSW Department of Planning and Environment (DPE) have not issued supplementary requirements in response to the C2WF proposed Mod-2 notification; however, DPE provided comments with regard to the consideration of potential visual impacts for the C2WF proposed Mod-2 development. These comments are as follows:

- *'Ensure that the level of assessment is commensurate with the level of impact associated with the proposed changes to the approved project. The assessment must also consider the cumulative impacts of the proposed modification with nearby operating, approved or proposed wind farms'.*
- *'The EA should include at least the following: ... a visual assessment of the project (as modified) on all residents within 5km of the wind farm, including any changes to direct visual impacts, shadow flicker, blade glint, and night lighting'.*
- *'The EA must also provide a clear description of the measures proposed to mitigate, manage and/or offset the impacts of the proposed modification, and how these would be integrated into the existing environmental management arrangements for the project'.*

1.2 Report structure

This VIA report been structured into eleven parts as follows:

Table 2 – Report structure

Report section	Description
Section 1 Introduction and report structure	This section provides an introductory section that describes the intent and purpose of the VIA and description of the report structure
Section 2 Project information provided to GBD	Identifies the information provided to, or sourced by, GBD in order to undertake the VIA
Section 3 Methodology	This section sets out the methodology employed in the VIA preparation
Section 4 Approved Crookwell 2 Wind Farm Mod-1 and Proposed Mod-2 amendments	This section describes the key differences in wind turbine layout and design criteria between the approved Mod-1 and proposed Mod-2 amendments
Section 5 Zone of Theoretical Visibility (ZTV)	This section identifies the area of land surrounding the wind farm from which wind turbines, or portions of wind turbine structures, may be theoretically visible

Table 2 – Report structure

Report section	Description
diagrams	
Section 6 Ancillary structures	This section describes infrastructure associated with the wind farm other than the wind turbines, including the new TransGrid transmission line tower
Section 7 Assessment of visual effects	This section describes the assessment and determination of residual visual effects between the approved Mod-1 and proposed Mod-2 amendments
Section 8 Shadow flicker and blade glint	This section describes potential shadow flicker effects and summarises the Shadow Flicker report included in the main C2WF Mod-2Amendment Report
Section 9 Photomontages	This section describes and presents the photomontages prepared for the C2WF Mod-2 VIA
Section 10 Review of Conditions of Consent	This section describes the potential impact of alternate existing and/or known infrastructure developments within proximity to the Crookwell 2 Wind Farm
Section 11 Conclusions	Conclusions are drawn on the overall impact of the proposed C2WF Mod-2 within the surrounding viewshed

2 Project information provided to GBD

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

- an amended wind turbine layout, including approved C2WF Mod-1 wind turbine to be deleted
- location and description of proposed Mod-2 wind turbines
- ZTV diagrams and
- amended photomontages illustrating the approved C2WF Mod-1 wind turbines and the proposed Mod-2 wind turbines and layout.

Additionally the Proponent has provided copies of the following reports by others, which have been reviewed and summarised as necessary into this VIA:

- AECOM Australia Pty Ltd (2012) Crookwell 2 Wind Farm New Transmission Line Tower Visual Impact Assessment
- Aviation Projects Pty Ltd (2016) Aeronautical Impact Assessment Crookwell 2 Wind Farm
- DNV-GL Energy Renewables Advisory Pty Ltd (2016) Crookwell 2 Wind Farm Shadow Flicker and Blade Glint Assessment.

3 Methodology

3.1 Introduction

The C2WF proposed Mod-2 methodology included the following activities:

- desktop study reviewing the approved C2WF original application, and the approved Mod-1 and proposed Mod-2 layouts
- site inspections and photography
- preparation of ZTV diagrams
- assessment of significance of residual visual effects and
- preparation of photomontages and illustrative figures.

3.2 Desktop study

A desktop study was carried out to review the approved C2WF original application and approved Mod-1 viewsheds. This was carried out by reference to topographic maps as well as aerial photographs of the surrounding landscape.

A preliminary ZTV diagram for the C2WF Mod-2 wind turbine layout was produced prior to the commencement of fieldwork to inform the likely extent and nature of residual visual effects within a 5km viewshed of the approved wind turbines.

Topographic maps and aerial photographs were also used to identify the locations and categories of potential view locations that could be verified during the fieldwork component of the assessment.

3.3 ZTV diagrams

ZTV Diagrams were prepared to illustrate the theoretical visibility of the approved C2WF Mod-1 wind turbines (tip height at 128 metres) and proposed Mod-2 wind turbines (tip height at 160 metres). The ZTV Diagrams are illustrated in **Figures 2 and 3**.

3.4 Fieldwork and photography

GBD undertook fieldwork for the C2WF Mod-2 project. The fieldwork included:

- a site inspection to determine and confirm the extent of residual effects between the approved C2WF Mod-1 and proposed Mod-2 wind turbines and ancillary project structures, and to identify landscape characteristics surrounding the wind farm site, and around the proposed electrical works; and
- photography for the photomontages from residential and public view locations.

3.5 Residual visual effects

The C2WF Mod-2 residual visual effects on surrounding receiver locations would result from a combination of the Modification 2 wind turbine visibility and the characteristics of the landscape between, and surrounding, the receiver locations and the wind farm. The potential degree of visibility and resultant visual effect would be partly determined by a combination of factors such as:

- category and type of situation from which people could view the wind farm (examples of view location categories include residents or motorists)
- visual sensitivity of view locations surrounding the wind farm
- distance of visual effect (between view locations and the wind farm) and

- duration of time people could view the wind farm from any particular static or dynamic view location.

3.6 Photomontages

Eight photomontages have been prepared from residential dwellings and public road corridors. The photomontages illustrate and contrast the approved C2WF Mod-1 and the proposed Mod-2 wind turbines and layout. The photomontage locations are illustrated in **Figure 8** and the photomontages in **Figures 9a to 16b**.

3.7 Shadow flicker & blade glint

A Shadow Flicker Assessment and shadow flicker diagram have been prepared for the C2WF Mod-2 amended proposal and are included in the C2WF Mod-2 main planning report. An overview of the Shadow Flicker Assessment and consideration of potential blade glint impacts are included in this VIA.

4 Approved C2WF Mod-1 and proposed Mod-2 amendment

4.1 Approved C2WF Mod-1 design

The Crookwell 2 Wind Farm, subject to the notice of amendment (for Mod-1) dated 29 June 2009, is approved for construction and operation of up to 50 wind turbines. Four of these wind turbines were subject to further development consent and subsequently removed by the Proponent, resulting in a total of up to 46 wind turbines.

Mod-1 of the development consent also permits the installation of wind turbines to a maximum tip height of 128 metres and relocation of up to 20 wind turbines. Obstacle lighting is also approved to be installed for 23 wind turbines.

4.2 Proposed C2WF Mod-2 design

The C2WF Mod-2 design would include:

- up to 33 wind turbines
- a hub height increase to 95 metres AHD
- an increase in blade length to a maximum 64 metres
- an increase in rotor diameter up to 130 metres and
- an increase of the blade tip height up to 160 metres.

The following table outlines the differences in the approved C2WF Mod-1 and proposed Mod-2 wind turbine design criteria.

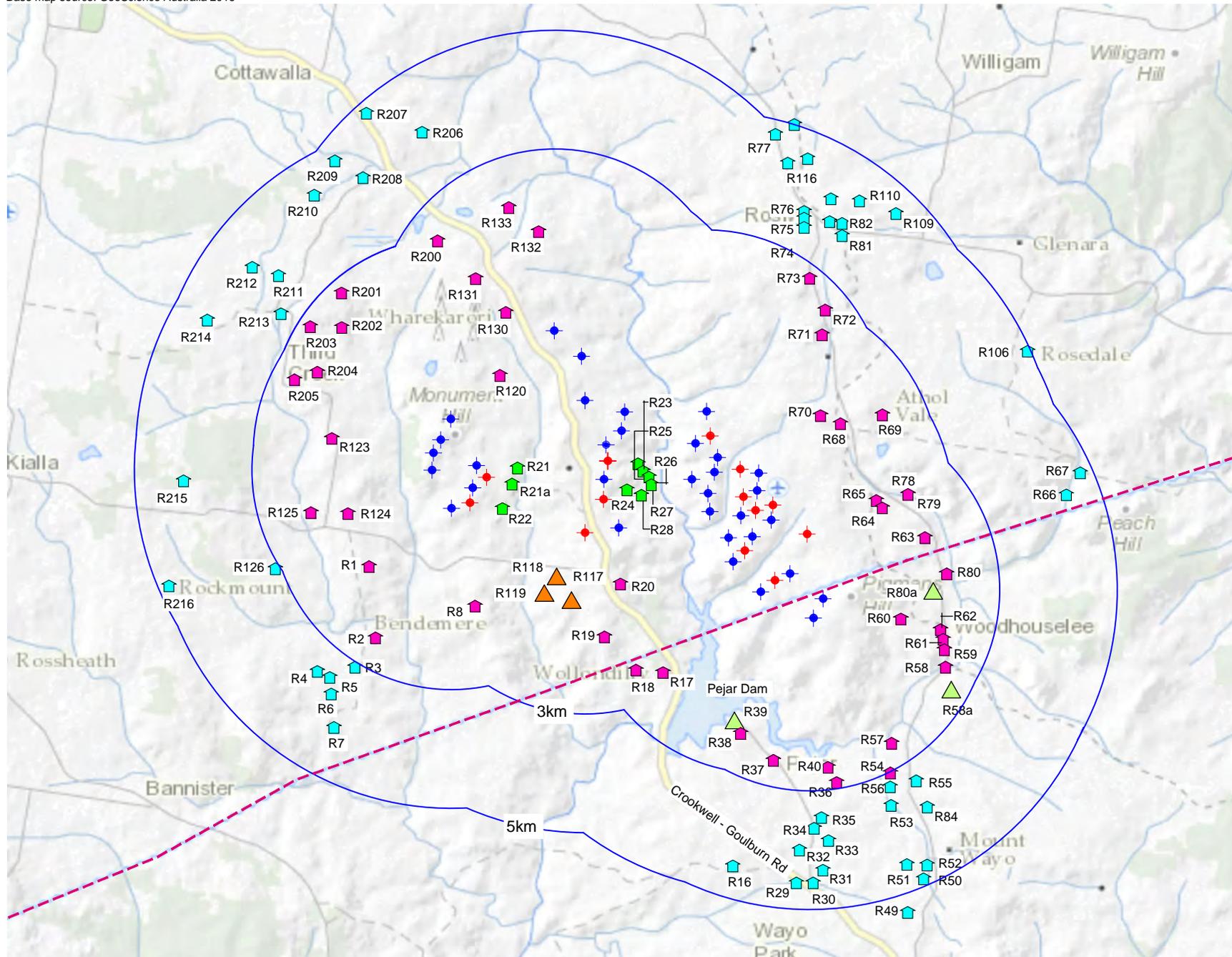
Table 3: Approved Mod-1 and Proposed Mod-2 design criteria

	Hub height	Rotor diameter	Tip height	Total number
Approved C2WF Mod-1 wind turbine	80 m	96 m	128 m	46
C2WF Mod-2 proposed wind turbine	95 m	130 m	160 m	33
Difference	+15 m	+34 m	+32 m	-13
Percentage difference	+19%	+35%	+25%	-28%

Table 4: Approved Mod-1 and Proposed Mod-2 swept area

	Rotor diameter	Swept area
Approved C2WF Mod-1 wind turbine	96 m	7,234 m ²
C2WF Mod-2 proposed wind turbine	130 m	13,266 m ²
Difference	+34 m	+6,032 m ²
Percentage difference	+35%	+83%

The approved C2WF Mod-1 and proposed Mod-2 amended wind turbine layouts, including location of wind turbines to be deleted are illustrated in **Figure 1**.



Legend

- Approved C2WF Mod-1 wind turbine layout subject to Mod-2 (indicative location)
 - Approved C2WF Mod-1 wind turbine to be removed (indicative location)
 - Approximate distance from approved Crookwell 2 wind turbine
 - Associated C2WF residential dwelling
 - Non associated residential dwelling within 3km of approved C2WF Mod 1 wind turbine
 - Non associated residential dwelling between 3km and 5km of approved C2WF Mod-1 wind turbine
 - Potential future dwelling location without DA lodged
 - Non residential structure
 - Existing 330kV transmission line
- Note: All house locations are indicative only

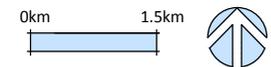


Figure 1 C2WF Approved Mod-1 and proposed Mod-2 layout

Crookwell 2 Wind Farm Mod-2 Visual Impact Assessment

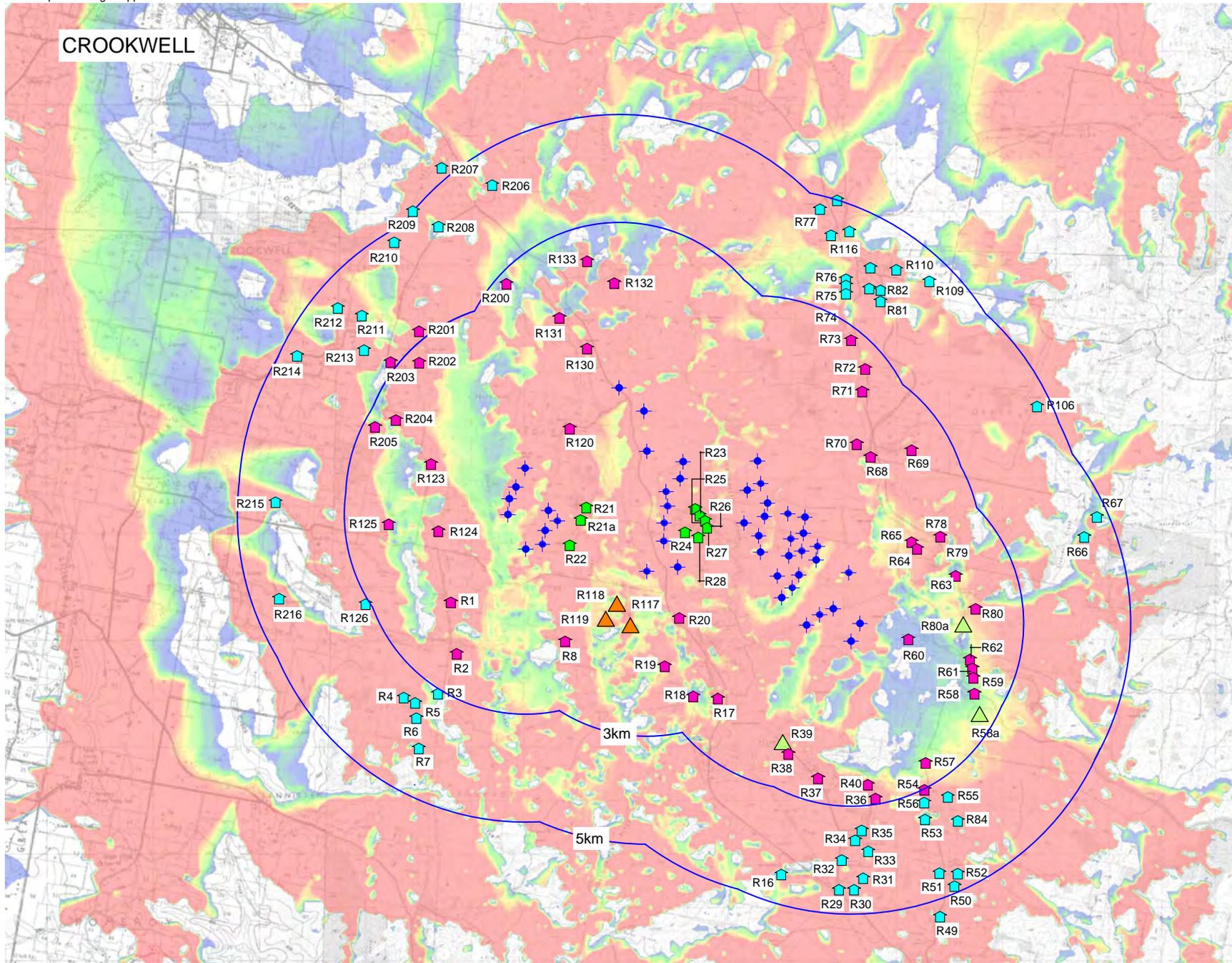
5 Zone of Theoretical Visibility Diagrams

5.1 Introduction

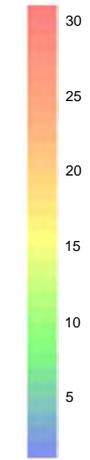
Within the recognised limitations of Zone of Theoretical Visibility (ZTV) diagrams, the overall extent of approved C2WF Mod-1 and proposed Mod-2 wind turbine visibility covers a similar extent within and beyond 5km of the landscape surrounding the approved C2WF Mod-1. **Figures 2** and **3** illustrate the theoretical visibility of the approved C2WF Mod-1 (at 128m tip height) and proposed Mod-2 (at 160m tip height) wind turbines.

The similarity in theoretical wind turbine visibility demonstrates the influence of local topographical features on views toward the approved C2WF Mod-1 and proposed Mod-2 wind turbines. The ZTV diagrams also illustrate that the proposed Mod-2 wind turbines would have a very limited increase in visual effects across the approved C2WF Mod-1 viewshed.

Whilst the overall extent of wind turbine visibility would be contained by topography for both the approved C2WF Mod-1 and the proposed Mod-2 wind turbines, the number of wind turbines visible from elevated receiver locations within the wind farm viewshed is likely to increase. However, when compared to the approved C2WF Mod-1 wind turbines, the increase in wind turbine visibility would be restricted to the upper sections (hubs and rotors) of wind turbine structures, rather than whole wind turbines.



Legend (ZTV Tips visible)



Legend

- Approved C2WF Mod-1 wind turbine (indicative location)
 - Approximate distance from approved C2WF Mod-1 wind turbine
 - Associated C2WF residential dwelling
 - Non associated residential dwelling within 3km of approved Mod-1 wind turbine
 - Non associated residential dwelling between 3km and 5km of an approved Mod-1 wind turbine
 - Potential future dwelling location without DA lodged
 - Non residential structure
- Note Residential dwelling locations are indicative only

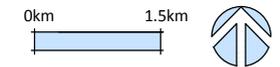
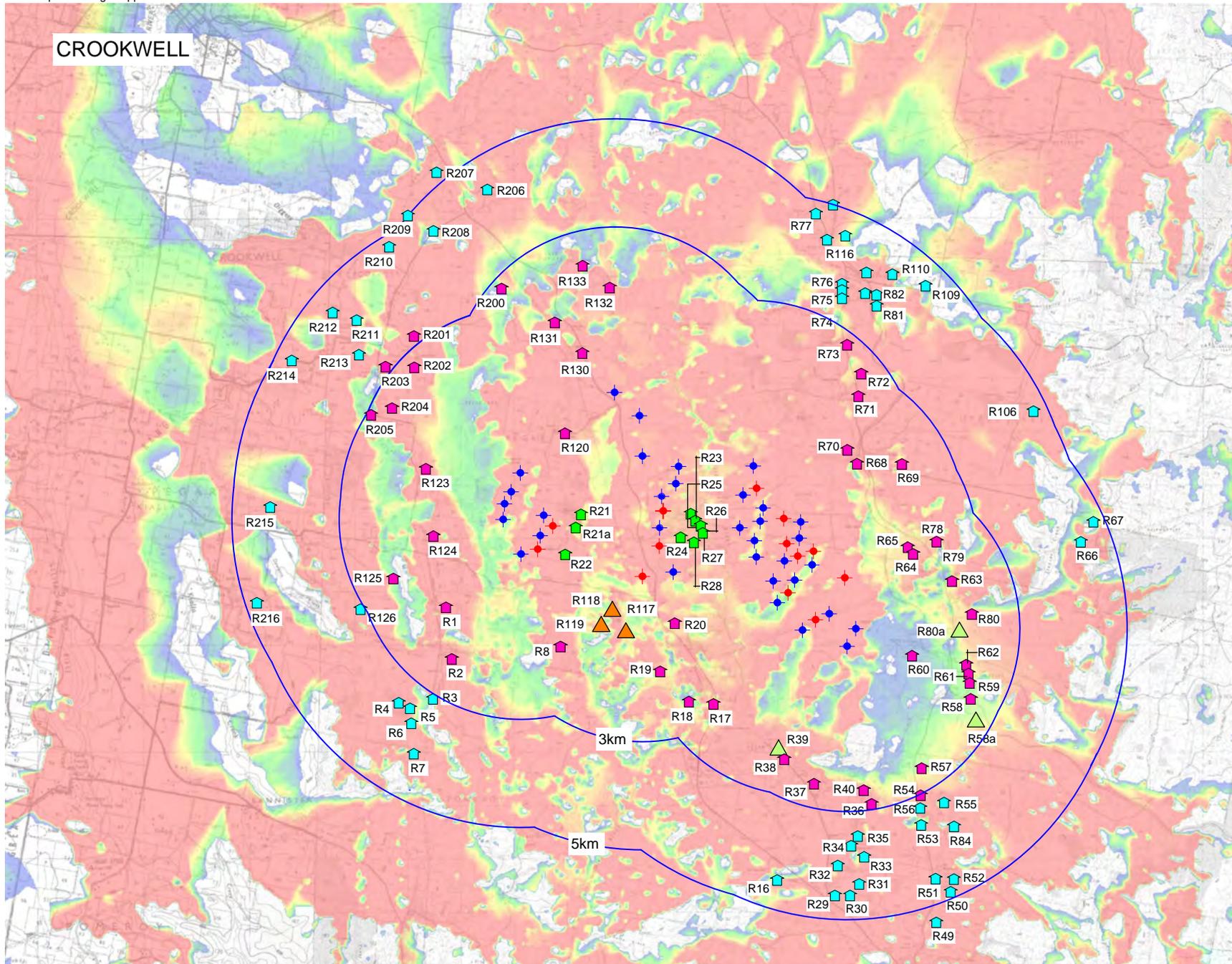
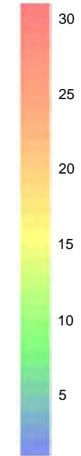


Figure 2 C2WF Mod-1 ZTV Diagram
Approved tip of blade at 128 metres

Crookwell 2 Wind Farm Mod-2 Visual Impact Assessment



Legend (ZTV Tips visible)



Legend

- Approved C2WF Mod-1 wind turbine subject to Mod-2 (indicative location)
 - Approved C2WF Mod-1 wind turbine to be removed (indicative location)
 - Approximate distance from approved C2WF Mod-2 wind turbine
 - Associated C2WF residential dwelling
 - Non associated residential dwelling within 3km of approved C2WF Mod-2 wind turbine
 - Non associated residential dwelling between 3km and 5km of an approved C2WF Mod-2 wind turbine
 - Potential future dwelling location without DA lodged
 - Non residential structure
- Note Residential dwelling locations are indicative only



Figure 3 - C2WF ZTV Diagram
Mod-2 tip of blade at 160 metres

Crookwell 2 Wind Farm Mod-2 Visual Impact Assessment

6 Ancillary structures

6.1 Introduction

The approved C2WF Mod-1 incorporates a range of ancillary structures which include:

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

The proposed Mod-2 would not result in any fundamental change to the majority of approved Mod-1 structures and would not result in any additional visual impacts to those outlined in previous visual assessments.

6.2 New transmission line tower

The Proponent commissioned AECOM Australia Pty Ltd to prepare a visual impact assessment detailing the potential visual impact that would arise from the change in grid connection configuration (requirement of TransGrid) of the C2WF to the TransGrid network. The AECOM visual impact assessment identified five receiver locations as being representative of key views toward the new transmission line tower. The receiver locations included:

- Crookwell-Goulburn Road
- Pejar Dam picnic area
- Woodhouselee Road (north)
- Woodhouselee Road (south)
- Valdarman Hill.

The AECOM visual impact assessment determined that the overall visual impact rating for the new transmission line tower would be minor to negligible. The minor to negligible visual impact rating was determined for the following reasons:

- The proposed transmission line tower *'is situated in a reasonably remote location, with no observers within a 1 km radius that have direct, detailed views of the structure'*;
- Views of the proposed new transmission line tower *'are generally quite distant (on average from 2 km away) with the tower often difficult to see from this distance'*;
- *'The closest residential viewers to the proposed stanchion are situated 1.4 km to the north east... and the proposed structure would tend to be visually recessive within the landscape'*;
- The new transmission line tower *'will replace an existing similar structure, and although it will be approximately 16 m taller than the existing tower, the distances it would be viewed from (i.e. greater than 1 km) will diminish the perceived change from the existing height'*;
- The new transmission line tower *'will be visually recessive due to the viewing distance and highly open structure'*; and

- The proposed transmission line towers *'will comprise a relatively small change within a landscape which is subject to larger (and approved) changes. Any change in the stanchion height will be mitigated by the construction of the (approved) wind farm turbines, which will be larger and in most cases closer all observer locations.*

The new transmission line tower has been illustrated in GBD photomontage:

- PM1 from Pejar Dam picnic area
- PM7 from the Valdarman Hill residential dwelling and
- PM8 from Woodhouselee Road.

GBD have reviewed the AECOM visual impact assessment and, following the GBD site inspection, concur with the findings presented in the AECOM report which determines the overall visual rating of the new transmission line tower is minor to negligible on surrounding receiver locations.

7 Visual effects

7.1 Introduction

Whilst the C2WF Mod-2 wind turbines would extend above the approved Mod-1 wind turbine height, this VIA has determined that the overall scale of the proposed Mod-2 wind turbines at a 5 kilometre (and over) view distance would not result in an order of visual magnitude that is significantly above the visual magnitude of the approved Mod-1 wind turbines. A comparison of the C2WF Mod-1 and proposed Mod-2 wind turbines is illustrated in **Figure 4**.

It is also noted that the proposed Mod-2 wind turbines would be consistent with the approved Mod-1 wind turbines with regard to their visual form, design, pattern and colour. The extent of the magnitude of effect would also be partly reduced by the proposed deletion of 13 approved Mod-1 wind turbines.

The location of non-associated residential dwellings within 5 kilometres of the proposed Mod-2 wind turbine layout is illustrated in **Figure 1**.

The degree of magnitude effect is illustrated in **Figures 5** and **6**. **Figure 5** illustrates the elevated angle of view (toward tip height) for the approved Mod-1 and proposed Mod-2 amended wind turbines from a view distance of 2 kilometres and 5 kilometres respectively. **Figure 5** illustrates that the proposed Mod-2 wind turbine would include an additional and approximate half degree view angle above the approved Mod-1 with 128 metre tip of blade wind turbine from a 2 kilometre view distance. The additional view angle from a view distance of 5 kilometres would be an additional and approximate one third of one degree (21 minutes) increase in view angle.

Figure 6 illustrates the perceived and relative height difference between the approved Mod-1 128 metre tip height wind turbine and the proposed Mod-2 160 metre tip height wind turbine. At a view distance of 5 kilometres the approved Mod-1 and proposed Mod-2 wind turbines would be perceived at less than half the height of the proposed Mod-2 wind turbine when viewed at a distance of 2 kilometres. The relatively small increase in view angle toward the proposed Mod-2 wind turbine tip height, at a view distance of 5 kilometres (and beyond) is considered unlikely to result in a level of visual magnitude greater than the approved wind turbines.

Within the parameters of normal human vision, the proposed Mod-2 wind turbines are not considered to give rise to an increased level of visual magnitude over and above that determined for the approved C2WF Mod-1 development.

7.2 Magnitude of visual effects

The determination of residual visual effects resulting from the C2WF proposed Mod-2 wind turbines would result primarily from observable differences between the approved Mod-1 and the proposed Mod-2 wind turbines. Observable differences may include:

- Views toward wind turbines where previously screened by landform or vegetation and
- Change in distance between a receiver location and wind turbine (note: a change in distance would only increase where wind turbines are removed, all other wind turbines remain in the approved C2WF Mod-1 location).

C2WF Mod-2 amended
160 metre tip height

Approved C2WF Mod-1 wind turbine
with a 128 metre tip height

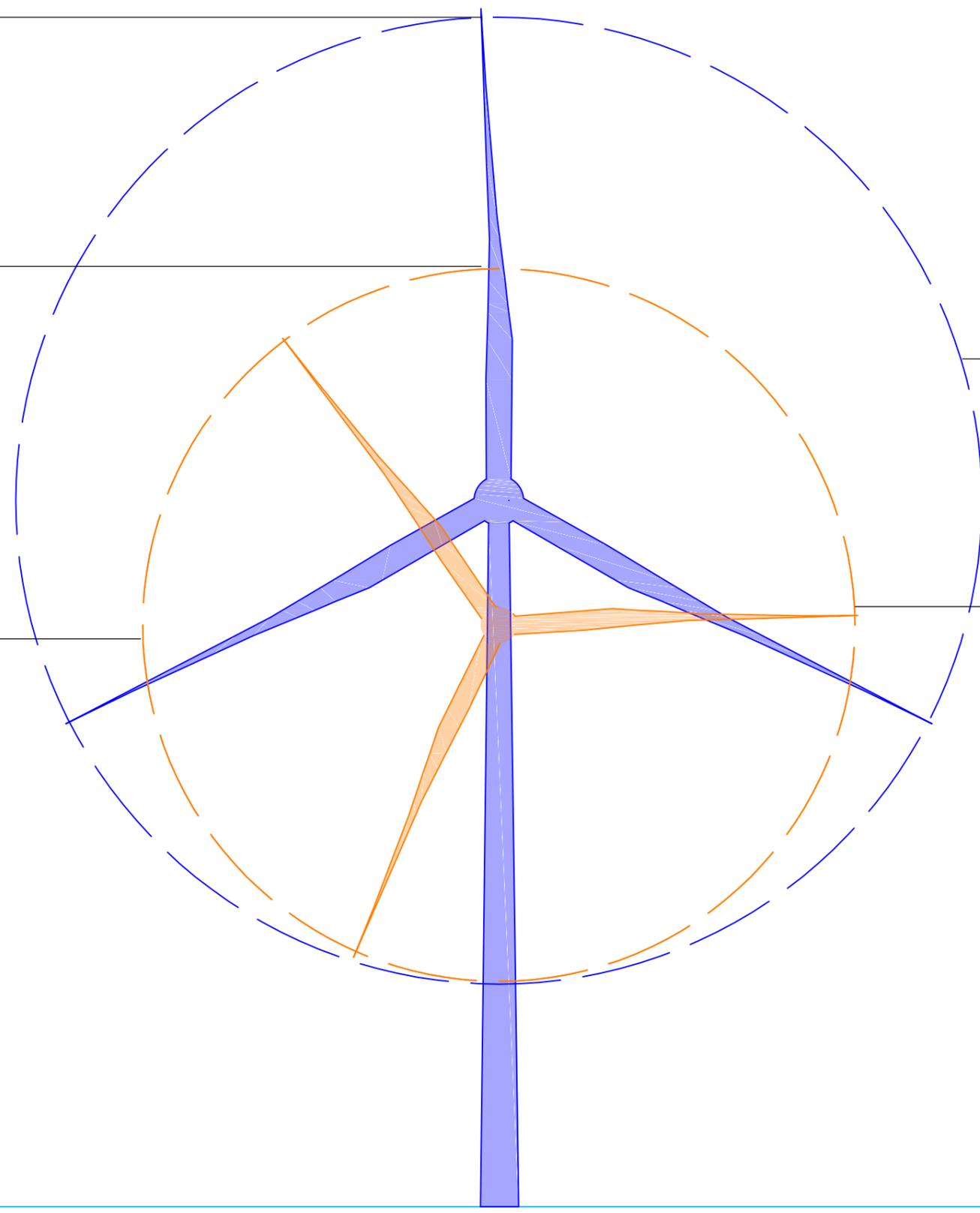
Approved C2WF Mod-1 wind turbine
swept path 7,234 m²

C2WFMod-2 amended
130 metre rotor diameter

C2WF Mod-2 amended
swept path 13,266 m²

Approved C2WF Mod-1 wind turbine with a
96 metre rotor diameter

Ground level



Crookwell 2 Wind Farm Mod-2 Visual Impact Assessment

Figure 4 - Approved C2WF Mod-1
and Mod-2 wind turbine comparison

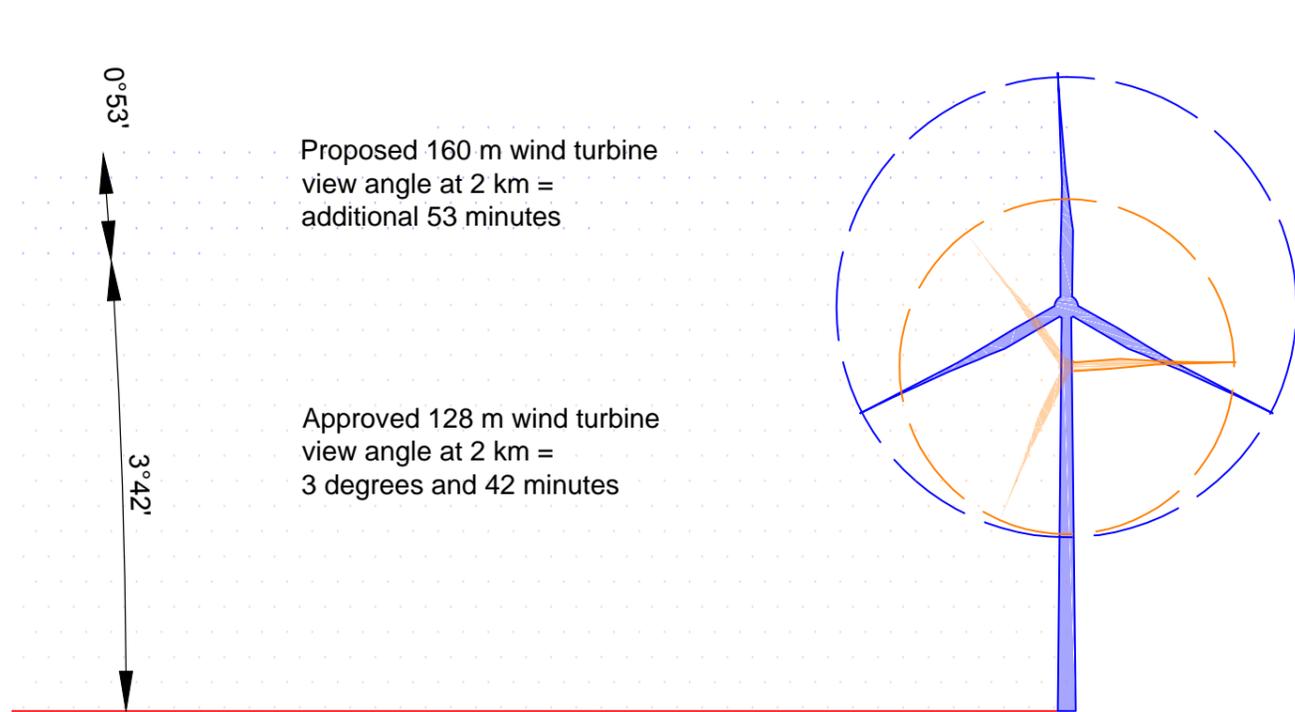
Orange line = view line toward tip height of approved C2WF Mod-1 wind turbine (128 metres)
 Blue line = view line toward tip height of C2WF Mod-2 wind turbine (160 metres)



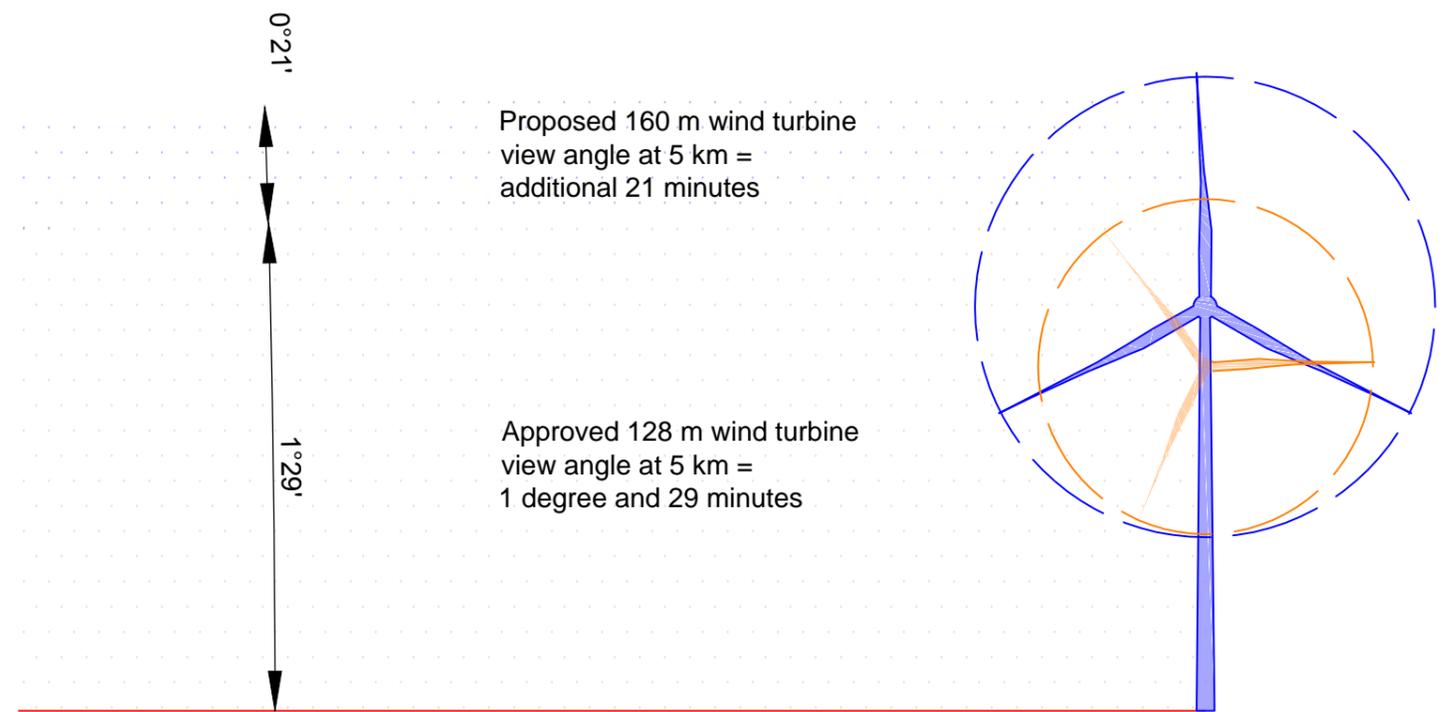
Comparative height of approved C2WF Mod-1 and CW2WF Mod-2 wind turbine from a 2 km view distance



Comparative height of approved C2WF Mod-1 and C2WF Mod-2 wind turbine from a 5 km view distance

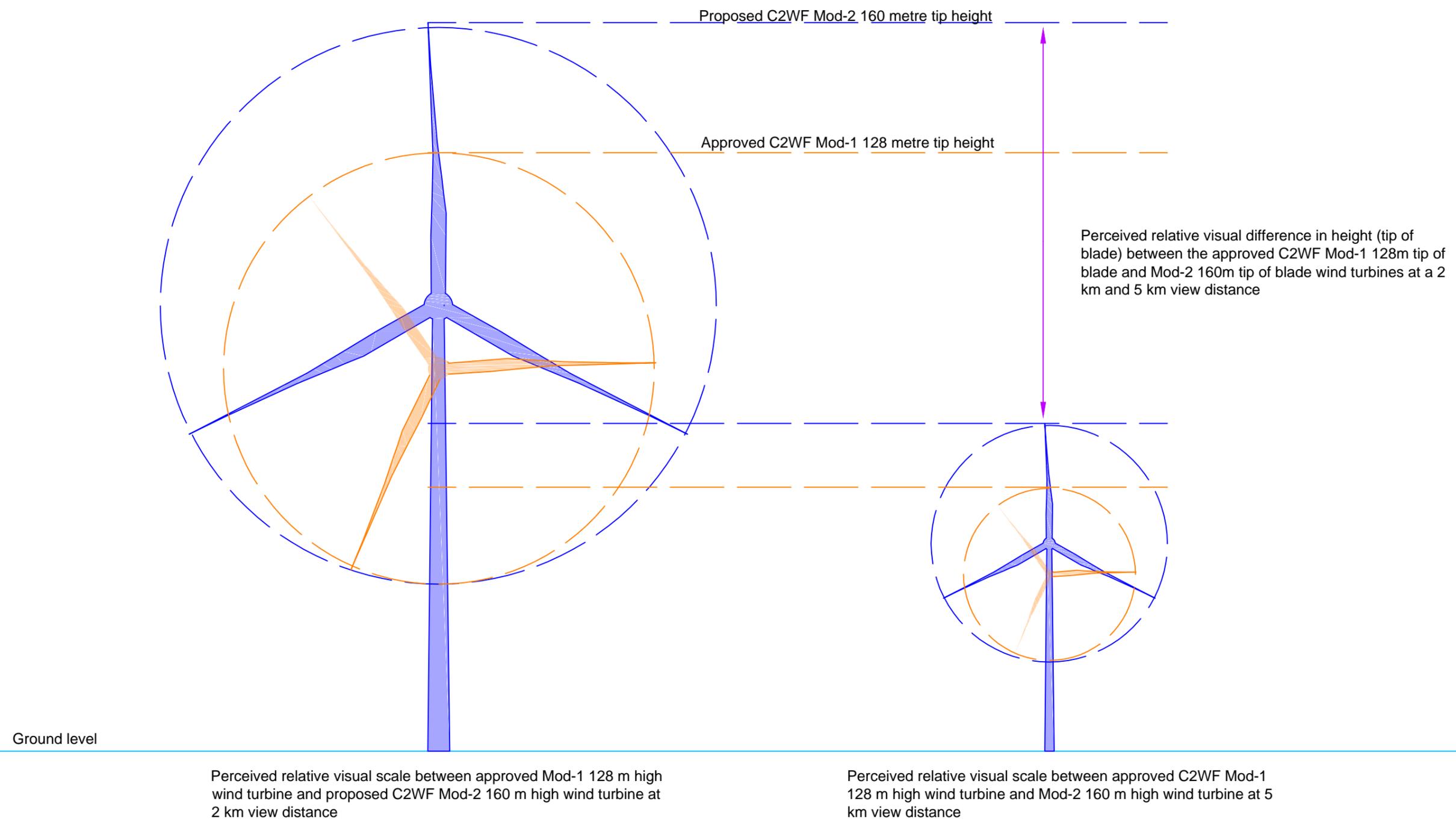


View angle toward approved C2WF Mod-1 and CW2WF Mod-2 wind turbine tip of blade from a 2 km view distance



View angle toward approved C2WF Mod-1 and C2WF Mod-2 wind turbine tip of blade from a 5 km view distance

Crookwell 2 Wind Farm Mod-2 Visual Impact Assessment



Crookwell 2 Wind Farm Mod-2 Visual Impact Assessment

Figure 6 - Approved C2WF Mod-1 and Mod-2 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 proposed Mod-2 wind turbine relative to the approved C2WF Mod-1 wind turbine.

For the purpose of this VIA the following table sets out ratings and definitions associated with the magnitude of visual effects.

Table 5 – Magnitude of visual effect

Visual effect	Magnitude
Amendments to the approved C2WF Mod-1 would result in a major and prominent visual effect and introduce elements that contrast, or are not in character with the approved C2WF Mod-1.	High
Amendments to the approved C2WF Mod-1 would result in a partial visual effect and introduce elements which may be prominent, but not completely out of character with the approved C2WF Mod-1.	Medium
Amendments to the approved C2WF Mod-1 would result in minor visual effects and introduce elements which are not prominent or out of character with the approved C2WF Mod-1.	Low
Amendments to the approved C2WF Mod-1 would result in a very minor visual effect and introduce elements which are not prominent or uncharacteristic of the approved C2WF Mod-1. There would likely be 'no change' to the approved C2WF Mod-1 visual effect.	Negligible

7.3 Visual effect matrix

The Visual Effects Matrix (Table 6) includes an assessment of visual effect for the approved C2WF Mod-1 project and provides a baseline against which the C2WF Mod-2 delta can be determined. The determination of the approved C2WF Mod-1 visual effect has considered the:

- Receiver sensitivity
- Distance between dwelling and approved C2WF Mod-1 wind turbine
- Overall wind turbine visibility and
- Degree of existing screening between approved C2WF Mod-1 wind turbine

A determination of visual effect from the combination of receiver sensitivity and the magnitude of visual effect is a well established methodology and has been applied extensively on VIA in New South Wales and across Australia. The standard methodology is set out in industry and best practice guidelines including the *Guidelines for Landscape and Visual Impact Assessment*, Third Edition, Landscape Institute and Institute of Environmental Management & Assessment, 2013 – Chapter 6 Assessment of visual effects.

Table 6 sets out the assessment of visual effects from residential dwellings up to 5 km from the approved C2WF Mod-1. 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 5** are noted against each dwelling, with a visual effect rating determined against the matrix in **Table 6**.

The professional judgement and determination of visual effects are also informed by the site inspection works, photographic records and figures prepared for this VIA. **Table 6** identifies individual residential dwellings, as well as groups of dwellings, where the determination of visual effect is expected to be the same.

Residential dwellings associated with hosting wind turbines for either the approved C2WF Mod-1 or proposed Crookwell 3 Wind Farms have not been included in the Visual Effects Matrix.

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
Residential dwellings within 3 km of approved Crookwell 2 Wind Farm Mod-1 and proposed Mod-2 wind turbine					
R1	Non associated residential dwelling	1.9 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of two wind turbines (F6 and F8) within the cluster closest to the dwelling, and in addition by the removal of wind turbines within distant views east of the Crookwell-Goulburn Road. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwelling would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer **Figure 1** for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				visual impact rating.	
R2	Non associated residential dwelling	2.5 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of two wind turbines (F6 and F8) within the cluster closest to the dwelling, in addition to the removal of wind turbines within distant views east of the Crookwell-Goulburn Road. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect
R8 Narangji	Non associated residential	1.9 km	Moderate to High	<p>Description:</p> <p>The observable scale of change would be limited by distance</p>	Moderate to High - resulting in no

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
	dwelling			<p>between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of three wind turbines (F6, F8 and F16) within the cluster closest to the dwelling and adjoining the Crookwell-Goulburn Road corridor. Other changes would be evident with the removal of approved Mod1 wind turbines across distant views east of the Crookwell-Goulburn Road. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	change to the approved C2WF Mod-1 visual effect
R17	Non associated (C3WF associated)	2.2 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be</p>	Low - resulting in no change to the approved C2WF Mod-1 visual

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>altered by the removal of up to 13 approved Mod-1 wind turbines. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	effect
R18	Non associated (C3WF associated)	2.5 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of up to 13 approved Mod-1 wind turbines. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R19 Wombat Hollow	Non associated residential dwelling	2.0 km	Moderate to High	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of up to 13 approved Mod-1 wind turbines, including wind turbine F16 closest to the dwelling (at 1.8 km) and adjoining the Crookwell-Goulburn Road corridor. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Moderate to High - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
R20 Normaroo	Non associated residential dwelling	1.2 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of around 8 approved Mod-1 wind turbines. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape with views toward the wind turbines largely screened and/or filtered by tree and shrub planting surrounding the dwelling.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect
R36 to R38, R40, R54 and R57	Non associated residential dwellings	Closest 2.7 km	Low to Moderate	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwellings and closest approved C2WF Mod-1 wind</p>	Low to Moderate - resulting in no change to the approved C2WF

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>turbine. Views toward the approved C2WF Mod-1 would be altered by the overall removal of wind turbines within the cluster east of the Crookwell-Goulburn Road. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Mod-1 visual effect
R58, R59, R61 and R62 Woodhouselee Road	Non associated residential dwellings	2.0 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. There would be some minor change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>This occurs where the approved Mod-1 visible wind turbines F48 and F50 would extend further above the hill resulting in wind turbine hubs being visible. Planting surrounding and beyond some dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R60 Pejar Park	Non associated residential dwelling	1.1 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by planting between the dwelling and closest approved C2WF Mod-1 wind turbine. There would be some minor change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p> <p>This occurs where the approved Mod-1 visible wind turbines F48 and F50 would extend above the hill with turbine hubs partially visible. Landform rising to the west, and tree planting</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>surrounding the main dwelling would also screen views toward the majority of approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R63 Rocky Corner	Non associated residential dwelling	2.0 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by planting between the dwelling and closest approved C2WF Mod-1 wind turbine. There would be a change in the composition or contrast between the approved Mod-1 and proposed Mod-2 through the removal of approved Mod-1 wind turbine F44, and where approved Mod-1 wind turbines would extend further above landform rising to the west. Tree planting surrounding and beyond the dwelling would screen views toward the majority of approved Mod-1 and proposed Mod-2 wind turbines.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R64 and R65 Valdarman Hill and Windalee	Non associated residential dwellings	1.7 km	Moderate to High	<p>Description:</p> <p>There would be changes in the composition or contrast between the approved C2WF Mod-1 and proposed Mod-1 development through the removal of approved Mod-1 wind turbine F44 and F39, and minor changes where approved Mod-1 wind turbines would extend further above landform rising to the west.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Moderate to High - resulting in no change to the approved C2WF Mod-1 visual effect
R68 to R70	Non associated residential dwellings	1.4 km	Moderate	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1</p>	Moderate - resulting in no change to the approved C2WF

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>would be altered by the removal of up to eight approved Mod-1 wind turbines within the cluster closest to the dwellings. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Mod-1 visual effect
R71 to R74	Non associated residential dwellings	2.3 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of approved Mod-1 wind turbines F25 and F33, as well as other approved Mod-1 wind turbines within the cluster closest to the dwellings. There would</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R117, 118 and 119	Non associated potential dwelling site without DA Approval	1.3 km	Low to Moderate	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of approved Mod-1 wind turbines F6 and F8 within the cluster closest to the dwellings, and also removal of approved Mod-1 F16 nearest to the dwellings. There would be very limited change in the composition or contrast between the approved Mod-1 and</p>	Low to Moderate - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>proposed Mod-2 development and the surrounding landscape.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R120 Elmgrove	Non associated residential dwelling	1 km	Moderate	<p>Description:</p> <p>The observable scale of change would be noticeable between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of two approved Mod-1 wind turbines F6 and F8 within the cluster south of the dwelling. There would be limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwelling would also screen and filter views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p>	Moderate - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
R123, R124 and R125	Non associated residential dwellings	2.0 km	Low to Moderate	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of two approved Mod-1 wind turbines (F6 and F8). There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1</p>	Low to Moderate - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				visual impact rating.	
R130	Non associated residential dwellings	840 m	Low	<p>Description:</p> <p>The observable scale of change would be noticeable between the dwelling and closest approved C2WF Mod-1 wind turbine. There would be limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwelling would also filter views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect
R131 to R133	Non associated residential dwellings	1.6 km	Low to Moderate	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1</p>	Low to Moderate - resulting in no change to the approved C2WF

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>would be altered by the overall removal of up to thirteen approved Mod-1 wind turbines. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding two of the dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	Mod-1 visual effect
R200	Non associated residential dwelling	2.5 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the overall removal of up to thirteen approved Mod-1 wind turbines. There would be very limited change in the composition or contrast between the approved</p>	Low- resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding the dwelling would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
Dwelling group R201 to R205	Non associated residential dwellings	2.7 km	Low	<p>Description:</p> <p>The observable scale of change would be partially limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the overall removal of up to thirteen approved Mod-1 wind turbines. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen views toward both approved Mod-1 and proposed Mod-</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				2 wind turbines. Magnitude: Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.	
Residential dwellings between 3 km and 5 km of approved Crookwell 2 Wind Farm Mod-1 and proposed Mod-2 wind turbine					
Residential dwelling group R3 to R7	Non associated residential dwellings	3.2 km	Low	Description: The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of wind turbines within the approved Mod-1. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating.</p>	
Residential dwelling group R16, R29 to R35	Non associated residential dwellings	3.6 km	Negligible to Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of wind turbines within the approved Mod-1. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	Negligible to Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
Residential dwelling group R49 to R52	Non associated residential dwellings	4.7 km	Negligible to Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of wind turbines within the approved Mod-1. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	Negligible to Low - resulting in no change to the approved C2WF Mod-1 visual effect
Residential dwelling group R53, R84 , R55 and R56	Non associated residential dwellings	2.7 km	Negligible to Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. There would be a very small change in the composition</p>	Negligible to Low - resulting in no change to the approved C2WF

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape due a small degree of additional visibility toward approved Mod-1 wind turbines F48 and F50 above Pigmans Hill.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	Mod-1 visual effect
R66 and R67	Non associated residential dwellings	4.5 km	Negligible	<p>Description:</p> <p>Views toward the approved C2WF Mod-1 and proposed Mod-2 wind turbines are screened by landform.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	Negligible - resulting in no change to the approved C2WF Mod-1 visual effect
R106	Non associated residential dwelling	4.7 km	Negligible to Low	<p>Description:</p> <p>The observable scale of change would be limited by distance</p>	Negligible to Low - resulting in no change to the

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of wind turbines within the approved Mod-1. There would be very limited change in the composition or contrast between the approved Mod-1 and Mod-2 development and the surrounding landscape. Planting adjoining the dwelling would also screen views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	approved C2WF Mod-1 visual effect
Residential dwelling group R75 to R77, R81, R82, R109, R110 and R116	Non associated residential dwellings	3.5 km	Negligible to Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting</p>	Negligible to Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>surrounding the dwellings would also screen the majority of views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	
R126	Non associated residential dwellings	3.1 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwelling and closest approved C2WF Mod-1 wind turbine. Views toward the approved C2WF Mod-1 would be altered by the removal of two approved Mod-1 wind turbines (F6 and F8) within the cluster closest to the dwelling, and in addition by the removal of several other approved Mod-1 wind turbines within distant views east of the Crookwell-Goulburn Road. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape.</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				<p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	
Residential dwelling group R206 to R210	Non associated residential dwellings	4 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen the majority of views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect

Table 6 – Visual Effects Matrix (Refer Figure 1 for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
Residential dwelling group R211 to R214	Non associated residential dwellings	3.5 km	Low	<p>Description:</p> <p>The observable scale of change would be limited by distance between the dwellings and closest approved C2WF Mod-1 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-1 and proposed Mod-2 development and the surrounding landscape. Planting surrounding some dwellings would also screen the majority of views toward both approved Mod-1 and proposed Mod-2 wind turbines.</p> <p>Magnitude:</p> <p>Low – resulting in no change to the approved C2WF Mod-1 visual impact rating</p>	Low - resulting in no change to the approved C2WF Mod-1 visual effect
Residential dwelling group R215 and R216	Non associated residential dwellings	4.3 km	Negligible	<p>Description:</p> <p>Views toward the approved C2WF Mod-1 and proposed Mod-2 wind turbines are screened by landform.</p> <p>Magnitude:</p>	Negligible - resulting in no change to the approved C2WF Mod-1 visual

Table 6 – Visual Effects Matrix (Refer **Figure 1** for residential receiver locations)

Receiver location/s	Category of receiver location	Approximate distance to approved and/or amended wind turbine	Approved C2WF Mod-1 Visual Effect	Description and Magnitude of C2WF Mod-2 amended visual effect	Proposed C2WF Mod-2 Visual Effect
				Low – resulting in no change to the approved C2WF Mod-1 visual impact rating	effect

7.4 Summary of C2WF Mod-2 visual effects

The Visual Effects Matrix identifies forty eight residential dwellings between 3 km and 5 km of a proposed C2WF Mod-2 wind turbine, and forty six residential dwellings within 3 km of a proposed C2WF Mod-2 wind turbine.

From the forty six dwellings within 3 km of an approved C2WF Mod-1 and proposed C2WF Mod-2 wind turbine:

- Four non associated dwellings will experience a Moderate to High visual effect
- Four non associated dwellings will experience a Moderate visual effect
- Fourteen non associated dwellings will experience a Low to Moderate visual effect
- Twenty four non associated dwellings will experience a Low visual effect.

From the forty eight dwellings between 3 km and 5 km of an approved C2WF Mod-1 and proposed C2WF Mod-2 wind turbine:

- Fifteen non associated dwellings will experience a Low to Moderate visual effect
- Twenty nine non associated dwellings will experience a Negligible to Low visual effect
- Four non associated dwellings will experience a Negligible visual effect.

The proposed modification to the approved C2WF Mod-1 wind turbine structures, whilst noticeable from proximate residential view locations is unlikely to result in a magnitude or overall visual effect any greater than the approved C2WF Mod-1 wind turbines. The overall assessment of visual effects associated with the proposed C2WF Mod-2 wind turbines is summarised as Low.

7.5 Cumulative visual effects

As proposed amendments to the approved C2WF Mod-1 are considered to result in a low level visual effects, and introduce elements which are not prominent or out of character with the approved C2WF Mod-1, the potential for the proposed Mod-2 wind turbines to result in any additional significant cumulative visual effects is considered to be low.

A detailed assessment of cumulative visual effects has been undertaken for the proposed Crookwell 3 Wind Farm project and considers the potential for cumulative visual effects in association with the C2WF proposed Mod-2.

7.6 Night time obstacle lighting

An Aeronautical Impact Assessment has been prepared for the C2WF proposed Mod-2 wind turbine layout. The assessment included a consideration of the need for hazard lighting and noted that the applicability of Civil Aviation Safety Authority (CASA) obstacle marking and lighting requirements *'is contingent on subsequent determination by CASA as to whether or not the wind farm constitutes a "hazard to aviation"'*.

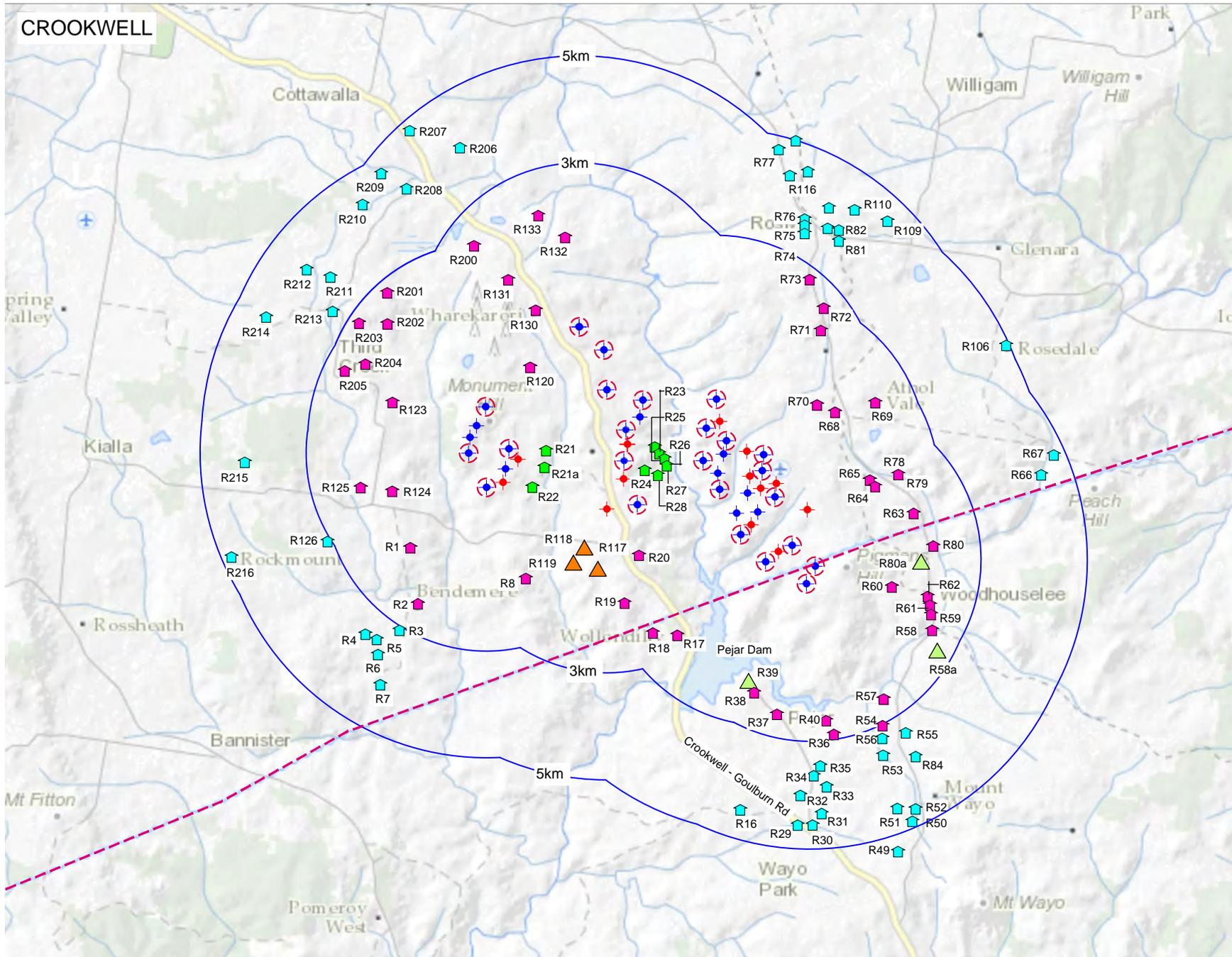
The assessment has determined a wind turbine lighting design in the event that obstacle lighting is required. The lighting layout, illustrated in **Figure 7**, has recommended installation of obstacle lighting on twenty four of

the proposed Mod-2 wind turbines. This would result in one additional set of wind turbine obstacle lights to be installed in comparison to the twenty three sets of wind turbine obstacle lights for the C2WF Mod-1.

The obstacle lights would be installed on the C2WF Mod-2 wind turbine nacelles at around 20 m above the approved Mod-1 wind turbine nacelles. The assessment also outlined generally accepted considerations regarding minimisation of visual impact associated with night time obstacle lighting. These are included as follows:

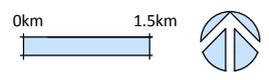
- To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness.
- Shielding may be provided to restrict the downward component of light to either, or both, of the following:
 - such that no more than 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.
- All obstacle lights on a wind farm should be synchronised so that they flash simultaneously.
- 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 comprising the daytime conspicuity of the overall turbine.

Whilst the C2WF proposed Mod-2 obstacle lighting would be located at around 20 m above the approved Mod-1 obstacle lighting location, the overall potential for lighting to be visible at locations not impacted by the approved Mod-1 obstacle lighting design would be limited.



Legend

- Approved C2WF Mod-1 wind turbine with lighting subject to Mod-2 (indicative location)
- Approved C2WF Mod-1 wind turbine layout subject to Mod-2 (indicative location)
- Approved C2WF Mod-1 wind turbine to be removed (indicative location)
- Approximate distance from approved C2WF Mod-2 wind turbine
- C2WF associated residential dwelling
- Non associated residential dwelling within 3km of an approved C2WF Mod-1 wind turbine
- Non associated residential dwelling between 3km and 5km of an approved C2WF Mod-1 wind turbine
- Potential future dwelling location without DA lodged
- Non residential structure
- Existing 330kV transmission line
- Note Residential dwelling location are indicative only



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Figure 7 C2WF Obstacle lighting

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8 Shadow flicker and blade glint

8.1 Shadow flicker

Due to their height, wind turbines can cast shadows on surrounding areas at a significant distance from the base of the wind turbine tower. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position, the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. When the sun is low in the sky the length of the shadows increases, increasing the shadow flicker affected area around the wind turbine. A shadow flicker assessment may over estimate the actual number of annual hours of shadow flicker at a particular location due to a number of reasons including:

- the probability that the wind turbines would not face into or away from the sun all of the time
- the occurrence of cloud cover
- the amount of particulate matter in the atmosphere (moisture, dust, smoke etc...) which may diffuse sunlight
- the presence of vegetation and
- periods where the wind turbine may not be in operation due to low winds, or high winds or for operational or maintenance reasons.

The C2WF proposed Mod-2 Shadow Flicker and Blade Glint Assessment determined that none of the non-associated residential dwellings surrounding the proposed Mod-2 wind turbines would experience shadow flicker in excess of 30 hours per year.

The shadow flicker assessment did identify that a number of associated residential dwellings within the site boundary would experience shadow flicker in excess of 30 hours per year.

Details of the shadow flicker assessment are included in the C2WF Mod-2Amendment report.

8.2 Blade glint

The C2WF proposed Mod-2 Shadow Flicker and Blade Glint Assessment determined that '*blade glint is not generally a problem for modern wind turbines, provided the blades are coated with a non-reflective paint*'.

9 Photomontages

9.1 Introduction

The photomontage locations have been selected to illustrate a range of key viewpoints from public road and residential dwellings with views toward the approved C2WF Mod-1 and other wind farm developments including the operational Crookwell 1 Wind Farm, the Gullen Wind Farm and the proposed Crookwell 3 Wind Farm.

The eight photomontage locations are illustrated in **Figure 8**, and the photomontages presented in **Figures 9a to 16b**. The photomontages (Figures a) illustrate views toward the approved C2WF Mod-1 and the proposed Mod-2 amendment. The photomontages illustrate the wind turbines with their individual identification numbers and include the approved Mod-1 wind turbines to be removed and those subject to the proposed Mod-2 amendments. For clarity, a copy of each photomontage (Figures b) has also been provided without labels for clarity.

The photomontage locations include:

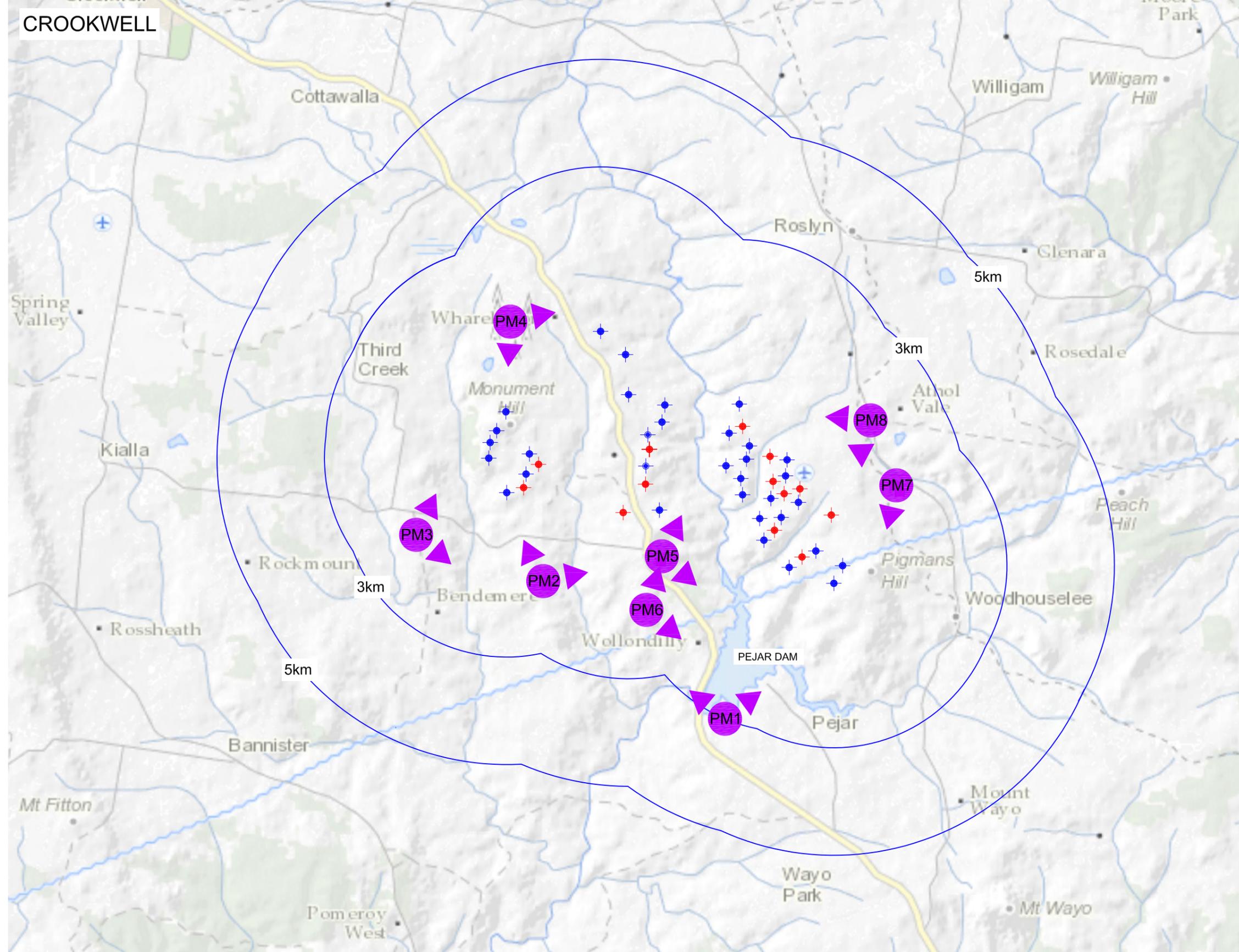
- Photomontage 1 (Figures 9a and 9b) from the Pejar Dam picnic area
- Photomontage 2 (Figures 10a and 10b) from Narangi residential dwelling
- Photomontage 3 (Figures 11a and 11b) from Dawson's Creek Road
- Photomontage 4 (Figures 12a and 12b) from Crookwell 1 Wind Farm lookout
- Photomontage 5 (Figures 13a and 13b) from Normaroo residential dwelling
- Photomontage 6 (Figures 14a and 14b) from Wombat Hollow residential dwelling
- Photomontage 7 (Figures 15a and 15b) from Valdarman Hill residential dwelling
- Photomontage 8 (Figures 16a and 16b) from Woodhouselee Road.

9.2 Photomontage preparation

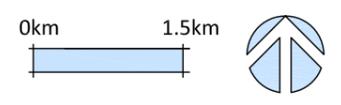
The photomontages have been prepared with regard to the general guidelines set out in the Scottish Natural Heritage (2006) Visual representation of windfarms: good practice guidance and British Landscape Institute Advice Note 01/11 (March 2011) Photography and photomontage in landscape and visual impact assessment. Photography for the photomontages was undertaken by GBD using tripod mounted Nikon D700 a digital single-lens reflex (SLR) full frame sensor camera. A 50 mm focal length prime lens was attached to the Nikon D700 SLR camera.

The Nikon D700 has a full frame image sensor (36 x 23.9 mm Nikon FX format), and when mounted with a 50mm lens results in a single photographic image with a view angle equivalent to a 35 mm SLR camera with a 50 mm lens. The 50 mm lens is commonly utilised, and cited in landscape and visual assessment manuals and guidelines, for the preparation of landscape and visual assessment photomontages. Following site photography the photomontages 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 (photo location) was configured in WindFarmer – the sun position for each viewpoint was configured by using the time and date of the photographs from that viewpoint
- the view from each photomontage location was then assessed in WindFarmer. This process requires accurate mapping of the terrain as modelled, with that as seen in the photographs. The photographs, taken from each photomontage location were loaded into WindFarmer and the visible turbines superimposed on the photographs
- the photomontage were adjusted using Photoshop CS3 to compensate for fogging due to haze or distance, as well as screening by vegetation or obstacles and
- the final image was converted to JPG format and imported and annotated as the final figure.



- Legend**
-  Indicative photomontage location
 -  Indicative approved C2WF Mod-1 wind turbine location subject to Mod-2
 -  Indicative approved C2WF Mod-1 wind turbine to be removed
 -  Indicative distance from approved C2WF Mod-1 wind turbine

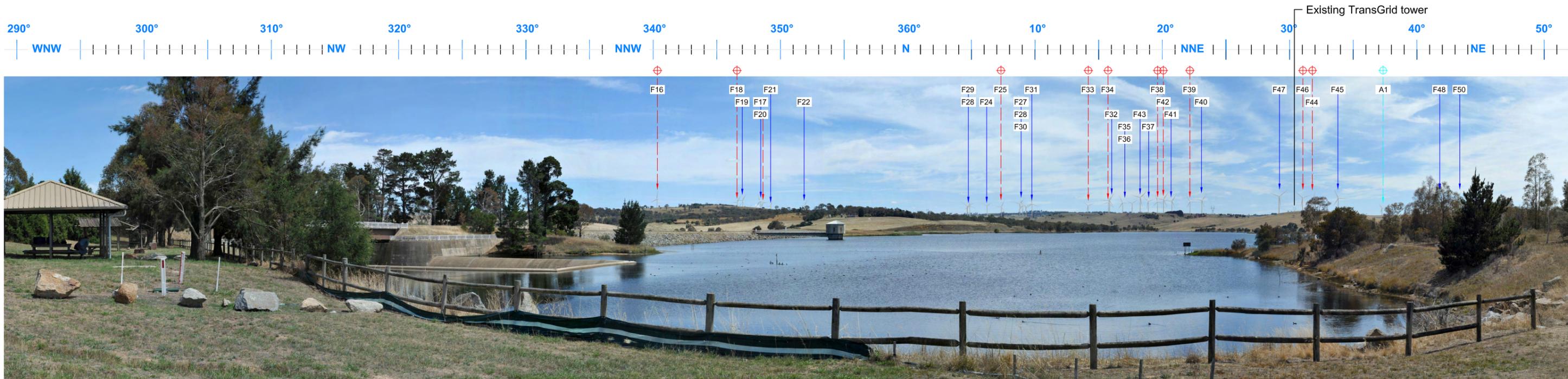


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Figure 8 - C2WF Photomontage location

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Photomontage 1a Pejar Dam picnic area - View looking west north west from the Pejar Dam picnic area toward the approved C2WF Mod-1 wind turbine layout. This photomontage illustrates the approved C2WF Mod-1 wind turbine layout at the 128 metre tip height and the approved C2WF Mod-1 wind turbines to be removed.

Proposed CW3 south wind turbines screened by trees

Pejar Dam

Proposed TransGrid tower



Photomontage 1b Pejar Dam picnic area - View looking west north west from the Pejar Dam picnic area toward the C2WF Mod-2 wind turbine layout. This photomontage illustrates the proposed C2WF Mod-2 wind turbine layout at the 160 metre tip height.

Photography GBD Pty Ltd 2016

-  Approved C2WF Mod-1 wind turbine
-  Approved C2WF Mod-1 wind turbine to be removed
-  Approved C2WF Mod-1 wind turbine subject to Mod-2
-  Proposed C3WF wind turbine
-  Proposed C3WF wind turbine to be removed

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Figure 9a - Photomontage location 1 Pejar Dam picnic area including wind turbine identification labels

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Photomontage 1c Pejar Dam picnic area - View looking west north west from the Pejar Dam picnic area toward the approved C2WF Mod-1 wind turbine layout. This photomontage illustrates the approved C2WF Mod-1 wind turbine layout at the 128 metre tip height and the approved C2WF Mod-1 wind turbines to be removed.



Photomontage 1d Pejar Dam picnic area - View looking west north west from the Pejar Dam picnic area toward the C2WF Mod-2 wind turbine layout. This photomontage illustrates the proposed C2WF Mod-2 wind turbine layout at the 160 metre tip height.

Photography GBD Pty Ltd 2016

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Figure 9b - Photomontage location 1
Pejar Dam picnic area without wind
turbine identification labels

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