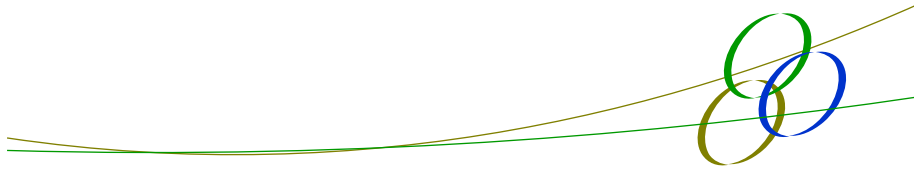
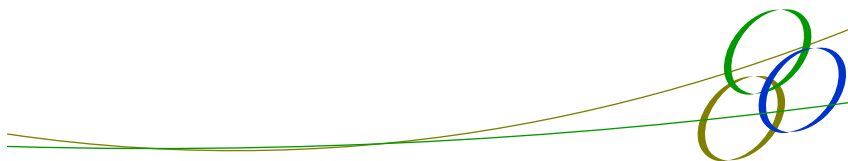


GLEN INNES WIND FARM ENVIRONMENTAL ASSESSMENT UNDER S75W MODIFICATION 4: TURBINE DESIGN CHANGES

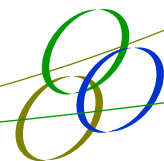
*Prepared for Glen Innes Windpower Pty Ltd
Prepared by Environmental Property Services*



Contact Information and Declaration	
Declaration:	The declaration relates to the submission of this Environmental Assessment prepared for Glen Innes Windpower Pty Ltd in respect of a proposed wind farm site at Glen Innes, NSW. The opinions and declarations in this document are ascribed to Environmental Property Services (EPS) and are made in good faith and trust that such statements are neither false nor misleading. In preparing this document, EPS has considered and relied upon information obtained from the public domain, supplemented by discussions between key EPS staff, representatives from Glen Innes Windpower Pty Ltd and other consultants.
Glen Innes Windpower Contact:	David Brown Project Manager Glen Innes Windpower Pty Ltd 448 St Kilda Road, Melbourne Victoria 3004
Prepared by:	Mike Shelly Consultant Environmental Property Services PO Box 348 NELSON BAY NSW 2315
Application address:	Gwydir Highway Glen Innes, NSW



Quality Assurance & Version Control Table				
Project: Glen Innes Wind Farm				
Client:	Glen Innes Windpower Pty Ltd			
Rev No.	Date	Our Reference	Author	Reviewer
Draft V01	30.01.2017	20170130_11262_75W Mod 4EA_OneWindGlenInnes	M. Shelly	T. Kelly
Draft V02	09.03.2017	20170306_11262_75W Mod 4EA_OneWindGlenInnes	M.Shelly, A.Tipper, T.Lambert	S. McCall
Draft V03	30.03.2017	20170330_11262_75W Mod 4EA_OneWindGlenInnes	M. Shelly	S. McCall
Draft V04	31.03.2017	20170331_11262_75W Mod 4EA_OneWindGlenInnes	A. Tipper	S. McCall
Draft V05	19.06.2017	20170619_11262_75W Mod 4EA_OneWindGlenInnes	M. Shelly	S. McCall
Final V01	28.06.2017	20170628_11262_75W Mod 4EA_OneWindGlenInnes	M. Shelly	S. McCall
Final V02	21.07.2017	20170721_11262_75W Mod 4EA_OneWindGlenInnes	M. Shelly	S. McCall
Checked by	21.07.2017		A. Tipper	
Approved by	21.07.2017		S. McCall	
ENVIRONMENTAL PROPERTY SERVICES				
Hunter 9 Yacaaba Street, Nelson Bay NSW 2315 (02) 4981 1600		Sydney Level 33, 264 George Street, Sydney NSW 2000 (02) 9258 1985		
Website: www.enviroproperty.com.au				



EXECUTIVE SUMMARY

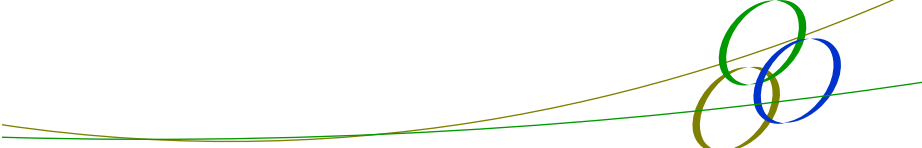
The Glen Innes Wind Farm consent was initially granted in October 2009 and since then, the following modifications have been approved:

- Modification 1 – extension of lapsing date by one year. Approved 2013.
- Modification 2 – installation of larger more efficient wind turbines and micro-siting. Approved 2016.
- Modification 3 – extension of lapsing date by one year. Approved 2016.

The original Environmental Assessment and the later assessment supporting Modification 2 foresaw the eventual selection of the most suitable and modern wind turbine assemblies in this fast-developing industry. Both assessments used reasonable-case designs for environmental impact assessment purposes pending final selection.

Glen Innes Wind Farm now proposes to use turbines with longer blades and correspondingly taller towers. As a consequence, the turbines are proposed to be located in slightly different locations to avoid boundary interference and to maximise wind flows. Minor changes to ancillary infrastructure are also proposed. These changes will require a modification under Section 75W to be approved. The key environmental and social impact aspects of the proposed modifications are as follows:

- Noise: the selected turbines will meet current approval conditions with optional operating mode adjustments;
- Visual: the proposed changes would result in a discernible change from some locations, but these changes would not be of a magnitude that would significantly increase the “approved” visual impacts. Additionally, a consideration of the cumulative impacts of Glen Innes Wind Farm and other adjacent windfarms shows that the proposed modification would not change the magnitude of cumulative impacts;
- Shadow flicker: the proposed changes do cause an increase in the predicted theoretical maximum shadow flicker without allowing for cloud cover. Turbine management devices will ensure that new turbines do not exceed 30 hours/annum received shadow flicker at any residence not associated with the project. The operational shadow flicker report required to be prepared (Condition 2.6) will clarify the actual received flicker at non-associated residences;
- Blade glint: the blades will be painted grey with glare preventative surface treatment similar to the previous turbine models;
- Aviation: the proposed modification will not impact on the operation of any airspace surveillance facilities or the Lowest Safe Altitudes of air routes nearby. However, it will necessitate an increase in the Minimum Sector Altitude for Glen Innes Aerodrome to provide sufficient clearance for the taller turbines;

- 
- Traffic: identical logistics requirements remain to transport the turbines therefore no additional traffic impacts are anticipated;
 - Heritage: turbines are proposed to be micrositied within the approved micrositing allowance area so no additional impacts to heritage are anticipated;
 - Biodiversity: turbines are proposed to be micrositied within the approved micrositing allowance area;
 - GHG: electrical generation potential is higher than the approved turbines so the GHG savings will increase by approximately one third; and
 - Blade throw: Senvion blades will be built to International Electrotechnical Commission 6140-23 standards and so blade throw risk remains negligible.

A modification is sought for under Section 75W, which continues to apply to transitional Part 3A projects, for approval of the modified turbines and minor changes to the layout to accommodate the turbine selection.

The modified project would inject 90 MW of wind powered electricity into the grid and in so doing will provide GHG savings to an annual total of 403,076 tonnes of CO₂e or the equivalent of 51,710 households. This provides a third more GHG savings than the approved turbines.

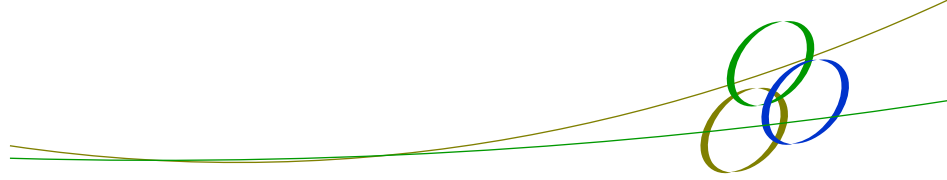


Table of Contents

Executive Summary	iv
1 Introduction	1
1.1 Existing Approval	1
1.2 Proposed Project Modification.....	3
1.3 Other Relevant Documents	16
2 Planning Framework	17
2.1 Environmental Planning and Assessment Act 1979	17
2.2 Environment Protection and Biodiversity Conservation Act 1999.....	17
3 Impact Assessment	18
3.1 Noise.....	18
3.2 Visual	20
3.2.1 Methodology	20
3.2.2 Cumulative Impacts.....	22
3.2.3 Aviation Hazard Lighting.....	23
3.2.4 Shadow Flicker.....	27
3.2.5 Blade Glint	29
3.3 Aviation Hazard	29
3.4 Traffic.....	31
3.5 Heritage	31
3.6 Biodiversity	33
3.6.1 Overview.....	33
3.6.2 Threatened Ecological Communities.....	34
3.6.3 Threatened Flora	35
3.6.4 Threatened Fauna	36
3.6.5 Commonwealth Matters	38
3.7 Communication Interference	41
3.7.1 Public Radio and Television	42
3.7.2 Two-way Radio Networks and Microwave Links.....	42
3.7.3 Mobile Phone Networks.....	43

3.7.4	Radar.....	43
3.8	Greenhouse Gas Emissions.....	44
3.9	Blade Throw.....	44
3.10	Consultation	44
4	Conclusion	46

Table of Figures

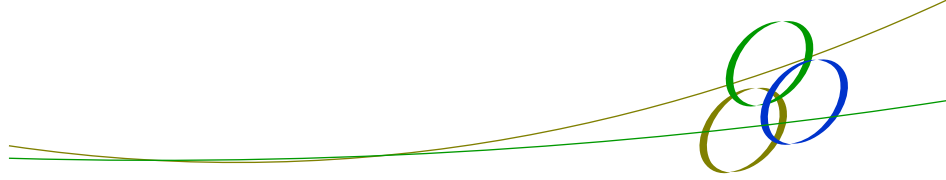
Figure 1-1: Glen Innes Windfarm Location.....	2
Figure 1-2: Glen Innes Wind Farm Proposed Site Layout.....	7
Figure 1-3: Approved Layout vs Proposed Layout.....	12
Figure 3-1: Residences within 5km of any turbine.....	25
Figure 3-2: Graphic Representation of Proposed Wind Turbine Changes	26

List of Tables

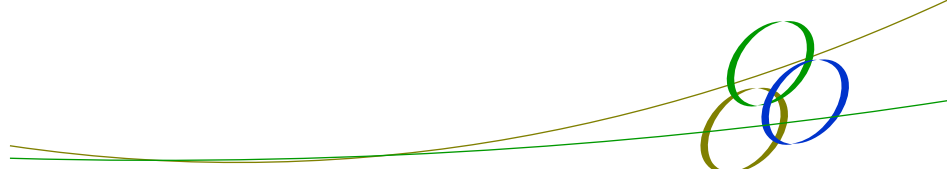
Table 1-1: Approved Versus Proposed Turbine Specifications.	4
Table 1-2: Refined Turbine Locations (UTM).....	5
Table 1-3 Approximate Disturbance Footprint.	6
Table 3-1: Approved Noise Criteria	18
Table 3-2: Overall sound power level for Senvion 3.6M140 WTG	19
Table 3-3: Mitigation Operating Modes	20
Table 3-4: Theoretical Maximum Shadow Flicker Predictions	28
Table 3-5 Threatened Fauna Species	37

Appendices

Appendix 1 – Project Approval
Appendix 2 – Noise Assessment
Appendix 3 – Visual Assessment
Appendix 4 – Shadow Flicker Assessment
Appendix 5 - Aviation Impact Assessment
Appendix 6 – Community Consultative Committee Minutes



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1 INTRODUCTION

1.1 Existing Approval

The construction and operation of the Glen Innes Wind Farm (GIWF) is authorised under Project Approval 07_0036 (Project Approval), granted by the Minister for Planning on 2 October 2009 under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project Approval was modified by the Land and Environment Court on 18 August 2010. Since that time, a number of modifications have been approved:

1. Modification 1 for an extension of lapsing date contained in Condition 1.5 of the Project Approval by one year. Approval was granted on 16 August 2013.
2. Modification 2 for the installation of larger and more efficient wind turbines and micro-siting within the approved layout to accommodate the larger dimension wind turbines. Approval was granted on 19 January 2016.
3. Modification 3 for an extension of lapsing date contained in Condition 1.5 of the Project Approval by one year. Approval was granted on 19 January 2016.

Physical commencement in accordance with Section 95(4) of the EP&A Act, occurred in January 2017.

The consolidated Project Approval (incorporating the modifications outlined above) is contained in Appendix 1 of this document.

The 2009 Environmental Assessment that supported the original application and the 2014 Environmental Assessment for Modification 2 both used example turbine specifications to realistically predict social and environmental impacts. As wind turbine technology was, and is, progressing quickly, both documents noted that the installed turbines would be selected from designs current during the pre-construction phase. The now proposed turbines are more efficient, with high levels of reliability and their selection will maximise electricity production, maximise greenhouse gas savings, and minimise maintenance costs. This flexibility in design selection is in keeping with the initial application and the Project Approval (07_0036).

As the selected Senvion turbine specifications differ to those referred to in the Project Approval, a modification under S75W of the *Environmental Planning and Assessment Act, 1979* (EP&A Act) is required.

Figure 1-1 shows the location of the project in relation to northern New South Wales.



Author:	B. Ellis
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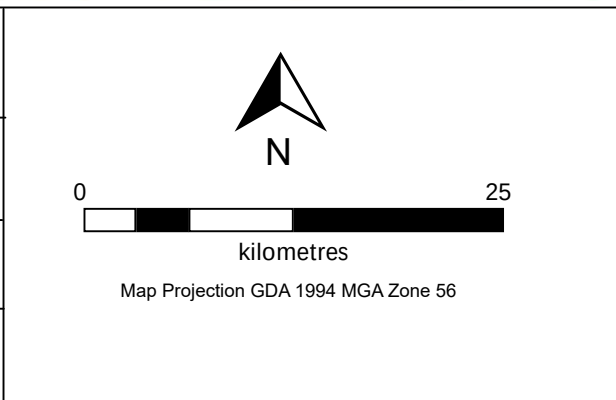


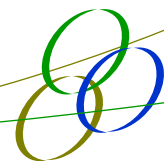
Figure:1-1

Glen Innes Wind Farm Site Location - MOD 4

Glen Innes Wind Farm
Glen Innes, NSW
14 March 2017

EPS

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1.2 Proposed Project Modification

The proposed modification application requests approval to modify and/or clarify the dimensions and locations of the following items:

1. Refined turbine dimensions as per Table 1-1.
2. Refined turbine locations as per Table 1-2, subject to 100 m micro-siting allowance due to potential site requirements including ecological constraints or shallow rock.
3. Increased nominal annual generation capacity to up to approximately 90 MW, subject to incremental changes due to installation and local conditions.
4. Increased construction track disturbance footprint from the approved 8m to approximately 12m to account for indirect impacts from track construction (the 12m impact width accords to OEH requested impact areas for biodiversity offset calculations and has been used in approved management plans such as the Construction Environmental Management Plan (EPS, 2016) and the Compensatory Habitat Plan (EPS, 2016))
5. Refined substation location to avoid the Travelling Stock Route, Crown Road and unfavourable topography.
6. Refined concrete batch plant location.

The Project Approval (Appendix 1) refers to the original Environmental Assessment (Aurecon 2008) and the subsequent assessments supporting the listed modifications, most relevantly the Section 75W Modification 2 Environmental Assessment, prepared by Aurecon in March 2014 (Aurecon 2014). Aurecon 2014 assessed an indicative turbine (Alstom ECO 122) and noted that the actual installed turbines would be selected from those available at the time of construction. Glen Innes Windpower Pty Ltd has now selected a turbine design, the Senvion 3.6M140 EBC, which has longer blades than Alstom ECO 122 and correspondingly taller towers.

The Project Approval does not specify the turbine dimensions, but Condition 1.1 requires the project to be carried out generally in accordance with the EA (which is defined in the approval as including the original EA, the submissions report, the revised layout report and the S75W Assessment Report. As the Modification 2 application specified smaller turbine dimensions, the larger turbines now proposed require approval. Table 1-1 provides a summary of approved and proposed turbine specifications.

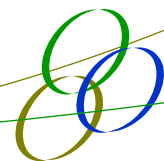


Table 1-1: Approved Versus Proposed Turbine Specifications.

Aspect	Approved Specifications	Proposed Specifications	Difference
Turbine numbers	25	25	Nil
Hub height (m)	89	110	24% taller
Blade length (m)	60	68.5	14% longer
Rotor diameter (m) ₁	122	140	15% larger
Rotor swept area (m ²)	11,690	15,394	32% larger
Rotor tip height (m)	150	180	20% taller
Blades per turbine	3	3	Nil
Paint colour	Light grey	Light grey	Nil
Nominal tip speed (m/s)	78	70	-10%
Nominal power per turbine (MW)	2.7	3.6	33%
Total generation capacity (MW)	67.5	90	33%

Note:

₁ Because the turbine blades are curved, rotor diameter is the diameter of the outer swept path of the blade tips, not simply twice the blade length.

Table 1-2 provides the location coordinates, a calculation of distance from the approved locations, the movement bearing and a brief justification. All turbine adjustments are less than 100m. Figure 1-2 (a to e) show the refined locations of the turbines and the ancillary facilities. Figure 1-3 (a to d) displays the differences between the approved and proposed layouts.

During the turbine selection phase, there was ongoing consultation with OEH, whose officers stated concern with the initially planned shorter towers, due to potential impacts on low-flying birds and bats. Consequently, Nexif chose an alternative design with taller turbine towers to substantially reduce this potential impact, even when compared to the approved design parameters.

The proposed modification will increase rated output of the wind farm and also will increase the percentage of time that power is produced. A Transmission Connection Agreement is currently being negotiated with TransGrid for 90 MW supply.

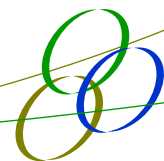
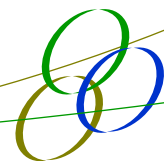


Table 1-2: Refined Turbine Locations (UTM).

Label	Proposed Eastings	Proposed Northings	Blade Tip Elevation mAHD	Distance Moved (m)	Bearing
WTG01	364902.3	6710276.5	1,361	42	SW
WTG02	364985	6709936	1,363	13	NE
WTG03	364925.9	6709583	1,363	0	N/A
WTG04	365131	6709251	1,360	0	N/A
WTG05	365343	6708692	1,352	0	N/A
WTG06	365850	6708179	1,375	0	N/A
WTG07	366170.2	6707771.3	1,414	38	NE
WTG08	366146	6707375	1,385	92	N
WTG09	366063	6707025	1,400	0	N/A
WTG10B	365939.9	6706230	1,354	22	SW
WTG11	365258.4	6705850.5	1,352	68	NW
WTG11B	365675	6705575	1,365	0	N/A
WTG12B	365980	6705375	1,379	0	N/A
WTG12C	366301.9	6704947	1,374	70	NE
WTG13	365933.2	6704425.1	1,386	94	SW
WTG13B	365792.7	6704174	1,380	20	NE
WTG14B	366071.3	6704670.8	1,384	29	SW
WTG15	366579.8	6703727.6	1,390	98	N
WTG16B	366605.2	6703206.2	1,436	5	SW
WTG16C	366618.7	6703415.8	1,434	21	NE
WTG17	366686	6702920.3	1,392	43	NW
WTG19	367318.4	6702281.3	1,446	40	SW
WTG20B	367521	6705469	1,404	10	NW
WTG22B	367651	6704952	1,415	0	N/A
WTG21B	367774	6705217	1,413	0	N/A

Justification for micro-siting the turbines is to accommodate the revised turbine design, to avoid boundary over-sail, to avoid Wind Sector Management (WSM) loss and to accommodate other layout reconfigurations.

Table 1-3 provides the approximate disturbance footprints of proposed individual windfarm components. A slight increase in temporary disturbance footprint is proposed, from 1.6 ha to 1.7 ha. A larger increase is proposed for the long-term disturbance footprint, going from 18.7 ha



to 23.6 ha. This increase is mainly due to the proposed increase in access track footprint. The original Environmental Assessment (Connell Wagner 2008) proposed an 8 m wide access track footprint, but in recent consultation with Office of Environment and Heritage, a more realistic, wider footprint was selected. Associated documents such as the approved Construction Environmental Management Plan (EPS 2017) and approved Biodiversity Offset Plan (EPS 2017) have both allowed for the wider disturbance footprint.

Table 1-3 Approximate Disturbance Footprint.

Table 1-3 Approximate Disturbance Footprint.								
	Approved				Proposed			
Project Component	Length (m)	Width (m)	Number ₁	Total area for Project (m ² , unless otherwise stated)	Length (m)	Width (m)	Total area for Project (m ² , unless otherwise stated)	Area Change
Temporary								
Batching plant	60	50	1	3,000	82	82	6,724	124% increase
Construction office	100	40	1	4,000	100	40	4,000	nil
Main laydown site	150	60	1	9,000	82	82	6,724	25% reduction
Total area				1.6ha			1.7ha	9% increase
Long Term								
Substation and permanent office	80	50	1	4,000	82	82	6,724	68% increase
Access tracks	14,000	8	1	112,000	14,000	12	168,000	50% increase
Turbine footings and transformer pad	18	18	25	8,100	22	22	12,100	49% increase
Turbine construction pads	50	50	25	62,500	62	32	49,600	21% decrease
Total area				18.7ha			23.6ha	27% increase

Note:

₁ The number of project components is identical for approved and proposed.

Legend

Biodiversity Study Area

Civil Works

Turbine Locations

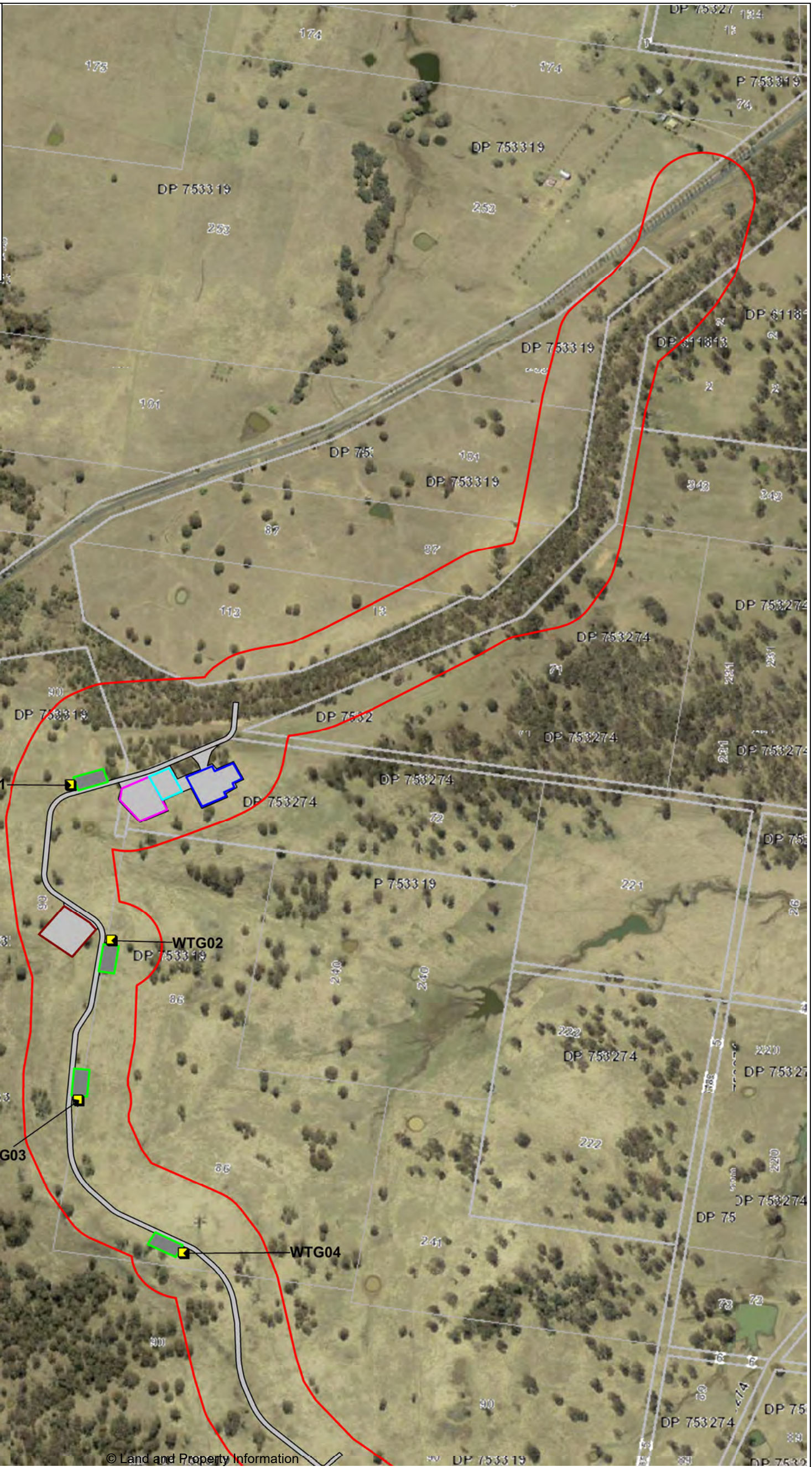
Site Compound

OMS Site

Substation

Crane Pad

Concrete Batch Plant



Author:	B. Ellis
Reviewer:	A. Tipper
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N

0

300

metres

Map Projection GDA 1994 MGA Zone 56

Figure:1-2a

Glenn Innes Wind Farm

Site Layout - MOD 4

Glenn Innes Wind Farm

Glen Innes, NSW

08 March 2017

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Legend

Biodiversity Study Area

Civil Works

Turbine Locations

Crane Pad

PCV Mast

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300

metres

Map Projection GDA 1994 MGA Zone 56

Figure:1-2b

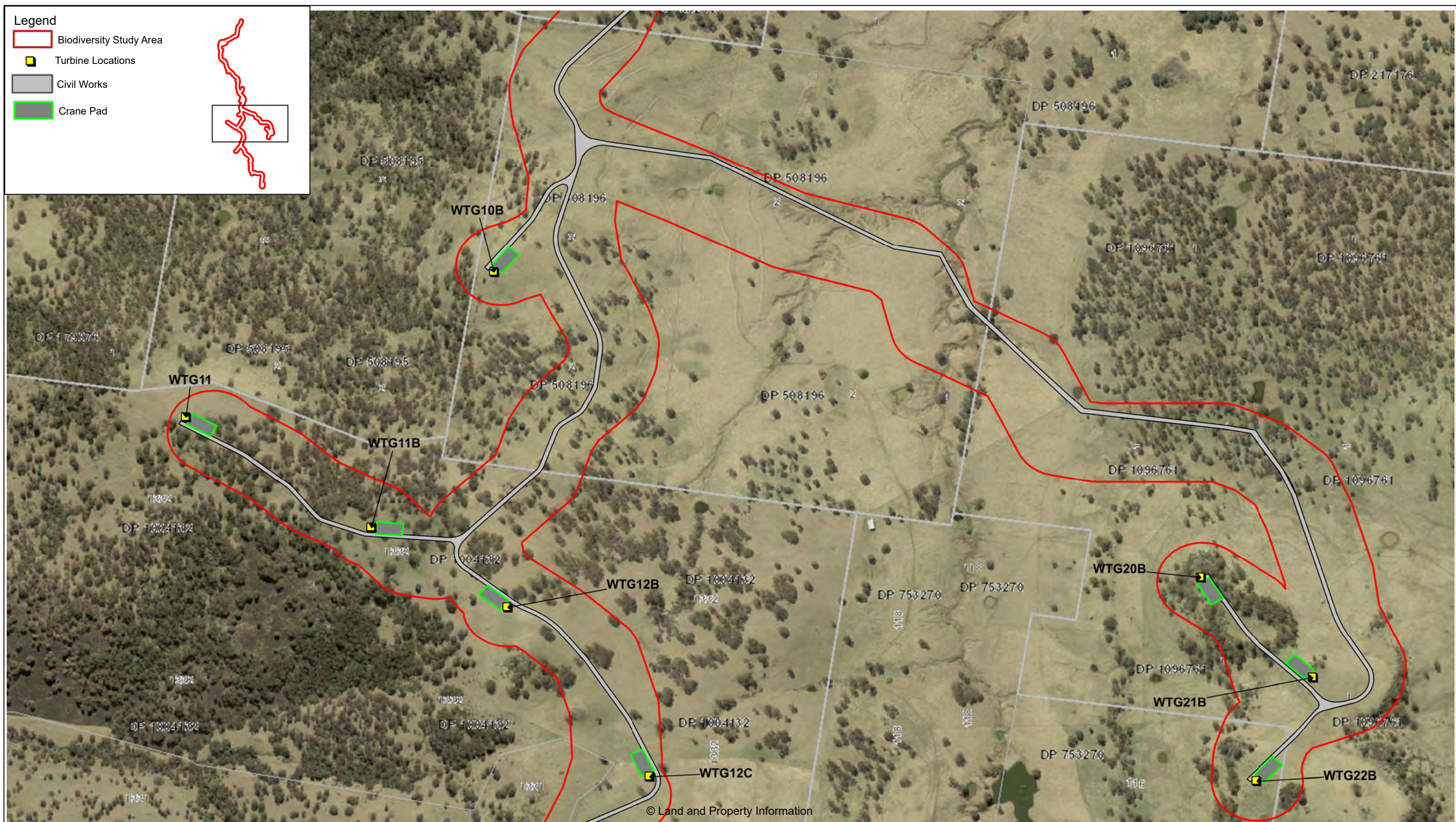
Glenn Innes Wind Farm
Site Layout - MOD 4

Glenn Innes Wind Farm
Glen Innes, NSW

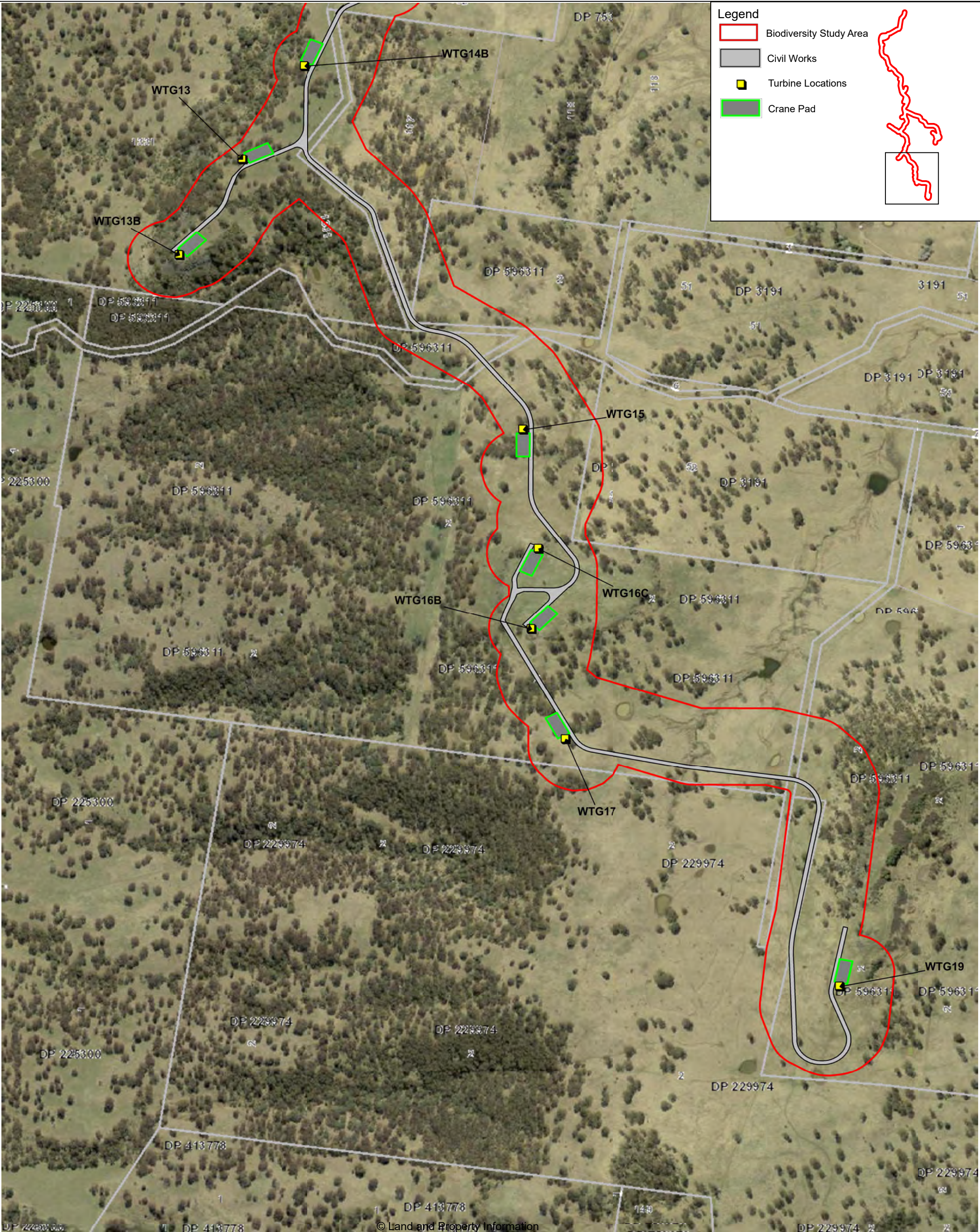
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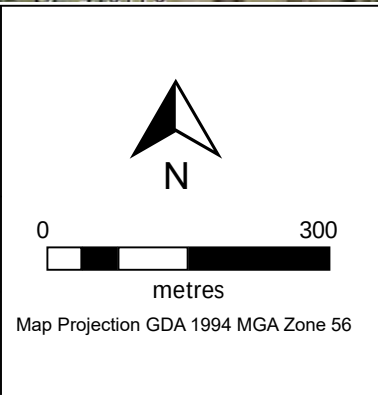


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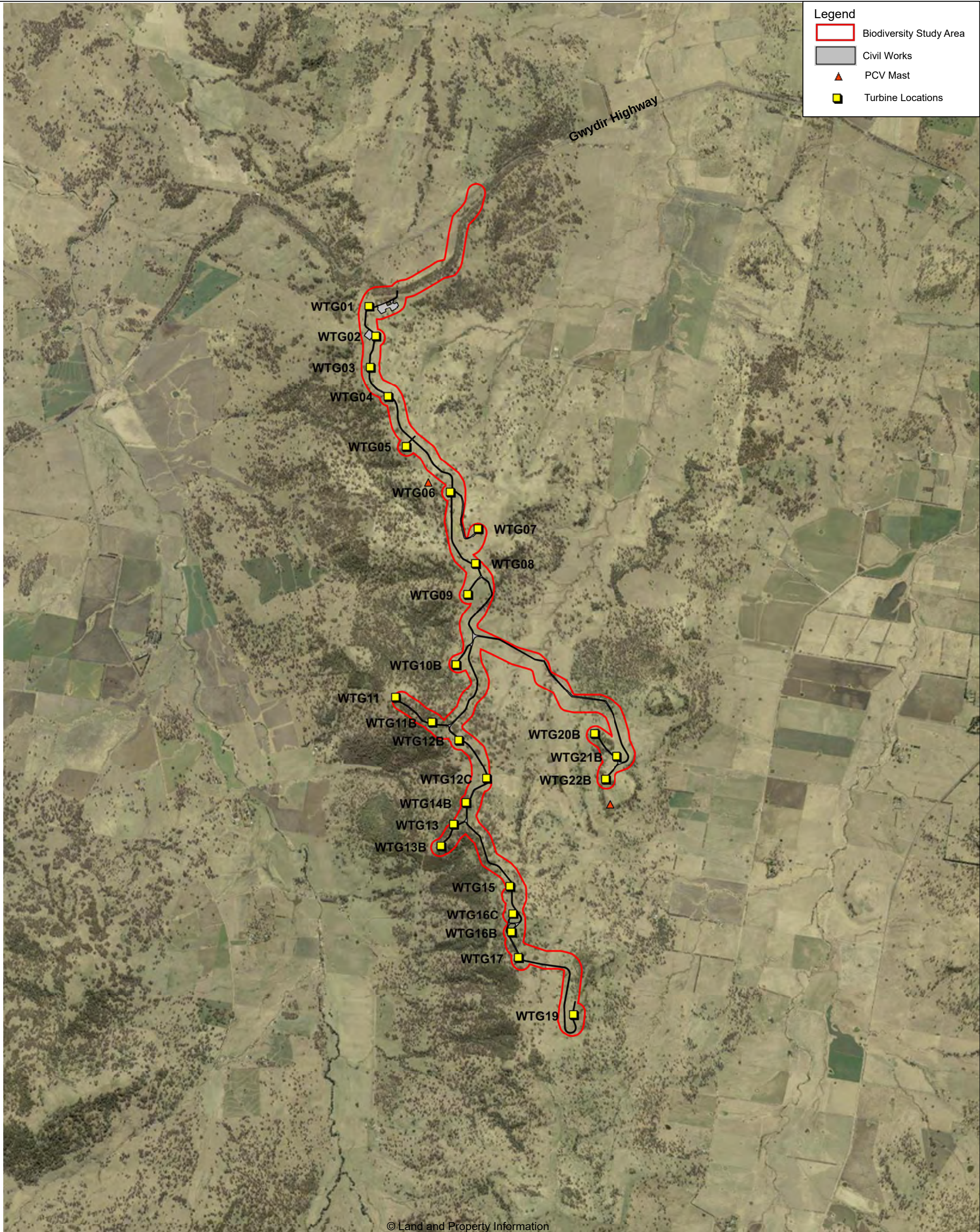
**Glenn Innes Wind Farm
Site Layout - MOD 4**

Glenn Innes Wind Farm
Glen Innes, NSW

08 March 2017



ENVIRONMENTAL PROPERTY SERVICES



Author:	B. Ellis
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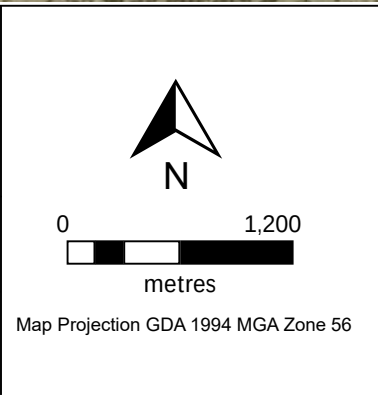


Figure: 1-2e

**Glenn Innes Wind Farm
Site Layout - MOD 4**

Glenn Innes Wind Farm
Glen Innes, NSW

08 March 2017



ENVIRONMENTAL PROPERTY SERVICES

Legend

Biodiversity Study Area

Proposed Amendments:

Civil Works

Turbine Locations

Site Compound

OMS Site

Substation

Crane Pad

Concrete Batch Plant

Approved Infrastructure:

Turbine Locations

Access Track (8m)

Site Facilities

Author:	B. Ellis	0 300 metres Map Projection GDA 1994 MGA Zone 56	Figure: 1-3a	Glenn Innes Wind Farm Site Layout - MOD 4 Glenn Innes Wind Farm Glen Innes, NSW 08 March 2017
Reviewer:	A. Tipper			
A3 Scale:	1:8,000			
Job Ref:	11262			

Legend

Biodiversity Study Area

Proposed Amendments:

Civil Works

Turbine Locations

Crane Pad

Approved Infrastructure:

Turbine Locations

Access Track (8m)

PCV Mast

Author:	B. Ellis
Reviewer:	A. Tipper
A3 Scale:	1:8,000
Job Ref:	11262

N

0

300

metres

Map Projection GDA 1994 MGA Zone 56

Figure: 1-3b

Glenn Innes Wind Farm

Site Layout - MOD 4

Glenn Innes Wind Farm

Glen Innes, NSW

08 March 2017

Legend

Biodiversity Study Area

Proposed Amendments:

Civil Works

Turbine Locations

Crane Pad

Approved Infrastructure:

Turbine Locations

Access Track (8m)

Author:	B. Ellis
Reviewer:	A. Tipper
Job Ref:	1:8,000
A3 Scale:	11262

Figure: 1-3c

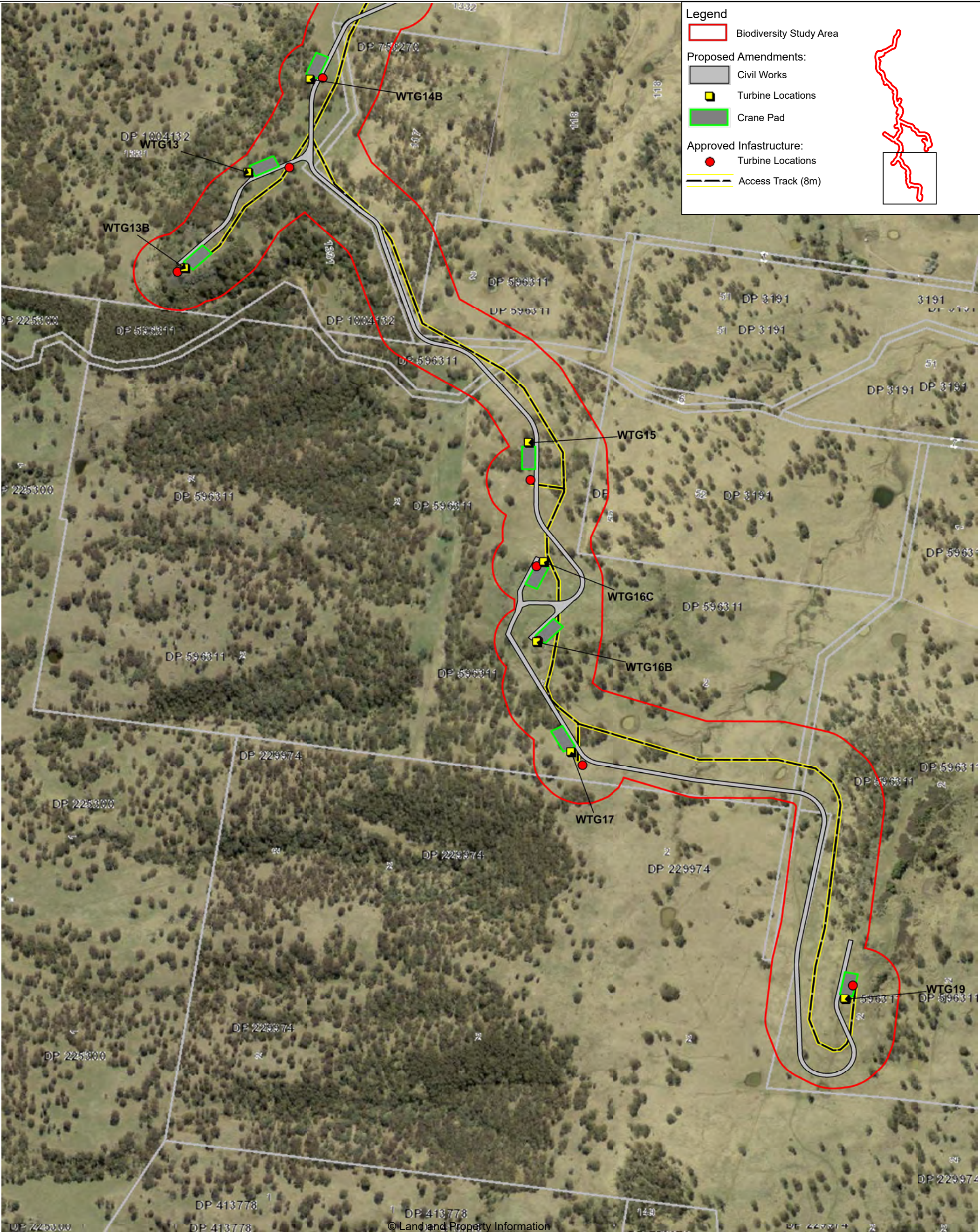
Glen Innes Wind Farm

Site Layout - MOD 4

Glen Innes Wind Farm

Glen Innes, NSW

March 11 2017



Author:	B. Ellis
Reviewer:	A. Tipper
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Job Ref:	11262

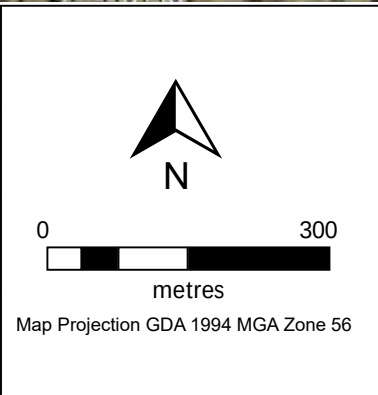
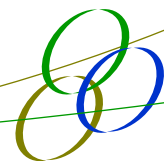


Figure: 1-3d

**Glenn Innes Wind Farm
Site Layout - MOD 4**

**Glenn Innes Wind Farm
Glen Innes, NSW**

08 March 2017



This Environmental Assessment considers how the environmental and social impacts of the proposed amendments compare against that which was assessed in Aurecon 2014. The following key aspects have been considered in following sections:

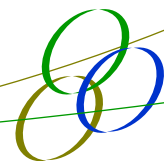
- Noise;
- Visual impact (including shadow flicker and blade glint);
- Aviation hazard;
- Traffic;
- Heritage;
- Biodiversity;
- Communication interference;
- Greenhouse gases;
- Blade throw; and
- Consultation.

1.3 Other Relevant Documents

Several documents have been prepared post-approval and those relevant to this proposed modification are listed as follows:

- Construction Environmental Management Plan (EPS, 2016) approved January 2017 that contains separate:
 - Noise Management Plan;
 - Traffic Management Plan;
 - Spoil and Fill Management Plan;
 - Bushfire Risk Management Plan;
 - Waste Management Plan;
 - Weeds Management Plan;
 - Cultural Heritage Management Plan;
 - European Heritage Management Plan;
 - Greenhouse Gas Management Plan;
 - Erosion and Sediment Control Management Plan;
 - Flora and Fauna Management Plan;
 - Emergency Response Plan; and
 - Dangerous Goods and Hazardous Materials Management Plan.
- Bird and Bat Adaptive Management Program (EPS, 2016) approved January 2017;
- Flora and Fauna Management Plan (EPS, 2016) approved January 2017; and
- Compensatory Habitat Plan (EPS, 2016) approved January 2017.

Note that the Construction Environmental Management Plan and Compensatory Habitat Plan have already considered the 12m wide track disturbance footprint as required by OEH for the biodiversity impact offset assessment.



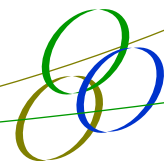
2 PLANNING FRAMEWORK

2.1 Environmental Planning and Assessment Act 1979

The Project Approval was granted under Part 3A of the EP&A Act and even though Part 3A has been repealed, it continues to apply to transitional Part 3A projects by virtue of Clause 3 of Schedule 6A. Accordingly, the Project Approval for GIWF may continue to be modified under Section 75W of the EP&A Act. Under Section 75W(4) of the EP&A Act, the Minister may modify a Part 3A approval with or without additional conditions.

2.2 Environment Protection and Biodiversity Conservation Act 1999

The GIWF has been subject to previous ecological assessments that concluded that an *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral and approval was not required for the project, as it was unlikely to have a significant impact on any Matters of National Environmental Significance (MNES). The listed MNES have been re-considered in Section 3.6.5, which reconfirms the previous assessment.



3 IMPACT ASSESSMENT

3.1 Noise

The associated noise assessment in Appendix E of Aurecon 2014 (provided for Modification 2) used specifications from Alstom ECO 110 – 3.0 MW turbines appropriately scaled to expected sound power spectral data for the Alstom ECO 122 – 2.7 MW. The outcome of the modelling was that the turbines proposed in Modification 2 were shown to be quieter than the originally approved turbines, due to lower tip velocities and different blade design.

Condition 2.16 of the Project Approval provides wind-scaled noise criteria for groups of non-associated residences. The noise criteria listed in Condition 2.16 are reproduced in Table 3-1.

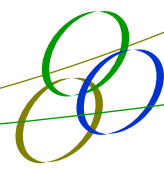
Table 3-1: Approved Noise Criteria

Residence	Criteria (dB(A)) at hub height wind speed (m/s)												
	3	4	5	6	7	8	9	10	11	12	13	14	
Cherry Tree (Eungai), Elm Vale, Klossie, Green House, Lombardy, Mayvona, Moonarie, Nullagai, Wandsworth	35	35	35	35	35	35	35	36	38	40	43	46	
Highfields, Wattle Vale	35	35	35	35	35	35	36	38	40	42	44	46	
Balaclava A, Ilparran A, Ilparran B, Kalanga A, Kalanga B, Kalanga C, Minamurra A, Minamurra B, Minamurra C, Green Valley (Oakes), Rivoli	35	35	35	35	35	36	37	38	39	40	40	41	
Girrahween, Glengarry	35	35	35	35	35	35	35	35	35	36	37	39	
All other non-associated residences	The higher of 35 dB(A) or the existing background noise level (LA90 (10-minute)) plus 5 dB(A)												

A Supplementary Noise Assessment report has been prepared by Sonus for the proposed Senvion wind turbines and a copy is attached in Appendix 2. This report informs this section of this Environmental Assessment.

The noise from the wind turbines was modelled using the CONCAWE propagation model within the SoundPlan noise modelling software. The CONCAWE noise propagation model is an internationally accepted model that takes into account:

- The sound power level and position of the noise sources;
- The separation between the noise sources and receivers;
- The ground topography between the noise sources and receivers;



- The hardness of the ground;
- Atmospheric absorption at different frequencies;
- Meteorological conditions;
- Atmospheric conditions at 10°C and 80% relative humidity;
- Acoustically soft ground (finite acoustic impedance);
- Maximum barrier attenuation from topography of 2 dB; and
- Worst case category 6 meteorological conditions (night with no clouds and wind from the wind farm to the residence under consideration).

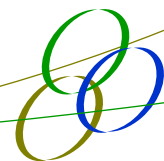
The *NSW Industrial Noise Policy* (INP) does not apply to this modification application and this noise assessment is based on the *SA Wind Farm Environmental Noise Guidelines 2009 (Modified)*.

Sonus reports the various noise emissions from the proposed turbines for a range of wind speeds and turbine operating modes. Table 3-2 provides these noise profiles. Note that while Consent Condition 2.16 includes criteria for 3 m/s and 14 m/s wind speeds, the proposed turbines do not operate under 4 m/s and the noise emissions from 13 m/s to turbine cut out at 22 m/s are identical.

Table 3-2: Overall sound power level for Servion 3.6M140 WTG

Hub Height Wind Speed (m/s)	4	5	6	7	8	9	10	11	12	13 to cutout
Overall Sound Power Level Normal Operating Mode (dB(A))	95.0	97.2	99.8	102.7	104.0	104.0	104.0	103.7	103.5	103.5
Overall Sound Power Level 102 dB(A) Operating Mode (dB(A))	95.0	97.2	99.8	102.0	102.0	102.0	101.9	101.5	101.5	101.5
Overall Sound Power Level 100 dB(A) Operating Mode (dB(A))	95.0	97.2	99.8	100.0	100.0	99.8	99.5	99.5	99.5	99.5
Overall Sound Power Level 98 dB(A) Operating Mode (dB(A))	95.0	97.2	98.0	98.0	97.8	97.5	97.5	97.5	97.5	97.5

Sonus predicts that there would be exceedances at certain residences at certain wind speeds when turbines are operating in normal mode (which provides greatest electrical generation). Table 3-3 provides possible mitigation measures to meet existing consent conditions. Nexif will also consider landholder agreements to avoid the down-rating of certain turbines at certain meteorological conditions. Any such agreements will be arranged in close consultation with



potential affected residents and will be reported to the DP&E. It should be noted that the Sonus prediction are based on worst-case meteorological conditions and the actual received noise levels may be lower than predictions.

Table 3-3: Mitigation Operating Modes

Wind speed	7m/s	8m/s	9m/s	10m/s
Required operating mode	WTG's 19, 16C, 21B, 22B in 98 dB(A) Mode.	WTG's 19, 16C, 17, 21B, 22B in 98 dB(A) Mode.	WTG's 19, 16C, 17, in 102 dB(A) Mode. 22B in 100 Mode. 21B in 98 Mode.	WTG's 21B, 22B in 102 dB(A) Mode.

In accordance with Condition 2.22, Glen Innes Windpower Pty Ltd will measure operational noise from GIWF within six months of operational commencement in accordance with the NSW Industrial Noise Policy and forward the results to the DP&E, and the Environment Protection Authority. Should any exceedance be measured at non-associated residences the required WTG will be run in a lower noise mode and re-tested to ensure the noise does not exceed requirements.

3.2 Visual

Green Bean Design was commissioned to prepare a Visual Impact Assessment of the proposed modifications to GIWF. A full copy of their report is attached in Appendix 3 and informs the following text.

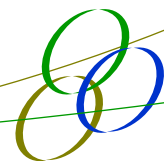
3.2.1 Methodology

The impact assessment by Green Bean Design (2017) used the following steps:

- A desktop study reviewing the approved and proposed turbine locations;
- The preparation of zone of visual influence (ZVI) diagrams showing areas of land within which wind turbines are theoretically visible;
- An assessment of significance of residual visual effects; and
- The preparation of wireframe models and illustrative figures.

The assessment (Green Bean Design, 2017) takes into account, and addresses, the visual impact process included in the New South Wales State Government Wind Energy: Visual Assessment Bulletin December 2016, as applicable to the Modification 4 application.

Firstly, a comparison between the approved GIWF layout (as per Modification 2) and the proposed layout was used to determine if any of the approved visual ratings, that apply to view locations within 3km of the approved project, are subject to an increased level of visual effect as a result of



the proposed modification. The assessment did not undertake to verify the visual ratings determined in the approved Modification 2 application.

The desktop study concluded that the proposed minor location changes due to the proposed micro-siting the turbines do not cause any greater visual impacts than that which is approved. The greatest proposed decrease in separation from a residence and a wind turbine will be 66 m between the residence Balaclava A and WGT 11.

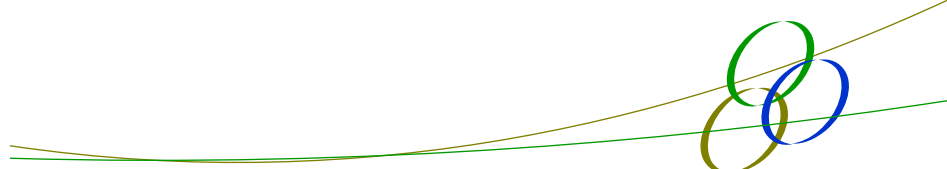
Analysis shows that the modification will result in up to four residential dwellings with views toward an additional three wind turbine hubs, and up to fifteen residential dwellings with views toward an additional one or two hubs. Table 5 in Appendix 3 provides analysis details for all houses within 3 km of any GIWF turbine and classifies all receivers with a visibility rating. Green Bean Design note that the viewing of additional hubs does not increase the visual impact of the approved wind farm.

ZVI diagrams are provided in Appendix 3 (Figures 2 and 3), which indicate that the proposed modification would result in a very limited increase in visual effects across the viewshed and the increase in wind turbine visibility would be largely restricted to the upper sections (hubs and rotors) of wind turbine structures, rather than whole wind turbines.

Table 7 of Appendix 3 provides a visual effect matrix of the 23 houses within 3 km of any proposed GIWF turbine and shows that for all houses, the change in visual impact due to the proposed modification is low, and thus the “approved” visual impacts remain unchanged. All ratings remain unchanged from those assigned in the visual impact assessment that supported Modification 2, prepared by Aurecon in 2013 (see Appendix D.1 of Aurecon 2013, Table 3). Within the parameters of normal human vision, the proposed turbines are not considered to give rise to an increased level of visual magnitude over and above that approved.

Further to the above comparisons, the visual assessment matrix in Table 8 of Appendix 3 considers a number of residences not previously required to be assessed. In accordance with the Bulletin, the matrix considers additional visibility distance zones and viewer sensitivity. While both the approved and proposed turbines would be visible (in whole or in part) from a majority of dwellings within 3.6km, overall visibility would be restricted from many areas (including from dwellings and associated curtilage) due to tree cover and/or the influence of surrounding landforms. Visual mitigation (including landscape works) would provide screening for a number of dwellings surrounding the approved wind farm site in accordance with the conditions of consent.

To better indicate the extent of change of visual impacts, wire frame models have been prepared for each of the 23 houses within 3 km of any proposed GIWF turbine (see Figures 7 to 42 of Appendix 3). These wireframe models do not account for trees that may obscure views from



houses to wind turbines, and so are a conservative representation. The wireframe models show separate representations for two scenarios from each house:

1. The approved and proposed GIWF turbines to indicate the extent of change; and
2. The proposed GIWF turbines, and where visible, those of the White Rock Wind Farm.

The visual impact assessment shows that while the proposed modification would result in a discernible change from some locations, these would not be of a magnitude that would significantly increase the “approved” visual impacts.

No changes to the relevant consent conditions (2.1, 2.1a, 2.2,2.3, 2.4, 2.7and 6.5) are sought as all remains relevant to the proposed modification.

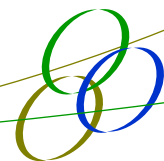
3.2.2 Cumulative Impacts

Green Bean Design prepared a cumulative impact assessment for the White Rock Wind Farm that considered turbines at Glen Innes, White Rock, Sapphire and Ben Lomond wind farms (Green Bean Design 2011).

Green Bean Design (2011) concluded that *“....the White Rock wind farm would not result in significant ‘direct’, ‘indirect’ or ‘sequential’ cumulative impacts when considered against any known existing or proposed wind farm developments, including the Glen Innes, Sapphire and Ben Lomond wind farm projects. Visibility between approved and proposed wind farms is influenced by undulating landform and tree cover within and beyond the White Rock 10km viewshed.”*

The key to wind farm cumulative impact is the extent of visibility between separate project’s turbines. Visibility is dependent on turbine location, height, local topography, intervening vegetation and distance to the viewpoint. Of the four wind farms considered in Green Bean Design (2011), Glen Innes and White Rock wind farms are by far the closest together. The report notes that while there is a low direct cumulative impact between the two farms from all residences, there would be some indirect cumulative impacts, where turbines from both projects could be seen from individual residence, albeit not from the same field of view and at some distance. Green Bean Design (2011) notes a similar situation for the cumulative impacts of the White Rock and Sapphire wind farms and concludes that the wind farms together, are unlikely to cause any significant direct to indirect visual impact.

The White Rock cumulative assessment (Green Bean Design, 2011) equally applies to GIWF as it considered all the local wind farms, and as the current GIWF modification visual impact assessment shows that the proposed modification would not result in change that would significantly increase the “approved” visual impacts, no change in the magnitude of cumulative impacts will result.



3.2.3 Aviation Hazard Lighting

The Civil Aviation Safety Authority (CASA) is currently undertaking a safety study into the risk to aviation posed by wind farms and is planning develop a new set of guidelines to replace a previous wind farm lighting advisory circular that was withdrawn in 2008. An aviation hazard risk assessment is currently in preparation for GIWF, of which part is an obstacle lighting assessment, from which an eventual finding maybe the need to install aviation hazard lighting.

The current consolidated consent condition 25 states that *“No external lighting other than low intensity security night lighting of infrastructure associated with the project, including wind turbine generators is permitted on site unless otherwise agreed or directed by the Secretary.”*

The adjacent White Rock Wind Farm consolidated consent condition 29 states that *“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.*

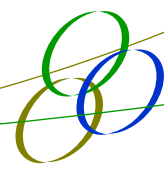
Prior to the commencement of construction, the Proponent shall consult with the Civil Aviation Safety Authority on the need for aviation hazard lighting in relation to the wind turbines. Any aviation hazard lighting shall be implemented in a manner that minimises visual intrusion to surrounding non-associated residences as far as reasonable and feasible.”

The nearby Sapphire Wind Farm consolidated consent condition 29A also refers to aviation hazard lighting: *“Prior to the commencement of operations, the Proponent shall: (a) consult further with CASA about the need for aviation hazard lighting; and (b) ensure that any aviation lighting that is needed complies with CASA’s requirements. If there is a dispute between CASA and the Proponent about the need for aviation hazard lighting, the Proponent may refer the matter to the Secretary for resolution.”*

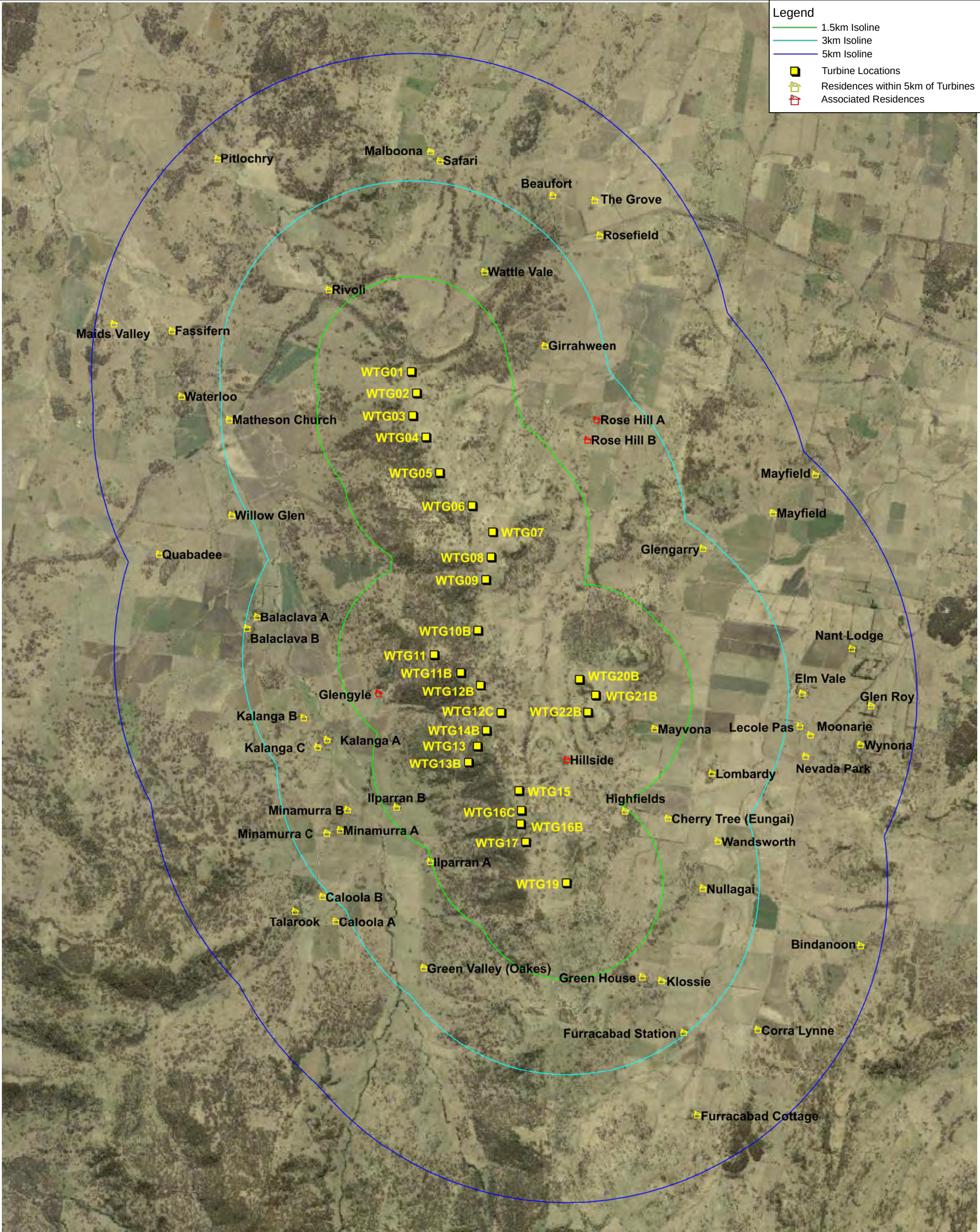
For consistency across the adjacent projects, all of which may be required by CASA to install aviation hazard lighting, it is requested that GIWF consent condition 25 be replaced with the following, or similar:

“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 residences as far as reasonable and feasible.”



Author:	B. Ellis
Reviewer:	A. Tipper
A3 Scale:	1:55,000
Job Ref:	11262

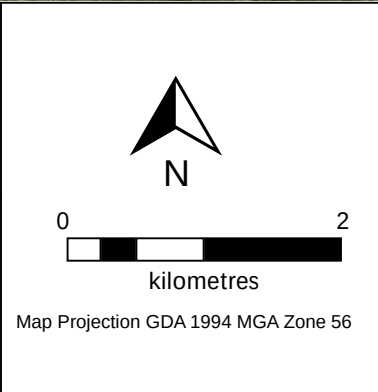


Figure: 3-1

**Residences Within 5km
Of Any Turbine - MOD 4**

Glen Innes Wind Farm
Glen Innes, NSW

25 July 2017



ENVIRONMENTAL PROPERTY SERVICES

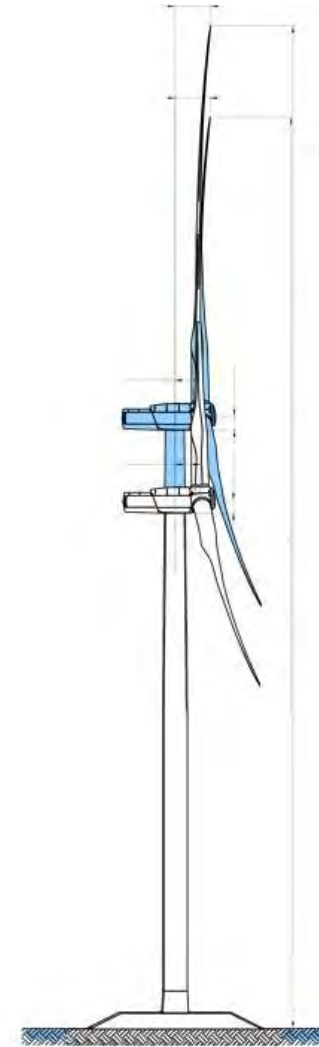
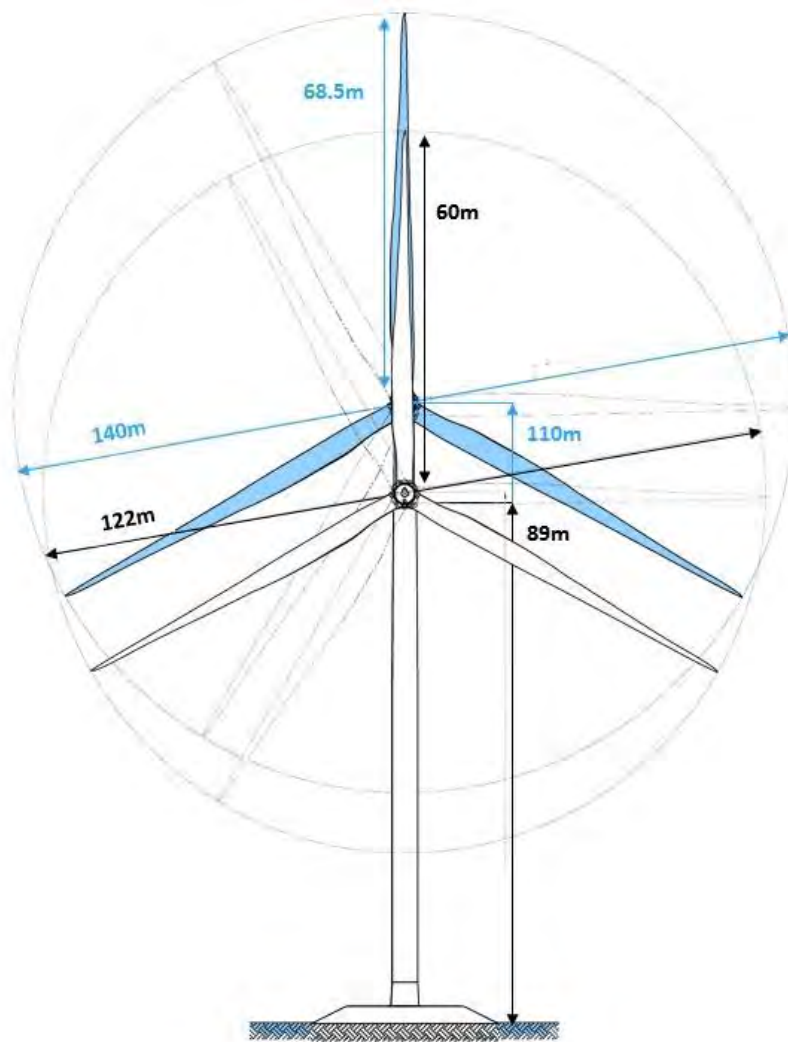
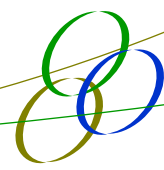


Figure 3-2: Graphic Representation of Proposed Wind Turbine Changes



3.2.4 Shadow Flicker

The National Wind Farm Development Guidelines DRAFT – July 2010 define shadow flicker as follows:

“The rotating blades of wind turbines can cast intermittent shadows that appear to flicker for an observer at a fixed ground position. Since wind turbines are tall structures, shadow flicker can be observed at considerable distances but usually only occurs for brief times at any given location. The most common effect of shadow flicker is annoyance. These impacts are most closely associated with the duration of shadow flicker experienced above a certain intensity.”

Condition 2.6 of the Project Approval relates to shadow flicker and states in part:

“Shadow Flicker arising from the operation of the project shall not exceed 30 hours/annum at any residence not associated with the project.”

Senvion has undertaken an analysis of shadow flicker for the proposed turbines in accordance with the National Wind Farm Development Guidelines DRAFT – July 2010 using the EMD WindPRO 3.0 software package and in consideration of the NSW Wind Energy: Visual Assessment Bulletin (D&PE, 2016). A full copy of the assessment is contained in Appendix 4 and informs this section of the Environmental Assessment.

The National Wind Farm Development Guidelines DRAFT – July 2010 define the zone of shadow flicker influence as being 265 times the maximum chord measurement of the turbine blades. The maximum chord measurement is essentially the straight-line distance from the blade’s leading edge to trailing edge at the widest section of the blade. The maximum chord of the selected blades is 4.257 m, for a zone of shadow influence of 1128 m. Nonetheless, Senvion has modelled shadow flicker to 2,000 m in accordance with the *Draft NSW Planning Guidelines: Wind Farms* (2011), a distance and area greater than the likely impact area predicted in the National Wind Farm Development Guideline. Table 3-4 provides the predicted maximum theoretical shadow flicker for residences within 2,000 m.

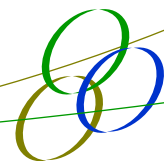


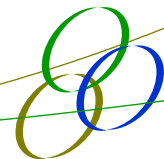
Table 3-4: Theoretical Maximum Shadow Flicker Predictions

Residence	Description	Nearest turbine (m)	Shadow flicker (hours/annum)
Hillside	Associated residence (vacant)	814	0
Mayvona	Non-associated residence (vacant)	1,060	58.5
Glengyle	Associated residence	1,116	72
Ilparran B	Non-associated residence (vacant)	1,299	48.4
Ilparran A	Non-associated residence	1,383	42.4
Highfields	Non-associated residence	1,420	29.95
Wattle Vale	Non-associated residence	1,821	0
Cherry Tree (Eungai)	Non-associated residence	1,932	0
Rose Hill B	Associated residence	1,932	9.3
Green House	Non-associated residence (vacant)	1,941	0
Rivoli	Non-associated residence	1,982	0

Shadow flicker modelling provides the maximum theoretical hours of flicker per year without a consideration of modifying technical and environmental factors. The most important of these factors is cloud. On cloudy days no shadows are produced, so no flicker can result. Based on the Bureau of Meteorology's Glen Innes weather station cloud data, the area has a mean of 130 cloudy days per year (defined as 6 eighths of the sky showing cloud). Considering cloud cover against the theoretical maximum predictions would significantly reduce the predictions provided in Table 3-4.

Given that flicker modelling provides a theoretical maximum figure and further that cloud cover varies daily, seasonally and even annually, actual prediction of shadow flicker is difficult to accurately predict. To limit received shadow flicker duration to 30 hours per year at all non-associated residences the turbines can be fitted with shadow management modules that monitor flicker causing conditions and shut down the affected turbines as necessary. Calculations show that such management modules will limit flicker to less than 30 hours per year at all non-associated residences.

In accordance with the current consent conditions, GIWF will prepare an operational shadow flicker report for *Cherry Tree*, *Highfields*, *Mayvona*, and *Ilparran B*. This report will clarify the actual received flicker at these residences.



3.2.5 Blade Glint

According to the Environment Protection and Heritage Council (2009) the risk of blade glint from modern wind turbines is very low. Blade glint at GIWF will be managed by finishing blades with a glare preventative surface treatment as per the conditions of consent. The rotor blades, nacelle and tower will be light grey (nominally standard colour code RAL 7035) in accordance with Condition 2.3. This reduces reflection without affecting the power characteristic.

While the selected turbines have longer blades, this is not expected to increase blade glint due to the grey, glare preventative surface treatment to be used.

3.3 Aviation Hazard

Wind turbines and tall meteorological monitoring masts pose potential hazards to aircraft. The original Environmental Assessment (Connell Wagner, 2008) noted the following airfields around the site:

- Glen Innes Aerodrome about 10 km to the north east;
- Six privately operated airfields on properties surrounding the wind farm site; and
- Inverell airfield about 50 km to the west.

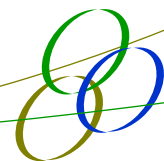
While the current Wind Energy Guideline (DP&E, 2016) does not specify the assessment methodology for aircraft risk, the associated standard Secretary's Environmental Assessment Requirements specify an assessment in accordance with National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft (the Guideline). In part, the Guideline notes the following:

When wind turbines over 150 metres above ground level are to be built within 30 kms of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority (CASA) and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.

The proposed Modification would bring the tip heights to 180 m.

The Guideline also notes that the Royal Australian Air Force Aeronautical Information Service (RAAF AIS) maintains a database of tall structures in the country. The RAAF AIS should be notified of all tall structures.

The Environmental Assessment that supported Modification 2 application (Aurecon 2013) considered the then proposed changes to blades lengths and tower heights. Aurecon found that GIWF is outside the Obstacle Limitation Surface (OSL) or Procedures for Air Navigation Services –



Operations (PANS-OPS) areas for Glen Innes Aerodrome. OSL identifies the lower limits of the aerodrome airspace above which objects are regarded as potential obstacles to aircraft operations in good weather. PANS-OPS surfaces are designed to protect aircraft flying in poor weather conditions from colliding with tall structures.

Two factors require consideration to consider the proposed modification: turbine location and rotor height. Table 1-2 shows the differences in approved and proposed turbine locations, with all re-locations being less than 100 m.

To properly consider this current proposed modification, a specialist aviation consultant, Ambidji Group (a division of Landrum and Brown) prepared an Aviation Impact Statement in accordance with Airservices Australia's 2014 guidance *Aviation Assessment for Wind Farm Developments*. A complete copy of the Aviation Impact Statement is provided in Appendix 5 and informs this section of the Environmental Assessment.

Ambidji found that the proposed modification:

1. Will not impact on any Obstacle Limitation Surface for registered or certified aerodromes.
2. Will not impact on the operation of any aviation communications or navigation aids.
3. Will not impact on the operation of any airspace surveillance facilities.
4. Will not impacts on Lowest Safe Altitudes of air routes nearby.
5. Will necessitate an increase in the Minimum Sector Altitude for Glen Innes Aerodrome.

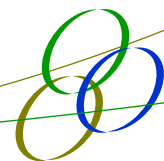
Glen Innes Aerodrome has two published instrument approach procedures, one of which (RWY 14RNAV) is impacted by the proposed taller GIWF turbines. GIWF is within the 10 nm plus 5 nm buffer Minimum Sector Altitude zone measured from Glen Innes Aerodrome. When the minimum obstacle clearance of 1000 ft is applied to the highest planned turbine (WTG 9 at 4594 ft), the 5500 ft Minimum Sector Altitude is penetrated by 94 ft. This will require the increase of the 25 nm sector Minimum Sector Altitude to be raised to 5600 ft, or 100 ft more than the current height. This will have minimal impact on flight operations.

GIWF will request Airservices Australia to raise the 25 nm sector Minimum Sector Altitude to 5600 ft. Copies of relevant correspondence will be forwarded to the DP&E.

Condition 2.38 of the Project Approval requires the following and remains relevant to the proposed modification:

"Prior to the commencement of construction and operation, the Proponent shall provide the following information to the Civil Aviation Safety Authority, Royal Australian Air Force-Aeronautical Information Service and Airservices Australia as well as all known users of privately owned local airfields:

a) "as constructed" 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. “*

Condition 2.52 provides for compensatory arrangements in the case of disruption to aerial agricultural spraying and remains relevant to the purposed modification. The main aerial agricultural company in the area, SuperAir was notified of the proposed modification on 08/06/2017. Unfortunately, at the time of writing, Mr Boundy the General Manager, remains overseas and GIWF awaits his response, which will be forwarded to DP&E once received.

3.4 Traffic

Amendments to the turbine design will not require changes to construction transport route although blade loads will be marginally longer and the additional turbine tower sections will generate additional loads. The White Rock Wind Farm has successfully transported 59.5 m long blades along the same route as proposed by GIWF. The Senvion blades are marginally longer and transport will be managed in accordance with the approved Construction Traffic Management Plan (EPS, 2016) which was prepared in consultation with Roads and Maritimes Services (RMS).

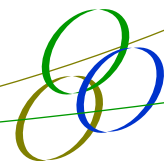
The approved Construction Traffic Management Plan (EPS, 2016) provides details of measures to minimise traffic disruption. The key components include:

- Construction of road access from the Gwydir Highway (through the Travelling Stock Route 67474) to the site in accordance with the AUSTROADS Rural Access Standards and to the satisfaction of the RMS and the Local Land Services;
- Approval of the relevant road authorities in accordance with Section 138 of the *Roads Act 1993* prior to commencement of relevant works on a public road including a Works Authorisation Deed from RMS;
- Dilapidation surveys of transport route;
- Implementation of the Community Information Plan; and
- Approval from the RMS Special Permit Branch prior to the transport of over-mass and over-dimension components.

3.5 Heritage

Adjustment of the layout is required to accommodate the new Senvion turbines. The revised turbine locations have resulted in some minor track amendments.

The heritage assessment supporting the original application surveyed the entire development area, concentrating on proposed areas of disturbance, including turbine pads, access tracks and ancillary facilities. The survey area encompasses the areas supporting the proposed access track amendments. Figure 8.1 of the original Environmental Assessment (Aurecon, 2008) shows the



survey units. The survey found one isolated artefact, GIWF 1. Condition 2.46 of the Project Approval states:

Should the final wind farm design require works in the vicinity of Site GIWF No. 1, the Proponent shall, prior to the commencement of construction in that area, develop a management and mitigation strategy for the site in consultation with the Glen Innes Aboriginal Land Council and OEH.

Works in the vicinity of GIWF 1 have been removed from the final design (i.e. construction of turbine 10 and access through the 'saddle' to turbine 10, is no longer proceeding). As such, development of a strategy and associated further consultation, is not required. The following extract from OEH letter dated 09/09/2016 confirms removal of disturbance in the area of 'saddle' is sufficient:

The OEH notes the changes to the design of the proposal which avoid harm to any Aboriginal objects at the location of GIWF 1. We consider that avoiding harm is the most appropriate management approach for Aboriginal objects and consider that, as a result of the redesign, that no further specific considerations or management protocols for ACH [Aboriginal Cultural Heritage] values are necessary for this project.

The proposed modifications will not increase impacts to known or potential heritage items as the sites of the turbines, tracks and ancillary facilities were previously surveyed, and no artefacts were found.

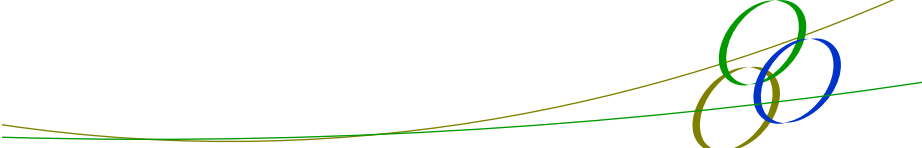
The approved Cultural Heritage Management Plan (EPS, 2016) provides details of measures to protect and preserve Aboriginal cultural heritage. The plan outlines three basic levels of management options in order of preference:

1. Avoidance;
2. Preservation through ongoing management; and
3. Salvage and interpretation.

The single known artefact on the site, a ground axe head GIWF1 near the proposed turbine site 10 has been avoided by excluding this turbine from the approval.

The construction site induction will address Aboriginal heritage. If an unrecorded artefact is found, work in that area will stop immediately and the matter reported promptly to the Environment and Community Manager for implementation of the Cultural Heritage Management Plan.

If during construction, suspected human remains are uncovered, the following procedure will be followed:

- 
- Inform Environment and Community Manager of the find and cease all works within the vicinity of the remains. Do not further disturb or remove any of the remains;
 - Inform the local police and OEH;
 - If the remains are determined to be Aboriginal then the Aboriginal stakeholders, following OEH advice should be informed of their discovery; and
 - The handling of the remains will be dealt with following the development of a management strategy in which the Aboriginal stakeholder groups will be involved.

3.6 Biodiversity

3.6.1 Overview

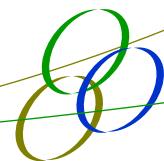
Biodiversity impacts of the project have been previously assessed by both Kevin Mills & Associates (general flora and fauna) and Greg Richards and Associates (specialist bat investigations). For biodiversity offset calculation purposes, EPS also undertook updated BioBanking surveys and vegetation mapping in 2016.

All areas proposed to be impacted by the modified layout have been subject to biodiversity surveys by Kevin Mills & Associates, Greg Richards and Associates and EPS over a number of years and seasons. As a result, the biodiversity constraints within the Biodiversity Study Area (as shown in the various maps in this document) are well understood.

During the turbine selection phase, there was ongoing consultation with OEH, whose officers stated concern with the initially planned shorter towers, due to potential impacts on low-flying birds and bats. Consequently, Nexif chose an alternative design with taller turbine towers to substantially reduce this potential impact, even when compared to the approved design parameters.

The main project modification that requires consideration is the change in turbine design. Other aspects such as minor micro-siting of the approved turbine locations, small changes to track locations and small changes to the locations of approved project components (such as batching plant, office, laydown site and substation) are very minor in terms of potential changes in biodiversity impacts when compared to the approved project design.

The main aspects of the modification of the proposed turbines are the increase in length of blades and increase in the hub height. The hub height is proposed to increase to 110 m from the approved 89 m. The blade length is proposed to be increased from the approved 60 m to 68.5 m. The rotor tip height therefore increases to around 180m, compared to the previous 150 m. This also increases the ground clearance between the blade tip and the ground from the approved 29 m to 41.5 m. This approach incorporated preferences for maximising ground clearance, as



outlined by OEH for the project modification. Effectively, this change would result in over 10 m of additional clearance compared to what is already approved, and this is expected to result in an overall benefit to a majority of native species likely to occur. For this reason, extensive reassessment of ecological impacts is not considered to be warranted, as impacts (particularly to birds and bats) are expected to be reduced further when compared to the approved design.

The refined turbine locations have also resulted in some minor track amendments. In accordance with discussions with OEH during the preparation of Bird and Bat Adaptive Management Program (BBAMP), Flora and Fauna Management Plan (FFMP) and Compensatory Habitat Package (CHP), a disturbance footprint of approximately 12 m has been introduced to allow calculation of indirect construction impacts and associated biodiversity offset requirements. The 12 m width incorporates impacts associated with drainage channels and batters. The amended track locations remain located within the Biodiversity Study Area used in the original documentation and in the approved CHP. Field data has been recorded for the Biodiversity Study Area to determine the condition of vegetation in the project development footprint. This data will be used to undertake a pre and post development assessment to confirm the number of final biodiversity offset credits required for the project disturbance. This work was undertaken as part of the biodiversity-related post-approval works in accordance with Condition 2.27 of the Project Approval.

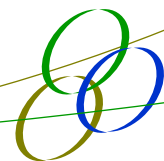
In terms of the potential total increase in disturbance area that will result from 4 m widening of the access track, the area will increase from 11.2 ha to 16.8 ha. The existing approved CHP already assessed the 12 m access track width, so appropriate offsets (via biodiversity credits) is already to be provided for this increased level of impact.

The biodiversity-related post-approval documentation includes the CHP, BBAMP and FFMP. All three documents were approved by DP&E in January 2017. All documents have been prepared in regular consultation with OEH. All documents incorporate consideration of the areas that includes the proposed turbine and specifications, refined ancillary facilities, new track widths and aspects such as carcass search methods in the BBAMP. The CHP incorporates indirect impacts into the BioBanking calculations as recommended by OEH and it is considered that such an approach also addresses the potential impacts of the turbine, including rotor swept area impacts, refined ancillary facilities, and new track widths.

More detailed analysis of the project modification is provided below for each important biodiversity consideration.

3.6.2 Threatened Ecological Communities

Kevin Mills and Associates (2007) identified two threatened ecological communities within the development site, Ribbon Gum – Mountain Gum Snow Gum Grassy Open Forest of the New England Tableland and White Box – Yellow Box – Blakely's Red Gum Woodland (listed as



endangered on the TSC Act and critically endangered on the EPBC Act). Updated surveys undertaken by EPS as part of the CHP preparation and associated BioBanking calculations, identified both communities listed as endangered in the TSC Act. However further assessment undertaken by EPS in the CHP against the EPBC Act listing of White Box – Yellow Box – Blakely’s Red Gum Woodland for vegetation on the site concluded that it does not meet the criteria for the listing of this community. Therefore, no threatened communities listed under the EPBC Act were recorded within the development site during the current surveys. No biodiversity offsets are required at the Commonwealth level.

The following threatened ecological communities have been confirmed by EPS.

Ribbon Gum Mountain Snow Gum Grassy open forest

The Ribbon Gum – Mountain Gum Snow Gum Grassy Open Forest of the New England Tableland open forest and derived grassland form of this community are both commensurate with the threatened ecological community of Ribbon Gum – Mountain Gum Snow Gum Grassy Open Forest of the New England Tableland listed as endangered on the TSC Act. This community is not listed under the EPBC Act.

White Box Yellow Box Blakely’s Red Gum Woodland – TSC Act

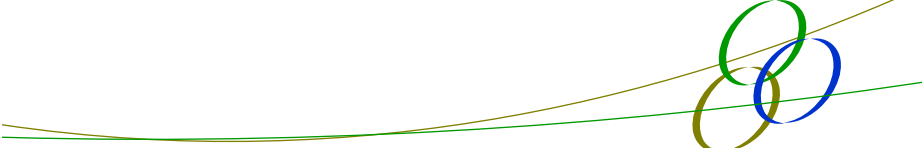
The Blakely’s Red Gum – Yellow Box Grassy Woodland of the New England Tableland Bioregion is commensurate with the endangered ecological community White Box Yellow Box Blakely’s Red Gum Woodland as listed on the TSC Act. No derived native grassland form of this community is to be impacted by the GIWF.

Impacts to threatened ecological communities are expected to remain relatively unchanged from those already assessed in the previously approved project. Condition 2.27 of the Project Approval states that “The Proponent shall undertake a post construction review of clearing to confirm the extent of clearing was not greater than predicted, if clearing is greater, then the package shall be modified and the offset increased to the value of actual habitat lost”. Therefore, given the ability to reconcile final offsets post-construction, at this stage no further assessment is warranted.

3.6.3 Threatened Flora

No threatened flora were recorded by Kevin Mills during previous investigations.

Thesium australe is listed as a vulnerable plant species under the TSC Act and the EPBC Act. The previous surveys conducted by Kevin Mills and Associates (2007) did not record this species, however potential habitat within the study area was identified.



The recent surveys by EPS recorded approximately 50 individuals of *Thesium australe*, within the study area, though outside of the direct impact zone of the Modification 4 layout. This species will not be impacted upon by the project and protection measures employed under the FFMP for the GIWF will ensure this is the case. Impacts to threatened flora are expected to remain unchanged from those already assessed in the previously approved project. The same general locations are to be impacted by the modified layout as were predicted to be impacted by the approved layout.

3.6.4 Threatened Fauna

Kevin Mills and Associates recorded 66 species of fauna which comprised of 55 birds, one frog, four reptiles and six introduced animals but no threatened fauna.

Three species of threatened fauna were recorded during the bat surveys by Greg Richards and Associates, which were:

- Large-Eared Pied Bat (*Chalinolobus dwyeri*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*); and
- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*).

Kevin Mills and Associates did however identify 11 threatened fauna species as having potential habitat within the development site.

An updated database search identified an additional 13 threatened fauna species with potential habitat within the site. These include Scarlet Robin, Varied Sittella, Squirrel Glider, Little Eagle, Scarlet Robin, Little Lorikeet, Hooded, Robin, Spotted Harrier, Regent Honeyeater, Swift Parrot, Eastern Bent Wing-bat, Eastern Freetail-bat and Eastern Cave Bat.

The Sapphire Wind Farm study area (EcoLogical, 2011) recorded fourteen species of threatened fauna, albeit over a much larger area with substantially more intact habitats.

Table 3-5 lists these threatened fauna species and notes whether they have been identified on the GIWF site.

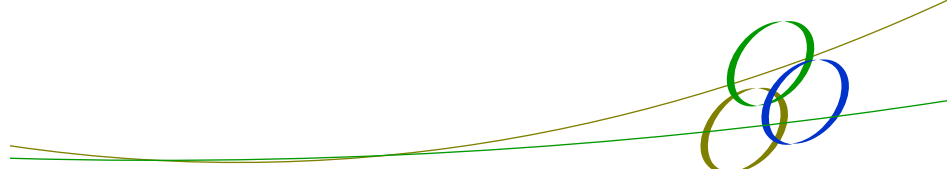
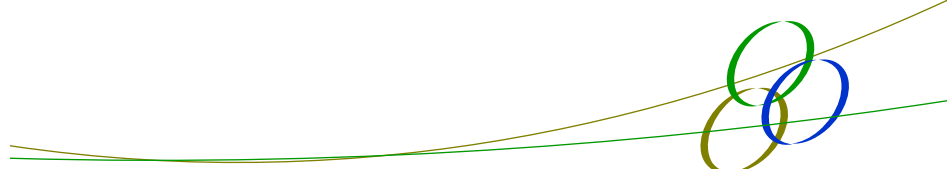


Table 3-5 Threatened Fauna Species

Scientific name	Common Name	TSC Act Status	EPBC Act Status	Recorded?
Birds				
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper	V	-	No
<i>Stagonopleura guttata</i>	Diamond Firetail	V	-	No
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	V	-	No
<i>Glossopsitta pusilla</i>	Little Lorikeet	V	-	No
<i>Petroica boodang</i>	Scarlet Robin	V	-	No
<i>Pyrrholaemus saggitatus</i>	Speckled Warbler	V	-	No
<i>Neophema pulchella</i>	Turquoise Parrot	V	-	No
Bats				
<i>Miniopterus schreibersii</i>	Eastern Bent-wing Bat	V	-	No
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat	V	-	No
<i>Chalinolobus dwyeri</i>	Large-Eared Pied Bat	V	V	Yes
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V	-	Yes
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat	V	-	Yes
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V	-	No
<i>Vespadelus troughtoni</i>	Eastern Cave Bat	V	-	No

The Sapphire Wind Farm has several different and more complex habitats in comparison to the GIWF. The additional bird species recorded at the former site are woodland birds that occur in the lower intact connected woodland habitats. The GIWF contains mostly cleared agricultural land on ridgelines with the surrounding slopes being steep and having dense vegetation. A small area of woodland habitat occurs within the south of the GIWF near Turbine 19, however this area has been intensively grazed and contains little native understory. Three of the microbat species recorded within the Sapphire Wind Farm site were recorded within the GIWF study area. The remaining species have been identified as having potential habitat within the study area. The survey effort was greater for the Sapphire Wind Farm due to the larger area of the study area and therefore additional microbat species were detected.

None of the above species are subject to species credits (Office of Environment and Heritage 2014) and thus the occurrence or not of these species does not impact the offset requirements for the GIWF project.



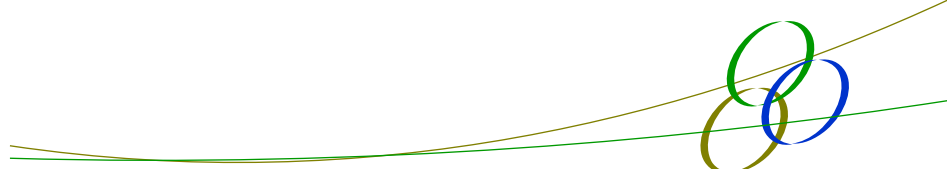
In terms of the change in impact from the proposed modification, the following observations can be made:

- No threatened birds were recorded within the project area. Any threatened birds that do occur on the site on a permanent basis are likely to be primarily woodland birds that generally remain within the woodland areas and would not directly interact with the wind turbines, particularly given the ground clearance is over 40m and the blades are therefore located well above the likely regular airspace used by these species;
- Greg Richards stated that the threatened microbats Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*) and Yellow-bellied Sheath-tail bat (*Saccolaimus flaviventris*) were infrequently recorded and concluded a significant impact was not likely to occur. An increase in blade length, ground-clearance and change in micro-sited project footprint location is not likely to negatively alter this previous conclusion. In fact, the increase of the ground clearance of the blade tips to over 40m would be likely to further reduce any such predicted impacts (which were already low-level impacts);
- The area in which the project occurs is quite open and there are few areas where turbines are actually adjacent to forested areas. An increase in blade length, ground-clearance and change in micro-sited project footprint location is likely to reduce impacts compared to those previously predicted, particularly with the ground clearance increasing to over 40m;
- Indirect impacts of the rotor swept area will already be directly offset via BioBanking credits, as outlined in the CHP. It is considered that the fact that such indirect impacts are already being offset should provide assurance that the change in turbine specification will in any case be appropriately offset;
- With the rotor swept area moving further from the ground surface due to the higher towers, impacts to both common and threatened species are overall predicted to decrease compared to the approved project design; and
- The BBAMP outlines appropriate monitoring and management procedures to ensure that unacceptable impacts do not occur to protected or threatened species.

Given the above factors, the previous conclusions in relation to threatened fauna remain valid and do not require further assessment. It is likely that impacts to fauna will decrease overall as a result of the project modification.

3.6.5 Commonwealth Matters

The GIWF has been subject to previous ecological assessments that concluded that an *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) referral and approval was not required for the project, as it is unlikely to have a significant impact on a matter of national environmental significance. The following Matters of National Environmental Significance (MNES) have been re-considered for this proposed modification:



1. World heritage properties;
2. National heritage places;
3. Wetlands of international importance (listed under the Ramsar Convention);
4. Listed threatened species and ecological communities;
5. Migratory species protected under international agreements;
6. Commonwealth marine areas;
7. The Great Barrier Reef Marine Park;
8. Nuclear actions (including uranium mines); and
9. A water resource, in relation to coal seam gas development and large coal mining development.

A brief analysis of each MNES follows.

1. World heritage properties;

No World Heritage properties exist within or near the GIWF. The closest is Gibraltar Range National Park which is approximately 30km to the east and is not likely to be affected by the project.

2. National heritage places;

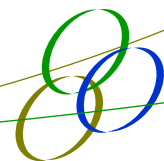
A Heritage Assessment was undertaken for the GIWF in 2007 by McCardle Cultural Heritage. The report stated that *“there are no listed items of National Environmental Significance within the Project Area and therefore there are no referral requirements for the project under the EPBC Act.”* A search of the Australian Heritage Database on 11th November 2016 confirms no national heritage places are of relevance to the GIWF.

3. Wetlands of international importance (listed under the Ramsar Convention);

The closest Wetland of International Importance is Little Llangothlin Nature Reserve, which contains Little Llangothlin Lagoon. It is approximately 25km south-east of the GIWF and will not be affected by the project.

4. Listed threatened species and ecological communities;

One threatened community White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland (listed as critically endangered) and one threatened fauna species Large-eared Pied Bat (listed as vulnerable) were recorded during the previous ecological surveys (Kevin Mills and Associates, 2007 & Greg Richards, 2008).



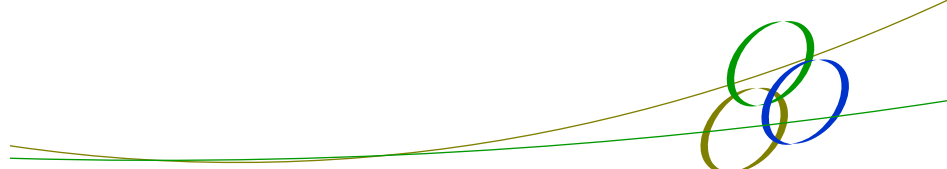
The surveys by EPS completed on 13th November 2016 have also recorded an additional threatened flora species, *Thesium australe* (listed as vulnerable) within the GIWF study area. The follow sections outline the assessment of these threatened biodiversity listed under the EPBC Act.

The Plant Community Type (PCT) Blakely's Red Gum – Yellow Box Grassy Woodland of the New England Tableland Bioregion was recorded within the study area and has potential to conform to the description of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland, which is listed as Critically Endangered under the EPBC Act. The Kevin Mills and Associates (2007) report indicated that this Critically Endangered community was present but not likely to be impacted to a significant degree by the project due to the lack of likely tree removal.

The data collected during the new surveys by EPS in October and November 2016 was used to determine if the Blakely's Red Gum – Yellow Box Grassy Woodland vegetation community within the site meets the criteria for the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland as listed on the EPBC Act. The Blakely's Red Gum – Yellow Box Grassy Woodland of the New England Tableland Bioregion recorded within the current study area does not meet the criteria for the federal listing of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland. The technical reason for this conclusion is that the woodland and grassland forms of the Blakely's Red Gum – Yellow Box Grassy Woodland within the study area support less than 5% native understorey cover.

In conclusion, the Blakely's Red Gum – Yellow Box Grassy Woodland within the site does not meet the criteria for listing as the Critically Endangered community of White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland listed under the EPBC Act. Therefore, despite the previous assessment in 2007 by Kevin Mills and Associates stating that the Commonwealth-listed community occurs and undertaking a brief assessment of the impacts, no such assessment (or more detailed assessment of that undertaken in 2016) is actually required due to the absence of this community from the larger study area. Due to the absence of the EPBC form of this community no significant impacts are likely to occur upon it as a result of the project.

Thesium australe is listed as a vulnerable plant species under the EPBC Act. The previous surveys conducted by Kevin Mills and Associates (2007) did not record this species, however potential habitat within the study area was identified. An impact assessment under the EPBC Act was not undertaken as part of the previous ecological report due to no observations of the species being recorded. The recent surveys by EPS recorded approximately 50 individuals of *Thesium australe*, within the study area, though outside of the direct impact zone. NSW Bionet Database also show records located to the north of the Wattlevale Travelling Stock Reserve (TSR). The modified GIWF project is unlikely to result in a significant impact upon *Thesium australe* as no direct or indirect impacts are likely and the population will be protected via the already approved FFMP.



Large-eared Pied Bat is listed as vulnerable under the EPBC Act and was recorded by Greg Richards. This species was recorded in the woodland outside of the study area to the west of Turbine 7. The report concluded the impacts would generally not be significant and therefore an assessment of the impact of the project on the species against the required criteria was not undertaken. The previous conclusions by Greg Richards that the project is unlikely to result in a significant impact upon the Large-eared Pied Bat remain valid, particularly given the ground clearance between the blade tips and the ground has been increased to over 40m.

5. Migratory species protected under international agreements;

Kevin Mills and Associates stated that Australian Wood Duck, Pacific Black Duck, Black-shouldered Kite and Nankeen Kestrel were recorded and that these were listed migratory species. Since the study completed by KMA these species have been removed from the EPBC Act migratory species list and therefore do not require an assessment. An updated database November 2016 search for any migratory species listed since 2008 was conducted and no migratory species listed after 2008 have been recorded within the study area by the previous Kevin Mills and Associates ecological surveys or the current surveys by EPS. Therefore, no further assessment of likely impact to migratory species is required.

6. Commonwealth marine areas;

The GIWF is not located near any Commonwealth marine area.

7. The Great Barrier Reef Marine Park;

The GIWF is not located near the coast and the Great Barrier Reef MNES is not relevant.

8. Nuclear actions (including uranium mines); and

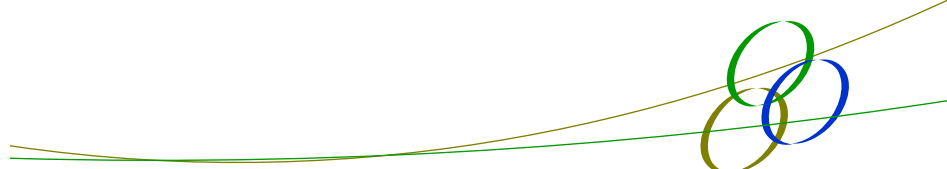
The GIWF is not a nuclear action and this MNES is not relevant.

9. A water resource, in relation to coal seam gas development and large coal mining development.

The GIWF is not a coal seam gas or large coal mining development and therefore this MNES is not relevant.

3.7 Communication Interference

Most electrical apparatus have the potential to disrupt radio communication systems, including public radio, television, two-way radio systems, mobile phone systems and radar. Wind turbines



can disrupt radio communication systems by the towers and blades scattering and reflecting signals.

The potential for the project to affect communications was assessed in the initial Environmental Assessment (Connell Wagner 2008) and the Modification 2 Environmental Assessment (Aurecon 2014). This current Environmental Assessment re-considers these effects due to the higher turbines and larger blades, noting that the primary factor in interference is the location of the turbines.

3.7.1 Public Radio and Television

The blades of a wind turbine can partially block or scatter the visual component of a television transmission, leading to poor television picture quality. The potential for the Project to affect radio and television signals was assessed by Connell Wagner (2008) which found that that few houses have potential for interference to reception. Connell Wagner (2008) noted:

“Locations to the east of the wind farm will receive direct signals transmitted from Carpenters Hill which is at a relatively close distance. The limited extent of the backward interference region and the distance of the closest residences from the wind farm will limit the potential for interference. In the case of residences to the west of Waterloo Range that currently experience topographic shielding and where no viewable reception is available then assessment of interference is not relevant.”

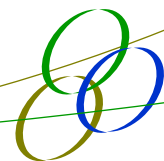
Where interference does occur, the effect is generally proportional to the strength of the scattered signal from the turbines compared to the strength of the direct signal. In the case where a receiver in close proximity to the wind farm is partly shielded from the transmitter by topography and the turbines are receiving a direct signal, the interference is likely to be more pronounced. The affected zone would be limited by distance from the wind farm. The actual degree of interference is also related to the turbine orientation, blade section, antenna type and signal strength.

Connell Wagner (2008) noted that accurate prediction of interference zones is not feasible given the varying topography in the Project site.

The minor relocation of turbines and the installation of longer blades and taller towers are unlikely to significantly affect the interference zones. To address the potential for interference, conditions 2.41 and 2.42 require GIWF to survey existing radio and television reception and to mitigate any impacts from the Project, including the potential installation of alternative antennae assemblies.

3.7.2 Two-way Radio Networks and Microwave Links

The Australian Communications and Media Authority issues licences under the *Radiocommunications Act 1992* and is the federal authority responsible for regulation and



management of the radio communications spectrum. Connell Wagner (2008) reports that local licences are held by RMS, NSW Fire Brigade, Country Energy, St Johns Ambulance, NSW Police, Telstra, National Parks and Wildlife Service, Optus, Vodafone and various other users.

A radio transmitter operated by National Parks and Wildlife Service is located between WTG 7 and WTG 8. In the same location is the Telstra microwave repeater tower, which transmits phone signals between Glen Innes and Inverell.

Aurecon (2014) found that the potential for interference with these networks is low, as the towers are close to the wind turbines so that the potential interference zone is narrow. Additionally, the direction of transmission does not pass through the turbine array, which also reduces the potential for interference. The minor changes to the location and specifications of the turbines is not expected to additionally effect radio communications.

Conditions 2.43 and 2.43a require GIWF to consult with the NSW Government Telecommunications Authority and radio network operators to minimise risks to licenced radio users and to mitigate and rectify any problems within 2 months of the problem being identified.

3.7.3 Mobile Phone Networks

Mobile phone signals are transferred to and from cellular transmitters, which are often linked to the wider communications network via microwave point to point links (see Section 3.7.2).

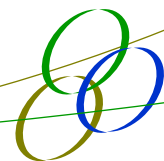
Telstra (<https://www.telstra.com.au/coverage-networks/our-coverage>) provides approximate mobile coverage data, which shows that higher parts of the Project area receive reliable signal. Areas of lower elevation, commonly where rural houses are located, receive less or no signal, even with the use of external aerials.

Mobile signal in the region is best around the town centres of Inverell and Glen Innes and along the New England Highway. A recent mobile phone tower installation by Vodaphone at the White Rock Wind Farm addresses some gaps in service between the two centres. Optus has also recently built a new mobile phone tower in Glen Innes.

The minor changes to the location and specifications of the turbines is not expected to additionally effect mobile phone communications and the ongoing rollout of mobile towers by several providers is improving mobile coverage state-wide.

3.7.4 Radar

The Aviation Impact Statement (Ambidji, 2017 in Appendix 5) notes that the nearest Airservices Australia radar installation is a secondary surveillance radar at Round Mountain, 100 km to the



southwest of the site. A combined primary and secondary surveillance radar is at Mt Somerville, 240 km to the northeast. Ambidji (2017) reports that both these radars are too far from the windfarm to be affected by the turbines.

3.8 Greenhouse Gas Emissions

The nominal electrical generation potential of the selected turbines is 33% higher than the Alstom ECO122 considered for Modification 2, reflecting the rapid pace of wind turbine development. There will be a consequent increase in greenhouse gas savings due to the operation of these more powerful turbines. The Environmental Assessment that supported Modification 2 (Aurecon 2014) noted that the now approved turbines would save 303,065 tonnes of CO_{2e} per year, or the equivalent of 38,880 household's annual greenhouse gas (GHG) production based on turbine ratings of 2.7 MW and capacity factor of 0.48. Using the same capacity factor, the 3.6 MW turbines proposed under Modification 4 would provide GHG savings to an annual total of 403,076 tonnes of CO_{2e} or the equivalent of 51,710 households. This provides a third more GHG savings than the approved turbines.

Construction, operation and decommissioning of the selected design is not expected to measurably change greenhouse gases generated in these phases.

3.9 Blade Throw

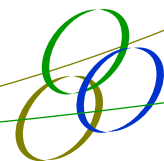
The selected wind turbines will be designed and built to latest International Electrotechnical Commission 6140-23 standards, ensuring that the likelihood of a blade failure is very low.

To minimise blade throw risk, all turbine components are monitored in real time and turbines are programmed to react to potential damaging winds or other environmental or mechanical conditions.

The risk of blade throw remains unchanged.

3.10 Consultation

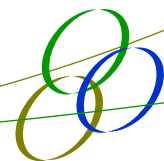
The final turbine selection process has occurred as stated in the various previous Environmental Assessments. Glen Innes Windpower Pty Ltd has notified the Community Consultative Committee (CCC) of the selected design during a meeting on 26 April 2017, and a copy of the resulting minutes are attached in Appendix 6. The CCC carried a motion to support the approval of the proposed taller towers with longer blades (see Appendix 6).



In addition, various phone conversations and face to face meetings have been held with some owners of non-associated residences such as Highfields, Minamurra, Ilparran, Kalanga, Glengarry and Wattle Vale.

During the turbine selection phase, there was ongoing consultation with OEH, whose officers stated concern with the initially planned shorter towers, due to potential impacts on low-flying birds and bats. Consequently, Nexif chose an alternative design with taller turbine towers to substantially reduce this potential impact, even when compared to the approved design parameters.

During the exhibition of this Modification Application, Glen Innes Windpower Pty Ltd senior staff will arrange individual meetings with owners of all potentially affected non-associated residences to discuss potential impact mitigation measures and amenity agreements. The potentially affected landholders will be those identified in the Visual Assessment Bulletin (DP&E 2016) preliminary assessment tool. These residences are identified in Appendix 3.



4 CONCLUSION

The proposed modification is required for installation of more modern and efficient turbines at the approved Glen Innes Wind Farm, and refined dimensions and locations of turbines and ancillary infrastructure.

The proposed modification application requests approval to modify and/or clarify the dimensions and locations of the following items:

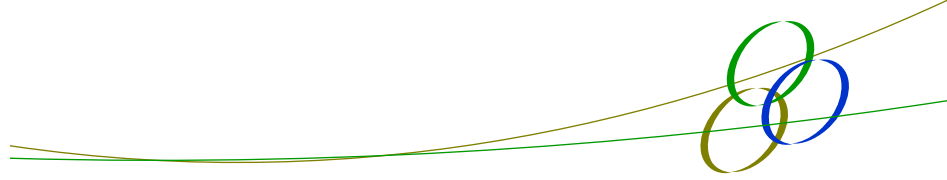
1. Refined turbine dimensions as per Table 1-1.
2. Refined turbine locations as per Table 1-2, subject to 100 m micro-siting allowance due to potential site requirements including ecological constraints or shallow rock.
3. Increased nominal annual generation capacity to up to approximately 90 MW, subject to incremental changes due to installation and local conditions.
4. Increased construction track disturbance footprint from the approved 8m to approximately 12m to account for indirect impacts from track construction (the 12m impact width accords to OEH requested impact areas for biodiversity offset calculations and has been used in approved management plans such as the Construction Environmental Management Plan (EPS, 2016) and the Compensatory Habitat Plan (EPS, 2016)
5. Refined substation location to avoid the Travelling Stock Route, Crown Road and unfavourable topography.
6. Refined concrete batch plant location.

This environmental assessment concludes that the proposed modifications will cause no significant change to the environmental and social impacts predicted for the wind farm as currently approved. The modifications will facilitate greater electricity production and consequent additional GHG savings. The modified project would inject 90 MW of wind powered electricity into the grid and in so doing will provide GHG savings to an annual total of 403,076 tonnes of CO₂e or the equivalent of 51,710 households. This provides a third more GHG savings than the approved turbines.

Approval of the modification would require only minor changes to the Project Approval conditions and importantly the currently required environmental management, emission limits and monitoring requirements will be maintained.

Appendix 1

Project Approval



Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

ATTACHMENT 1

Glen Innes Landscape Guardians Inc. v Glen Innes WindPower Pty Ltd & Minister for Planning

Land and Environment Court Proceedings No. 10926 of 2009

CONDITIONS OF APPROVAL

Blue type represents Modification 1 – August 2013.

Red type represents Modifications 2 and 3 – January 2016.

SCHEDULE 1

Application No:	07_0036
Proponent:	Glen Innes WindPower Pty Ltd
Approval Authority:	Minister for Planning
Land:	The land shown in Appendix 1
Project:	Glen Innes Wind Farm Project

TABLE OF CONTENTS

1.	ADMINISTRATIVE CONDITIONS	4
	Terms of Approval	4
	Statutory Requirements	4
	Decommissioning	4
	Decommissioning Road Dilapidation	5
	Decommissioning Environmental Management Plan	5
	Construction Site Office	6
2.	SPECIFIC ENVIRONMENTAL CONDITIONS	6
	Visual	6
	Noise & Vibration	7
	Flora & Fauna	8
	Traffic	9
	Hazards & Risk	9
	Electromagnetic Interference	10
	Water Quality Impacts	10
	Heritage Impacts	11
	Waste Generation & Management	11
	Survey Marks	11
	Aerial Agricultural Spraying	11
	Ancillary Facilities	11
3.	ENVIRONMENTAL MONITORING AND AUDITING	11
	Bird & Bat Monitoring	11
	Independent Environmental Auditing	12
4.	COMMUNITY INFORMATION, CONSULTATION AND INVOLVEMENT	12
	Provision of Electronic Information	12
	Community Consultative Committee	13
	Community Information Plan	13
	Complaints Procedure	13
	Community Enhancement Program	14
5.	COMPLIANCE TRACKING PROGRAM	14
6.	ENVIRONMENTAL MANAGEMENT	14
	Environmental Representative	14
	Construction Environmental Management Plan	15
	Operation Environmental Management Plan	16
7.	ENVIRONMENTAL REPORTING	16
	Incident Reporting	16
	APPENDIX 1: SCHEDULE OF LAND	17
	APPENDIX 2: PROJECT LAYOUT	18
	APPENDIX 3: NOISE COMPLIANCE ASSESSMENT	19

SCHEDULE 2

Ancillary infrastructure	All wind farm infrastructure with the exception of wind turbines, including but not limited to collector substations, switching stations, permanent offices and site compounds, electricity transmission lines and internal roads
CEMP	Construction Environmental Management Plan
Conditions of Approval	The Minister's conditions of approval for the project.
Construction	The construction of the development, including but not limited to the construction of wind turbines, ancillary infrastructure and road upgrades (excludes geotechnical drilling and surveying)
Council	Glen Innes Severn Council
Curtilage	The land immediately surrounding a residence, including any closely associated buildings or structures where domestic and/or recreational activities take place
Decommissioning	The removal of wind turbines and any associated above ground infrastructure
Department	Department of Planning and Environment
DPI Water	Department of Primary Industries - Water
Dust	Any solid material that may become suspended in air or deposited
EA	<i>Glen Innes Wind Farm Environmental Assessment</i> (Glen Innes Wind Power, 2008) as amended by: • <i>Glen Innes Wind Farm Submissions Report</i>, prepared by Connell Wagner and dated May 2009; • <i>Glen Innes Wind Farm Revised Turbine Layout</i>, prepared by Aurecon and dated June 2010; and • <i>Glen Innes Wind Farm Section 75W Modification Environmental Assessment</i>, prepared by Aurecon and dated March 2014.
EPA	Environment Protection Authority
Feasible	Feasible relates to engineering considerations and what is practical to build or implement
LLS	Local Land Services
Minister, the	Minister for Planning
Non-associated residence	Any residence on privately-owned land where the landowner has not reached a financial or in kind agreement with the Proponent in relation to the development. In some cases, this agreement will be restricted. First, it may only cover certain aspects of the development (such as the noise or visual impacts). In such cases, the residence is only associated for those aspects covered by the agreement, and remains a non-associated residence for all those aspects that are not covered by the agreement. Second, while the agreement may cover a certain aspect of the development (such as noise impacts), it may limit the extent of any such impact (by setting absolute noise levels at a residence, for instance). In these cases, the residence is only associated to the extent that the impact is covered by the agreement, and is considered to be non-associated for any impacts that exceed the limits specified in the agreement
OEH	Office of Environment and Heritage
Operation	The operation of the development, but does not include commissioning trials of equipment or use of temporary facilities
Project	The development described in the EA and shown in Appendix 2
Proponent	Glen Innes WindPower (GIWP), or any other person who seeks to carry out the project approved under this approval
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
Residence	Any dwelling in existence at the date of this consent, or a dwelling that is the subject of a development application that was lodged but not yet determined at the date of this consent
RFS	NSW Rural Fire Service
RMS	NSW Roads and Maritime Services
Secretary	Secretary of the Department, or nominee
Sector management	Sector management refers to the implementation of techniques that reduce the impacts generated by individual wind turbines, or clusters. Such techniques may include operating the turbines in 'low noise' mode, shutting down turbines, or using firmware controls
Site	The land defined in Appendix 1

1. ADMINISTRATIVE CONDITIONS

Terms of Approval

- 1.1 The Proponent shall carry out the project:
- generally in accordance with the EA; and
 - in accordance with the conditions of this approval.

Note: The general layout of the project is depicted in Appendix 2.

- 1.2 If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this approval shall prevail to the extent of any inconsistency.
- 1.3 The Proponent shall comply with any reasonable requirement(s) of the Secretary arising from the Department's assessment of:
- any strategies, plans, programs, reviews, audit correspondence that are submitted in accordance with the requirements of this approval;
 - any reports, reviews or audits commissioned by the Department regarding compliance with this approval; and
 - the implementation of any actions or measures contained in these documents.
- 1.4 This project is modified to delete Turbines 10 and 18 from the scope of the project. This approval does not authorise their construction.

Note: turbine 18 has been removed from the project based on a precautionary approach with respect to cumulative visual and noise impacts predicted to occur at the closest non-involved residence.
--

- 1.5 The approval shall lapse on 31 January 2017 unless the Proponent has physically commenced the project.

Statutory Requirements

- 1.6 The Proponent shall ensure that all licences, permits and approvals are obtained and maintained as required throughout the life of the project. No condition of this approval removes the obligation for the Proponent to obtain, renew or comply with such licences, permits or approvals. The Proponent shall ensure that a copy of this approval and all relevant environmental approvals are available on the site at all times during the project.
- 1.7 The Proponent may elect to construct or operate the project in discrete work packages or stages. In this case, these conditions of approval may be complied with separately for each discrete work package or stage, as relevant.

Decommissioning

- 1.8 Unless otherwise agreed by the Secretary, within 18 months of the cessation of operation of the Project, the site shall be decommissioned and returned by the Proponent, as far as practicable, to its condition prior to the commencement, in consultation with the relevant landowner(s) and to the satisfaction of the Secretary (and in accordance with the Decommissioning and Rehabilitation Plan required by condition 1.9).

All generating facilities and associated infrastructure (including but not necessarily limited to the substations and transformers, switchyard, operation and maintenance facility, overhead transmission lines and access roads) shall be removed from the site unless otherwise agreed by the Secretary. Project related infrastructure (including access roads) may only be retained on site, where the Proponent has demonstrated to the satisfaction of the Secretary prior to the commencement of decommissioning, that these components: are permissible under the site's statutory landuse provisions in force upon commencement of the decommissioning; would not pose an ongoing impediment to permissible landuse at the properties; and their retention has been agreed to in writing (with evidence provided to the Secretary) by the relevant landowners.

This condition does not apply to any infrastructure which, as at the relevant date, is owned by a network operator under the *Electricity Supply Act 1995* (NSW) (or any equivalent provisions which are in force as at the relevant date).

- 1.9 The Proponent shall prepare prior to construction commencing and update a Decommissioning and Rehabilitation Plan every five years from the date of preparation, until decommissioning and rehabilitation is completed. A copy of the Plan and updated versions are to be provided to the Secretary and made publicly available. The updated Plan shall be consistent with the requirements of the draft NSW Planning Guidelines – Wind Farms (December 2011), as updated. The updated Plan shall include estimated costs of and funding arrangements for decommissioning, including provision for a decommissioning bond or other funding mechanisms, where the Plan concludes that estimated costs and funding arrangements are inadequate.

- 1.10 Any individual turbine that ceases operating for a period of more than 12 consecutive months shall be dismantled within 18 months after the 12 month period, unless the Secretary agrees otherwise.

1.10A Deleted.

Decommissioning Road Dilapidation

- 1.10B Unless otherwise agreed by the Secretary, the Proponent shall commission an independent, qualified person or team to undertake the following in consultation with the relevant road authority:

- a) prior to the commencement of decommissioning, review the proposed route and existing access provisions to the Wind Farm Site to determine whether the route and existing provisions allow for safe access of decommissioning 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 in consultation with the relevant road authority, prior to the commencement of decommissioning and at the full expense of the Proponent;
- 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 decommissioning 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 in consultation with the relevant road authority, prior to the commencement of decommissioning and at the full expense of the Proponent.

Upon determining the haulage route(s) for decommissioning vehicles associated with the Project, and prior to decommissioning, an independent and qualified person or team shall undertake a **Road Dilapidation Report**. 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 decommissioning of the Project. The Report shall be submitted to the relevant road authority for review prior to the commencement of haulage.

Within three months of completion of decommissioning, a subsequent Report shall be prepared to assess any damage that may have resulted from the decommissioning of the Project.

Measures undertaken to restore or reinstate roads affected by the Project shall be undertaken in a timely manner, in accordance with the reasonable requirements of the relevant road authority, and at the full expense of the Proponent.

Decommissioning Environmental Management Plan

- 1.10C Prior to the commencement of decommissioning, or as otherwise agreed by the Secretary, the Proponent shall prepare and implement (following approval) a Decommissioning Environmental Management Plan for the Project. The Plan shall outline the environmental management practices and procedures that are to be followed during decommissioning, and shall be prepared in consultation with the relevant agencies and in accordance with the *Guideline for the Preparation of Environmental Management Plans* (Department of Infrastructure, Planning and Natural Resources, 2004). The Plan shall include, but not necessarily be limited to:

- a) a description of activities to be undertaken during decommissioning of the Project (including staging and scheduling);
- b) statutory and other obligations the Proponent is required to fulfil during decommissioning, including approval/approvals, consultations and agreements required from authorities and other stakeholders under key legislation and policies;
- c) a description of the roles and responsibilities for relevant employees involved in the decommissioning of the Project, including relevant training and induction provisions for ensuring that employees, including contractors and sub-contractors are aware of their environmental and compliance obligations under these conditions of Approval;
- d) an environmental risk analysis to identify the key environmental performance issues associated with the decommissioning phase; and
- e) details of how environmental performance will be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the decommissioning of the Project). In particular, the following environmental performance issues shall be addressed in the Plan:
 - i) compounds and ancillary facilities management;
 - ii) noise and vibration;
 - iii) traffic and access;
 - iv) soil and water quality and spoil management;
 - v) air quality and dust management;
 - vi) hazardous material and waste management; and
 - vii) hazard and risk management, including bushfire risk.

The Plan shall be submitted for the approval of the Secretary no later than one month prior to the commencement of decommissioning, or as otherwise agreed by the Secretary. The Plan may be prepared in stages, however, decommissioning works shall not commence until written approval has been received from the Secretary.

Construction Site Office

- 1.11 The Proponent shall not use any part of Travelling Stock Route 67474 for a temporary construction site office for the project without the prior approval of the LLS.

2. SPECIFIC ENVIRONMENTAL CONDITIONS

Visual

Visual Impact Mitigation

- 2.1 Prior to the commencement of construction, the Proponent shall notify in writing the owner/s of non-associated residences within 4 kilometres of any wind turbine that they have the right to request implementation of visual impact mitigation measures at their residence if the wind turbines will be visible from the residence (including its curtilage).

Note: If the construction of the development is being staged, the Proponent is only required to notify those owners that would be within 4 kilometres of any wind turbine that forms part of the relevant stage.

- 2.1A If following the commencement of construction, the Proponent receives a written request from the owner of any residence referred to in condition 2.1 above for the implementation of visual impact mitigation measures, then the Proponent shall implement measures such as landscaping treatments or vegetation screens at the residence (including its curtilage) in consultation with the landowner.

These mitigation measures must be reasonable and feasible, directed towards reducing the visual impacts of the wind turbines on the residence (including its curtilage), and commensurate with the level of visual impact.

The 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.

Notes:

- To avoid any doubt, the visual impact mitigation measures must be aimed at reducing the visibility of the wind turbines from the residence and its curtilage. Mitigation measures are not required to be implemented to reduce the visibility of wind turbines from other locations on the property.*
- In some cases, mitigation measures may not be warranted as the wind turbines would not be visible from the residence and its curtilage.*
- The identification of appropriate visual impact mitigation measures will be easier following the construction of the wind turbines. While landowners may ask for the implementation of visual impact mitigation measures shortly after the commencement of construction, they should consider the merits of delaying this request until the wind turbines are visible from their residence.*

- 2.2 Prior to the commencement of operation, the Proponent shall consult with Council and the RMS in relation to the need to provide landscaping screening measures along public road reserves including but not limited to the Gwydir Highway and shall report to the Secretary on the outcomes of this consultation. The Proponent shall implement landscaping screening measures in accordance with the Secretary's requirements.

Turbine External Design

- 2.3 Wind turbine generators shall be painted matt off-white/grey. The blades shall be finished with a surface treatment that minimises any potential for glare or reflection.
- 2.4 No advertising, signs or logos shall be mounted on the turbines, except where required for safety purposes. A corporate logo may be placed on the turbines provided it is not distinguishable by the naked eye from any publicly accessible location or from any, properties not associated with the project.

Lighting

- 2.5 No external lighting other than low intensity security night lighting of infrastructure associated with the project, including wind turbine generators is permitted on site unless otherwise agreed or directed by the Secretary.

Shadow-flicker

- 2.6 Shadow flicker arising from the operation of the project shall not exceed 30 hours/annum at any residence not associated with the project.

Within 6 months of the commencement of operation of the project (or such other period agreed to by the Secretary), the Proponent shall prepare a Shadow Flicker Report for the approval of the Secretary which assesses the impact of blade flicker at Cherry Tree, being Lot 89 DP 753270; Highfields, being Lot 2 DP 229974; Mayvona, being Lot 45 DP 3191 and Ilparan B, being Lot 1 DP 225300.

The Proponent shall also keep records of any sector management used to comply with this condition.

Viewing Site

- 2.7 Prior to the commencement of construction, the Proponent shall in consultation with Council and/or the RMS, investigate the potential for a wind farm viewing site, interpretive signage and associated facilities to be installed and maintained in the locality. If required by Council and/or the RMS, the Proponent shall install a viewing site, signage and associated facilities. Responsibilities for maintenance of the viewing site shall be agreed to between the Proponent and Council and/or the RMS.

Noise & Vibration

Construction & Decommissioning

- 2.8 The Proponent shall implement all reasonable and feasible measures to minimise the construction or decommissioning noise of the development, including any associated traffic noise.
- 2.9 The Proponent shall ensure that the noise generated by any construction or decommissioning activities is managed in accordance with the best practice requirements outlined in the *Interim Construction Noise Guideline* (DECC, 2009), or its latest version.
- 2.10 Unless the Secretary agrees otherwise, the Proponent shall only undertake construction or decommissioning activities between:
- 7 am to 6 pm Monday to Friday;
 - 8 am to 1 pm Saturdays; and
 - at no time on Sundays and NSW public holidays.

The following construction activities may be undertaken outside these hours without the approval of the Secretary:

- activities that are inaudible at non-associated residences;
- the delivery of materials as requested by the NSW Police Force or other authorities for safety reasons; or
- emergency work to avoid the loss of life, property and/or material harm to the environment.

- 2.11 The Proponent shall only carry out blasting on site between 9 am and 5 pm Monday to Saturday inclusive. No blasting is allowed on Sundays or public holidays.
- 2.12 The Proponent shall ensure that any blasting carried out during construction of the development does not exceed the criteria in Table 1.

Table 1: Blasting criteria

Location	Airblast overpressure (dB(L in Peak))	Ground vibration (mm/s)	Allowable exceedance
Any non-associated residence	120	10	0%
	115	5	5% of the total number of blasts or events over a period of 12 months

- 2.13 Deleted.
- 2.14 Deleted.
- 2.15 Deleted.

Operational Noise Criteria – Wind Turbines

- 2.16 The Proponent shall ensure that the noise generated by the operation of wind turbines does not exceed the relevant criteria in Table 2 at any non-associated residence.

Table 2: Noise criteria dB(A)

Residence	Criteria (dB(A)) with Reference to Hub Height Wind Speed (m/s)											
	3	4	5	6	7	8	9	10	11	12	13	14
Cherry Tree (Eungai), Elm Vale, Klossie, Green House, Lombardy, Mayvona, Moonarie, Nullagai, Wandsworth	35	35	35	35	35	35	35	36	38	40	43	46
Highfields, Wattle Vale	35	35	35	35	35	35	36	38	40	42	44	46

Residence	Criteria (dB(A)) with Reference to Hub Height Wind Speed (m/s)											
	3	4	5	6	7	8	9	10	11	12	13	14
Balacava A, Ilparran A, Ilparran B, Kalanga A, Kalanga B, Kalanga C, Minamurra A, Minamurra B, Minamurra C, Green Valley (Oakes), Rivoli	35	35	35	35	35	36	37	38	39	40	40	41
Girrahween, Glengarry	35	35	35	35	35	35	35	35	35	36	37	39
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)											

Note: To identify the residences referred to in Table 2, see the figure in Appendix 2.

Noise generated by the operation of the wind turbines is to be measured in accordance with the relevant requirements of the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines 2009* (or its latest version), as modified by the provisions in Appendix 3. If this guideline is replaced by an equivalent NSW guideline, then the noise generation is to be measured in accordance with the requirements in the NSW guideline.

2.17 Deleted.

2.18 Deleted.

2.19 Deleted.

2.20 Deleted.

Operational Noise Criteria – Ancillary Infrastructure

2.21 The Proponent shall ensure that the noise generated by the operation of ancillary infrastructure does not exceed 35 dB(A) L_{Aeq}(15 minute) at any non-associated residence.

Noise generated by the development is to be measured in accordance with the relevant requirements of the *NSW Industrial Noise Policy* (or its equivalent) as modified by the provision in Appendix 3.

Noise Monitoring

2.22 Within six months of the commencement of operations, the Proponent shall:

- undertake noise monitoring to determine whether the development is complying with the relevant conditions of this consent; and
- submit a copy of the monitoring results to the Department and the EPA.

2.23 The Proponent shall undertake further noise monitoring of the development if required by the Secretary.

2.24 Deleted.

2.25 Deleted.

2.26 Deleted.

Flora & Fauna

2.27 Prior to the commencement of construction of the project, the Proponent shall, in consultation with OEH, develop (and following approval, implement) a compensatory habitat package to offset in perpetuity the value of habitat lost as a result of the project, to the satisfaction of the Secretary. The package shall:

- develop a methodology to quantify the offset of vegetation communities based on an improve or maintain outcome; and
- demonstrate reasonable timeframes for implementation and describe how the offset shall be guaranteed and monitored in perpetuity.

The Proponent shall undertake a post construction review of clearing to confirm the extent of clearing was not greater than predicted, if clearing is greater, then the package shall be modified and the offset increased to the value of actual habitat lost.

Prior to the commencement of construction, clearly defined work areas (including access trails) shall be established using a combination of posts, fencing or markers, and suitably marked up maps as appropriate. All on-site construction movements are to be restricted to these areas, to prevent uncontrolled or inadvertent access by vehicles or construction personnel to vegetation and fauna habitat to be protected under this approval. All works and structures shall be located to avoid abutting forest and woodland remnants protected under this approval. The Proponent shall engage a suitably qualified ecologist to advise on the limits of clearing for turbine hardstand areas and access roads.

Traffic

- 2.28 The Proponent shall only use the former Gwydir Highway Alignment (within Travelling Stock Route 67474) for temporary access to the site during the construction phase of the project. The former Gwydir Highway Alignment is not to be used during the operational phase of the project without the prior consent of the **LLS**.
- 2.29 The Proponent shall ensure that all heavy construction vehicles use the Gwydir Highway to access the project.
- 2.30 The Proponent shall design and construct the road access from the Gwydir Highway (through the Travelling Stock Route 67474) to the site in accordance with the AUSTROADS Rural Access Standards and to the satisfaction of the **RMS** and the **LLS**. The Proponent shall obtain approval of the road access design from the **RMS**, prior to construction of the road access to the site.
- 2.31 Deleted.
- 2.32 Deleted.
- 2.33 Should road access via the former Gwydir Highway Alignment not be permitted by the **LLS** for the operational phase of the project, the Proponent (and its contractors) shall only use Rose Hill Road for operational access to the site. Other roads are not permitted to be used by the Proponent for site access, except in the case of emergencies or site evacuation. Should Rose Hill Road be used for the operation of the project, the Proponent shall seal the section of Rose Hill Road from its junction with the Gwydir Highway up to the private residences in consultation with the Council, prior to the commencement of operation of the project.
- 2.34 Upon determining the haulage route(s) for the construction phase of the project, the Proponent shall:
- commission a qualified person to undertake a Road Dilapidation Report of all roads proposed to be used for construction activities excluding the Gwydir Highway in consultation with relevant road authorities. The Report shall assess the current condition of the relevant roads; and
 - following completion of construction a subsequent Road Dilapidation Report shall be prepared by a qualified person and in consultation with relevant road authorities to assess any damage that may have resulted due to traffic and transport related to the construction of the project.

Any damage identified in the subsequent Road Dilapidation Report or recommended by the relevant road authorities after review of the subsequent Report shall be restored to a state, described in the original Road Dilapidation report at the Proponent's cost. Such work shall be undertaken at a time as agreed upon between the Proponent and the relevant road authorities. In the event of a dispute between the parties with respect to the extent of restorative work that may be required under this condition, any party may refer the matter to the **Secretary** for resolution. The **Secretary's** determination of any such dispute shall be final and binding on the parties.

- 2.34A The Proponent shall ensure the future use of any unformed Crown road reserve is not compromised by the development.

Hazards & Risk

Bushfire Risk

- 2.35 Throughout the life of the project, the Proponent shall regularly consult with the local RFS to ensure its familiarity with the project, including the construction timetable and the final location of all infrastructure on the site. The Proponent shall comply with any reasonable request of the local RFS to reduce the risk of bushfire and to enable fast access in emergencies.
- 2.36 The Proponent shall:
- ensure there is appropriate fire-fighting equipment held on site to respond to any fires that may occur at the site during construction and operation of the project; and
 - assist the RFS and emergency services as much as possible if there is a fire on-site during the project.
- 2.37 The Proponent shall manage as an "Inner Protection Area" the land around any structure associated with the project to a distance of 10 metres or to the property boundary, as outlined within the "Planning for Bush Fire Protection 2006" and the RFS Document "Standards for Asset Protection Zones."

Aviation Obstacles & Hazards

- 2.38 Prior to the commencement of construction and operation, the Proponent shall provide the following information to the Civil Aviation Safety Authority, Royal Australian Air Force- Aeronautical Information Service and Airservices Australia as well as all known users of privately owned local airfields:
- "as constructed" coordinates in latitude and longitude of each wind turbine generator;
 - final height of each wind turbine generator in Australian Height Datum; and
 - ground level at the base of each wind turbine generator in Australian Height Datum.

Bunding & Spill Management

- 2.39 The Proponent shall store and handle all dangerous goods (as defined by the Australian Dangerous Goods Code) and combustible liquids, strictly in accordance with:
- a) all relevant Australian Standards;
 - b) a minimum bund volume requirement of 110% of the volume of the largest single stored volume within the bund; and
 - c) the EPA's Environment Protection Manual Technical Bulletin *Bunding and Spill Management*.

In the event of an inconsistency between requirements listed from a) to c) above, the most stringent requirement shall prevail to the extent of the inconsistency.

Safety Management System

- 2.40 At least two months prior to the commencement of commissioning, the Proponent shall prepare a report outlining a comprehensive Safety Management System, covering all on-site systems related to ensuring the safe operation of the project. The report shall clearly specify all safety related procedures, responsibilities and policies, along with details of mechanisms for ensuring adherence to the procedures. Records shall be kept at the site and shall be available for inspection by the Department upon request. The Safety Management System shall be developed in accordance with the Department's *Hazardous Industry Planning Advisory Paper No. 9, 'Safety Management'*, and should include:
- a) procedures and programs for the maintenance and testing of the safety related equipment to ensure its integrity over the life of the project; and
 - b) an outline of a documented procedure for the management of change.

Electromagnetic Interference

Television & Radio Interference

- 2.41 Prior to the commencement of commissioning of the project, the Proponent shall undertake an assessment of the existing quality of the television/radio transmission available at a representative sample of residential dwellings located within 5 kilometres of any wind turbine.
- 2.42 The Proponent shall undertake reasonable and feasible mitigation to rectify any television/radio transmission problems reasonably attributable to the project at any residential dwelling located within 5 kilometres of a wind turbine. Such measures may include:
- a) modification to or replacement of receiving antenna;
 - b) installation and maintenance of a parasitic antenna system;
 - c) provision of a land line between the affected receiver and an antenna located in an area of favourable reception; or
 - d) other feasible measures.

If interference cannot be overcome by the measures outlined in a) to d), the Proponent shall negotiate with the impacted landowner about installing and maintaining a satellite receiving antenna.

Any requested works shall be completed within three months of the completion of the relevant television and/or radio reception assessment, unless otherwise agreed by the landowner. The Proponent shall be responsible for all costs associated with implementing mitigation measures.

- 2.43A Prior to the commencement of construction, the Proponent shall 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.

Radio Communication

- 2.43 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 consult with the operator and undertake appropriate remedial measures to rectify any issue within 2 months of the problem being identified. Such measures may include:
- a) modification to or relocation of the existing antennae;
 - b) installation of a directional antennae; and/ or
 - c) installation of an amplifier to boost the signal strength.

Water Quality Impacts

- 2.44 Except as may be expressly provided by an Environment Protection Licence for the project, the Proponent shall comply with section 120 of the *Protection of the Environment Operations Act 1997* which prohibits the pollution of waters.
- 2.45 Soil and water management controls shall be employed to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction activities, in accordance with Landcom's *Managing Urban Stormwater: Soils and Conservation*.

Heritage Impacts

- 2.46 Should the final wind farm design require works in the vicinity of Site GIWF No. 1, the Proponent shall, prior to the commencement of construction in that area, develop a management and mitigation strategy for the site in consultation with the Glen Innes Aboriginal Land Council and **OEH**.
- 2.47 If during the course of construction the Proponent becomes aware of any previously unidentified Aboriginal object(s), all work likely to affect the object(s) shall cease immediately and the **OEH** informed in accordance with the *National Parks and Wildlife Act 1974* as well as the Glen Innes Aboriginal Land Council. Works shall not recommence until written authorisation from **OEH** is received by the Proponent.
- 2.48 If during the course of construction the Proponent becomes aware of any unexpected historical relic(s), all work likely to affect the relic(s) shall cease immediately and the Heritage Office notified in accordance with the *Heritage Act 1977*. Works shall not recommence until the Proponent receives written authorisation from the Heritage Office.

Waste Generation & Management

- 2.49 The Proponent shall not cause, permit or allow any waste generated outside the site to be received at the site for storage, treatment, processing, reprocessing, or disposal or any waste generated on site to be disposed of at the site, except as expressly permitted by a licence under the *Protection of the Environment Operations Act 1997*, if such a licence is required in relation to that waste.
- 2.50 The Proponent shall ensure that all liquid and / or non-liquid waste generated and / or stored on the site is assessed and classified in accordance with *Waste Classification Guidelines Part 1: Classifying Waste* (DECC, 2008), or any future guideline that may supersede that document.

Survey Marks

- 2.51 The Proponent shall comply with the requirements of the Department of Lands should it need to utilise the Ross Trig Station at any time during construction or operation of the Project.

Aerial Agricultural Spraying

- 2.52 If any aerial agricultural activity is demonstrated to be disrupted on any property surrounding the site, being any non-associated property having a boundary located within 2.5 kilometres of a turbine constructed in accordance with this Project, due to the operation of the turbines, the Proponent shall fully fund to the affected landowner, the cost difference between the current aerial agricultural activities:
- and a reasonable alternative application method in the affected area; or
 - and continuing aerial agricultural activities should additional expenses occur due to the extra flight time and trips required because of the presence of wind turbines.

If the Proponent and affected landowner cannot agree on the amount of compensation payable under this condition, either party may refer the matter to the **Secretary** for resolution at any time. The **Secretary's** determination of the matter will be final and binding to both parties.

Ancillary Facilities

- 2.53 The sites for ancillary facilities shall satisfy the following criteria unless otherwise approved through the Construction Environmental Management Plan(s) for the project (refer to condition 6.2):
- be located within the site;
 - have ready access to the road network;
 - be located to minimise the need for heavy vehicles to travel through residential areas;
 - be sited on relatively level land;
 - be separated from nearest residences by at least 200 metres (or at least 250 metres for a temporary batch plant) with the exception of the temporary site office location;
 - be located above the 20 ARI flood level unless a contingency plan to manage flooding is prepared and implemented;
 - not require vegetation clearing beyond that already required for the project; and
 - not adversely affect the land use of adjacent properties.

The location of the Ancillary Facilities shall be identified in the Construction Environmental Management Plan(s) and shall include an analysis against the above criteria. Where these criteria cannot be met, the Construction Environmental Management Plan(s) shall demonstrate there will be no adverse impacts from the Ancillary Facility's construction or operation.

3. ENVIRONMENTAL MONITORING AND AUDITING

Bird & Bat Monitoring

- 3.1 Prior to the commencement of construction, the Proponent shall prepare and submit for the approval of the **Secretary** a **Bird and Bat Adaptive Management Program**, which takes account of bird/ bat monitoring methods identified in the current editions of *AusWEA Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia* and *Wind Farm and Birds: Interim Standards for Risk Assessment*. The Program shall be prepared and implemented by a suitably qualified expert, approved by the **Secretary**. The

Program shall incorporate Monitoring, and a Decision Matrix that clearly sets out how the Proponent will respond to the outcomes of monitoring. It shall:

- a) incorporate an ongoing role for the suitably qualified expert;
- b) set out monitoring requirements in order to assess the impact of the project on bird and bat populations, including details on survey locations, parameters to be measured, frequency of surveys and analyses and reporting. The monitoring program shall be capable of detecting any changes to the population of birds and/ or bats that can reasonably be attributed to the operation of the project, that is, data may be required to be collected prior to the commencement of construction;
- c) incorporate a decision making framework that sets out specific actions and when they may be required to be implemented to reduce any impacts on bird and bat populations that have been identified as a result of the monitoring;
- d) identify 'at risk' bird and bat groups and include monthly mortality assessments and periodic local population censuses and bird utilisation surveys;
- e) identify 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; and
- f) identify matters to be addressed in periodic reports in relation to the outcomes of monitoring, the application of the decision making framework, the need for mitigation measures, progress with implementation of such measures, and their success.

The Reports referred to under part f) shall be submitted to the **Secretary** on an annual basis, from the commencement of operation, and shall be prepared within two months of the end of the reporting period. The **Secretary** may, at the request of the Proponent, vary the reporting requirement or period by notice in writing to the Proponent. The Proponent may request the **Secretary** to consider a variation to the reporting requirements at any time.

The Proponent is required to implement reasonable and feasible mitigation measures as identified under part e) where the need for further action is identified through the Bird and Bat Adaptive Management Program, or as otherwise agreed with the **Secretary**.

Independent Environmental Auditing

- 3.2 Within two years of the commencement of Operation of the project, and then as may be directed by the **Secretary**, the Proponent shall commission an independent person or team to undertake an **Environmental Audit** of the project. The independent person or team shall be approved by the **Secretary** prior to the commencement of the Audit. The Audit shall:
- a) be carried out in accordance with ISO 19011:2002 - Guidelines for Quality and or Environmental Management Systems Auditing;
 - b) assess compliance with the requirements of this approval, and other licences and approvals that apply to the project;
 - c) assess the environmental performance of the project against the predictions made and conclusions drawn in the documents referred to under condition 1.1 of this approval;
 - d) review the effectiveness of the environmental management of the project, including any environmental impact mitigation works; and
 - e) review the adequacy of the Proponent's response to any complaints made about the project through the Complaints Register required under condition 5.4.

An **Environmental Audit Report** shall be submitted for comment to the **Secretary** within two months of the completion of the Audit, detailing the findings and recommendations of the Audit and including a detailed response from the Proponent to any of the recommendations contained in the Report.

4. COMMUNITY INFORMATION, CONSULTATION AND INVOLVEMENT

- 4.1 Subject to confidentiality, the Proponent shall make all documents required under this approval (including all reports required to be produced or procured during the commissioning, operation and decommissioning phases of the project) available for public inspection on request.

Provision of Electronic Information

- 4.2 Prior to the commencement of construction of the project, the Proponent shall establish a dedicated website or maintain dedicated pages within its existing website for the provision of electronic information associated with the project subject to confidentiality. The Proponent shall publish and maintain up-to-date information on this website or dedicated pages including, but not necessarily limited to:
- a) the current implementation status of the project;
 - b) a copy of this approval and any future modification to this approval;
 - c) a copy of each relevant environmental approval, licence or permit required and obtained in relation to the project;
 - d) a copy of each plan, report, or required monitoring program under this approval; and
 - e) details of the outcomes of compliance reviews and audits of the project.

Community Consultative Committee

- 4.2A The Proponent shall establish and operate a Community Consultative Committee (CCC) for the development to the satisfaction of the Secretary. This CCC must be established and operated in accordance with any applicable CCC guideline.

Notes:

- *The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Proponent complies with the consent.*
- *The CCC should be comprised of an independent chair and appropriate representation from the Proponent, Council and the local community.*

Community Information Plan

- 4.3 Prior to the commencement of construction, the Proponent shall prepare and implement a **Community Information Plan** which sets out the community communications and consultation processes to be undertaken during construction and operation of the project. Hard copies are to be made available to dwellings within 3km of the Project upon request (otherwise on Proponent's web-site). The Plan shall include but not be limited to:
- a) procedures to inform the local community of planned investigations and Construction activities, including blasting works;
 - b) procedures to inform the relevant community of Construction traffic routes and any potential disruptions to traffic flows and amenity impacts;
 - c) procedures to consult with local landowners with regard to Construction traffic to ensure the safety of livestock and to limit disruption to livestock movements;
 - d) procedures to inform the community where work has been approved to be undertaken outside the normal Construction hours, in particular noisy activities;
 - e) procedures to inform and consult with those landowners who are eligible for landscaping on their property as determined under condition 2.1 of this approval;
 - f) procedures to notify relevant landowners of the process available to review potential impacts on radio and television transmission; and
 - g) procedures to notify relevant landowners of the process available to review potential impacts on aerial spraying.

Complaints Procedure

- 4.4 Prior to the commencement of construction of the project, the Proponent shall ensure that the following are available for community complaints for the life of the project (including construction and operation):
- a) a 24 hour telephone number on which complaints about construction and operational activities at the site may be registered;
 - b) a postal address to which written complaints may be sent; and
 - c) an email address to which electronic complaints may be transmitted.

The telephone number, the postal address and the e-mail address shall be advertised in a newspaper circulating in the locality on at least one occasion prior to the commencement of construction and at six-monthly intervals for two years following commencement of operation of the project. These details shall also be provided on the Proponent's internet site. The telephone number, the postal address and the email address shall be displayed on a sign near the entrance to the site, in a position that is clearly visible to the public.

- 4.5 The Proponent shall record details of all complaints received through the means listed under condition 4.4 of this approval in an up-to-date Complaints Register. The Register shall record, but not necessarily be limited to:
- a) the date and time, where relevant, of the complaint;
 - b) the means by which the complaint was made (telephone, mail or email);
 - c) any personal details of the complainant that were provided, or if no details were provided, a note to that effect;
 - d) the nature of the complaint;
 - e) any action(s) taken by the Proponent in relation to the complaint, including timeframes for implementing the action;
 - f) if no action was taken by the Proponent in relation to the complaint, the reason(s) why no action was taken; and
 - g) the Complaints Register is to be made available to the public on request. Any unresolved dispute is to be referred to the **Secretary** for determination.

The complaints Register shall be made available for inspection by the **Secretary** upon request.

- 4.6 The Proponent shall provide an initial response to any complaints made in relation to the project during construction or operation within 48 hours of the complaint being made. The response and any subsequent action taken shall be recorded in accordance with condition 4.5.

Community Enhancement Program

- 4.7 Prior to the commencement of construction of the project, the Proponent shall prepare and submit for the approval of the **Secretary**, a **Community Enhancement Program** with the aim of funding community enhancement measures to the benefit of the local community, in particular in the immediate vicinity of the project. 50% of the annual contribution specified by this condition will be allocated to enhancement measures identified within 5km of the Project and the other 50% will be allocated to the remainder of the Glen Innes Community.

The Community Enhancement Program shall be developed in consultation with the Council and the local community, including the Glen Innes Landscape Guardians Inc, and provide details of:

- a) the process by which the program's fund would be administered, including mechanisms for accounting and reporting;
- b) how measures and initiatives to be funding by the program would be identified, assessed, prioritised and implemented over the life of the project; and
- c) any other terms agreed to by the parties.

The Proponent shall each year contribute the sum of \$75,000 to the Community Enhancement Program, commencing upon commissioning of the project until the end of its life. The contribution shall be adjusted annually to take account of any increase in the Consumer Price Index (All Groups Index for Sydney) over time, commencing at the September 2010 quarter.

If the Proponent and council cannot agree on the terms of administration or implementation of the community enhancement program, either party may refer the matter to the **Secretary's** determination for resolution at any time. The **Secretary's** determination of the matter will be final and binding on the parties.

5. COMPLIANCE TRACKING PROGRAM

- 5.1 Prior to the commencement of construction, the Proponent shall develop and implement a **Compliance Tracking Program** for the project, to track compliance with the requirements of this approval during the construction and operation of the project and shall include, but not necessarily limited to:
- a) provisions for periodic reporting of the compliance status to the **Secretary** including at least prior to the commencement of construction of the project, prior to the commencement of operation of the project and within two years of operational commencement;
 - b) a program for independent environmental auditing in accordance with *AS/NZ ISO 19011:2003 - Guidelines for Quality and/or Environmental Management Systems Auditing*;
 - c) procedures for rectifying any non-compliance identified during environmental auditing or review of compliance;
 - d) mechanisms for recording environmental incidents and actions taken in response to those incidents;
 - e) provisions for reporting environmental incidents to the **Secretary** during construction and operation; and
 - f) provisions for ensuring all employees, contractors and sub-contractors are aware of, and comply with, the conditions of this approval relevant to their respective activities.

6. ENVIRONMENTAL MANAGEMENT

Environmental Representative

- 6.1 Prior to the commencement of any construction or operational activities, or as otherwise agreed by the **Secretary**, the Proponent shall nominate for the approval of the **Secretary** a suitably qualified and experienced Environmental Representative(s) independent of the design, construction and operation personnel. The Proponent shall engage the Environmental Representative(s) during any construction activities, and throughout the life of the project, or as otherwise agreed by the **Secretary**. The Environmental Representative(s) shall be the Proponent's principal point of advice in relation to the environmental performance of the project and shall have responsibility for:
- a) overseeing the implementation of all environmental management plans and monitoring programs required under this approval, and advise the Proponent upon the achievement of these plans/programs;
 - b) considering and advising the Proponent on its compliance obligations against all matters specified in the conditions of this approval, the Statement of Commitments, permits and licences; and
 - c) having the authority and independence to recommend to the Proponent reasonable steps to be taken to avoid or minimise unintended or adverse environmental impacts, and, failing the effectiveness of such steps, to recommend to the Proponent that relevant activities are to be ceased as soon as reasonably practicable if there is a significant risk that an adverse impact on the environment will be likely to occur; and
 - d) reporting to the **Secretary** any non-compliances identified in relation to the environmental performance of the project and general environmental requirements of these conditions.

Construction Environmental Management Plan

- 6.2 The Proponent shall prepare and implement a **Construction Environmental Management Plan** in accordance with the *Guideline for the Preparation of Environmental Management Plans* (DUAP, 2004) or its latest revision. The Plan shall include but not be necessarily be limited to:
- a) a description of all activities to be undertaken on the site during construction including an indication of stages of construction, where relevant;
 - b) statutory and other obligations that the Proponent is required to fulfil during construction including all approvals, consultations and agreements required from authorities and other stakeholders, and key legislation and policies;
 - c) details of how the environmental performance of the construction works will be monitored, and what actions will be taken to address identified adverse environmental impacts. In particular, the following environmental performance issues shall be addressed in the Plan;
 - viii) measures to monitor and minimise soil erosion on local black clay soils and the discharge of sediment and other pollutants to lands and/ or waters during construction activities, particularly during any construction works at or near drainage lines;
 - ix) details of water sources to be used in consultation with **DPI Water** (including interactions with private landowner water entitlements where water is to be sourced from private property, volume of water to be used, and licensing and permit requirements);
 - x) details of the amount and source of spoil to be used during construction in consultation with Council;
 - xi) measures to monitor and manage dust emissions; and
 - xii) measures to mitigate and manage bushfire hazards .
 - d) a description of the roles and responsibilities for all relevant employees involved in the construction of the project;
 - e) complaints handling procedures as identified in conditions 4.4 to 1.1; and
 - f) the Management Plans listed under condition 6.3 of this approval.

The Plan shall be submitted for the approval of the **Secretary** no later than one month prior to the commencement of any construction works associated with the project, or within such period otherwise agreed by the **Secretary**. Construction works shall not commence until written approval has been received from the **Secretary**. Upon receipt of the **Secretary's** approval, the Proponent shall make the Plan publicly available as soon as practicable.

- 6.3 As part of the Construction Environmental Management Plan required under condition 6.2 of this approval, the Proponent shall prepare and implement the following Management Plans:
- a) a **Noise Management Plan** to detail measures to minimise noise emissions associated with the construction of the project. The Plan shall include, but not necessarily be limited to:
 - i) identification of all major sources of noise that may be emitted as a result of the construction of the project;
 - ii) specification of the noise criteria as it applies to a particular activity;
 - iii) identification and implementation of best practice management techniques for minimisation of noise and vibration emissions;
 - iv) an assessment of how any proposed blasting will meet the blasting criteria in this Approval (Condition 2.11 and 2.12);
 - v) procedures for the monitoring of noise emissions; and
 - vi) description of the procedures to be undertaken if any non-compliance is detected.
 - b) a **Traffic Management Plan** to outline measures for the management and coordination of road works required under this approval and to minimise potential conflicts between different user groups. The Plan shall be prepared in consultation with the **RMS** and Council and shall include, but not necessarily be limited to:
 - i) procedures for the construction and maintenance of the construction site entrance along the Gwydir Highway;
 - ii) details of measures to minimise interactions between the project and other users of the roads such as the use of fencing, lights, barriers, traffic diversions etc;
 - iii) procedures for informing the public where any road access will be restricted as a result of the project;
 - iv) procedures to inform vehicle drivers and Glen Innes business owners of the traffic routes to be used by heavy vehicles associated with the project;
 - v) procedures to manage construction traffic to ensure the safety of livestock and to minimise disruption to livestock, and school children and limit disruption to school bus timetables;
 - vi) speed limits to be observed along routes to and from the site and within the site;
 - vii) minimum requirements for vehicle maintenance to address noise and exhaust emissions, particularly along roads in close proximity to residences; and
 - viii) details of the expected behavioural requirements for vehicle drivers travelling to and from the site and within the site.
 - c) a **Flora and Fauna Management Plan** to outline measures to protect and minimise loss of native vegetation and native fauna habitat as a result of construction of the project. The Plan shall include, but not necessarily be limited to:
 - i) plans showing terrestrial vegetation communities; important flora and fauna habitat areas; locations where threatened species, have been recorded or are likely to occur; and areas to

- be cleared. The plans shall also identify vegetation adjoining the site where this contains important habitat areas and/or threatened species, populations or ecological communities;
- ii) methods to manage impacts on flora and fauna species and their habitat which may be directly or indirectly affected by the project, such as location of fencing, procedures for clearing of vegetation or soil and procedures for re-locating hollows or installing nesting boxes; and
- iii) rehabilitation details, and a program for reporting on the effectiveness of terrestrial flora and fauna management measures. Management methods shall be reviewed where found to be ineffective.

Operation Environmental Management Plan

- 6.4 The Proponent shall prepare and implement an **Operation Environmental Management Plan** in accordance with the *Guideline for the Preparation of Environmental Management Plans* (DUAP, 2004) or its latest revision. The Plan shall include but not necessarily be limited to:
- a) identification of all statutory and other obligations that the Proponent is required to fulfil in relation to the operation of the development, including all consents, licences, approvals and consultations;
 - b) a management organisational chart identifying the roles and responsibilities for all relevant employees involved in the operation of the project;
 - c) overall environmental policies to be applied to the operation of the project;
 - d) standards and performance measures to be applied to the project, and means by which environmental performance can be periodically monitored, reviewed and improved, (where appropriate) and what actions would be taken in the case that non-compliance with the requirements of this approval are identified. In particular the following environmental performance issues shall be addressed:
 - i) bushfire hazard and risk management; and
 - ii) management and maintenance of offsets;
 - e) the environmental monitoring requirements outlined under this approval;
 - f) complaints handling procedures as identified in conditions 4.4 to 1.1;
 - g) the Management Plans listed under condition 6.5 of this approval; and
 - h) details of how sector management would be used and monitored to ensure that operational noise criteria and shadow flicker criteria are not exceeded.

The Plan shall be submitted for the approval of the **Secretary** no later than one month prior to the commencement of Operation of the project or within such period as otherwise agreed by the **Secretary**. Operation shall not commence until written approval has been received from the **Secretary**. Upon receipt of the **Secretary's** approval, the Proponent shall make the Plan publicly available as soon as practicable.

- 6.5 As part of the **Operational Environmental Management Plan** required under condition 6.4, the Proponent shall prepare and implement the following management plans:
- a) a **Noise Management Plan** to outline measures to minimise noise emissions from the operation of the project. The Plan shall include, but not necessarily be limited to:
 - i) details of procedures to ensure ongoing compliance with the operational noise limits specified in this approval as they apply to identified receivers. This shall include identification of monitoring requirements;
 - ii) identification and implementation of best practice management techniques for minimisation of noise emissions where reasonable and feasible;
 - iii) measures to be undertaken to rectify annoying characteristics resulting from the operation of the project such as, but not limited to, infrasound or adverse mechanical noise from component failure; and
 - iv) procedures and corrective actions to be undertaken if non-compliance is detected or in the case of complaints.
 - b) a **Landscape Management Plan** to outline measures to ensure appropriate development and maintenance of landscaping on the site to address the visual impacts arising from the project including, turbines, site access roads, substation and control and facilities building, as far as is reasonable and feasible. The Plan shall be prepared by a qualified landscape architect and meet the requirements of Council.
- 6.6 Within three years of the commencement of operation, and at least every three years thereafter, unless otherwise agreed by the **Secretary**, the Proponent shall undertake a formal review of the Operation Environmental Management Plan. The review shall ensure that the Plan is up-to-date and all changes to procedures and practices since the previous review have been fully incorporated into the Plan. The Proponent shall notify the **Secretary** of the completion of each review, and shall supply a copy of the updated Plan on request.

7. ENVIRONMENTAL REPORTING

Incident Reporting

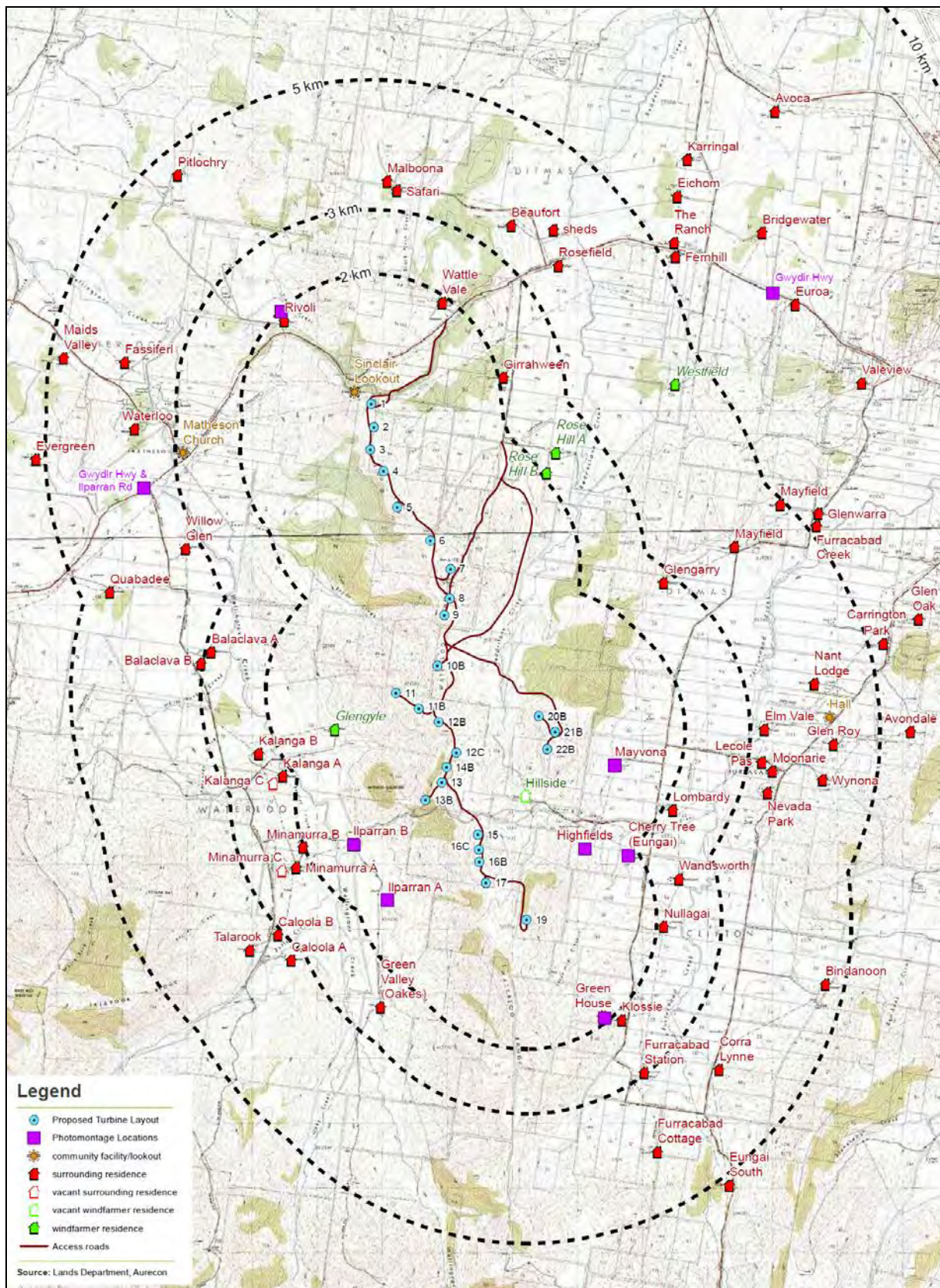
- 7.1 The Proponent shall notify the **Secretary** and any relevant Government authority of any incident with actual or potential significant off-site impacts on people or the biophysical environment as soon as practicable after the occurrence of the incident. The Proponent shall provide written details of the incident to the **Secretary** within seven days of the date on which the incident occurred.

- 7.2 The Proponent shall meet the requirements of the **Secretary** to address the cause or impact of any incident, as it relates to this approval, reported in accordance with condition 7.1 of this approval, within such period as the **Secretary** may require.

**APPENDIX 1
SCHEDULE OF LAND**

<i>Property</i>	<i>Lot/DP</i>
1	72/753274
	89/753274
	Pt 90/753319
	86/753319
	105/753319
	2/562615
2	1/1096761
	2/508195
	116/753270
	118/753270
	2/508196
3	1332/1004132
4	1331/1004132
5	117/753270
	2/596311
6	1/562615
7	Wattle Vale Travelling Stock Route (TSR) 67474 including the former Gwydir Highway alignment

APPENDIX 2 PROJECT LAYOUT



APPENDIX 3 NOISE COMPLIANCE ASSESSMENT

PART A: SOUTH AUSTRALIAN WIND FARMS: ENVIRONMENTAL NOISE GUIDELINES 2009 (MODIFIED)

South Australian *Wind Farms: Environmental Noise Guidelines 2009* (Modified) refers to the South Australian EPA document modified for use in NSW.

The modifications are as follows:

Tonality

The presence of excessive tonality (a special noise characteristic) is consistent with that described in *ISO 1996.2: 2007 Acoustics — Description, measurement and assessment of environmental noise – Determination of environmental noise levels* and is defined as when the level of one-third octave band measured in the equivalent noise level $L_{eq(10\text{minute})}$ exceeds the level of the adjacent bands on both sides by:

- 5dB or more if the centre frequency of the band containing the tone is in the range 500Hz to 10,000Hz;
- 8dB or more if the centre frequency of the band containing the tone is in the range 160 to 400Hz; and/or
- 15dB or more if the centre frequency of the band containing the tone is in the range 25Hz to 125Hz.

If tonality is found to be a repeated characteristic of the wind turbine noise, 5 dB(A) should be added to measured noise levels from the wind farm. If tonality is only identified for certain wind directions and speeds, the penalty is only applicable under these conditions. The tonal characteristic penalty applies only if the tone from the wind turbine is audible at the relevant receiver. Absence of tone in noise emissions measured at an intermediate location is sufficient proof that the tone at the receiver is not associated with the wind farm's operation. The assessment for tonality should only be made for frequencies of concern from 25 Hz to 10 KHz and for sound pressure levels above the threshold of hearing (as defined in *ISO 389.7: 2005 Acoustics - Reference zero for the calibration of audiometric equipment - Part 7: Reference threshold of hearing under free-field and diffuse-field listening conditions*).

Low Frequency Noise

The presence of excessive low frequency noise (a special noise characteristic) [i.e. noise from the wind farm that is repeatedly greater than 65 dB(C) during the day time or 60 dB(C) during the night time at any relevant receiver] will incur a 5 dB(A) penalty, to be added to the measured noise level for the wind farm, unless a detailed internal low frequency noise assessment demonstrates compliance with the proposed criteria for the assessment of low frequency noise disturbance (UK Department for Environment, Food and Rural Affairs (DEFRA, 2005)) for a steady state noise source.

Notes:

- For the purposes of these conditions, a special noise characteristic is defined as a repeated characteristic if it occurs for more than 10% of an assessment period. This equates to being identified for more than 144 minutes during any 24 hour period. This definition refers to verified wind farm noise only.
- The maximum penalty to be added to the measured noise level from the wind farm for any special noise characteristic individually or cumulatively is 5 dB(A).

PART B: NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions – Wind Turbines

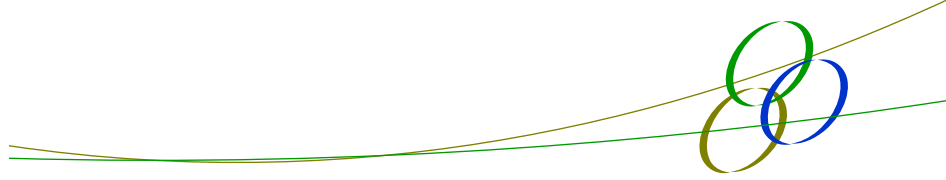
1. The noise criteria in condition 2.16 are to apply under all meteorological conditions.

Applicable Meteorological Conditions – Other Facilities

2. The noise criteria in condition 2.21 are to apply under all meteorological conditions except the following:
 - a) wind speeds greater than 3 m/s at 10 m above ground level; or
 - b) temperature inversion conditions between 1.5 °C and 3°C/100m and wind speeds greater than 2 m/s at 10 m above ground level; or
 - c) temperature inversion conditions greater than 3°C/100m.

Appendix 2

Noise Assessment



Glen Innes Wind Farm

Supplementary Environmental Noise Assessment

June 2017

sonus.

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TABLE OF CONTENTS

1	INTRODUCTION	3
2	CRITERIA	4
3	ASSESSMENT	5
3.1	Noise Propagation Model and Inputs	5
3.1.1	Meteorological Conditions.....	5
3.1.2	Noise Sources and Data	5
3.1.3	Other Input Parameters	6
3.2	Predicted Noise Levels	7
3.3	Tonality.....	11
4	CONCLUSION	12
	APPENDIX A: WIND FARM LAYOUT AND RECEIVERS.....	13
	APPENDIX B: MODELLED SOUND POWER LEVELS	16

1 INTRODUCTION

An environmental noise assessment of the proposed Glen Innes Wind Farm was previously conducted by Connell Wagner and summarised in their reports “25766-008-01” (dated 26 June 2008).

Since then, changes have been made to the proposed turbine model and layout. This assessment predicts the noise from the proposed turbines and compares the predicted noise levels against the criteria contained in the Project Approval.

2 CRITERIA

The MOD 3 Project Approval for the Glen Innes Wind Farm includes the following condition:

Operational Noise Criteria – Wind Turbines

2.16 The Proponent shall ensure that the noise generated by the operation of wind turbines does not exceed the relevant criteria in Table 2 at any non-associated residence.

Residence	Criteria (dB(A)) with Reference to Hub Height Wind Speed (m/s)											
	3	4	5	6	7	8	9	10	11	12	13	14
Cherry Tree (Eungai), Elm Vale, Klossie, Green House, Lombardy, Mayvona, Moonarie, Nullagai, Wandsworth	35	35	35	35	35	35	35	36	38	40	43	46
Highfields, Wattle Vale	35	35	35	35	35	35	36	38	40	42	44	46
Balaclava A, Ilparran A, Ilparran B, Kalanga A, Kalanga B, Kalanga C, Minamurra A, Minamurra B, Minamurra C, Green Valley (Oakes), Rivoli	35	35	35	35	35	36	37	38	39	40	40	41
Girrahween, Glengarry	35	35	35	35	35	35	35	35	35	36	37	39
All other non-associated residences	The higher of 35 dB(A) or the existing background noise level (LA90 (10-minute)) plus 5 dB(A)											

These criteria have been used in the assessment.

3 ASSESSMENT

The assessment has been conducted based on the wind farm consisting of Servion 3.6M140 WTGs with 110m hub height. The wind farm layout and the location of the relevant receivers are provided in Appendix A.

The assessment predicts the noise levels at the receivers from the wind farm and compares them with the noise criteria provided in the project approval.

3.1 Noise Propagation Model and Inputs

The noise from the wind turbines was modelled using the CONCAWE¹ propagation model within the SoundPlan noise modelling software. The CONCAWE noise propagation model is an internationally accepted noise propagation model that takes into account:

- the sound power level and position of the noise sources;
- the separation between the noise sources and receivers;
- the ground topography between the noise sources and receivers;
- the hardness of the ground;
- atmospheric absorption at different frequencies; and,
- meteorological conditions.

The inputs to the noise propagation model are described in detail below.

3.1.1 Meteorological Conditions

The CONCAWE system categorises the possible meteorological conditions into six categories, from Category 1 to Category 6. Category 1 is considered the “best-case” meteorological conditions (i.e., lowest noise level) while Category 6 is considered the “worst-case” meteorological conditions (i.e., highest noise level).

For a conservative assessment, the noise model has considered meteorological conditions corresponding to Category 6 (night with no clouds and wind from the wind farm to the residence under consideration).

3.1.2 Noise Sources and Data

The noise from the WTGs has been modelled based on the overall sound power levels provided in the Servion 3.6M140 WTG specification for the “normal” operating mode and the specifications for the 98 dB(A), 100 dB(A) and 102 dB(A) operating modes. The overall sound power level for each mode is summarised in Table 1 below and the one-third octave band sound power level spectra are provided in Appendix B.

¹ CONCAWE The oil companies’ international study group for conservation of clean air and water – Europe “The propagation of noise from petrochemical complexes to neighbouring communities”.

Table 1: Overall sound power level for Senvion 3.6M140 WTG.

Hub Height Wind Speed (m/s)	4	5	6	7	8	9	10	11	12	13 to cutout
Overall Sound Power Level Normal Operating Mode (dB(A))	95.0	97.2	99.8	102.7	104.0	104.0	104.0	103.7	103.5	103.5
Overall Sound Power Level 102 dB(A) Operating Mode (dB(A))	95.0	97.2	99.8	102.0	102.0	102.0	101.9	101.5	101.5	101.5
Overall Sound Power Level 100 dB(A) Operating Mode (dB(A))	95.0	97.2	99.8	100.0	100.0	99.8	99.5	99.5	99.5	99.5
Overall Sound Power Level 98 dB(A) Operating Mode (dB(A))	95.0	97.2	98.0	98.0	97.8	97.5	97.5	97.5	97.5	97.5

3.1.3 Other Input Parameters

Other model input parameters associated with the atmospheric absorption, ground absorption and shielding are summarised below:

- atmospheric conditions at 10°C and 80% relative humidity;
- acoustically soft ground (finite acoustic impedance); and,
- a maximum barrier attenuation from topography of 2 dB.

It is noted that the Guidelines provide a default prediction method which incorporates hard ground in the noise propagation model unless justification is provided for using another input. The CONCAWE propagation model separates ground attenuation into the categories of hard ground and ground with finite acoustic impedance. CONCAWE states that hard ground should be used for surfaces such as concrete or water and all other surfaces including grass or soil should be considered as finite acoustic impedance. The ground between the WTGs and receivers is not concrete nor water, and therefore a finite acoustic impedance (corresponding to grass or rough pasture within the CONCAWE model) has been used.

3.2 Predicted Noise Levels

Based on the predictions the following operating scenario is required in order to achieve the noise criteria at all receivers;

7m/s	8m/s	9m/s	10m/s
WTG's 19, 16C, 21B, 22B in 98 dB(A) Mode	WTG's 19, 16C, 17, 21B, 22B in 98 dB(A) Mode	WTG's 19, 16C, 17, , in 102 dB(A) Mode 22B in 100 Mode 21B in 98 Mode	WTG's 21B, 22B in 102 dB(A) Mode

The predicted noise levels from the wind turbines, based on the above operating scenario, are summarised in Table 2, along with the relevant noise criteria. Predicted noise contours at a wind speed of 10m/s is provided in Appendix C.

Table 2: Predicted noise levels from the wind turbines and substation.

Name	Assumed Associated	Predicted Noise Level (dB(A)) for Integer Wind Speeds (m/s)																			
		4		5		6		7		8		9		10		11		12		13	
		Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction
Avoca	NO	35	2	35	4	35	7	35	11	35	11	35	11	35	11	35	10	35	10	35	10
Avondale	NO	35	8	35	10	35	13	35	15	35	16	35	16	35	16	35	16	35	15	35	15
Balaclava A	NO	35	19	35	21	35	23	35	27	36	28	37	27	38	27	39	26	40	26	40	26
Balaclava B	NO	35	18	35	20	35	23	35	26	35	27	35	27	35	26	35	26	35	26	35	26
Beaufort	NO	35	13	35	15	35	17	35	21	35	22	35	21	35	21	35	20	35	20	35	20
Bindanoon	NO	35	9	35	11	35	14	35	16	35	16	35	17	35	17	35	17	35	17	35	17
Bridgewater	NO	35	5	35	7	35	10	35	14	35	14	35	14	35	14	35	13	35	13	35	13
Caloola A	NO	35	18	35	20	35	22	35	25	35	25	35	26	35	26	35	25	35	25	35	25
Caloola B	NO	35	18	35	20	35	23	35	25	35	26	35	26	35	26	35	26	35	26	35	26
Carrington Park	NO	35	8	35	11	35	13	35	16	35	17	35	17	35	17	35	16	35	16	35	16
Cherry Tree (Eungai)	NO	35	25	35	27	35	29	35	31	35	31	35	32	36	33	38	32	40	32	43	32
Corra Lynne	NO	35	11	35	13	35	16	35	18	35	18	35	19	35	19	35	19	35	19	35	19
Eichom	NO	35	7	35	9	35	11	35	15	35	16	35	15	35	15	35	15	35	14	35	14
Elm Vale	NO	35	16	35	18	35	20	35	22	35	23	35	23	36	23	38	23	40	23	43	23
Eungai South	NO	35	6	35	9	35	11	35	13	35	14	35	14	35	15	35	14	35	14	35	14
Euroa	NO	35	5	35	8	35	10	35	14	35	15	35	14	35	14	35	13	35	13	35	13
Evergreen	NO	35	8	35	10	35	13	35	16	35	17	35	17	35	17	35	16	35	16	35	16
Fassiferl	NO	35	12	35	14	35	17	35	20	35	21	35	21	35	21	35	20	35	20	35	20
Fernhill	NO	35	9	35	11	35	13	35	17	35	18	35	17	35	17	35	16	35	16	35	16
Furracabad Cottage	NO	35	10	35	12	35	14	35	16	35	16	35	17	35	18	35	17	35	17	35	17
Furracabad Creek	NO	35	10	35	12	35	15	35	17	35	18	35	18	35	18	35	18	35	17	35	17
Furracabad Station	NO	35	14	35	16	35	19	35	20	35	20	35	22	35	22	35	22	35	22	35	22
Girrahween	NO	35	22	35	25	35	27	35	30	35	31	35	31	35	31	35	30	36	30	37	30
Glen Oak	NO	35	7	35	9	35	12	35	14	35	15	35	15	35	15	35	15	35	15	35	15
Glen Roy	NO	35	11	35	14	35	16	35	18	35	19	35	19	35	19	35	19	35	19	35	19
Glengarry	NO	35	18	35	21	35	23	35	25	35	26	35	26	35	26	35	26	36	26	37	26
Glengyle	YES		29		32		34		37		38		38		38		37		37		37
Glenwarra	NO	35	9	35	12	35	14	35	17	35	18	35	18	35	18	35	17	35	17	35	17

Name	Assumed Associated	Predicted Noise Level (dB(A)) for Integer Wind Speeds (m/s)																			
		4		5		6		7		8		9		10		11		12		13	
		Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction
Green House	NO	35	20	35	22	35	25	35	26	35	26	35	27	36	28	38	28	40	28	43	28
Green Valley (Oakes)	NO	35	20	35	22	35	25	35	27	36	27	37	28	38	28	39	28	40	27	40	27
Hall	NO	35	12	35	14	35	16	35	19	35	19	35	19	35	20	35	19	35	19	35	19
Highfields	NO	35	29	35	31	35	33	35	35	35	35	36	36	38	37	40	36	42	36	44	36
Hillside	Yes		34		36		39		41		41		41		42		42		42		42
Ilparran A	NO	35	28	35	30	35	33	35	35	36	35	37	36	38	36	39	36	40	35	40	35
Ilparran B	NO	35	28	35	30	35	32	35	35	36	36	37	36	38	36	39	35	40	35	40	35
Kalanga A	NO	35	23	35	26	35	28	35	31	36	32	37	32	38	32	39	31	40	31	40	31
Kalanga B	NO	35	22	35	24	35	27	35	30	36	31	37	30	38	30	39	30	40	29	40	29
Kalanga C	NO	35	23	35	25	35	27	35	30	36	31	37	31	38	31	39	30	40	30	40	30
Karringal	NO	35	5	35	7	35	10	35	14	35	14	35	14	35	14	35	13	35	13	35	13
Klossie	NO	35	19	35	21	35	23	35	24	35	24	35	26	36	27	38	26	40	26	43	26
Lecole Pas	NO	35	16	35	18	35	21	35	22	35	23	35	23	35	24	35	24	35	23	35	23
Lombardy	NO	35	22	35	24	35	27	35	28	35	29	35	29	36	30	38	30	40	30	43	30
Maids Valley	NO	35	9	35	11	35	14	35	17	35	18	35	18	35	17	35	17	35	17	35	17
Malboona	NO	35	12	35	15	35	17	35	20	35	21	35	21	35	21	35	20	35	20	35	20
Matheson Church	NO	35	18	35	20	35	22	35	26	35	27	35	26	35	26	35	25	35	25	35	25
Mayfield	NO	35	11	35	13	35	15	35	18	35	19	35	19	35	19	35	19	35	18	35	18
Mayfield	NO	35	14	35	16	35	19	35	21	35	22	35	22	35	22	35	22	35	22	35	22
Mayvona	NO	35	29	35	31	35	34	35	34	35	35	35	35	36	36	38	37	40	37	43	37
Minamurra A	NO	35	22	35	24	35	27	35	30	36	30	37	30	38	30	39	30	40	30	40	30
Minamurra B	NO	35	23	35	25	35	28	35	31	36	32	37	32	38	32	39	31	40	31	40	31
Minamurra C	NO	35	21	35	23	35	26	35	28	36	29	37	29	38	29	39	29	40	28	40	28
Moonarie	NO	35	15	35	17	35	20	35	22	35	22	35	22	36	23	38	23	40	23	43	23
Nant Lodge	NO	35	12	35	14	35	17	35	19	35	20	35	20	35	20	35	20	35	20	35	20
Nevada Park	NO	35	15	35	17	35	20	35	22	35	22	35	23	35	23	35	23	35	23	35	23
Nullagai	NO	35	20	35	22	35	25	35	26	35	26	35	27	36	28	38	28	40	27	43	27
Pitlochry	NO	35	8	35	10	35	13	35	16	35	17	35	17	35	17	35	16	35	16	35	16
Quabadee	NO	35	13	35	15	35	18	35	21	35	22	35	22	35	21	35	21	35	20	35	20
Rivoli	NO	35	22	35	24	35	26	35	29	36	31	37	30	38	30	39	29	40	29	40	29

Name	Assumed Associated	Predicted Noise Level (dB(A)) for Integer Wind Speeds (m/s)																			
		4		5		6		7		8		9		10		11		12		13	
		Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction	Criterion	Prediction
Rose Hill A	Yes		22		24		27		30		31		30		30		30		29		29
Rose Hill B	Yes		23		25		28		31		32		32		31		31		31		31
Rosefield	NO	35	13	35	15	35	18	35	21	35	22	35	22	35	22	35	21	35	21	35	21
Safari	NO	35	13	35	15	35	18	35	21	35	22	35	22	35	21	35	21	35	21	35	21
sheds	NO	35	12	35	14	35	17	35	20	35	21	35	21	35	20	35	20	35	19	35	19
Sinclair Lookout	N/A		38		40		43		46		47		47		46		46		46		46
Talarook	NO	35	16	35	18	35	21	35	23	35	24	35	24	35	24	35	24	35	23	35	23
The Ranch	NO	35	8	35	10	35	13	35	16	35	17	35	17	35	17	35	16	35	16	35	16
Valeview	NO	35	6	35	8	35	10	35	14	35	14	35	14	35	14	35	14	35	13	35	13
Wandsworth	NO	35	20	35	22	35	25	35	26	35	26	35	27	36	28	38	28	40	28	43	28
Waterloo	NO	35	14	35	16	35	19	35	22	35	23	35	23	35	22	35	22	35	22	35	22
Wattle Vale	NO	35	21	35	23	35	26	35	29	35	30	36	30	38	30	40	29	42	29	44	29
Westfield	NO	35	13	35	15	35	17	35	21	35	22	35	21	35	21	35	20	35	20	35	20
Willow Glen	NO	35	17	35	20	35	22	35	25	35	26	35	26	35	26	35	25	35	25	35	25
Wynona	NO	35	12	35	14	35	17	35	19	35	19	35	20	35	20	35	20	35	20	35	20

The prediction indicates that the noise level from the wind farm at any wind speed can achieve the criteria at all receivers in accordance with the project approval.

3.3 Tonality

The one-third octave band sound power levels detailed in Appendix D, demonstrate that the noise from the turbines is not tonal.

4 CONCLUSION

The noise from the latest wind farm configuration for the proposed Glen Innes Wind Farm has been predicted based on the Senvion 3.6M140 WTG.

The predictions indicate that the noise will achieve the criteria of the Project approval with the wind turbines operating in the noise modes described within this report. Should agreements be reached with additional landowners, the noise modes may be adjusted, whilst still achieving the relevant criteria.

APPENDIX A: WIND FARM LAYOUT AND RECEIVERS

Coordinates of WTGs

Turbine ID	Coordinates	
	Easting	Northing
WTG01	364902	6710276
WTG02	364985	6709936
WTG03	364926	6709583
WTG04	365131	6709251
WTG05	365343	6708692
WTG06	365850	6708179
WTG07	366170	6707771
WTG08	366146	6707375
WTG09	366063	6707025
WTG10B	365940	6706230
WTG11	365258	6705851
WTG11B	365675	6705575
WTG12B	365980	6705375
WTG12C	366302	6704947
WTG13	365933	6704425
WTG13B	365793	6704174
WTG14B	366071	6704671
WTG15	366580	6703727
WTG16B	366605	6703206
WTG16C	366619	6703416
WTG17	366686	6702920
WTG19	367318	6702281
WTG20B	367521	6705469
WTG22B	367651	6704952
WTG21B	367774	6705217

Coordinates of Receivers

Receiver	Type	Coordinates	
		Easting	Northing
Rivoli	surrounding residence	363,609	6,711,568
Willow Glen	surrounding residence	362,089	6,708,040
Waterloo	surrounding residence	361,304	6,709,891
Matheson Church	community facility/lookout	362,050	6,709,530
Fassiferl	surrounding residence	361,156	6,710,922
Balaclava A	surrounding residence	362,484	6,706,451
Glengyle	windfarmer residence	364,384	6,705,252
Kalanga A	surrounding residence	363,584	6,704,532
Ilparran B	vacant surrounding residence	364,665	6,703,476
Minamurra A	surrounding residence	363,787	6,703,120
Caloola B	surrounding residence	363,511	6,702,078
Talarook	surrounding residence	363,076	6,701,847
Cherry Tree (Eungai)	surrounding residence	368,903	6,703,304
Wandsworth	surrounding residence	369,683	6,702,942
Nullagai	surrounding residence	369,447	6,702,207
Hillside	vacant windfarmer residence	367,316	6,704,226
Lombardy	surrounding residence	369,589	6,704,005
Mayvona	vacant surrounding residence	368,693	6,704,706
Glengarry	surrounding residence	369,447	6,707,518
Rose Hill A	windfarmer residence	367,786	6,709,527
Wattle Vale	surrounding residence	366,037	6,711,845
Westfield	windfarmer residence	369,619	6,710,581
Girrahween	surrounding residence	366,978	6,710,689
Safari	surrounding residence	365,341	6,713,575
Malboona	surrounding residence	365,194	6,713,722
Beaufort	surrounding residence	367,100	6,713,036
sheds	surrounding residence	367,752	6,712,967
Rosefield	surrounding residence	367,830	6,712,414
The Ranch	surrounding residence	369,609	6,712,771
Fernhill	surrounding residence	369,629	6,712,556
Eichom	surrounding residence	369,658	6,713,482
Karringal	surrounding residence	369,810	6,714,055
Euroa	surrounding residence	371,471	6,711,816
Mayfield	surrounding residence	371,241	6,708,729
Mayfield	surrounding residence	370,540	6,708,077
Glenwarra	surrounding residence	371,824	6,708,591
Elm Vale	surrounding residence	370,996	6,705,255
Nant Lodge	surrounding residence	371,760	6,705,955

Hall	community facility/lookout	371,995	6,705,441
Glen Roy	surrounding residence	372,059	6,705,024
Wynona	surrounding residence	371,893	6,704,471
Bindanoon	surrounding residence	371,932	6,701,315
Eungai South	surrounding residence	370,457	6,698,213
Furracabad Station	surrounding residence	369,148	6,699,953
Klossie	surrounding residence	368,800	6,700,765
Avoca	surrounding residence	371,158	6,714,797
Pitlochry	surrounding residence	361,969	6,713,814
Sinclair Lookout	community facility/lookout	364,681	6,710,470
Balaclava B	surrounding residence	362,329	6,706,274
Kalanga B	surrounding residence	363,211	6,704,876
Minamurra B	surrounding residence	363,900	6,703,434
Corra Lynne	surrounding residence	370,303	6,699,999
Nevada Park	surrounding residence	371,046	6,704,276
Moonarie	surrounding residence	371,122	6,704,607
Lecole Pas	surrounding residence	370,958	6,704,744
Furracabad Creek	surrounding residence	371,799	6,708,397
Rose Hill B	windfarmer residence	367,642	6,709,213
Bridgewater	surrounding residence	370,965	6,712,926
Green Valley (Oakes)	surrounding residence	365,090	6,700,966
Caloola A	surrounding residence	363,717	6,701,690
Minamurra C	vacant surrounding residence	363,576	6,703,070
Ilparran A	surrounding residence	365,191	6,702,621
Kalanga C	vacant surrounding residence	363,435	6,704,417
Carrington Park	surrounding residence	372,828	6,706,578
Glen Oak	surrounding residence	373,368	6,706,959
Avondale	surrounding residence	373,249	6,705,220
Quabadee	surrounding residence	360,922	6,707,371
Evergreen	surrounding residence	359,787	6,709,427
Maids Valley	surrounding residence	360,215	6,710,991
Green House	vacant surrounding residence	368,502	6,700,820
Furracabad Cottage	surrounding residence	369,350	6,698,727
Valeview	surrounding residence	372,494	6,710,604
Highfields	surrounding residence	368,235	6,703,415

APPENDIX B: MODELLED SOUND POWER LEVELS

Senvion 3.6M140 WTG (Normal Operating Mode) sound power levels

One-third Octave Band Frequency (Hz)	Sound Power Level (dB(A)) by Hub Height Integer Wind Speed									
	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s to cutout
20	53.6	55.8	58.4	61.7	62.6	62.5	62.7	61.5	61.3	61.3
25	57.9	60.1	62.7	66.1	67.0	67.2	67.2	66.2	66.0	66.0
31.5	62.8	65.0	67.6	70.7	71.8	71.7	72.1	70.8	70.6	70.6
40	66.7	68.9	71.5	74.9	76.0	75.9	76.2	74.7	74.5	74.5
50	69.7	71.9	74.5	78.1	79.3	79.2	79.3	78.5	78.3	78.3
63	72.5	74.7	77.3	80.9	82.1	81.8	81.8	80.4	80.2	80.2
80	74.4	76.6	79.2	82.8	84.3	83.7	83.0	81.9	81.7	81.7
100	77.7	79.9	82.5	85.8	86.4	86.6	85.3	84.9	84.7	84.7
125	78.7	80.9	83.5	89.0	89.9	89.2	88.8	88.1	87.9	87.9
160	78.8	81.0	83.6	87.4	88.6	87.9	87.4	86.6	86.4	86.4
200	81.2	83.4	86.0	88.1	89.1	89.1	88.7	88.0	87.8	87.8
250	81.2	83.4	86.0	89.3	90.1	89.8	89.2	88.7	88.5	88.5
315	83.2	85.4	88.0	91.3	92.2	91.9	91.6	91.0	90.8	90.8
400	83.7	85.9	88.5	91.1	92.2	92.1	91.9	91.3	91.1	91.1
500	81.5	83.7	86.3	89.2	90.4	90.1	90.0	89.4	89.2	89.2
630	84.0	86.2	88.8	91.5	92.6	92.4	92.3	92.2	92.0	92.0
800	84.2	86.4	89.0	91.4	92.6	92.1	91.9	91.7	91.5	91.5
1000	85.3	87.5	90.1	92.4	93.5	93.1	93.0	93.1	92.9	92.9
1250	85.5	87.7	90.3	92.5	93.8	93.4	93.1	93.0	92.8	92.8
1600	84.5	86.7	89.3	92.5	93.8	93.9	93.9	93.6	93.4	93.4
2000	82.8	85.0	87.6	90.7	92.2	92.1	92.0	91.5	91.3	91.3
2500	81.6	83.8	86.4	90.0	91.5	91.8	92.2	92.0	91.8	91.8
3150	82.2	84.4	87.0	89.0	90.6	92.2	93.5	93.8	93.6	93.6
4000	78.6	80.8	83.4	86.3	88.5	90.3	91.3	91.2	91.0	91.0
5000	72.3	74.5	77.1	81.9	84.9	86.3	86.9	86.0	85.8	85.8
6300	68.2	70.4	73.0	78.2	81.3	83.2	83.8	82.3	82.1	82.1
8000	63.3	65.5	68.1	74.1	77.1	78.8	79.3	77.9	77.7	77.7
10000	58.2	60.4	63.0	69.4	72.4	74.1	74.4	73.1	72.9	72.9
L _{WA}	95.0	97.2	99.8	102.7	104.0	104.0	104.0	103.7	103.5	103.5

Senvion 3.6M140 WTG (102 dB(A) Operating Mode) sound power levels

One-third Octave Band Frequency (Hz)	Sound Power Level (dB(A)) by Hub Height Integer Wind Speed									
	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s to cutout
20	53.6	55.8	58.4	61.0	60.6	60.5	60.6	59.3	59.3	59.3
25	57.9	60.1	62.7	65.4	65.0	65.2	65.1	64.0	64.0	64.0
31.5	62.8	65.0	67.6	70.0	69.8	69.7	70.0	68.6	68.6	68.6
40	66.7	68.9	71.5	74.2	74.0	73.9	74.1	72.5	72.5	72.5
50	69.7	71.9	74.5	77.4	77.3	77.2	77.2	76.3	76.3	76.3
63	72.5	74.7	77.3	80.2	80.1	79.8	79.7	78.2	78.2	78.2
80	74.4	76.6	79.2	82.1	82.3	81.7	80.9	79.7	79.7	79.7
100	77.7	79.9	82.5	85.1	84.4	84.6	83.2	82.7	82.7	82.7
125	78.7	80.9	83.5	88.3	87.9	87.2	86.7	85.9	85.9	85.9
160	78.8	81.0	83.6	86.7	86.6	85.9	85.3	84.4	84.4	84.4
200	81.2	83.4	86.0	87.4	87.1	87.1	86.6	85.8	85.8	85.8
250	81.2	83.4	86.0	88.6	88.1	87.8	87.1	86.5	86.5	86.5
315	83.2	85.4	88.0	90.6	90.2	89.9	89.5	88.8	88.8	88.8
400	83.7	85.9	88.5	90.4	90.2	90.1	89.8	89.1	89.1	89.1
500	81.5	83.7	86.3	88.5	88.4	88.1	87.9	87.2	87.2	87.2
630	84.0	86.2	88.8	90.8	90.6	90.4	90.2	90.0	90.0	90.0
800	84.2	86.4	89.0	90.7	90.6	90.1	89.8	89.5	89.5	89.5
1000	85.3	87.5	90.1	91.7	91.5	91.1	90.9	90.9	90.9	90.9
1250	85.5	87.7	90.3	91.8	91.8	91.4	91.0	90.8	90.8	90.8
1600	84.5	86.7	89.3	91.8	91.8	91.9	91.8	91.4	91.4	91.4
2000	82.8	85.0	87.6	90.0	90.2	90.1	89.9	89.3	89.3	89.3
2500	81.6	83.8	86.4	89.3	89.5	89.8	90.1	89.8	89.8	89.8
3150	82.2	84.4	87.0	88.3	88.6	90.2	91.4	91.6	91.6	91.6
4000	78.6	80.8	83.4	85.6	86.5	88.3	89.2	89.0	89.0	89.0
5000	72.3	74.5	77.1	81.2	82.9	84.3	84.8	83.8	83.8	83.8
6300	68.2	70.4	73.0	77.5	79.3	81.2	81.7	80.1	80.1	80.1
8000	63.3	65.5	68.1	73.4	75.1	76.8	77.2	75.7	75.7	75.7
10000	58.2	60.4	63.0	68.7	70.4	72.1	72.3	70.9	70.9	70.9
L_{WA}	95.0	97.2	99.8	102.0	102.0	102.0	101.9	101.5	101.5	101.5

Senvion 3.6M140 WTG (100 dB(A) Operating Mode) sound power levels

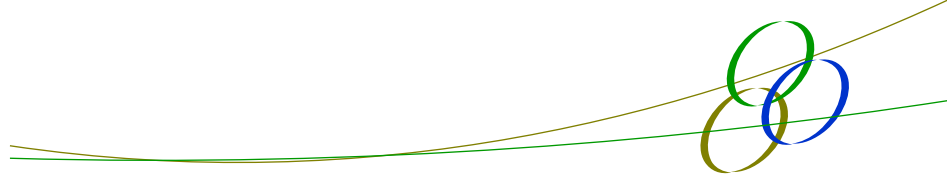
One-third Octave Band Frequency (Hz)	Sound Power Level (dB(A)) by Hub Height Integer Wind Speed									
	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s to cutout
20	53.6	55.8	58.4	59.0	58.6	58.3	58.2	57.3	57.3	57.3
25	57.9	60.1	62.7	63.4	63.0	63.0	62.7	62.0	62.0	62.0
31.5	62.8	65.0	67.6	68.0	67.8	67.5	67.6	66.6	66.6	66.6
40	66.7	68.9	71.5	72.2	72.0	71.7	71.7	70.5	70.5	70.5
50	69.7	71.9	74.5	75.4	75.3	75.0	74.8	74.3	74.3	74.3
63	72.5	74.7	77.3	78.2	78.1	77.6	77.3	76.2	76.2	76.2
80	74.4	76.6	79.2	80.1	80.3	79.5	78.5	77.7	77.7	77.7
100	77.7	79.9	82.5	83.1	82.4	82.4	80.8	80.7	80.7	80.7
125	78.7	80.9	83.5	86.3	85.9	85.0	84.3	83.9	83.9	83.9
160	78.8	81.0	83.6	84.7	84.6	83.7	82.9	82.4	82.4	82.4
200	81.2	83.4	86.0	85.4	85.1	84.9	84.2	83.8	83.8	83.8
250	81.2	83.4	86.0	86.6	86.1	85.6	84.7	84.5	84.5	84.5
315	83.2	85.4	88.0	88.6	88.2	87.7	87.1	86.8	86.8	86.8
400	83.7	85.9	88.5	88.4	88.2	87.9	87.4	87.1	87.1	87.1
500	81.5	83.7	86.3	86.5	86.4	85.9	85.5	85.2	85.2	85.2
630	84.0	86.2	88.8	88.8	88.6	88.2	87.8	88.0	88.0	88.0
800	84.2	86.4	89.0	88.7	88.6	87.9	87.4	87.5	87.5	87.5
1000	85.3	87.5	90.1	89.7	89.5	88.9	88.5	88.9	88.9	88.9
1250	85.5	87.7	90.3	89.8	89.8	89.2	88.6	88.8	88.8	88.8
1600	84.5	86.7	89.3	89.8	89.8	89.7	89.4	89.4	89.4	89.4
2000	82.8	85.0	87.6	88.0	88.2	87.9	87.5	87.3	87.3	87.3
2500	81.6	83.8	86.4	87.3	87.5	87.6	87.7	87.8	87.8	87.8
3150	82.2	84.4	87.0	86.3	86.6	88.0	89.0	89.6	89.6	89.6
4000	78.6	80.8	83.4	83.6	84.5	86.1	86.8	87.0	87.0	87.0
5000	72.3	74.5	77.1	79.2	80.9	82.1	82.4	81.8	81.8	81.8
6300	68.2	70.4	73.0	75.5	77.3	79.0	79.3	78.1	78.1	78.1
8000	63.3	65.5	68.1	71.4	73.1	74.6	74.8	73.7	73.7	73.7
10000	58.2	60.4	63.0	66.7	68.4	69.9	69.9	68.9	68.9	68.9
L _{WA}	95.0	97.2	99.8	100.0	100.0	99.8	99.5	99.5	99.5	99.5

Senvion 3.6M140 WTG (98 dB(A) Operating Mode) sound power levels

One-third Octave Band Frequency (Hz)	Sound Power Level (dB(A)) by Hub Height Integer Wind Speed									
	4 m/s	5 m/s	6 m/s	7 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	13 m/s to cutout
20	53.6	55.8	56.6	57.0	56.4	56.0	56.2	55.3	55.3	55.3
25	57.9	60.1	60.9	61.4	60.8	60.7	60.7	60.0	60.0	60.0
31.5	62.8	65.0	65.8	66.0	65.6	65.2	65.6	64.6	64.6	64.6
40	66.7	68.9	69.7	70.2	69.8	69.4	69.7	68.5	68.5	68.5
50	69.7	71.9	72.7	73.4	73.1	72.7	72.8	72.3	72.3	72.3
63	72.5	74.7	75.5	76.2	75.9	75.3	75.3	74.2	74.2	74.2
80	74.4	76.6	77.4	78.1	78.1	77.2	76.5	75.7	75.7	75.7
100	77.7	79.9	80.7	81.1	80.2	80.1	78.8	78.7	78.7	78.7
125	78.7	80.9	81.7	84.3	83.7	82.7	82.3	81.9	81.9	81.9
160	78.8	81.0	81.8	82.7	82.4	81.4	80.9	80.4	80.4	80.4
200	81.2	83.4	84.2	83.4	82.9	82.6	82.2	81.8	81.8	81.8
250	81.2	83.4	84.2	84.6	83.9	83.3	82.7	82.5	82.5	82.5
315	83.2	85.4	86.2	86.6	86.0	85.4	85.1	84.8	84.8	84.8
400	83.7	85.9	86.7	86.4	86.0	85.6	85.4	85.1	85.1	85.1
500	81.5	83.7	84.5	84.5	84.2	83.6	83.5	83.2	83.2	83.2
630	84.0	86.2	87.0	86.8	86.4	85.9	85.8	86.0	86.0	86.0
800	84.2	86.4	87.2	86.7	86.4	85.6	85.4	85.5	85.5	85.5
1000	85.3	87.5	88.3	87.7	87.3	86.6	86.5	86.9	86.9	86.9
1250	85.5	87.7	88.5	87.8	87.6	86.9	86.6	86.8	86.8	86.8
1600	84.5	86.7	87.5	87.8	87.6	87.4	87.4	87.4	87.4	87.4
2000	82.8	85.0	85.8	86.0	86.0	85.6	85.5	85.3	85.3	85.3
2500	81.6	83.8	84.6	85.3	85.3	85.3	85.7	85.8	85.8	85.8
3150	82.2	84.4	85.2	84.3	84.4	85.7	87.0	87.6	87.6	87.6
4000	78.6	80.8	81.6	81.6	82.3	83.8	84.8	85.0	85.0	85.0
5000	72.3	74.5	75.3	77.2	78.7	79.8	80.4	79.8	79.8	79.8
6300	68.2	70.4	71.2	73.5	75.1	76.7	77.3	76.1	76.1	76.1
8000	63.3	65.5	66.3	69.4	70.9	72.3	72.8	71.7	71.7	71.7
10000	58.2	60.4	61.2	64.7	66.2	67.6	67.9	66.9	66.9	66.9
L _{WA}	95.0	97.2	98.0	98.0	97.8	97.5	97.5	97.5	97.5	97.5

Appendix 3

Visual Impact Assessment



Glen Innes Wind Farm Modification 4

VISUAL IMPACT ASSESSMENT

Prepared for:

GLEN INNES WIND POWER PTY LTD

Prepared by:

GREEN BEAN DESIGN
landscape architects

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July 2017

DOCUMENT CONTROL

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Report Title:	Visual Impact Assessment
Project Number:	17-235
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:	20 July 2017

Contents		Page
	Executive summary	8
1	Introduction	10
2	Report structure	11
3	Methodology	13
4	Approved GIWF Mod-2 and proposed Mod-4 amendments	15
5	Zone of Visual Influence Diagrams	20
6	Ancillary structures	23
7	Visual effects (approved and proposed)	24
8	Visual assessment	43
9	Wire frame models	61
10	Review of Conditions of Consent	104
11	Conclusion	108

Figures

Figure 1	GIWF Approved Mod-2 and proposed Mod-4 layout
Figure 2	GIWF Mod-2 ZVI Diagram
Figure 3	GIWF Mod-4 ZVI Diagram
Figure 4	Approved GIWF Mod-2 and Mod-4 wind turbine comparison
Figure 5	Approved GIWF Mod-2 and Mod-4 wind turbine view angle comparison
Figure 6	Approved GIWF Mod-2 and Mod-4 comparison at 2km and 5km view distance
Figure 7	Wireframe 1 – Furracabad Station
Figure 8	Wireframe 2 – Furracabad Station
Figure 9	Wireframe 3 – Klossie
Figure 10	Wireframe 4 – Klossie
Figure 11	Wireframe 5 – Green House
Figure 12	Wireframe 6 – Green Valley
Figure 13	Wireframe 7 – Green Valley
Figure 14	Wireframe 8 – Nullagai
Figure 15	Wireframe 9 – Nullagai
Figure 16	Wireframe 10 – Ilparran A
Figure 17	Wireframe 11 – Ilparran A
Figure 18	Wireframe 12 – Wandsworth
Figure 19	Wireframe 13 – Wandsworth
Figure 20	Wireframe 14 – Minamurra C
Figure 21	Wireframe 15 – Minamurra C
Figure 22	Wireframe 16 – Minamurra A
Figure 23	Wireframe 17 – Minamurra A
Figure 24	Wireframe 18 – Cherry Tree
Figure 25	Wireframe 19 – Cherry Tree
Figure 26	Wireframe 20 – Highfields
Figure 27	Wireframe 21 – Minamurra B

Figure 28	Wireframe 22 – Minamurra B
Figure 29	Wireframe 23 – Ilparran B
Figure 30	Wireframe 24 – Ilparran B
Figure 31	Wireframe 25 – Lombardy
Figure 32	Wireframe 26 – Lombardy
Figure 33	Wireframe 27 – Kalanga C
Figure 34	Wireframe 28 – Kalanga C
Figure 35	Wireframe 29 – Kalanga A
Figure 36	Wireframe 30 – Kalanga A
Figure 37	Wireframe 31 – Mayvona
Figure 38	Wireframe 32 – Mayvona
Figure 39	Wireframe 33 – Kalanga B
Figure 40	Wireframe 34 – Kalanga B
Figure 41	Wireframe 35 – Balaclava A
Figure 42	Wireframe 36 – Balaclava A
Figure 43	Wireframe 37 – Glengarry
Figure 44	Wireframe 38 – Glengarry
Figure 45	Wireframe 39 – Girrahween
Figure 46	Wireframe 40 – Rivoli
Figure 47	Wireframe 41 – Rivoli
Figure 48	Wireframe 42 – Wattle Vale

Tables

Table 1 Glossary

Table 2 Report structure

Table 3 Approved Mod-2 and Proposed Mod-4 design criteria

Table 4 Approved Mod-2 and Proposed 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 Conditions of Consent

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 GIWF Mod-2 project and the proposed Mod-4 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 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 impacted.
Visual significance	A measure of visual effect culminating from the degree of magnitude and receiver sensitivity.
Zone of Visual Influence Diagram	A map, usually digitally produced, showing areas of land within which wind turbines are theoretically visible.

Executive summary

Green Bean Design Pty Ltd has been commissioned by Glen Innes Windpower Pty Ltd , to prepare a Visual Impact Assessment (VIA) report for the Glen Innes Wind Farm proposed Modification-4 Application. 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 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 Modification-4 Application.

The GIWF Mod-2 and Mod-3 consolidated development consent (dated January 2016) permits the construction and operation of up to 25 wind turbines to a maximum 150 metre tip height. This VIA has been prepared to assess the potential visual effect of the GIWF proposed Mod-4 amendments which include an increased:

- hub height to 110 metres (24% taller)
- rotor diameter to 140 metres (15% longer)
- swept area to 15,394 metres squared (32% larger) and
- tip height to a maximum 180m.

The total number of wind turbines would remain at 25 in accordance with the Consolidated Development Consent, January 2016.

The approved wind turbine locations have been subject to micro-siting adjustments. The minimum decrease in distance between dwelling and wind turbine is around 66 metres. The maximum increase in distance between dwelling and wind turbine is around 43 metres. The proposed micro-siting adjustments would not result in any changes to the magnitude and significance of visual effect as previously determined in the Mod-2 VIA.

The Zone of Visual Influence Diagrams (**Figures 2 and 3**) demonstrate the area of land within which the GIWF Mod-2 and Mod-4 would be theoretically visible (as well as overall number of wind turbines being visible at tip height), would be very similar. Further analysis has determined that no more than two to three Mod-4 wind turbine hubs and tips would be visible from any residential dwelling within 3 kilometres of the GIWF Mod-4 wind turbines.

Previously approved ancillary wind farm infrastructure would not result in unacceptable levels of visual impact from surrounding key receiver locations with regard to the proposed GIWF Mod-4 development.

This VIA included an assessment of twenty-three residential dwellings within 3km of a GIWF proposed Mod-4 wind turbine. The overall assessment of visual effects associated with the GIWF proposed Mod-4 wind turbines is summarised as Low to Negligible. The GIWF Mod-4 wind turbine is not considered to be of a magnitude that would significantly increase visual effects associated with the approved GIWF Mod-2 development. Key differences in the approved GIWF Mod-2 and proposed Mod-4 are illustrated in **Figures 4, 5 and 6**.

This VIA also included a visual assessment of an additional twelve residential dwellings identified between 3km and 3.6km from the approved GIWF Mod-2 wind turbines.

Twenty-three wire frame model diagrams have been prepared to illustrate the location and extent of wind turbines within the approved GIWF Mod-2 and Mod-4 wind turbine layouts.

The proposed amendments to the approved GIWF Mod-2 would result in a low level of visual magnitude and an unchanged visual rating in accordance with the approved GIWF Mod-2 project. The proposed amendments would not introduce elements that are prominent or out of character with the approved GIWF Mod-2 project, and the potential for the proposed Mod-4 wind turbines to result in any additional significant cumulative visual effects is considered to be low.

1 Introduction

Green Bean Design Pty Ltd (GBD) has been commissioned by Glen Innes Windpower Pty Ltd (the Proponent) to prepare a VIA report for the Glen Innes Wind Farm (GIWF) proposed Modification-4 Application (Mod-4).

This VIA has been prepared to compare the potential visual effect of the proposed GIWF Mod-4 project with the visual ratings determined and approved for the GIWF Mod-2 project. The approved GIWF Mod-2 visual ratings have been extracted from the Glen Innes Wind Farm DA Approval Modification Visual Assessment Report, Aurecon December 2013.

The comparison between the approved GIWF Mod-2 and proposed Mod-4 projects has been used to determine if any of the approved GIWF Mod-2 visual ratings applied to view locations within 3 kilometres of the approved GIWF are subject to an increased level of visual effect as a result of the proposed Mod-4 works. This VIA has not undertaken as assessment to verify the visual ratings determined in the approved GIWF Mod-2 application.

This VIA has also undertaken a further refined level of visual assessment with regard to the Guidelines.

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

- the Mod-4 wind turbine layout (generally conforming with the approved Mod-2 layout)
- location and description of proposed Mod-4 wind turbines
- Zone of Visual Influence (ZVI) diagrams
- wireframe models illustrating the approved GIWF Mod-2 wind turbines and the proposed Mod-4 wind turbines and layout
- Glen Innes Wind Farm Project Approval and Consolidated Conditions of Consent January 2016 and
- Glen Innes Wind Farm DA Approval Modification Visual Assessment Report, Aurecon December 2013.

2 Report structure

2.1 Report structure

This VIA report been structured into ten parts as follows:

Table 2 – Report structure

Report section	Description
Section 1 Report structure	This section provides a 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 Glen Innes Mod-2 Wind Farm and proposed Mod-4 amendments	This section describes the key differences in wind turbine layout and design criteria between the approved Mod-2 and proposed Mod-4 amendments
Section 5 Zone of Visual Influence (ZVI) diagrams	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
Section 6 Ancillary structures	This section describes infrastructure associated with the wind farm other than the wind turbines
Section 7 Assessment of visual effects (approved and proposed)	This section describes the assessment and determination of residual visual effects between the approved Mod-2 and proposed Mod-4 amendments
Section 8 Visual Assessment	This section describes the application of the NSW State Government Wind Energy: Visual Assessment Bulletin December 2016 to the GIWF Mod-4 VIA
Section 9 Wire frame models	This section describes and presents wire frame models prepared for the GIWF Mod-4 VIA

Table 2 – Report structure

Report section	Description
Section 10 Review of Consolidated Conditions of Consent	This section identifies the GIWF Consolidated Conditions of Consent relevant to visual amenity and confirms their applicability to the proposed Mod-4 amendments
Section 11 Conclusion	Conclusions are drawn on the overall impact of the proposed GIWF Mod-4 within the surrounding viewshed.

3 Methodology

3.1 Introduction

The GIWF proposed Mod-4 methodology included the following activities:

- desktop study reviewing the approved GIWF original application, the approved Mod-2 and proposed Mod-4 layouts
- 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 approved GIWF application and approved Mod-2 Visual Assessment Report.

The desktop review included a review of the approved project layout and surrounding landscape. This was carried out by reference to topographic maps as well as aerial photographs of the surrounding landscape. Topographic maps and aerial photographs were also used to confirm the locations and categories of potential view locations to be reviewed.

3.3 ZVI diagrams

ZVI Diagrams were prepared to illustrate the theoretical visibility of the approved GIWF Mod-2 wind turbines (tip height at 150 metres) and proposed Mod-4 wind turbines (tip height at 180 metres). The ZVI Diagrams are illustrated in **Figures 2 and 3**.

3.4 Residual visual effects

The GIWF Mod-4 residual visual effects on surrounding receiver locations would result from a combination of the Mod-4 wind turbine visibility (beyond that of the approved Mod-2 project) 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 in addition to the approved Mod-2 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.

3.5 Visual Assessment

The GIWF Mod-4 VIA has undertaken a further visual assessment which extends to residential dwellings located within 3.6 kilometres of the approved GIWF Mod-2 project. The 3.6-kilometre threshold distance (blue line, refer Figure 1) has been established by reference to the Guidelines (Figure 5 Visual magnitude thresholds for visual assessment).

This VIA has not addressed the Stage 1 Preliminary Environmental Assessment (pre-lodgement) guidelines as these do not appear to be 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 GIWF Mod-4 project where relevant to the Modification Application.

3.6 Wire frame models

Wire frame models have been prepared from the twenty-three residential dwelling locations included in the approved GIWF Mod-2 Visual Assessment Report. The wire frame models illustrate and contrast the approved GIWF Mod-2 and the proposed Mod-4 wind turbine and layout. The wireframe models are illustrated in **Figures 7 to 48**. The wire frame models also illustrate the location of the approved Stage 1 and Stage 2 White Rock Wind Farm wind turbine locations.

4 Approved GIWF Mod-2 and proposed Mod-4 amendment

4.1 Approved GIWF Mod-2 design

The approved GIWF permits construction and operation of up to 25 wind turbines and the installation of wind turbines to a maximum tip height of 150 metres.

4.2 Proposed GIWF Mod-4 design

The GIWF Mod-4 design would include:

- up to 25 wind turbines
- a hub height increase to 110 metres
- an increase in blade length to a maximum 68.5 metres
- an increase in rotor diameter up to 140 metres and
- an increase of the blade tip height up to 180 metres.

Table 3 outlines the differences in the approved GIWF Mod-2 and proposed Mod-4 wind turbine design criteria.

Table 3: Approved Mod-2 and proposed Mod-4 design criteria

	Hub height	Rotor diameter	Tip height	Total number
Approved GIWF Mod-2 wind turbine	89 m	122 m	150 m	25
GIWF Mod-4 proposed wind turbine	110 m	140 m	180 m	25
Difference	+21 m	+18 m	+30 m	0
Percentage difference	+24%	+15%	+20%	0%

Table 4: Approved Mod-2 and proposed Mod-4 swept area

	Rotor diameter	Swept area
Approved GIWF Mod-2 wind turbine	122 m	11,960 m ²
Proposed GIWF Mod-4 wind turbine	140 m	15,394 m ²
Difference	+30 m	+3,434 m ²
Percentage difference	+20%	+32%

The approved GIWF Mod-2 and proposed Mod-4 amended wind turbine layouts are illustrated in **Figure 1**.

4.3 Approved GIWF Mod-2 and proposed Mod-4 design distance and hub visibility

The proposed Mod-4 wind turbine layout and design would result in some minor changes to distances between residential dwellings and wind turbines, as well as the number of wind turbine hubs visible from residential dwellings surrounding the wind farm site. **Table 5** identifies residential dwellings within 3 kilometres of a proposed Mod-4 wind turbine and associated changes in wind turbine distances and hub visible.

Table 5: Distance and hub height changes

Residential dwelling (Refer Figure 1)	Approved Mod-2 distance to closest wind turbine (m)	Proposed Mod-4 distance to closest wind turbine (m)	Difference in distance (m)	Approved Mod-2 wind turbine hubs and tips visible. (Tips in brackets)	Proposed Mod-4 wind turbine hubs visible	Difference in number of hubs and tips visible. (Tips in brackets)	Approved Mod-2 Visibility Rating
Furracabad Station	2,980	2,962	-18	5 (10)	7 (12)	+2 (+2)	Moderate
Klossie	2,135	2,120	-15	4 (10)	7 (12)	+3 (+2)	Moderate
Green House	1,899	1,881	-18	5 (8)	7 (8)	+2 (0)	Moderate
Green Valley	2,514	2,523	+9	15 (18)	17 (18)	+2 (0)	Moderate
Nullagai	2,115	2,130	+15	1 (3)	1 (5)	0 (+2)	Moderate
Ilparran A	1,535	1,525	-10	11 (14)	11 (16)	0 (+2)	High
Wandsworth	2,429	2,455	+26	13 (16)	15 (19)	+2 (+3)	Moderate
Minamurra C	2,456	2,477	+21	22 (25)	23 (25)	+1 (0)	High
Minamurra A	2,246	2,266	+20	21 (23)	23 (25)	+2 (+2)	High
Cherry Tree	1,852	1,886	+34	13 (15)	14 (15)	+1 (0)	High
Highfields	1,419	1,458	+39	14 (17)	17 (17)	+3 (0)	High
Minamurra B	2,012	2,032	+20	20 (21)	21 (23)	+1 (+2)	High
Ilparran B	1,306	1,326	+20	8 (10)	10 (11)	+2 (+1)	High
Lombardy	2,157	2,157	0	12 (15)	13 (15)	+1 (0)	High
Kalanga C	2,349	2,319	-30	21 (25)	23 (25)	+2 (0)	High
Kalanga A	2,162	2,131	-31	19 (25)	21 (25)	+2 (0)	High
Mayvona	1,051	1,051	0	8 (8)	8 (8)	0 (0)	High
Kalanga B	2,310	2,267	-43	21 (25)	24 (25)	+3 (0)	High

Table 5: Distance and hub height changes

Residential dwelling (Refer Figure 1)	Approved Mod-2 distance to closest wind turbine (m)	Proposed Mod-4 distance to closest wind turbine (m)	Difference in distance (m)	Approved Mod-2 wind turbine hubs and tips visible. (Tips in brackets)	Proposed Mod-4 wind turbine hubs visible	Difference in number of hubs and tips visible. (Tips in brackets)	Approved Mod-2 Visibility Rating
Balaclava A	2,904	2,838	-66	22 (25)	24 (25)	+2 (0)	Moderate
Glengarry	2,817	2,812	-5	2 (4)	3 (4)	+1 (0)	Moderate
Girrahween	2,074	2,117	+43	12 (14)	12 (22)	0 (+8)	High
Rivoli	1,849	1,827	-22	3 (4)	4 (5)	+1 (+1)	Moderate
Wattle Vale	1,903	1,936	+33	15 (22)	18 (25)	+3 (+3)	High

4.4 Magnitude of visual effects

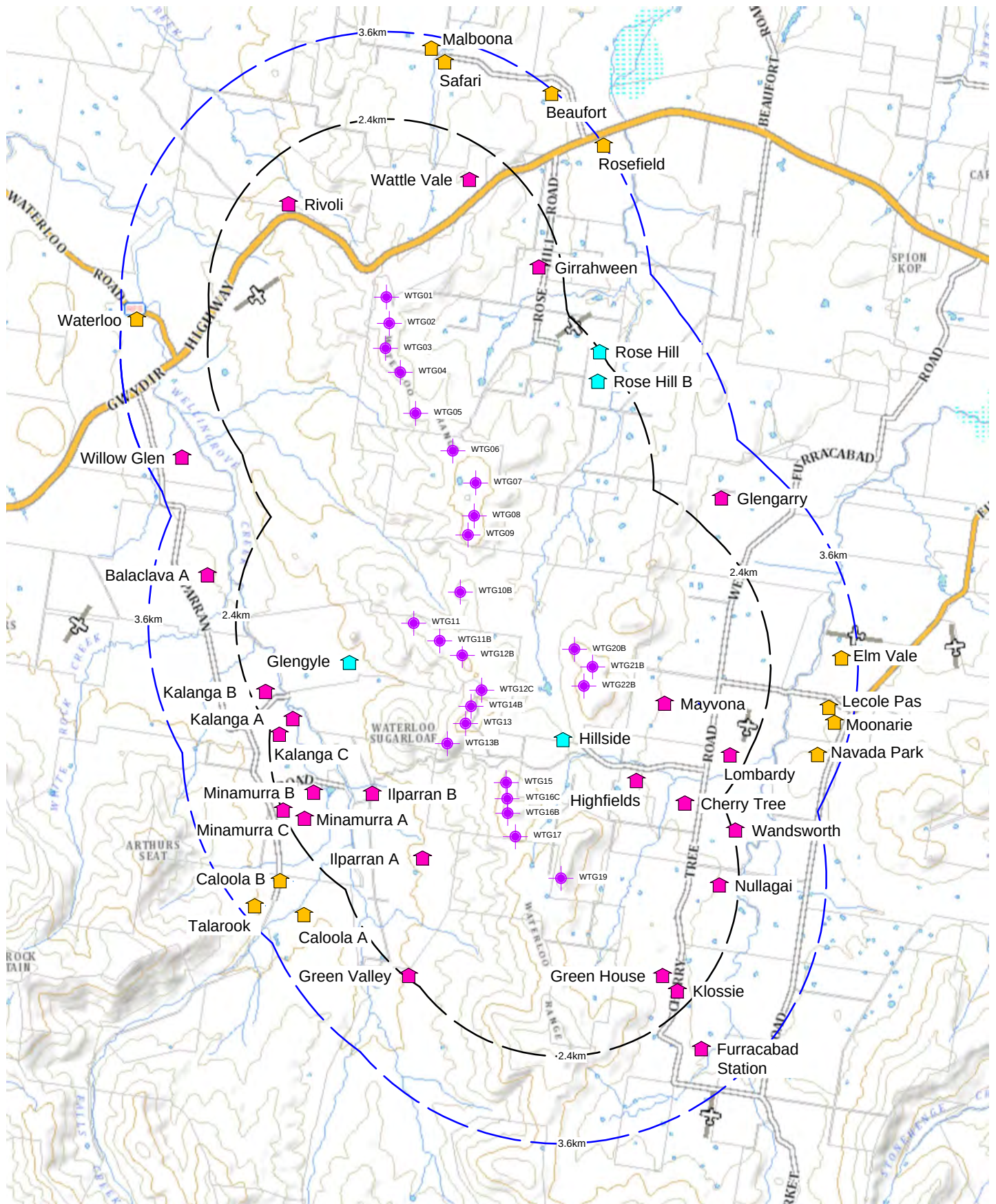
The determination of residual visual effects resulting from the GIWF proposed Mod-4 wind turbines would result primarily from observable differences between the approved Mod-2 and the proposed Mod-4 wind turbines. Observable differences would include:

- views toward wind turbines (hubs and blade tips) where previously screened by landform and
- a change in distance between a receiver location and wind turbine.

Table 5 indicates that the proposed Mod-4 wind turbines would result in:

- up to four residential dwellings with views toward an additional three wind turbine hubs
- up to fifteen residential dwellings with views toward an additional two or less wind turbine hubs
- up to four residential dwellings with views toward no additional wind turbine hubs
- the greatest decrease in distance between wind turbine and residential dwelling would be 66 metres (Balaclava A and wind turbine ID 11) and
- the greatest increase in distance between a wind turbine and residential dwelling would be 43 metres (Girrahween and wind turbine ID 01).

Views toward additional wind turbine hubs (and tips) are not considered to result in a magnitude of visual effect which is greater than the magnitude of visual effect associated with the approved GIWF Mod-2 project. The minor changes to distances are within general allowances provided for micro-siting wind turbines and are not considered to result in a magnitude of visual effect which is greater than the magnitude of visual effect associated with the approved GIWF Mod-2 project



Legend

- Approved GIWF Mod-2 and proposed Mod-4 wind turbine (indicative location)
- Associated residential dwelling within 3km of an approved Mod-2 and proposed Mod-4 wind turbine
- Non associated residential dwelling within 3.6 km of approved Mod-2 and proposed Mod-4 wind turbine
- Non associated residential dwelling between 2.4 km and 3.6 km of proposed Mod-4 wind turbine not assessed in the approved GIWF Mod-2 Application
- 2.4 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 180 m tip height
- 3.6 km wind turbine distance offset in accordance with DPE Visual Bulletin Dec 2016, Figure 5 - 180 m tip height

Glen Innes Wind Farm Mod 4 Visual Impact Assessment

Figure 1 GIWF Approved Mod-2 and proposed Mod-4 layout

5 Zone of Visual Influence Diagrams

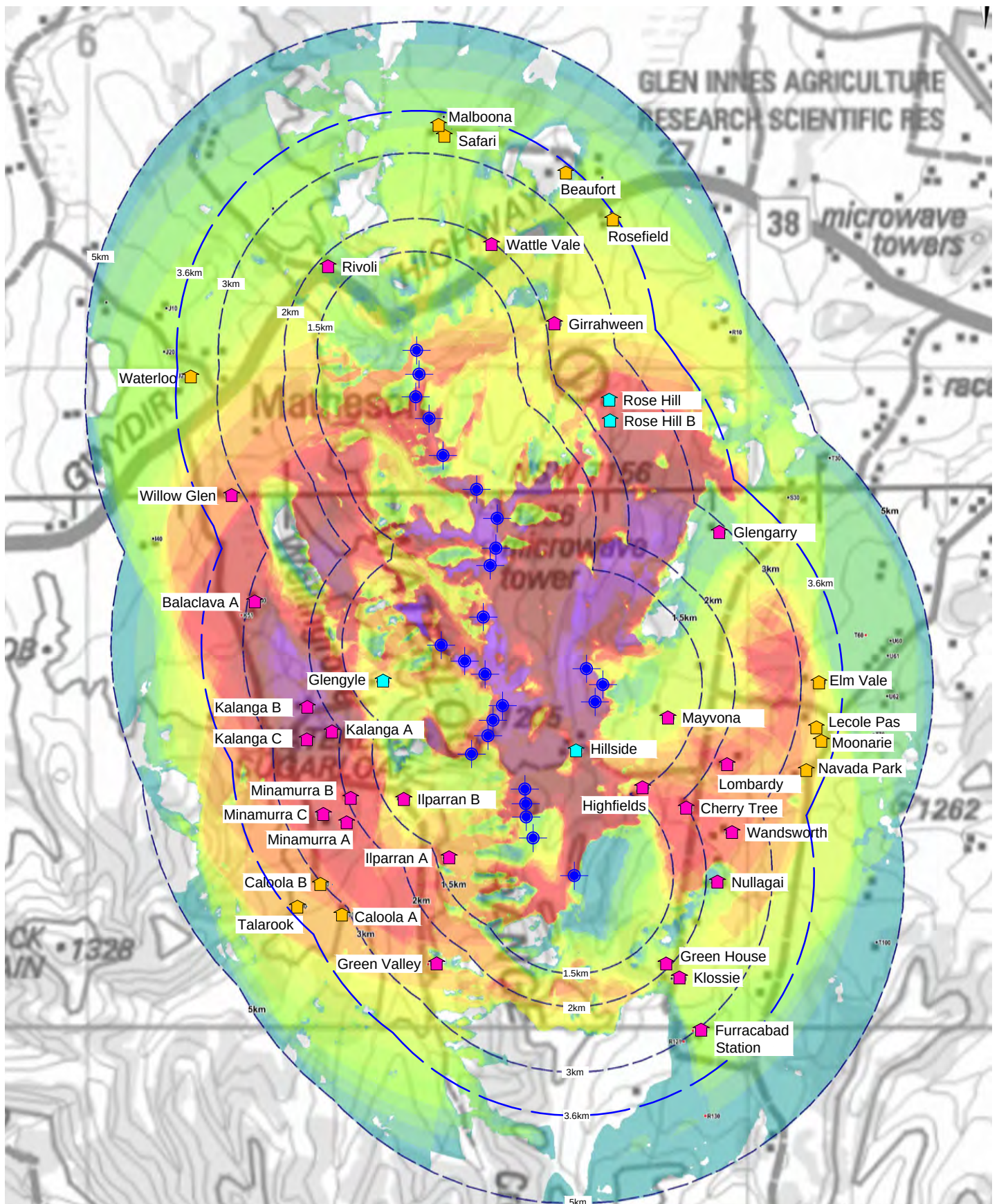
5.1 Introduction

Within the recognised limitations of Zone of Visual Influence (ZVI) diagrams, the overall extent of approved GIWF Mod-2 and proposed Mod-4 wind turbine visibility covers a very similar extent within 5 kilometres of the landscape surrounding the approved GIWF Mod-2 wind farm.

Figures 2 and 3 illustrate the theoretical visibility of the approved GIWF Mod-2 (at 150 metre tip height) and proposed Mod-4 (at 180m tip height) wind turbines.

The similarity in theoretical wind turbine visibility demonstrates the influence of local topographical features on views toward the approved GIWF Mod-2 and proposed Mod-4 wind turbines. The ZVI diagrams also illustrate that the proposed Mod-4 wind turbines would have a very limited increase in visual effects across the approved GIWF Mod-2 viewshed.

Whilst the overall extent of wind turbine visibility would be contained by topography for both the approved GIWF Mod-2 and the proposed Mod-4 wind turbines, the number of wind turbines visible from receiver locations within the wind farm viewshed is likely to be subject to a minor increase. However, when compared to the approved GIWF Mod-2 wind turbines, the increase in wind turbine visibility would be largely restricted to the upper sections (hubs and rotors) of wind turbine structures, rather than whole wind turbines.



Legend

Zone of Visual Influence
(Tips Visible)



Approved GIWF Mod-2 and proposed Mod-4 wind turbine (indicative location)

Associated residential dwelling within 3km of an approved GIWF Mod-2 and proposed Mod-4 wind turbine

Non associated residential dwelling within 3km of approved GIWF Mod-2 and proposed Mod-4 wind turbine



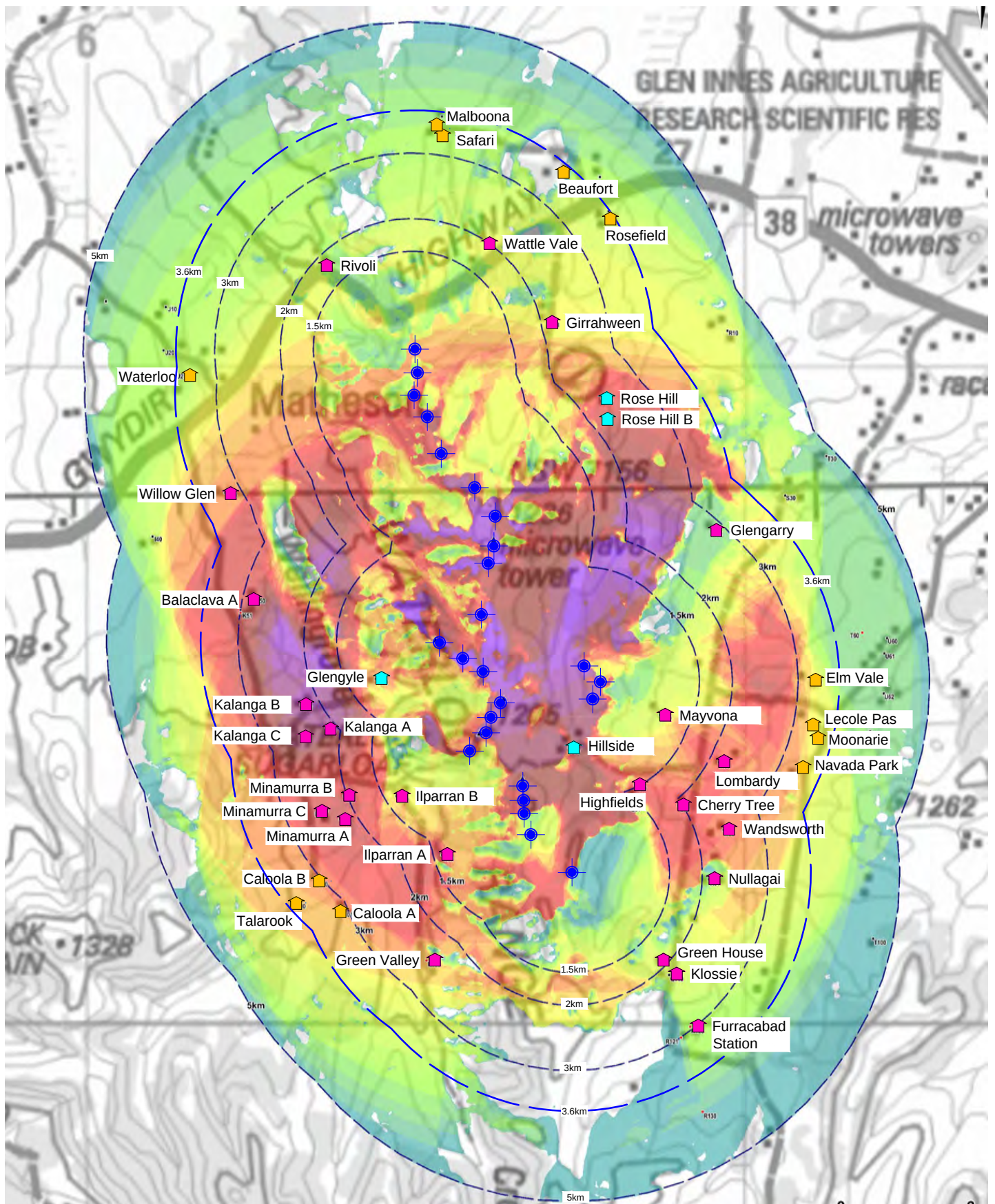
Non associated residential dwelling up to 3.6 km from a proposed GIWF Mod-4 wind turbine not assessed in the approved GIWF Mod-2 Application

Wind turbine distance offset



Glen Innes Wind Farm Mod 4 Visual Impact Assessment

Figure 2 GIWF Mod-2 ZVI
Diagram approved tip of blade
at 150 metres



Legend

Zone of Visual Influence
(Tips Visible)

0	11-15
1-5	16-20
6-10	21-25



Approved GIWF Mod-2 and proposed Mod-4
wind turbine (indicative location)



Associated residential dwelling within
3km of an approved Mod-2 and proposed
Mod-4 wind turbine



Non associated residential dwelling within
3km of approved Mod-2 and proposed
Mod-4 wind turbine



Non associated residential dwelling up to 3.6 km
from a proposed GIWF Mod-4 wind turbine not
assessed in the approved GIWF Mod-2 Application

Wind turbine distance offset



0km 1km

Glen Innes Wind Farm Mod 4 Visual Impact Assessment

Figure 3 GIWF Mod-4 ZTV
Diagram proposed tip of blade
at 180 metres

6 Ancillary structures

6.1 Introduction

The approved GIWF Mod-2 identifies 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-4 wind farm would not result in any fundamental change to the majority of approved Mod-2 ancillary structures and would not result in any additional visual impacts to those outlined in the approved Mod-2 application.

7 Visual effects

7.1 Introduction

Whilst the proposed GIWF Mod-4 wind turbines would extend above the approved Mod-2 wind turbine height, this VIA has determined that the overall scale of the proposed Mod-4 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-2 wind turbines. A comparison of the GIWF Mod-2 and proposed Mod-4 wind turbines is illustrated in **Figure 4**.

It is also noted that the proposed GIWF Mod-4 wind turbines would be consistent with the approved Mod-2 wind turbines with regard to their visual form, design, pattern and colour. The location of associated and non-associated residential dwellings within 3 kilometres of the proposed Mod-4 wind turbine layout is illustrated in **Figure 1**.

The degree of visual magnitude is illustrated in **Figures 5** and **6**. **Figure 5** illustrates the elevated angle of view (toward tip height) for the approved Mod-2 and proposed Mod-4 amended wind turbines from a view distance of 2 kilometres and 5 kilometres respectively. **Figure 5** illustrates that the proposed Mod-4 wind turbine would include an additional and approximate half degree view angle above the approved Mod-2 with 150 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 half degree (34 minutes) increase in view angle.

Figure 6 illustrates the perceived and relative height difference between the approved Mod-2 150 metre tip height wind turbine and the proposed Mod-4 180 metre tip height wind turbine. At a view distance of 5 kilometres the approved Mod-2 and proposed Mod-4 wind turbines would be perceived at less than half the height of the proposed Mod-4 wind turbine when viewed at a distance of 2 kilometres. The relatively small increase in view angle toward the proposed Mod-4 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-4 wind turbines are not considered to give rise to an increased level of visual magnitude over and above that determined for the approved GIWF Mod-2 project.

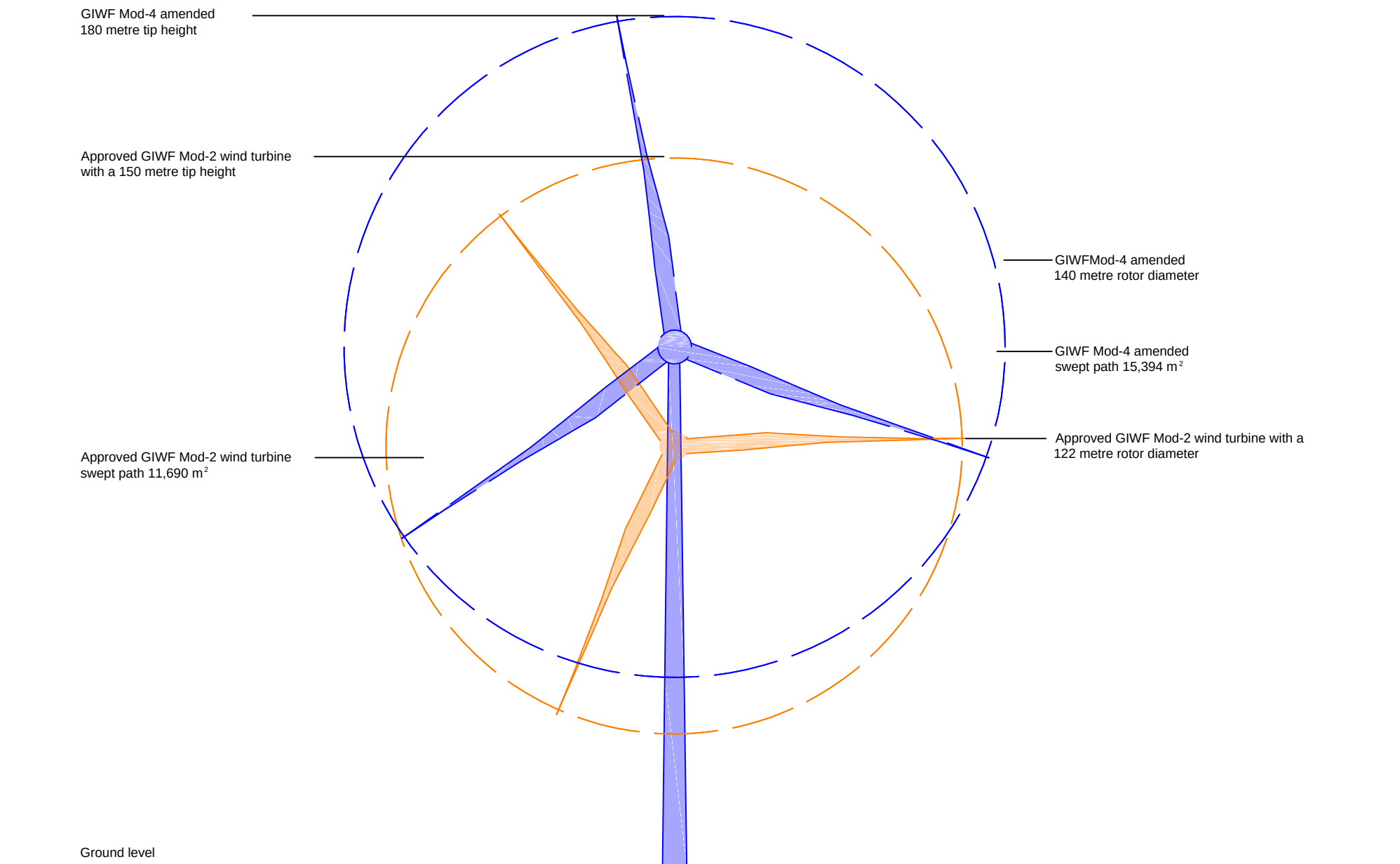


Figure 4- Approved GIWF Mod-2
and proposed Mod-4 wind turbine
comparison

Glen Innes Wind Farm Mod 4 Visual Impact Assessment

GREEN BEAN DESIGN

landscape architects

Orange line = view line toward tip height of approved Mod-2 wind turbine (150 metres)

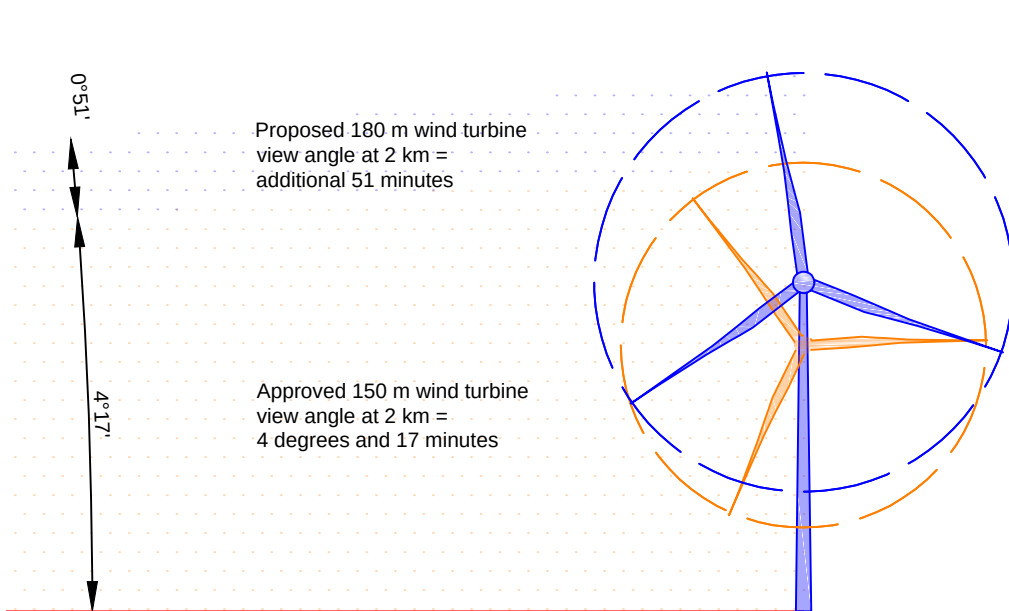
Blue line = view line toward tip height of proposed Mod-4 wind turbine (180 metres)



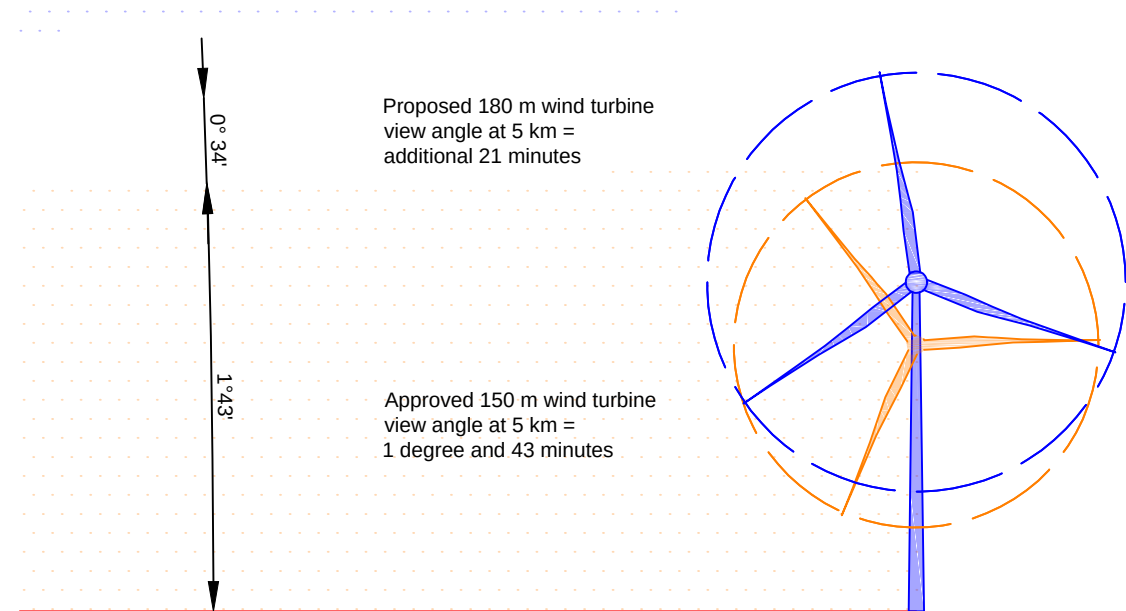
Comparative height of approved GIWF Mod-2 and proposed Mod-4 wind turbine from a 2 km view distance



Comparative height of approved GIWF Mod-2 and proposed Mod-4 wind turbine from a 5 km view distance



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



View angle toward approved GIWF Mod-2 and proposed Mod-4 wind turbine tip of blade from a 5 km view distance

Glen Innes Wind Farm Mod-4 Visual Impact Assessment

Figure 5 - Approved GIWF Mod-2 and proposed Mod-4 wind turbine view angle comparison

GREEN BEAN DESIGN

landscape architects

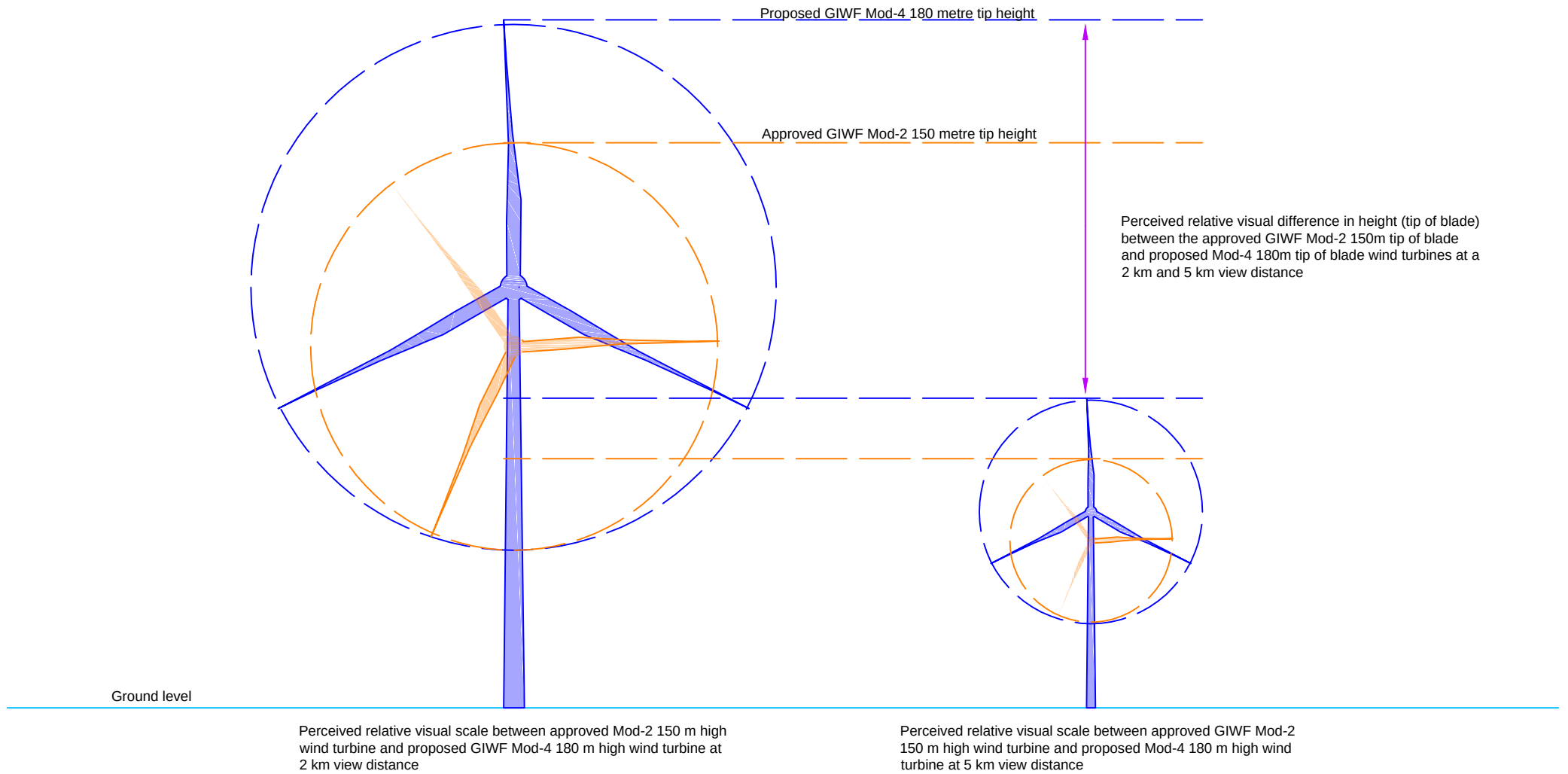


Figure 6 - Approved GIWF Mod-2 and proposed Mod-4 wind turbine comparison at 2 km and 5 km view distance

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 proposed Mod-4 wind turbine relative to the approved GIWF Mod-2 wind turbine.

For the purpose of this VIA **Table 6** out ratings and definitions associated with the magnitude of visual effects.

Table 6 – Magnitude of visual effect

Visual effect	Magnitude
Amendments to the approved GIWF Mod-2 project would result in a major and prominent visual effect and introduce elements that contrast, or are not in character with the approved GIWF Mod-2 project.	High
Amendments to the approved GIWF Mod-2 project would result in a partial visual effect and introduce elements which may be prominent, but not completely out of character with the approved GIWF Mod-2 project.	Medium
Amendments to the approved GIWF Mod-2 project would result in minor visual effects and introduce elements which are not prominent or out of character with the approved GIWF Mod-2 project.	Low
Amendments to the approved GIWF Mod-2 project would result in a very minor visual effect and introduce elements which are not prominent or uncharacteristic of the approved GIWF Mod-2 project. There would likely be 'no change' to the approved GIWF Mod-2 visual effect.	Negligible

7.3 Visual effect matrix

Table 7 sets out the assessment of visual effects from residential dwellings up to 3 kilometres from the approved GIWF Mod-2 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 – Visual effect matrix (Refer Figure 1 for non-associated residential dwelling locations)

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
Residential dwellings within 3 km of approved Glen Innes Wind Farm Mod-2 turbine					
Furracabad Station	Non-associated residential dwelling	2,962	Moderate	The observable scale of change would be limited by distance between the dwelling and closest proposed GIWF Mod-4 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 wind turbine layout and the surrounding landscape. Mature trees alongside the driveway and to the north west of the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Klossie	Non-associated residential dwelling	2,120	Moderate	The observable scale of change would be limited by distance between the dwelling and closest proposed GIWF Mod-4 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				cover beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Green House	Non-associated residential dwelling	1,881	Moderate	The observable scale of change would be limited by distance between the dwelling and closest proposed GIWF Mod-4 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree cover beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Green Valley	Non-associated residential dwelling	2,523	Moderate	The observable scale of change would be limited by distance between the dwelling and closest proposed GIWF Mod-4 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				wind turbine layout and the surrounding landscape. A small grouping of mature trees to the north of the dwelling would filter some views toward the proposed Mod-4 wind turbines from the dwelling. Magnitude Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Nullagai	Non-associated residential dwelling	2,130	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Ilparran A	Non-associated residential dwellings	1,525	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				development and the surrounding landscape. Scattered tree planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Wandsworth	Non-associated residential dwellings	2,455	Moderate	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Minamurra C	Non-associated residential dwelling	2,477	High	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development.	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Minamurra A	Non-associated residential dwelling	2,266	High	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Cherry Tree	Non-associated residential dwellings	1,886	High	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
Highfields	Non-associated residential dwellings	1,458	High	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Minamurra B	Non-associated residential dwellings	2,032	High	The observable scale of change would be partially limited by distance between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Ilparran B	Non-associated potential dwelling site	1,326	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition	Unchanged from approved GIWF

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
	without DA Approval			or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Mod-2 Visual Rating
Lombardy	Non-associated residential dwelling	2,157	High	The observable scale of change would be noticeable between the dwelling and closest approved GIWF Mod-2 wind turbine. There would be limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree planting surrounding the dwelling would also screen and filter some views toward both approved Mod-2 and proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
Kalanga C	Non-associated residential dwellings	2,319	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Kalanga A	Non-associated residential dwellings	2,131	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines.	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Mayvona	Non-associated residential dwellings	1,051	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Kalanga B	Non-associated residential dwelling	2,267	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines.	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Balaclava A	Non-associated residential dwellings	2,838	Moderate	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Glengarry	Non-associated residential dwellings	2,812	Moderate	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Girrahween	Non-associated residential dwellings	2,117	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating
Rivoli	Non-associated residential dwellings	1,827	Moderate	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Scattered tree	Unchanged from approved GIWF Mod-2 Visual Rating

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

Receiver location/s	Category of receiver location	Approximate distance to proposed GIWF Mod-4 wind turbine (m)	Approved GIWF Mod-2 Visual Rating*	Description and Magnitude of GIWF Mod-4 amended visual effect	GIWF Mod-4 Visual Rating
				planting beyond the dwelling would filter some views toward the proposed Mod-4 wind turbines. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	
Wattle Vale	Non-associated residential dwellings	1,936	High	The observable scale of change would be limited by distance between the dwellings and closest approved GIWF Mod-2 wind turbine. There would be very limited change in the composition or contrast between the approved Mod-2 and proposed Mod-4 development and the surrounding landscape. Magnitude rating Low – resulting in no change to the approved GIWF Mod-2 visual impact rating.	Unchanged from approved GIWF Mod-2 Visual Rating

* Approved GIWF Mod-2 Visual Rating as determined by Aurecon (Visual Assessment Report Rev 2 18 December 2013)

7.4 Summary of visual effects

The Visual Effects Matrix includes twenty-three residential dwellings within 3 kilometres of a GIWF proposed Mod-4 wind turbine.

The overall assessment of the magnitude of visual effects associated with the GIWF proposed Mod-4 wind turbines is summarised as Low. The scale of change in the wind turbine structures, whilst noticeable from proximate residential view locations would not result in a degree of change significantly above the visibility of the approved GIWF Mod-2 wind turbines.

7.5 Cumulative visual effects

A consideration of potential cumulative visual effects between the Glen Innes, White Rock and Sapphire Wind Farms was detailed in the White Rock Wind Farm Landscape and Visual Assessment Report V8 March 2011 (LVIA).

The LVIA concluded that sequential views between the Sapphire, White Rock and Glen Innes Wind Farms would occur for motorists travelling along the Gwydir Highway, as well as a small number of local roads although the journey between the wind farms would include a range of views extending toward and beyond turbines within each project. The extent and overall visibility of turbines would be influenced by the direction of travel relative to the alignment of wind turbines as well as the relatively short travel time along the highway and local road network alongside and between the wind farm turbines.

Visibility between the Glen Innes and White Rock wind turbines would occur from residential dwellings north and north east of the White Rock Wind Farm and south to south east of the GIWF. Direct views between the two wind farms would be mostly limited to a small number residential dwellings within 3 kilometres of both wind farms due to their position and orientation relative to the proposed Mod-4 and approved turbines.

Indirect views would occur within these same areas; however, the number of visible turbines would be relatively low and hence in addition to the individual impact assessment, the cumulative impact assessment would be low for the majority of these residential dwellings.

Motorists travelling along the Gwydir Highway would experience a low direct cumulative impact as turbine visibility is limited by local landform, tree cover and the direction of travel relative to turbine locations. Certain local roads would experience sequential views for relatively short durations.

The amended GIWF Mod-4 wind turbines would result in a low level magnitude of residual visual effects, and introduce elements which are neither prominent or out of character with the approved GIWF Mod-2 project. Therefore, the potential for the amended Mod-4 wind turbines to result in any additional significant cumulative visual effect is considered to be low.

The extent of approved Stage 1 and Stage 2 White Rock wind turbines visible from residential dwellings within 3 kilometres of the GIWF Mod-4 have been illustrated in the wire frames (**Figures 7 to 48**).

This VIA has not applied the Multiple Wind Turbine Tool included in the Guidelines. The Multiple Wind Turbine Tool is included in the Stage 1 Preliminary Environmental Assessment (pre-lodgement) and Stage 2 Visual Baseline Study; however, the Multiple Wind Turbine Tool is not defined as applicable to a Modification Application. Furthermore, the wind turbine locations for the approved GIWF Mod-2 project as well as the White Rock and Sapphire Wind Farms have been consented. The White Rock Wind Farm is partially operational and exporting power to the grid and construction works have commenced at the Sapphire Wind Farm site.

7.6 Night time obstacle lighting

The current consolidated consent condition 25 states that *“No external lighting other than low intensity security night lighting of infrastructure associated with the project, including wind turbine generators is permitted on site unless otherwise agreed or directed by the Secretary.”*

An aviation hazard risk assessment is currently in preparation for GIWF. An assessment of potential visual impacts associated with obstacle lighting may be undertaken subject to confirmation for the requirement of night time obstacle lighting.

8 Visual assessment

8.1 Introduction

Following the assessment of the magnitude of visual effects between the approved GIWF Mod-2 and the proposed Mod-4 wind turbines, this VIA has undertaken a further visual assessment of the proposed GIWF Mod-4 project on people at residential dwellings surrounding the approved wind farm development. The visual assessment 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 GIWF Mod-4 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 Landscape character type

The broader landscape character type surrounding the approved GIWF Mod-2 project has been previously described as both pastoral with agricultural improvements (Aurecon 2008 and 2013).

'The landscape of the wind farm site comprises mostly cleared pastoral land with areas of remnant woodlands adjacent to parts of the wind farm. Mature trees both dead and alive are scattered through the landscape. Areas of remnant woodland can relate to areas of steep slopes, poor soils or simply different priorities of the owners of the land. There are extensive areas of wooded land to the west of the site on the steeper slopes above Wellingrove Creek. The tracts of woodland close to the wind farm will not be affected significantly by the development and they will still be present in views after the windfarm has been installed'.

'There are few outcropping rock features in the mostly basalt terrain. As far as possible, rock features will be avoided or, if disturbed, relocated nearby to preserve habitat for reptiles. The retention of these rock features can also serve to maintain the appearance of the location. Watercourses on the upper slopes of the range are intermittent. Drainage from the site is to the creeks to the east and west of the site. Disturbance of watercourses will be minimised. Overall there is a high proportion of vegetation in most views, varying from cleared paddocks with varying degrees of exotic grass and some native grass to patches of remnant woodlands'.

Subsequent to previous landscape assessments undertaken for the approved GIWF Mod-2 development, this VIA notes that the approved White Rock and Sapphire Wind Farms are currently under construction/operational. The pastoral/agricultural landscape surrounding the approved GIWF Mod-2 development contains elements of wind energy land use including wind turbines, access roads and associated infrastructure.

The Scenic Quality Class applicable to the landscape surrounding the approved GIWF Mod-2 project is Moderate.

8.4 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 as well as two Level 1 Viewer Sensitivity Levels for the Balaclava A and Waterloo Homesteads. 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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Furracabad Station	Non-associated residential dwelling Level 2	2,962 Near middle-ground	VIZ2	Moderate	Mature trees alongside the driveway and to the north west of the dwelling would filter some views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines. Visual mitigation measures are unlikely result in any significant screening benefit toward a relatively small number of approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines within the southern portion of the approved wind farm project area.
Klossie	Non-associated residential dwelling Level 2	2,120 Near middle-ground	VIZ2	Moderate	Scattered tree cover beyond the dwelling would filter some views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines. Visual mitigation measures are unlikely result in any significant screening benefit toward a relatively small number of approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines within the southern portion of the approved wind farm project area.
Green House	Non-associated residential dwelling Level 2	1,881 Far foreground	VIZ1	Moderate	Scattered tree cover beyond the dwelling would filter some views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines. Visual mitigation measures are unlikely result in any significant screening benefit toward a relatively small number of

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines within the southern portion of the project area.
Green Valley	Non-associated residential dwelling Level 2	2,523 Near middle-ground	VIZ2	Moderate	A small group of mature trees to the north of the dwelling would filter some views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines. Visual mitigation measures are unlikely result in any significant screening benefit toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbine locations.
Nullagai	Non-associated residential dwelling Level 2	2,130 Near middle-ground	VIZ2	Moderate	The dwelling is orientated east to west, with views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines partially screened by scattered tree cover together with a gently rising landform to the west of the dwelling. Visual mitigation measures are unlikely result in any significant screening benefit toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Ilparran A	Non-associated residential dwelling Level 2	1,525 Far foreground	VIZ1	High	The dwelling is orientated east to west with direct and elevated views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines on proximate hills. Whilst scattered tree planting extending beyond the dwelling would filter some views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines, the wind turbines would be visible and dominant within views from the dwelling and surrounding curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Wandsworth	Non-associated residential dwelling Level 2	2,455 Near middle-ground	VIZ2	Moderate	The dwelling is orientated north to south with views extending toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines. The wind turbines would be visible and within views from the dwelling and surrounding curtilage. Visual mitigation through planting to the west of the dwelling would provide some level of screening or filtering of views from the dwelling and surrounding building curtilage.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Minamurra C	Non-associated residential dwelling	2,477 Near middle-ground	VIZ2	High	Views from the dwelling and curtilage toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines would have partial screening and filtering of views by existing trees surrounding the dwelling and curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Minamurra A	Non-associated residential dwelling Level 2	2,266 Near middle-ground	VIZ2	High	Views from the dwelling and curtilage toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines would have partial screening and filtering of views by existing trees surrounding the dwelling and curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Cherry Tree	Non-associated residential dwelling Level 2	1,886 Far foreground	VIZ1	High	The dwelling is orientated north to south with tree planting adjacent to and extending west beyond the dwelling and curtilage area. Whilst tree planting would provide some screening and filtering of views toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines, views would extend toward wind turbines from some

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					areas proximate to the dwelling and within the curtilage. Visual mitigation through planting would provide some potential screening or filtering of views from the dwelling and surrounding building curtilage.
Highfields	Non-associated residential dwelling Level 2	1,458 Far foreground	VIZ1	High	The dwelling is orientated north east to south west with scattered and grouped tree planting surrounding and extending beyond the dwelling and curtilage area. Whilst tree planting would provide some screening and filtering of views toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines, views would extend toward wind turbines from some areas proximate to the dwelling and within the curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Minamurra B	Non-associated residential dwelling Level 2	2,032 Near middle-ground	VIZ2	High	Views from the dwelling and curtilage toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines would have partial screening and filtering of views by existing trees surrounding the dwelling and curtilage. Visual mitigation through planting would be

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Ilparran B	Non-associated potential dwelling site without DA Approval Level 2	1,326 Far foreground	VIZ1	High	The dwelling is orientated east to west with direct and elevated views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines on proximate hills. Whilst tree planting extending beyond the dwelling will filter some views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines, the wind turbines would be visible and dominant within views from the dwelling and surrounding curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Lombardy	Non-associated residential dwelling Level 2	2,157 Near middle-ground	VIZ2	High	The dwelling is orientated north east to south west with views extending toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines. The wind turbines would be visible from some parts of the dwelling and surrounding curtilage; however, scattered mature tree planting would provide some screening or filtering of

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					views. Visual mitigation through planting to the west of the dwelling would provide some level of screening or filtering of views from the dwelling and surrounding building curtilage.
Kalanga C	Non-associated residential dwelling Level 2	2,319 Near middle-ground	VIZ2	High	Views from the dwelling and curtilage toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines would have partial screening and filtering of views by existing trees surrounding the dwelling and curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Kalanga A	Non-associated residential dwelling Level 2	2,131 Near middle-ground	VIZ2	High	Views from the dwelling and curtilage toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines would have partial screening and filtering of views by existing trees surrounding the dwelling and curtilage. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Mayvona	Non-associated residential dwelling Level 2	1,051 Far foreground	VIZ1	High	The dwelling is orientated north to south with some minor tree planting adjacent to the dwelling and curtilage area. Existing tree planting would provide limited screening and filtering of views toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines. Views would extend toward wind turbines from some areas proximate to the dwelling and within the curtilage. Visual mitigation through planting may provide some potential screening or filtering of views from the dwelling and surrounding building curtilage toward the 3 proximate wind turbines within the eastern portion of the wind farm site. However, the proximity and relative elevation of the wind turbines may limit the effectiveness of mitigation works.
Kalanga B	Non-associated residential dwelling Level 2	2,267 Near middle-ground	VIZ2	High	Views from the dwelling and curtilage toward the approved GIWF Mod-2 (and approved Mod-4) wind turbines would have partial screening and filtering of views by existing trees surrounding the dwelling and curtilage. Visual mitigation through planting would be

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.
Balaclava A	Non-associated residential dwelling Level 1 (Local Heritage Listing)	2,838 Near middle-ground	VIZ2	Moderate	The dwelling is located within tree planting surrounding the dwelling and curtilage. The dwelling, orientated north to south, and garden to the north of the dwelling, would provide some opportunities to view approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines; however, extensive views toward the approved wind turbines would be mitigated by existing tree planting. Additional mitigation would provide no significant screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Glengarry	Non-associated residential dwelling Level 2	2,812 Near middle-ground	VIZ2	Moderate	Scattered tree planting and undulating landform to the south west and west of the dwelling would screen and filter views toward the majority of approved GIWF Mod-2 (and proposed Mod-4) wind turbines.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Girrahween	Non-associated residential dwelling Level 2	2,117 Near middle-ground	VIZ2	High	The dwelling is orientated east to west with the principal view directed away from the approved GIWF Mod-2 (and proposed Mod-4) wind turbines toward Rosehill Road. Views to the west of the dwelling extend toward a rising landform with scattered and grouped tree cover. Views would extend toward wind turbines from areas beyond the dwelling and within the curtilage. Additional visual mitigation including planting south of the dwelling and curtilage would provide some degree of screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Rivoli	Non-associated residential dwelling Level 2	1,827 Near middle-ground	VIZ1	Moderate	Tree planting beyond the dwelling and forming a buffer to the Gwydir Highway would screen and/or filter some views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines. The dwelling is also located to the north and below the Gwydir Highway corridor resulting in some additional screening through landform. Additional visual mitigation would provide a limited degree of

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Wattle Vale	Non-associated residential dwelling Level 2	1,936	VIZ1	High	The dwelling is orientated north east to south west and set back around 136 metres from the Gwydir Highway corridor. Views from the dwelling toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines would be partially contained by landform rising to the south west together with scattered tree cover. Additional visual mitigation including planting south west of the dwelling would provide some degree of screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Rosefield	Non-associated residential dwelling Level 2	3,600 Near middle-ground	VIZ2	-	The dwelling is orientated north to south and is set back around 65 metres from the Gwydir Highway corridor. Views from the dwelling toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines would be partially contained by surrounding trees and agricultural sheds; however, the wind turbines would be visible from the dwelling curtilage. Additional mitigation would provide a limited

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					degree of screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Beaufort	Non-associated residential dwelling Level 2	3,500 Near middle-ground	VIZ2	-	Views toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines from the dwelling and surrounding curtilage would be screened by landform and vegetation.
Safari	Non-associated residential dwelling Level 2	3,300 Near middle-ground	VIZ2	-	The dwelling is orientated north east to south west with views from the dwelling and curtilage extending south to south west toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines. Views would be partially restricted by landform rising toward, and beyond, the Gwydir Highway corridor. A small number of wind turbines would be visible within the northern portion of the approved project site. Visual mitigation would provide some screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Malboona	Non-associated residential dwelling Level 2	3,400 Near middle-ground	VIZ2	-	The dwelling is orientated east to west. Views from the dwelling toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines would be partially restricted by scattered tree planting to the south of the dwelling. A small number of wind turbines would be visible within the northern portion of the approved project site from areas beyond the dwelling. Additional visual mitigation would provide a limited degree of screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Waterloo	Non-associated residential dwelling Level 1 (Local Heritage Listing)	3,500 Near middle-ground	VIZ2	-	The dwelling is located around 770 metres north of the Gwydir Highway corridor within a parkland type setting. Mature tree planting flanks the driveway access from Waterloo Road and is scattered to the west and north of the dwelling. Views south east toward the approved GIWF Mod-2 (and proposed Mod-4) wind turbines are generally open and extend to wind turbines around 7 kilometres from the dwelling. Whilst there is some potential for visual mitigation through tree planting, this would have a likely

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					undesired effect of foreshortening views and indirectly impacting the heritage values associated with the property.
Caloola B	Non-associated residential dwelling Level 2	3,000 Near middle-ground	VIZ2	-	The dwelling is located proximate to a small cluster of mature trees which provide some limited screening potential toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines. The dwelling is orientated north to north north east with views likely to extend toward wind turbines from the dwelling and curtilage. There are potential opportunities to provide visual mitigation through strategic tree planting to supplement existing trees beyond the dwelling.
Talarook	Non-associated residential dwelling Level 2	3,600 Near middle-ground	VIZ2	-	The approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines would be partially screened and filtered by mature tree planting to the east and north east of the residential dwelling. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Caloola A	Non-associated residential dwelling Level 2	3,200 Near middle-ground	VIZ2	-	The dwelling is located within tree planting surrounding the dwelling and curtilage. The dwelling, orientated north to north east, and garden to the north of the dwelling, would provide opportunities to view approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines; however, extensive views toward the approved wind turbines would be mitigated by existing tree planting. Additional mitigation would provide a limited degree of screening and/or filtering of views toward the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines.
Navada Park	Non-associated residential dwelling Level 2	3,300 Near middle-ground	VIZ2	-	The dwelling and surrounding curtilage would provide opportunities to view wind turbines within the eastern and southern portions of the approved GIWF Mod-2 (and proposed GIWF Mod-4). Turbine within the approved northern and western portion of the wind farm site would be screened and/or partially screened by landform. There are potential opportunities to provide visual mitigation through tree planting to supplement exiting planting to the west of the dwelling.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
Moonarie	Non-associated residential dwelling Level 2	3,300 Near middle-ground	VIZ2	-	The dwelling is orientated north to south with principal views from within the dwelling directed away from the approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines. Wind turbines would be visible from areas surrounding the dwelling, however, a line of mature eucalypt tree planting around 70 metres to the west of the dwelling would provide some filtering of views toward the wind turbines. There are potential visual mitigation opportunities to provide supplementary planting to screen and/or filter views toward wind turbines to the west of the dwelling. This includes extending the line of existing eucalypt tree planting north by around 40 metres.
Lecole Pas	Non-associated residential dwelling Level 2	3,200 Near middle-ground	VIZ2	-	The dwelling is orientated north to north north west, and located proximately to grouped and scattered mature tree planting which extends beyond the dwelling toward (and alongside) the Furracabad Road corridor. The approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines would be visible from the dwelling and garden area to the west of the dwelling, however the axis of view south from the dwelling is indirect to the approved wind turbine locations.

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 GIWF Mod-4 wind turbine (m) and Distance Zone	Visual Influence Zone	Approved GIWF Mod-2 Visual Rating*	GIWF Mod-4 amended visual assessment
					There are potential visual mitigation opportunities to provide supplementary planting to screen and/or filter views toward wind turbines along a field boundary around 40 metres west of the dwelling.
Elm Vale	Non-associated residential dwelling Level 2	3,200 Near middle-ground	VIZ2	-	The approved GIWF Mod-2 (and proposed GIWF Mod-4) wind turbines would be partially screened and filtered by mature tree planting to the west and north west of the residential dwelling. Visual mitigation through planting would be unlikely to provide any additional level of screening or filtering of views from the dwelling and surrounding building curtilage.

* Approved GIWF Mod-2 Visual Rating as determined by Aurecon (Visual Assessment Report Rev 2 18 December 2013)

9 Wire frame models

9.1 Introduction

The wireframe model locations have been selected to illustrate viewpoints from residential dwellings with views toward the approved GIWF Mod-2 and the approved White Rock Wind Farm which is currently under construction and partially operational.

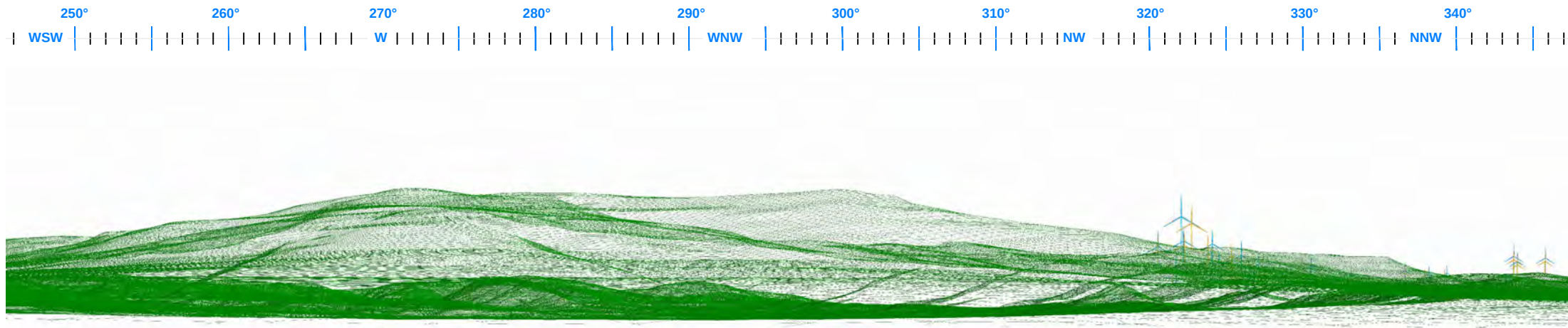
The twenty-three wireframe locations are illustrated in **Figure 1**, and the wireframes presented in **Figures 7 to 48**. The wireframe models illustrate views toward the approved GIWF Mod-2 and the proposed Mod-4 amendment. The wire frame models illustrate the wind turbines with and without their individual identification numbers for clarity.

The wire frame models do not include, or illustrate, the location of tree planting between the wire frame view point (dwelling) and the approved Mod-2 and proposed 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.

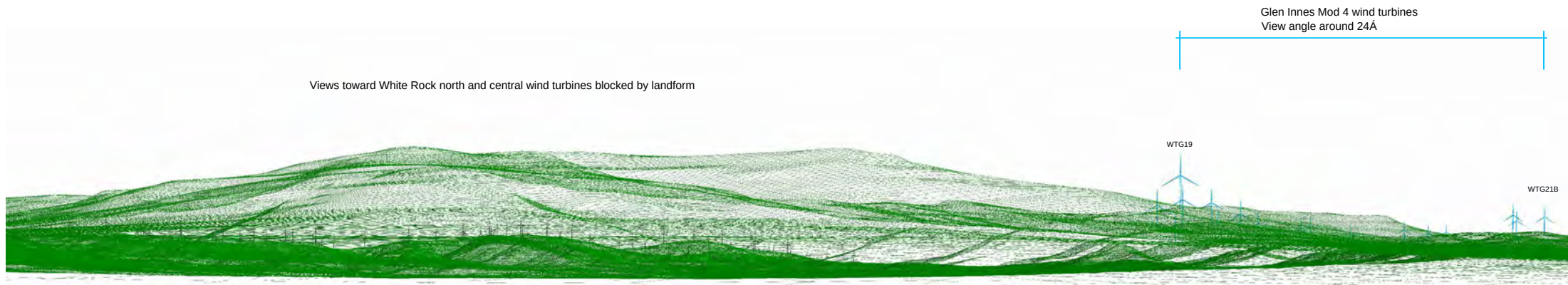
9.2 Wireframe model preparation

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:

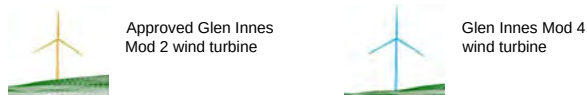
- a digital terrain model (DTM) of the project site was created from a terrain model of the surrounding area using digital contours
- the site DTM was loaded in the DNV-GL 'WindFarmer' software package
- the layout of the wind farm and 3D representation of the wind turbine was configured in 'WindFarmer'
- 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.



Furracabad Station: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.98 kilometres. Tips visible 10, Hubs visible 5
 Distance to closest Glen Innes Mod 4 wind turbine 2.96 kilometres. Tips visible 12, Hubs visible 7



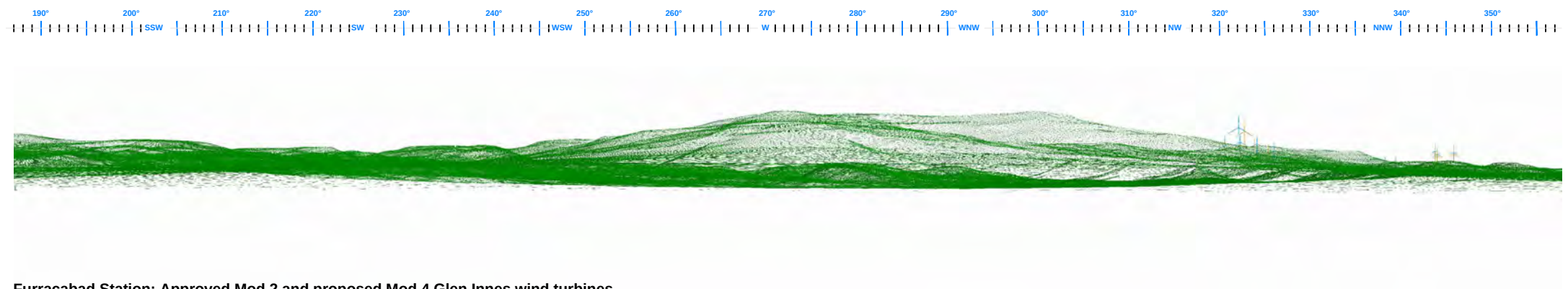
Furracabad Station: Glen Innes Mod 4 wind turbines



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.

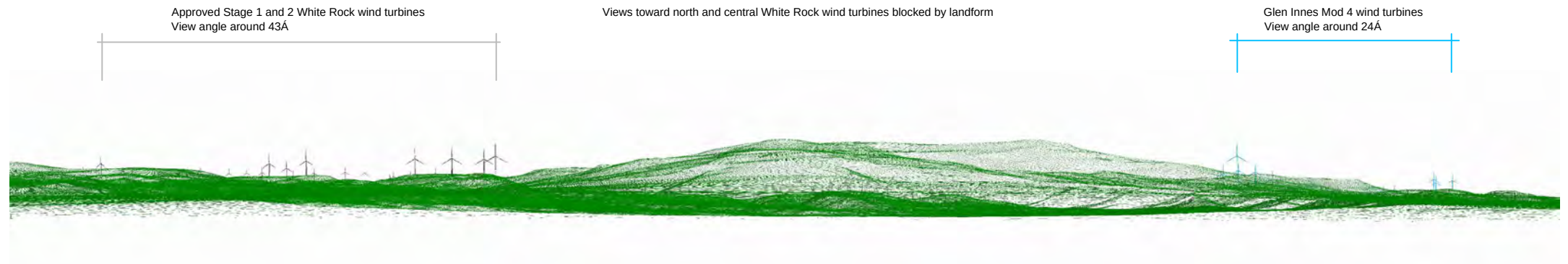
Figure 7 - Wireframe 1 Furracabad Station



Furracabad Station: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.98 kilometres. Tips visible 10, Hubs visible 5

Distance to closest Glen Innes Mod 4 wind turbine 2.96 kilometres. Tips visible 12, Hubs visible 7



Furracabad Station: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.96 kilometres. Tips visible 12, Hubs visible 7

Distance to closest White Rock wind turbine 2.41 kilometres. Tips visible 24, Hubs visible 18



Approved Glen Innes
Mod 2 wind turbine

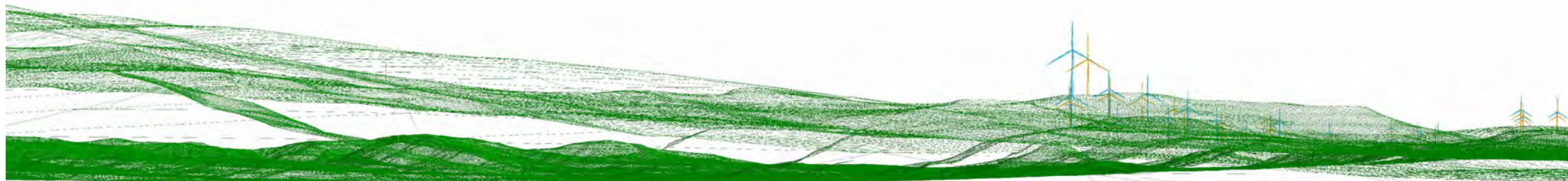


Glen Innes Mod 4
wind turbine



Approved Stage 1 and 2
White Rock wind turbine

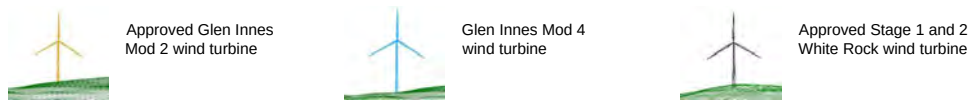
Figure 8 -
Wireframe 2 Furracabad Station



Klossie: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.13 kilometres. Tips visible 10, Hubs visible 4
 Distance to closest Glen Innes Mod 4 wind turbine 2.12 kilometres. Tips visible 12, Hubs visible 7



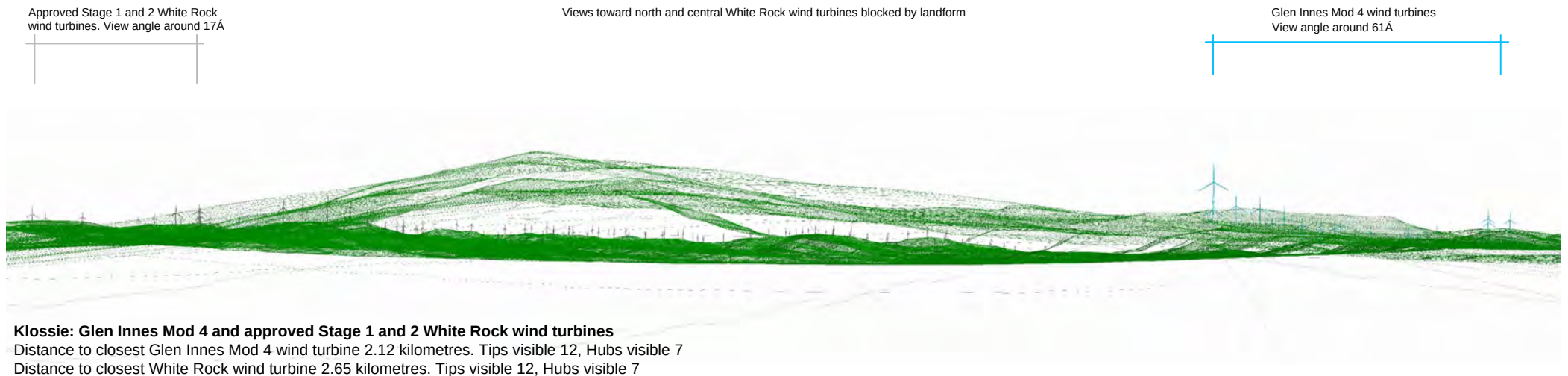
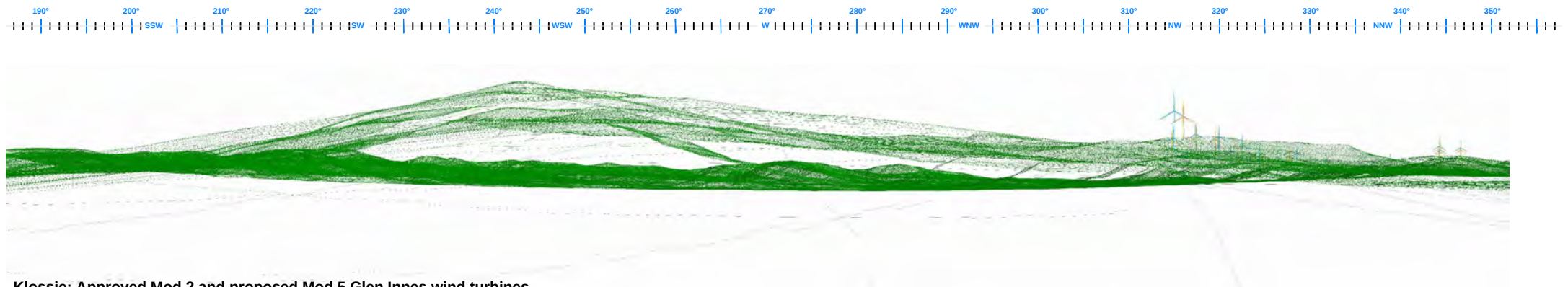
Klossie: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines



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 9 - Wireframe 3 Klossie



Approved Glen Innes
Mod 2 wind turbine

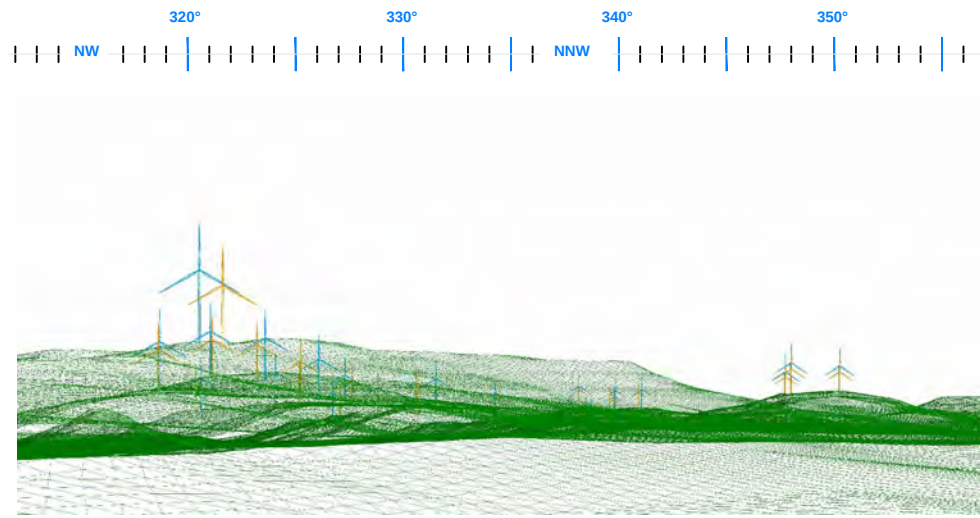


Glen Innes Mod 4
wind turbine

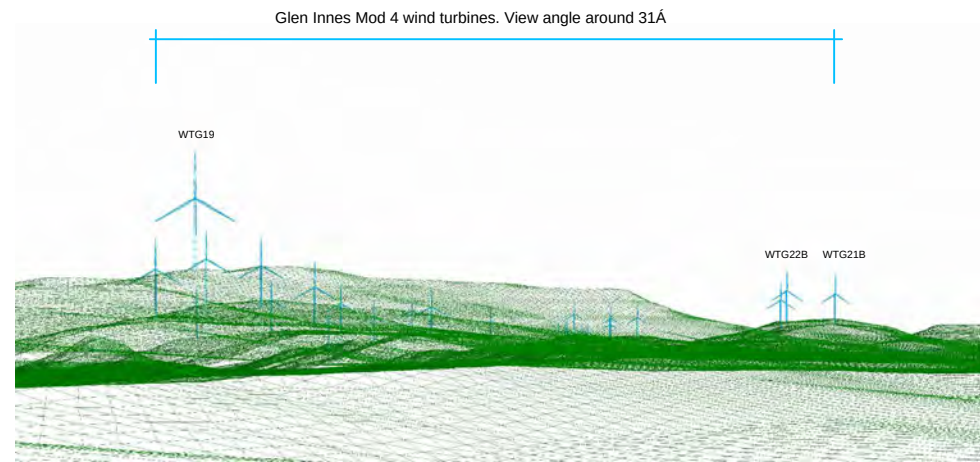


Approved Stage 1 and 2
White Rock wind turbine

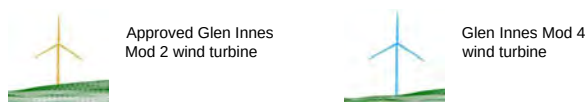
Figure 10 -
Wireframe 4 Klossie



Green House: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 1.89 kilometres. Tips visible 8, Hubs visible 5
 Distance to closest Glen Innes Mod 4 wind turbine 1.88 kilometres. Tips visible 8, Hubs visible 7



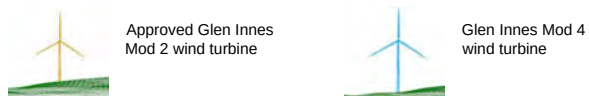
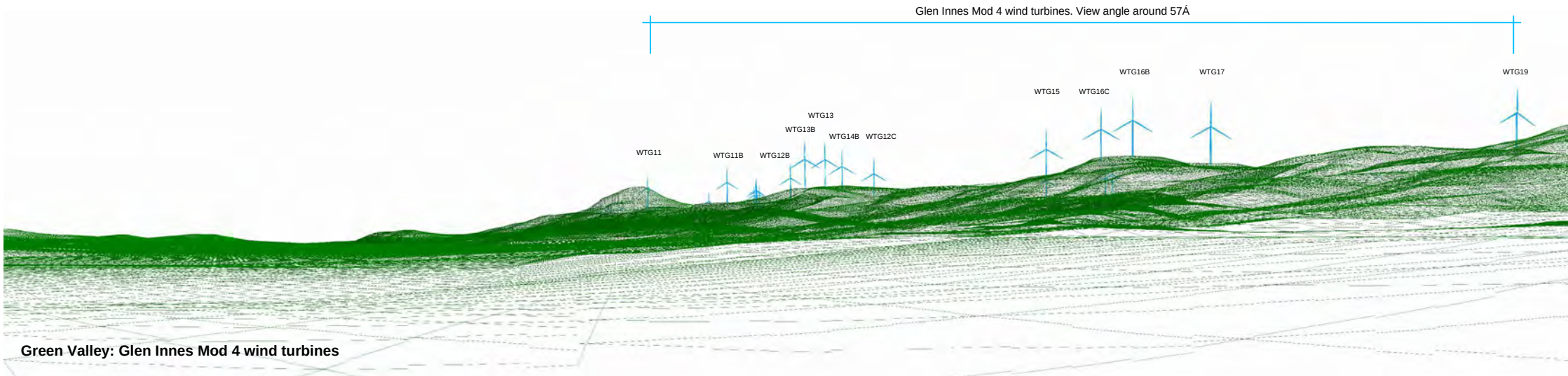
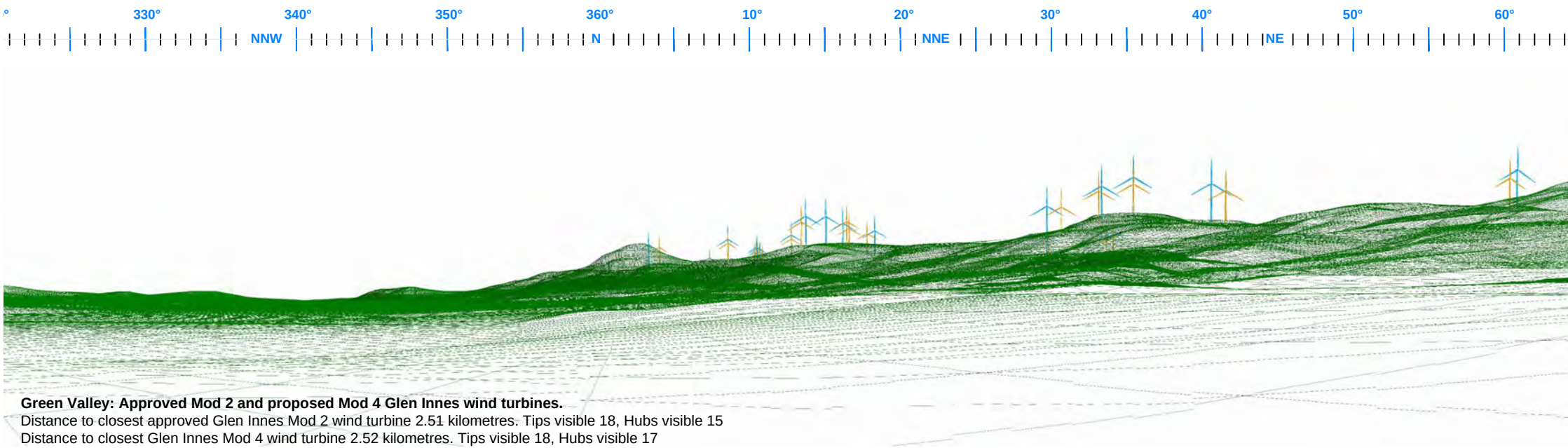
Green House: Glen Innes Mod 4 wind turbines
 The wire frame modelling indicates that no White Rock wind turbines will be visible from the Green House residential dwelling



Glen Innes Wind Farm Modification 4

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

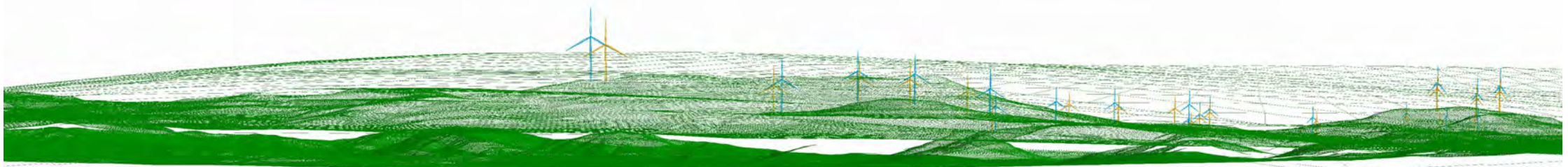
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.



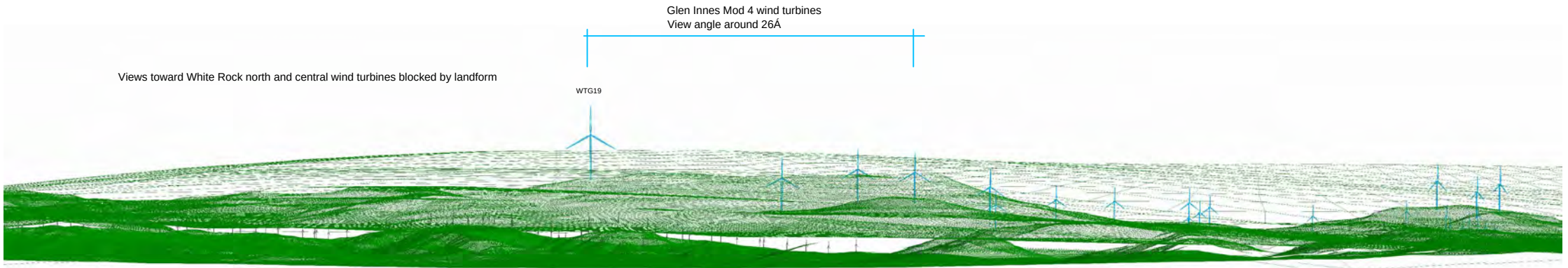
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

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

Figure 12 - Wireframe 6 Green Valley



Nullagai: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
Distance to closest approved Glen Innes Mod 2 wind turbine 2.11 kilometres. Tips visible 3, Hubs visible 1
Distance to closest Glen Innes Mod 4 wind turbine 2.13 kilometres. Tips visible 5, Hubs visible 1



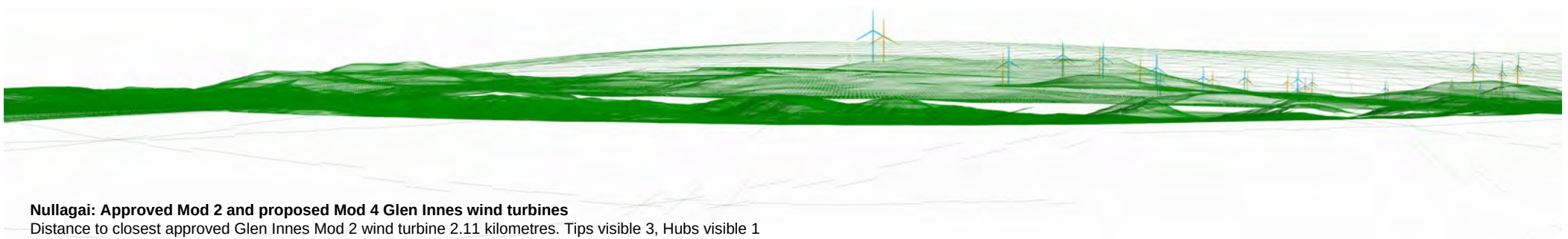
Nullagai: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines



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 14 - Wireframe 8 Nullagai



Nullagai: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

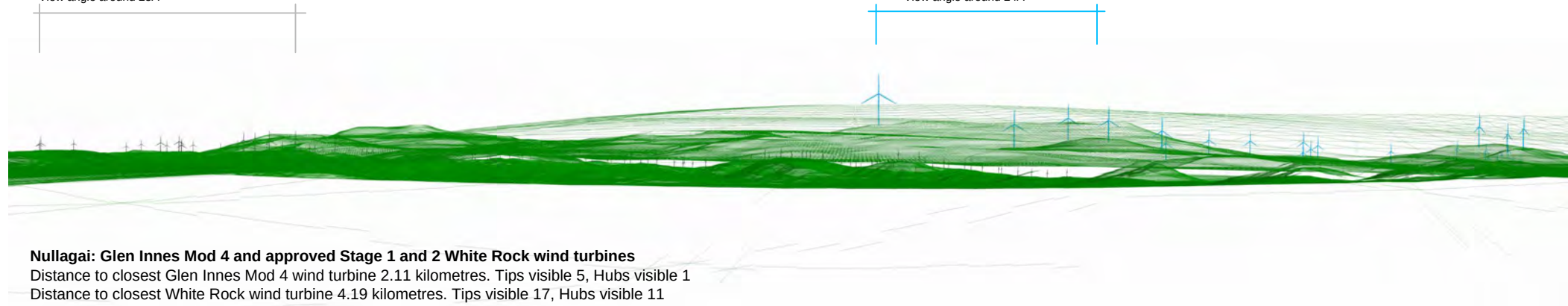
Distance to closest approved Glen Innes Mod 2 wind turbine 2.11 kilometres. Tips visible 3, Hubs visible 1

Distance to closest Glen Innes Mod 4 wind turbine 2.13 kilometres. Tips visible 5, Hubs visible 1

Approved Stage 1 and 2 White Rock wind turbines
View angle around 23A

Views toward north and central White Rock wind turbines blocked by landform

Glen Innes Mod 4 wind turbines
View angle around 24A



Nullagai: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.11 kilometres. Tips visible 5, Hubs visible 1

Distance to closest White Rock wind turbine 4.19 kilometres. Tips visible 17, Hubs visible 11



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine



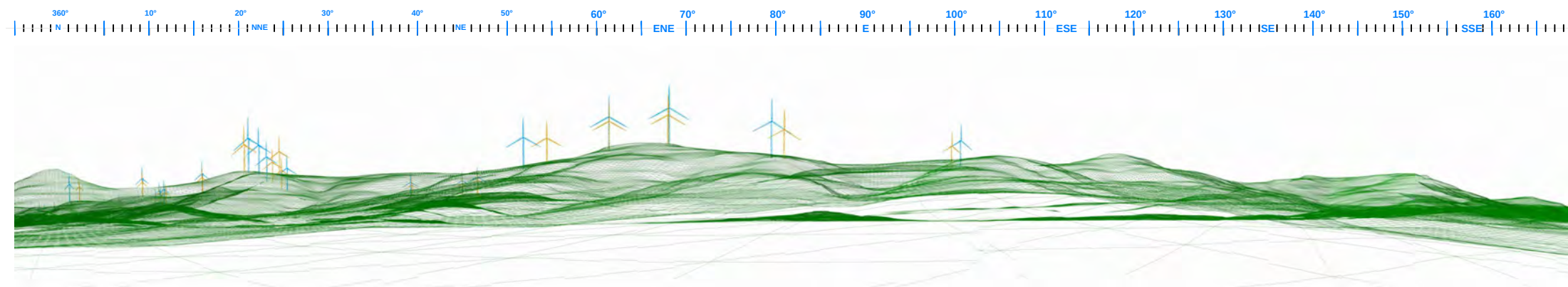
Approved Stage 1 and 2
White Rock wind turbine

Figure 15 -
Wireframe 9 Nullagai

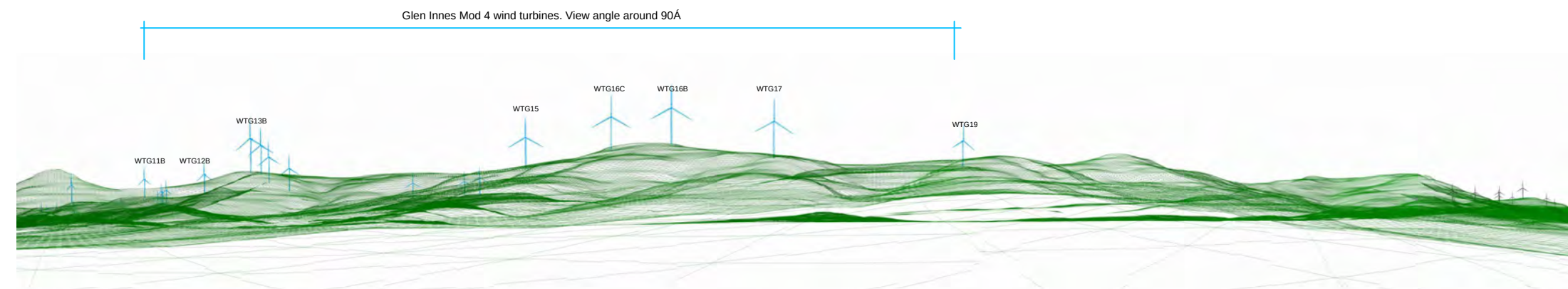
GREEN BEAN DESIGN

landscape architects

Glen Innes Wind Farm Modification 4



Ilparran A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 1.53 kilometres. Tips visible 14, Hubs visible 11
 Distance to closest Glen Innes Mod 4 wind turbine 1.52 kilometres. Tips visible 16, Hubs visible 11



Ilparran A: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines



Approved Glen Innes Mod 2 wind turbine



Glen Innes Mod 4 wind turbine

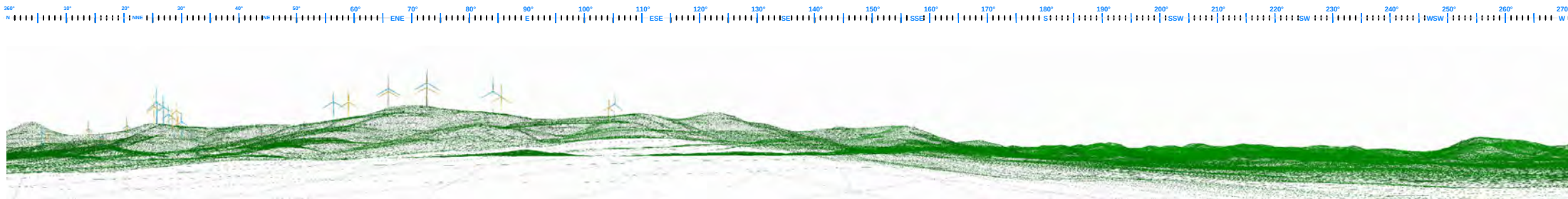


Approved Stage 1 and 2 White Rock wind turbine

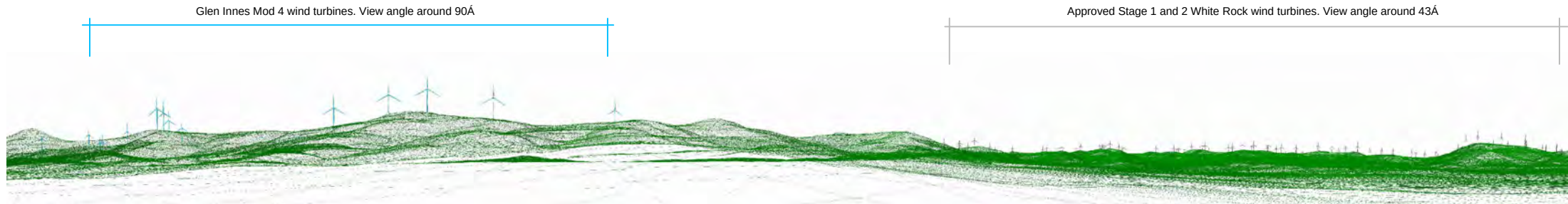
Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landform.

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

Glen Innes Wind Farm Modification 4



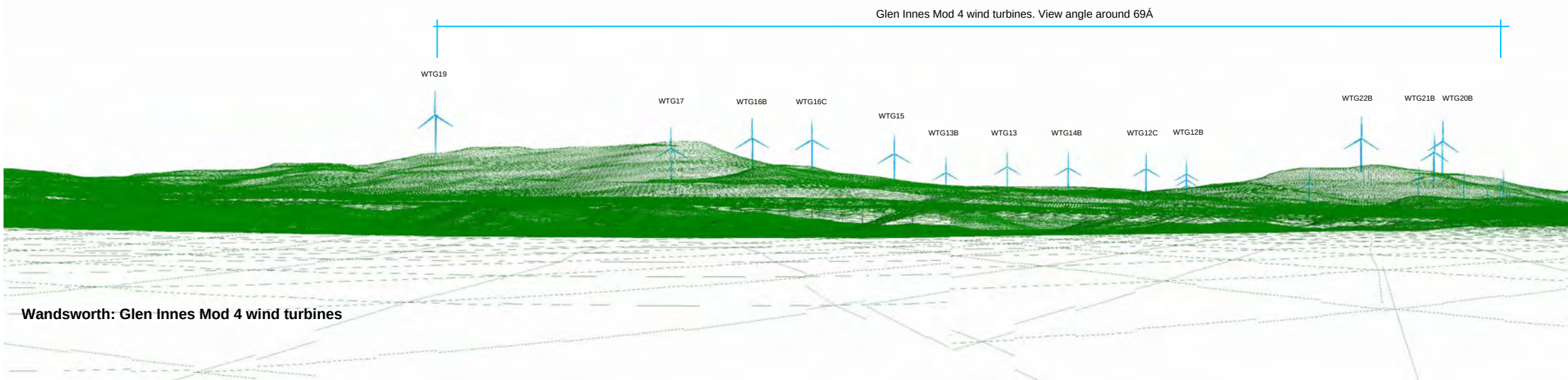
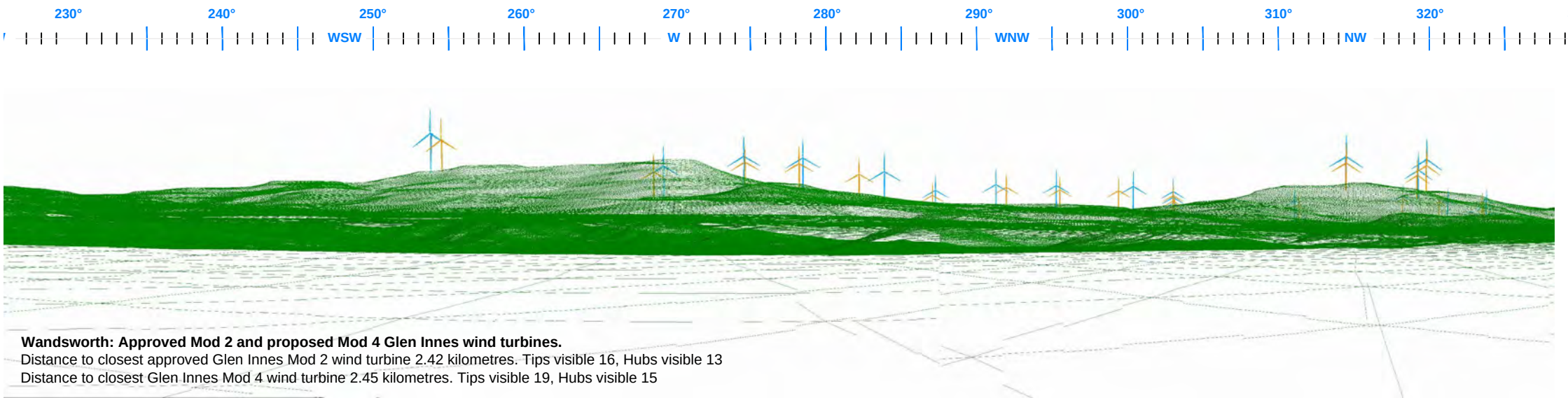
Ilparran A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines
 Distance to closest approved Glen Innes Mod 2 wind turbine 1.53 kilometres. Tips visible 14, Hubs visible 11
 Distance to closest Glen Innes Mod 4 wind turbine 1.52 kilometres. Tips visible 16, Hubs visible 11



Ilparran A: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines
 Distance to closest Glen Innes Mod 4 wind turbine 1.52 kilometres. Tips visible 16, Hubs visible 11
 Distance to closest White Rock wind turbine 3.48 kilometres. Tips visible 99, Hubs visible 82



Figure 17 - Wireframe 11 Ilparran A



Approved Glen Innes Mod 2 wind turbine



Glen Innes Mod 4 wind turbine



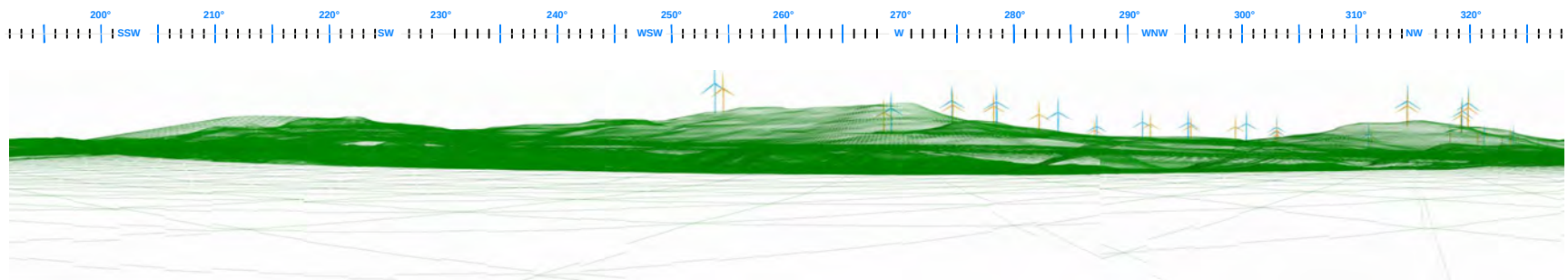
Approved Stage 1 and 2 White Rock wind turbine

Notes:

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

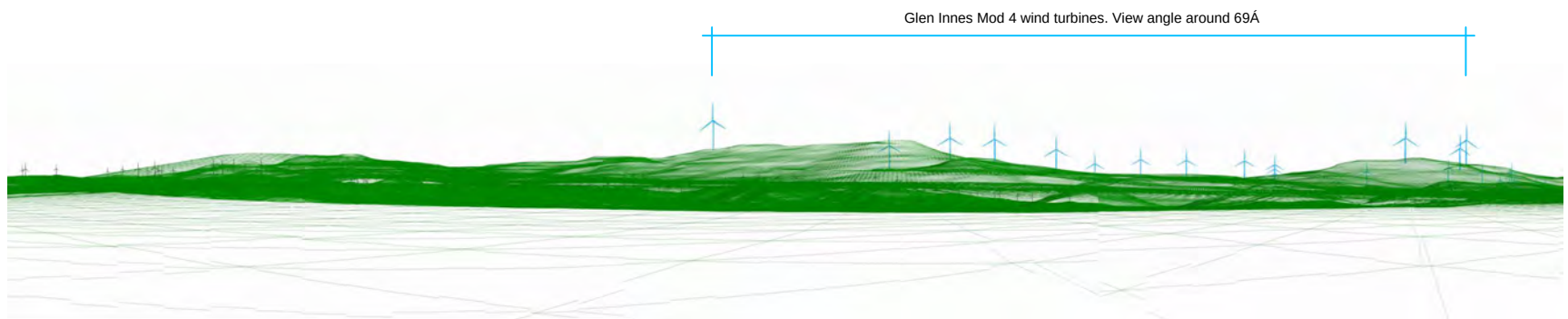
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.

Figure 18 - Wireframe 12 Wandsworth



Wandsworth: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.42 kilometres. Tips visible 16, Hubs visible 13
 Distance to closest Glen Innes Mod 4 wind turbine 2.45 kilometres. Tips visible 19, Hubs visible 14



Wandsworth: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.42 kilometres. Tips visible 16, Hubs visible 13
 Distance to closest White Rock wind turbine 4.93 kilometres. Tips visible 10, Hubs visible 7



Approved Glen Innes Mod 2 wind turbine

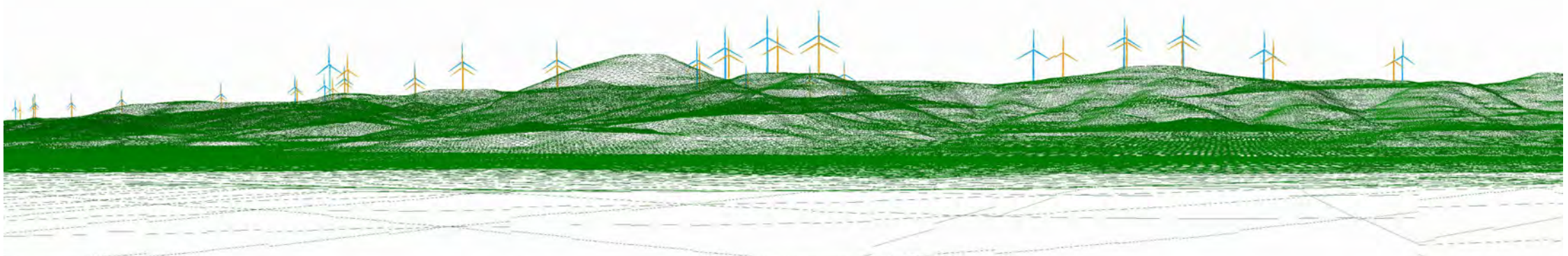


Glen Innes Mod 4 wind turbine



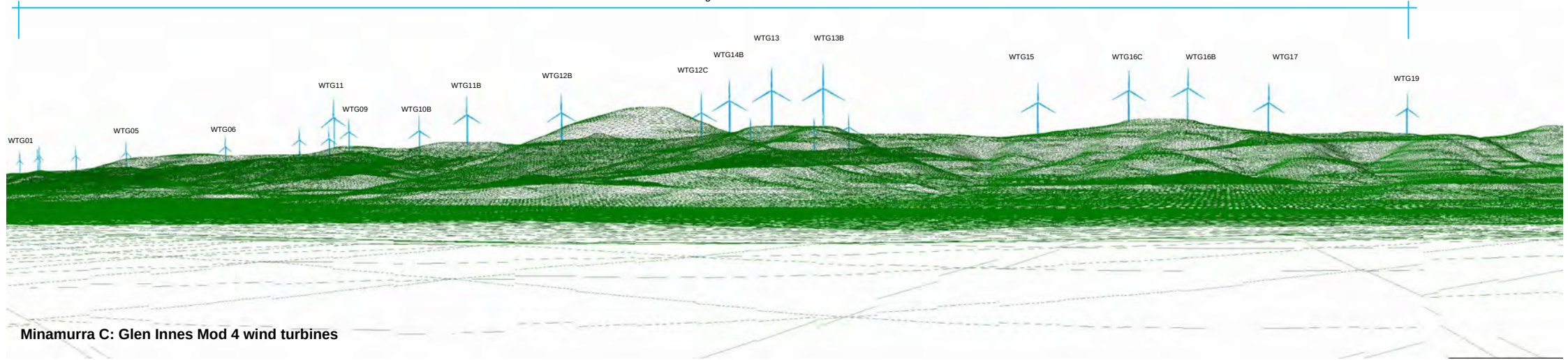
Approved Stage 1 and 2 White Rock wind turbine

Figure 19 - Wireframe 13 Wandsworth



Minamurra C: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
Distance to closest approved Glen Innes Mod 2 wind turbine 2.45 kilometres. Tips visible 25, Hubs visible 22
Distance to closest Glen Innes Mod 4 wind turbine 2.47 kilometres. Tips visible 25, Hubs visible 23

Glen Innes Mod 4 wind turbines. View angle around 90°



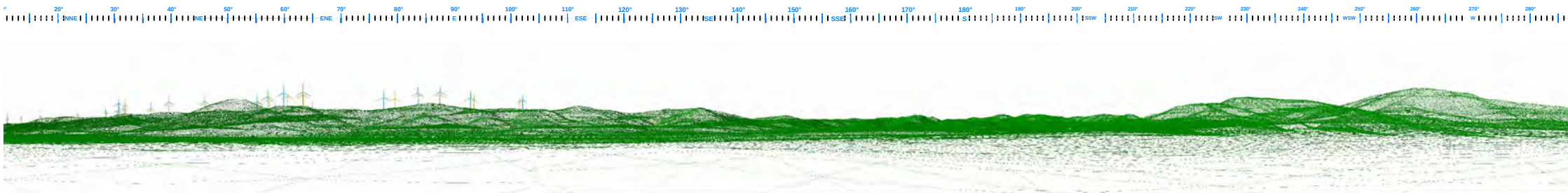
Minamurra C: Glen Innes Mod 4 wind turbines



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.

Glen Innes Wind Farm Modification 4



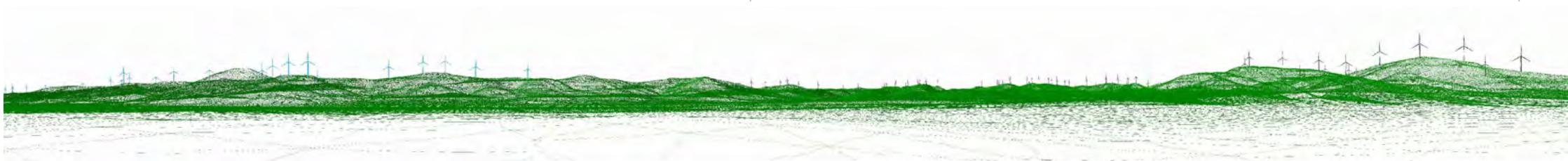
Minamurra C: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.45 kilometres. Tips visible 25, Hubs visible 22

Distance to closest Glen Innes Mod 4 wind turbine 2.47 kilometres. Tips visible 25, Hubs visible 23

Glen Innes Mod 4 wind turbines. View angle around 90°

Approved Stage 1 and 2 White Rock wind turbines
View angle around 148°



Minamurra C: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.47 kilometres. Tips visible 25, Hubs visible 23

Distance to closest White Rock wind turbine 1.83 kilometres. Tips visible 80, Hubs visible 64



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine

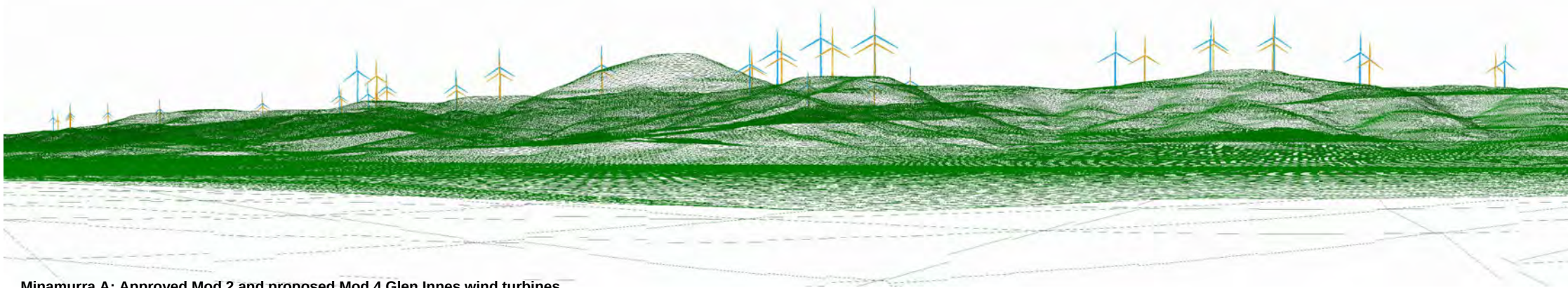


Approved Stage 1 and 2
White Rock wind turbine

Figure 21 -
Wireframe 15 Minamurra C

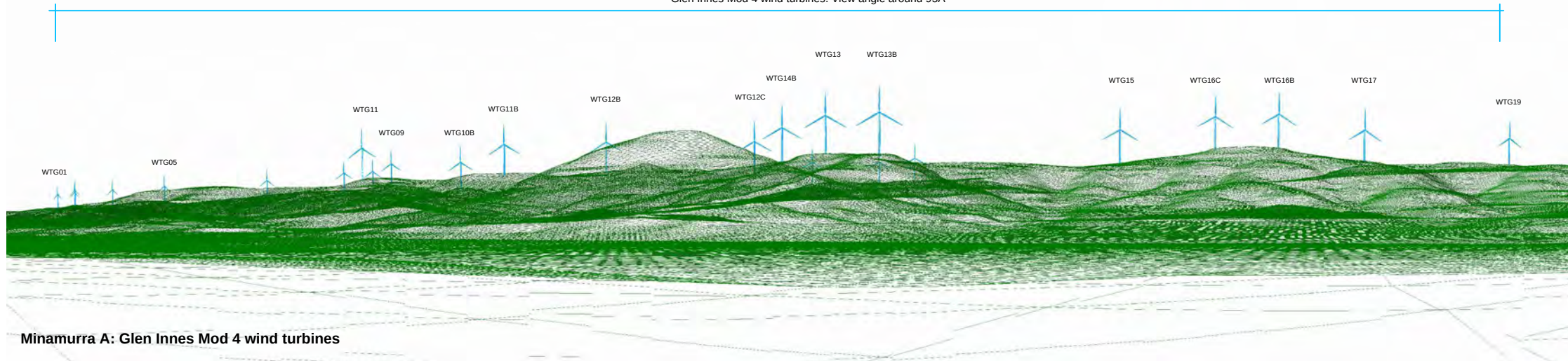
GREEN BEAN DESIGN

landscape architects

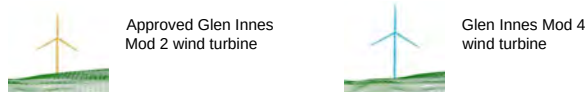


Minamurra A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.24 kilometres. Tips visible 23, Hubs visible 21
 Distance to closest Glen Innes Mod 4 wind turbine 2.26 kilometres. Tips visible 25, Hubs visible 23

Glen Innes Mod 4 wind turbines. View angle around 95°



Minamurra A: Glen Innes Mod 4 wind turbines



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 22 - Wireframe 16 Minamurra A



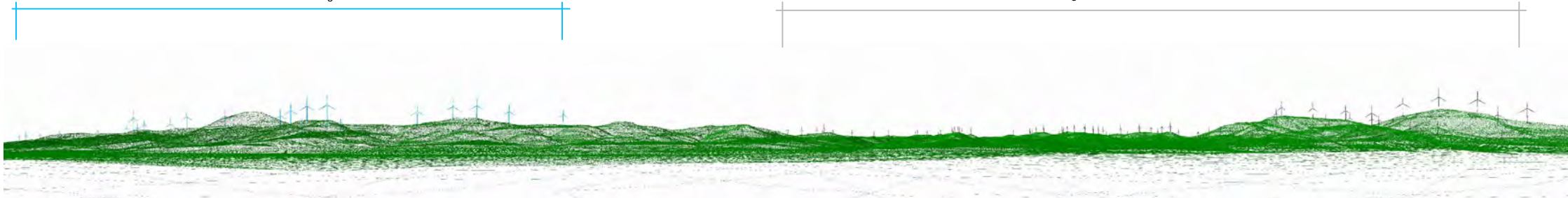
Minamurra A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.24 kilometres. Tips visible 23, Hubs visible 21

Distance to closest Glen Innes Mod 4 wind turbine 2.26 kilometres. Tips visible 25, Hubs visible 23

Glen Innes Mod 4 wind turbines. View angle around 95°

Approved Stage 1 and 2 White Rock wind turbines
View angle around 148°



Minamurra A: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.26 kilometres. Tips visible 25, Hubs visible 23

Distance to closest White Rock wind turbine 2.03 kilometres. Tips visible 83, Hubs visible 68



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine

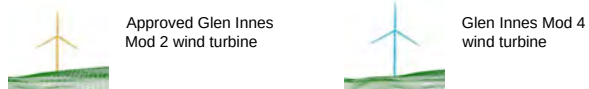
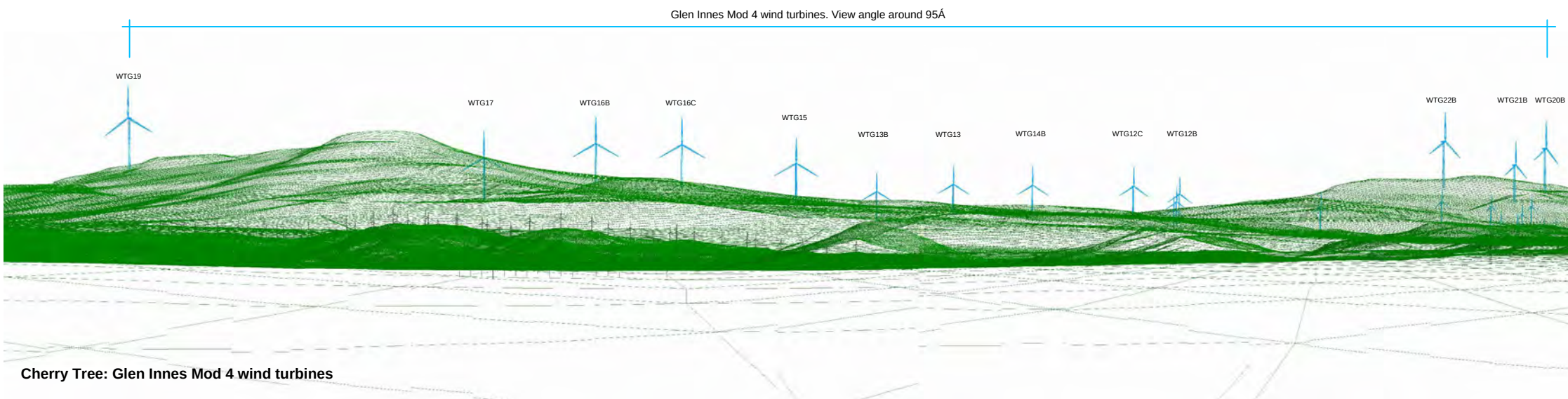
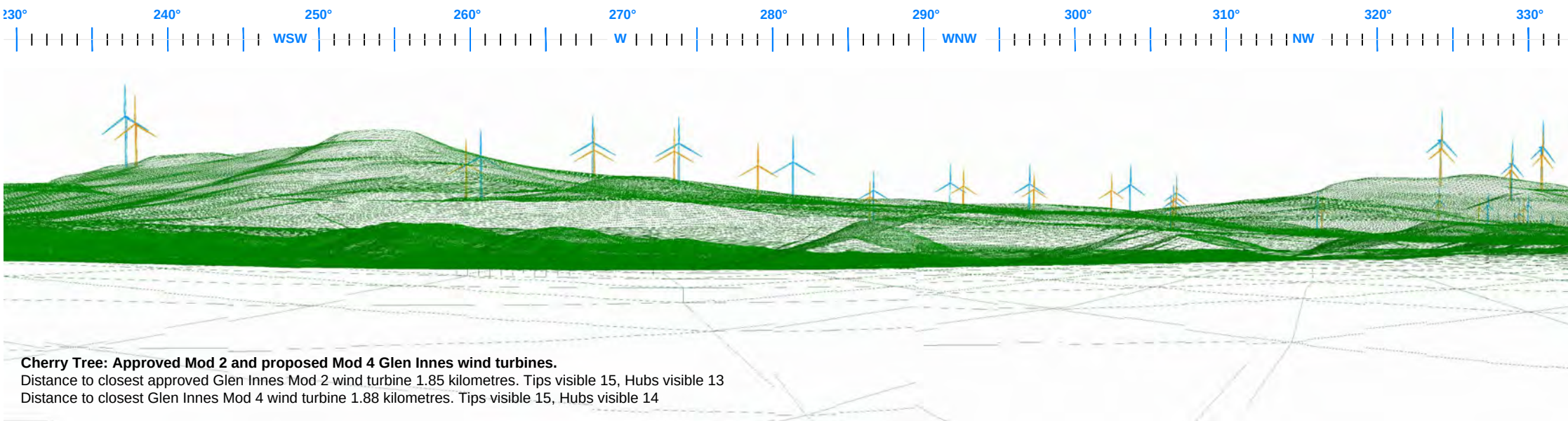


Approved Stage 1 and 2
White Rock wind turbine

Figure 23 -
Wireframe 17 Minamurra A

GREEN BEAN DESIGN

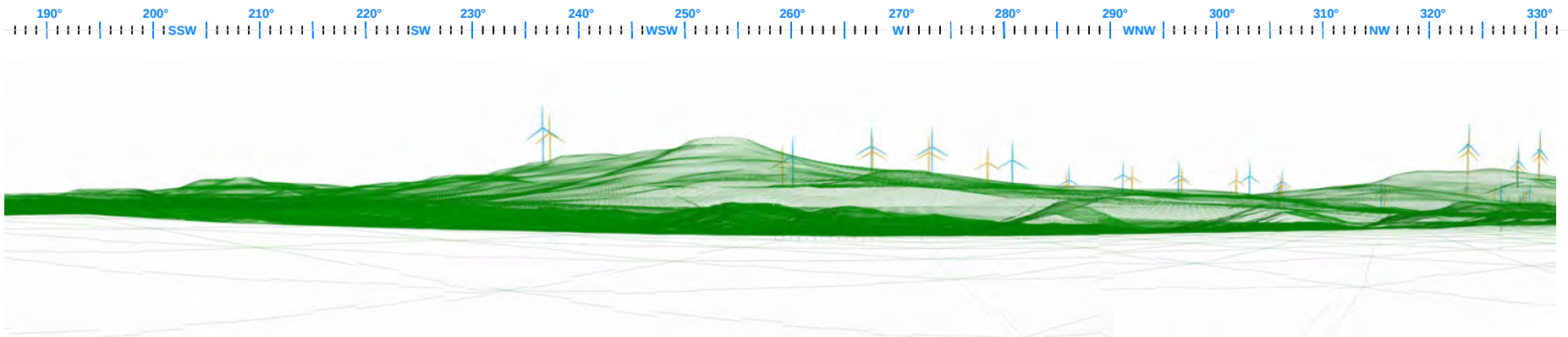
landscape architects



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 24 - Wireframe 18 Cherry Tree



Cherry Tree: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines
 Distance to closest approved Glen Innes Mod 2 wind turbine 1.85 kilometres. Tips visible 15, Hubs visible 13
 Distance to closest Glen Innes Mod 4 wind turbine 1.88 kilometres. Tips visible 15, Hubs visible 14



Cherry Tree: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines
 Distance to closest Glen Innes Mod 4 wind turbine 1.88 kilometres. Tips visible 15, Hubs visible 14
 Distance to closest White Rock wind turbine 4.90 kilometres. Tips visible 13, Hubs visible 3



Approved Glen Innes Mod 2 wind turbine

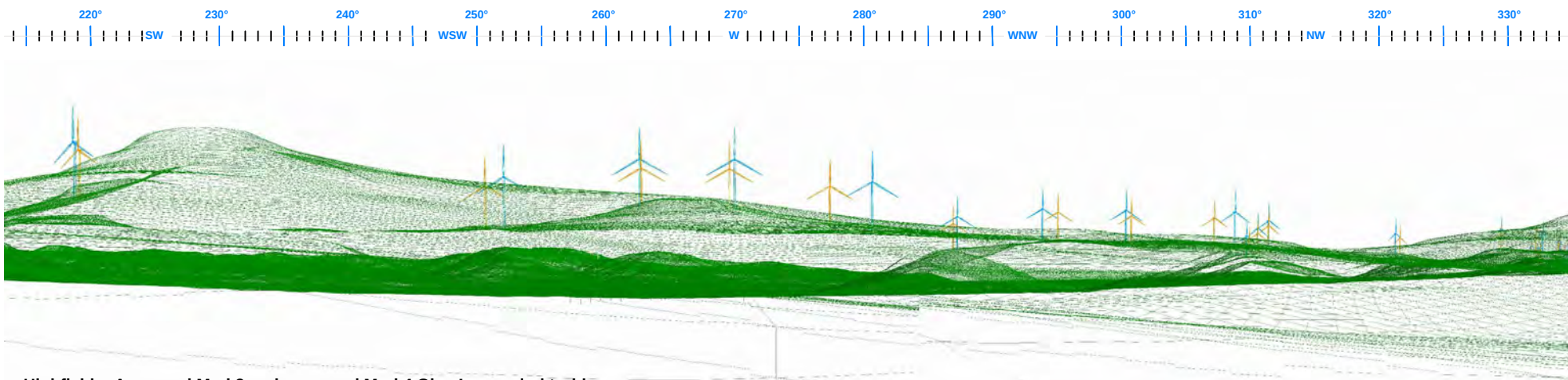


Glen Innes Mod 4 wind turbine

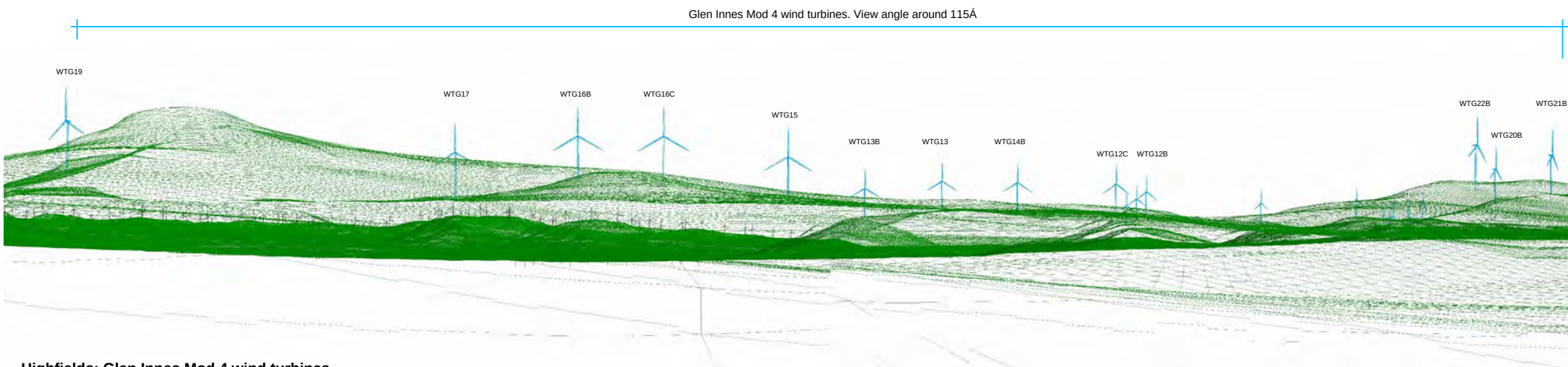


Approved Stage 1 and 2 White Rock wind turbine

Figure 25 - Wireframe 19 Cherry Tree



Highfields: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 1.42 kilometres. Tips visible 17, Hubs visible 14
 Distance to closest Glen Innes Mod 4 wind turbine 1.45 kilometres. Tips visible 17, Hubs visible 17



Highfields: Glen Innes Mod 4 wind turbines



Approved Glen Innes Mod 2 wind turbine

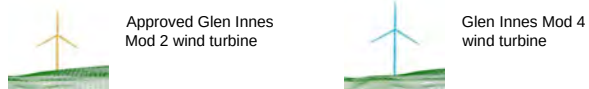
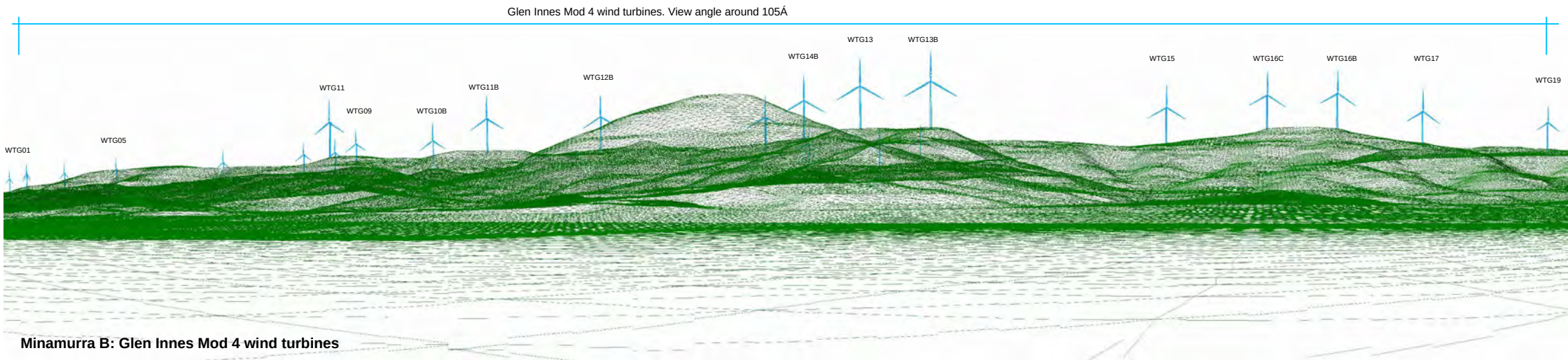
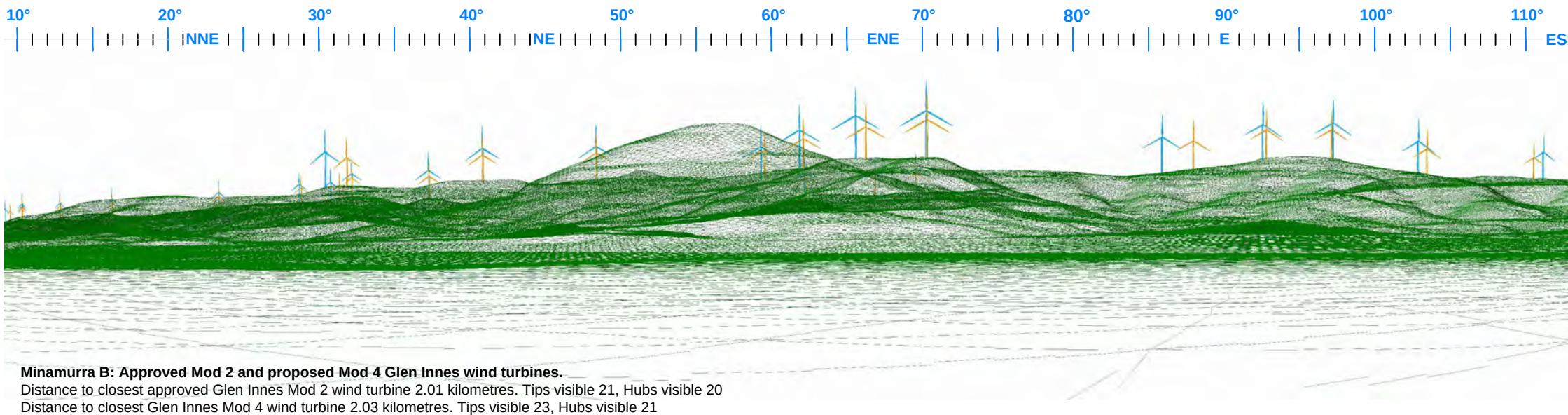


Glen Innes Mod 4 wind turbine

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 26 - Wireframe 20 Highfields



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 27 - Wireframe 21 Minamurra B

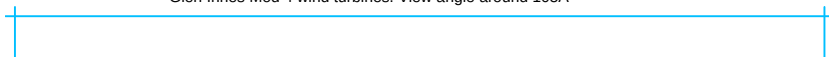


Minamurra B: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

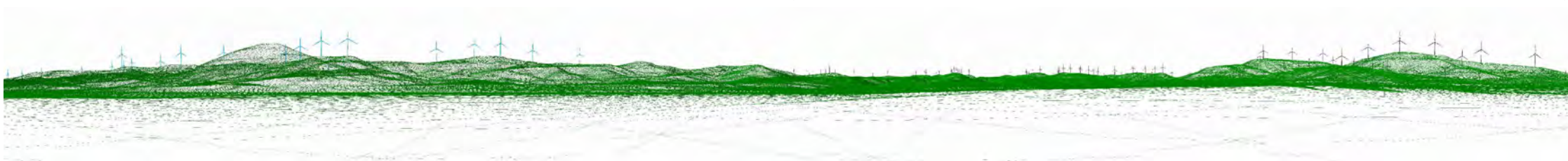
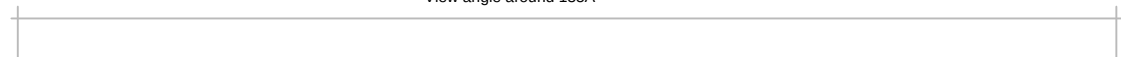
Distance to closest approved Glen Innes Mod 2 wind turbine 2.01 kilometres. Tips visible 21, Hubs visible 20

Distance to closest Glen Innes Mod 4 wind turbine 2.03 kilometres. Tips visible 23, Hubs visible 21

Glen Innes Mod 4 wind turbines. View angle around 105°



Approved Stage 1 and 2 White Rock wind turbines
View angle around 135°



Minamurra B: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.03 kilometres. Tips visible 23, Hubs visible 21

Distance to closest White Rock wind turbine 2.15 kilometres. Tips visible 86, Hubs visible 70



Approved Glen Innes
Mod 2 wind turbine

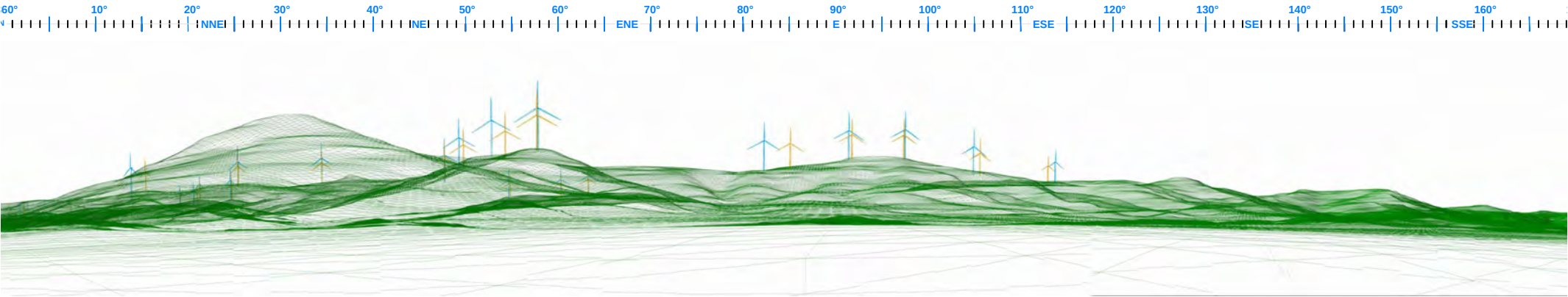


Glen Innes Mod 4
wind turbine



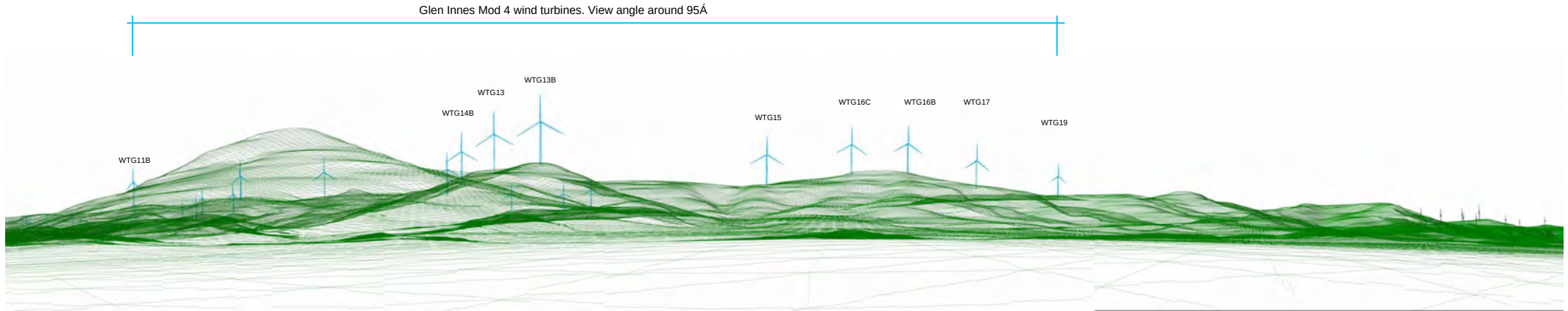
Approved Stage 1 and 2
White Rock wind turbine

Figure 28 -
Wireframe 22 Minamurra B



Ilparran B: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.

Distance to closest approved Glen Innes Mod 2 wind turbine 1.30 kilometres. Tips visible 10, Hubs visible 8
 Distance to closest Glen Innes Mod 5 wind turbine 1.32 kilometres. Tips visible 11, Hubs visible 10



Ilparran B: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines



Approved Glen Innes Mod 2 wind turbine



Glen Innes Mod 4 wind turbine



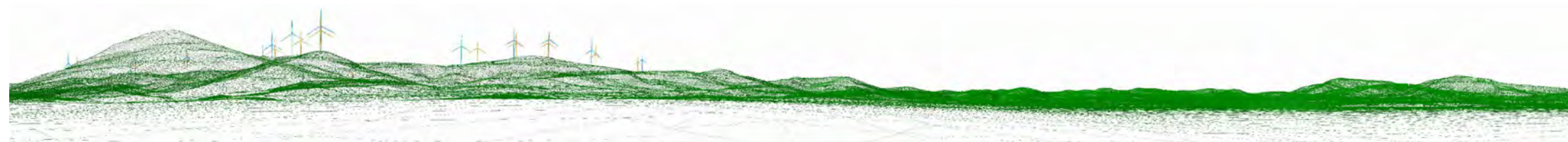
Approved Stage 1 and 2 White Rock wind turbine

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 29 - Wireframe 23 Ilparran B

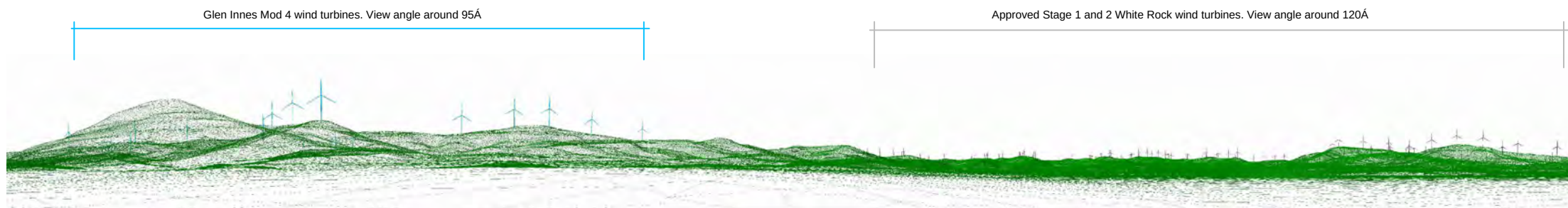
Glen Innes Wind Farm Modification 4



Ilparran B: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 1.30 kilometres. Tips visible 10, Hubs visible 8

Distance to closest Glen Innes Mod 4 wind turbine 1.32 kilometres. Tips visible 11, Hubs visible 10



Ilparran B: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 1.30 kilometres. Tips visible 11, Hubs visible 10

Distance to closest White Rock wind turbine 2.92 kilometres. Tips visible 94, Hubs visible 78



Approved Glen Innes
Mod 2 wind turbine

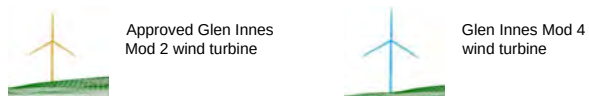
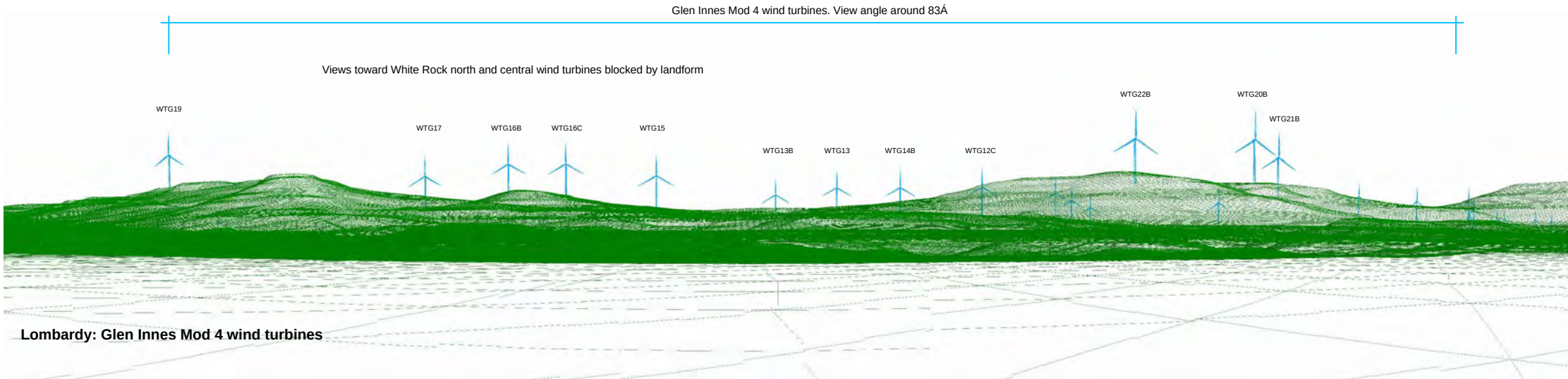
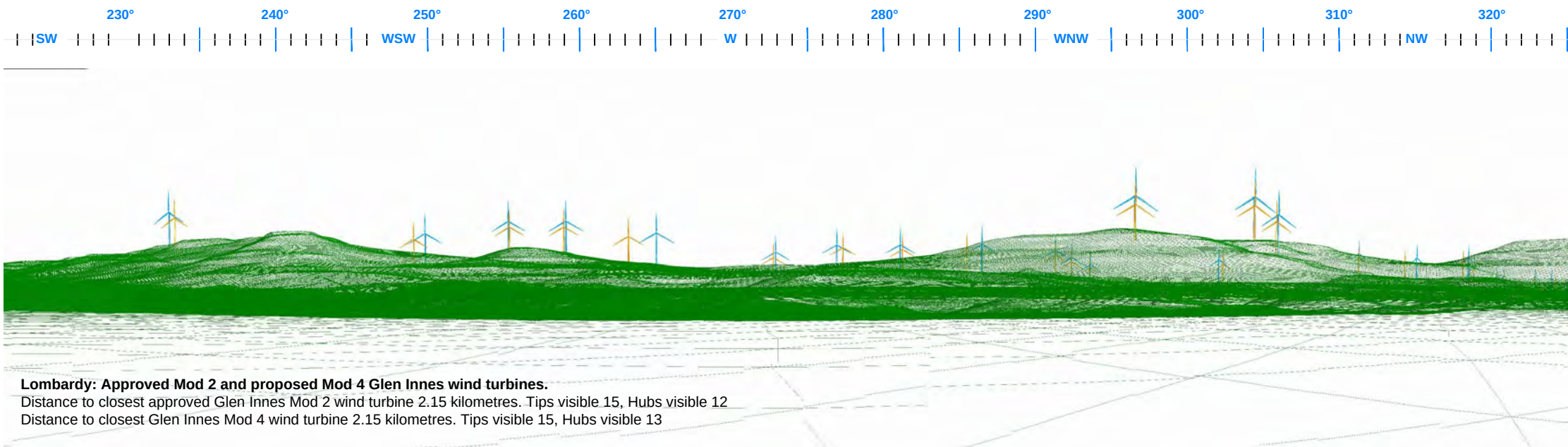


Glen Innes Mod 4
wind turbine



Approved Stage 1 and 2
White Rock wind turbine

Figure 30 -
Wireframe 24 Ilparran B



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 31 - Wireframe 25 Lombardy



Lombardy: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

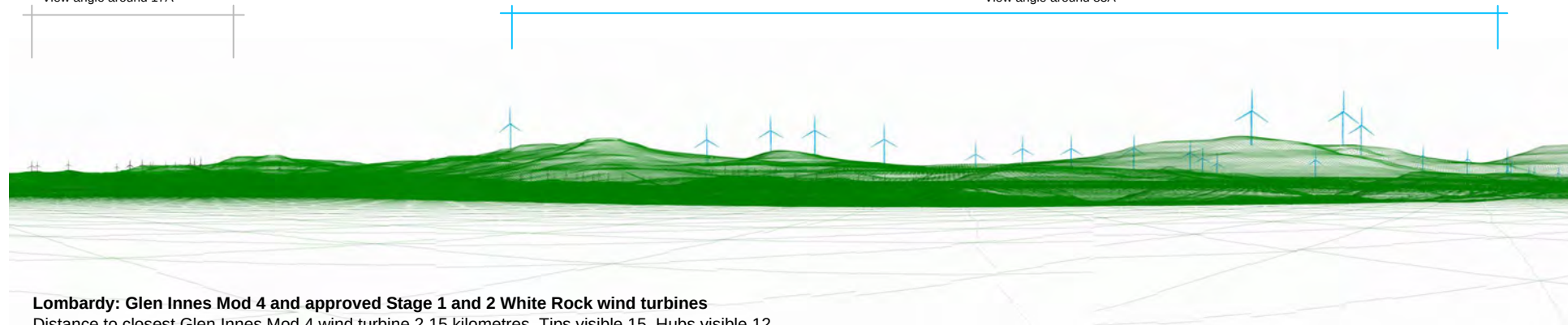
Distance to closest approved Glen Innes Mod 2 wind turbine 2.15 kilometres. Tips visible 15, Hubs visible 12

Distance to closest Glen Innes Mod 4 wind turbine 2.15 kilometres. Tips visible 15, Hubs visible 13

Approved Stage 1 and 2 White Rock wind turbines
View angle around 17A

Views toward north and central White Rock wind turbines blocked by landform

Glen Innes Mod 4 wind turbines
View angle around 83A



Lombardy: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.15 kilometres. Tips visible 15, Hubs visible 12

Distance to closest White Rock wind turbine 5.82 kilometres. Tips visible 17, Hubs visible 10



Approved Glen Innes
Mod 2 wind turbine

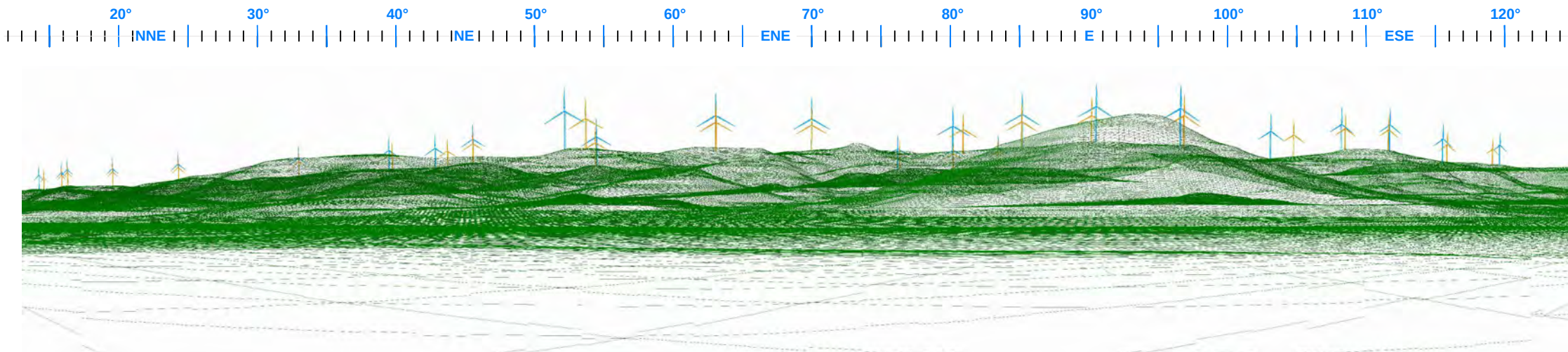


Glen Innes Mod 4
wind turbine

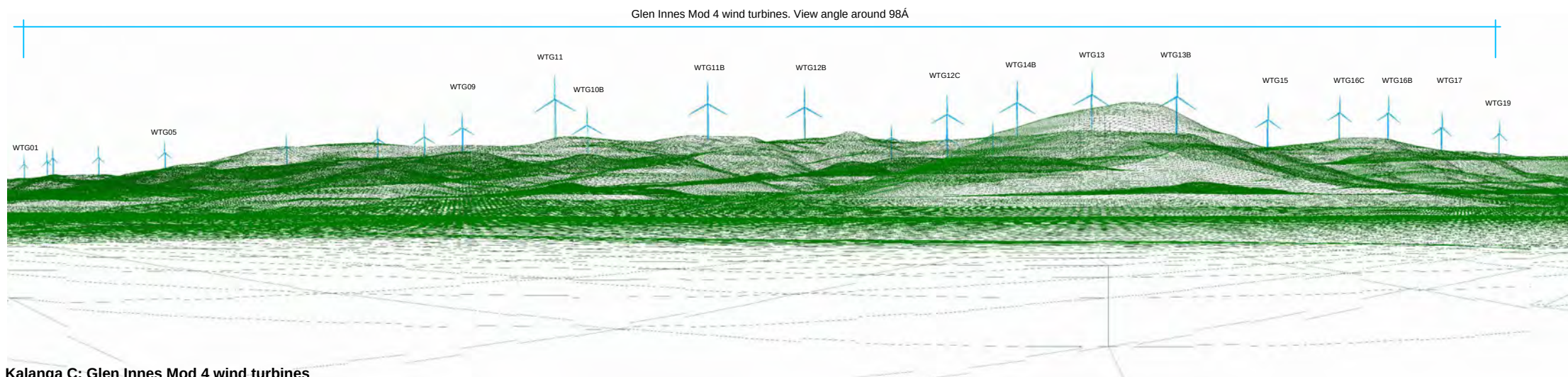


Approved Stage 1 and 2
White Rock wind turbine

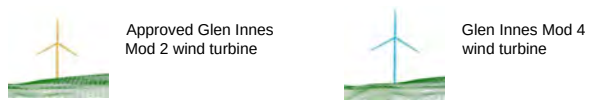
Figure 32 -
Wireframe 26 Lombardy



Kalanga C: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.34 kilometres. Tips visible 25, Hubs visible 21
 Distance to closest Glen Innes Mod 4 wind turbine 2.32 kilometres. Tips visible 25, Hubs visible 23



Kalanga C: Glen Innes Mod 4 wind turbines

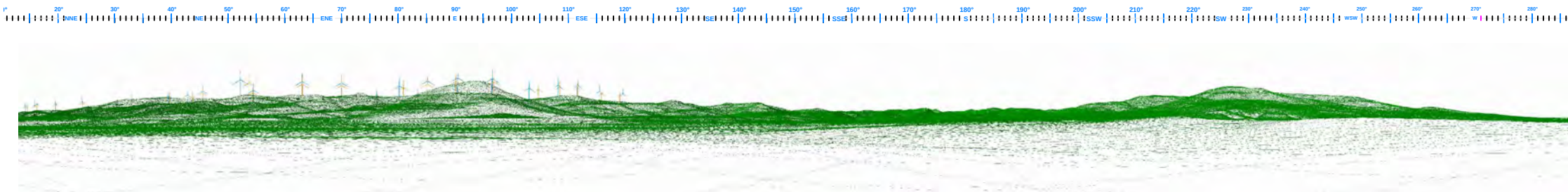


Notes:
 Views toward wind turbines or portions of wind turbines below the green wireframe will be screened by landscape.

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

Figure 33 - Wireframe 27 Kalanga C

Glen Innes Wind Farm Modification 4



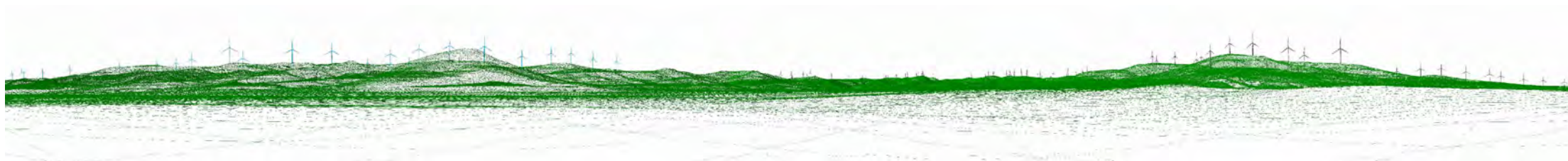
Kalanga C: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.34 kilometres. Tips visible 25, Hubs visible 21

Distance to closest Glen Innes Mod 4 wind turbine 2.32 kilometres. Tips visible 25, Hubs visible 23

Glen Innes Mod 4 wind turbines. View angle around 98°

Approved Stage 1 and 2 White Rock wind turbines
View angle around 140°



Kalanga C: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.32 kilometres. Tips visible 25, Hubs visible 23

Distance to closest White Rock wind turbine 1.88 kilometres. Tips visible 82, Hubs visible 71



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine

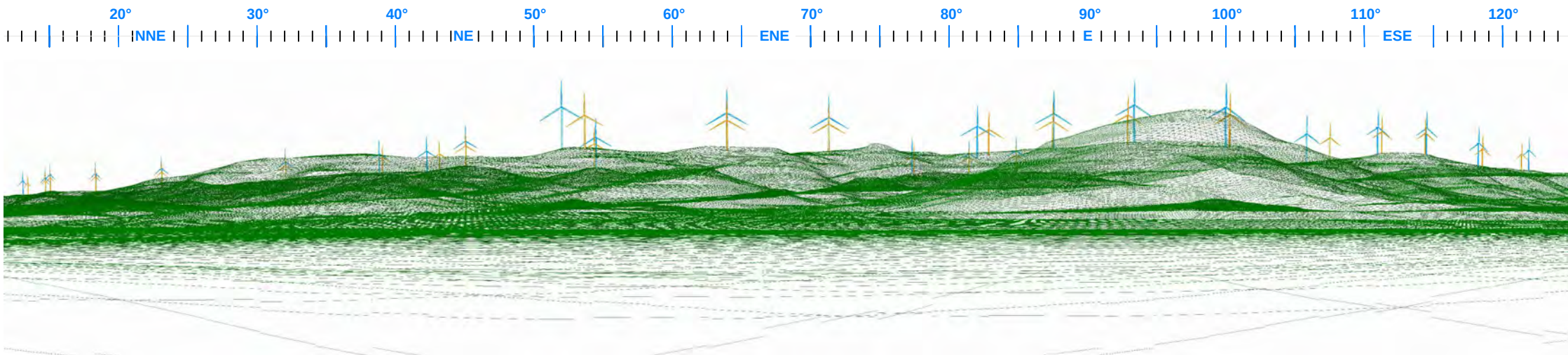


Approved Stage 1 and 2
White Rock wind turbine

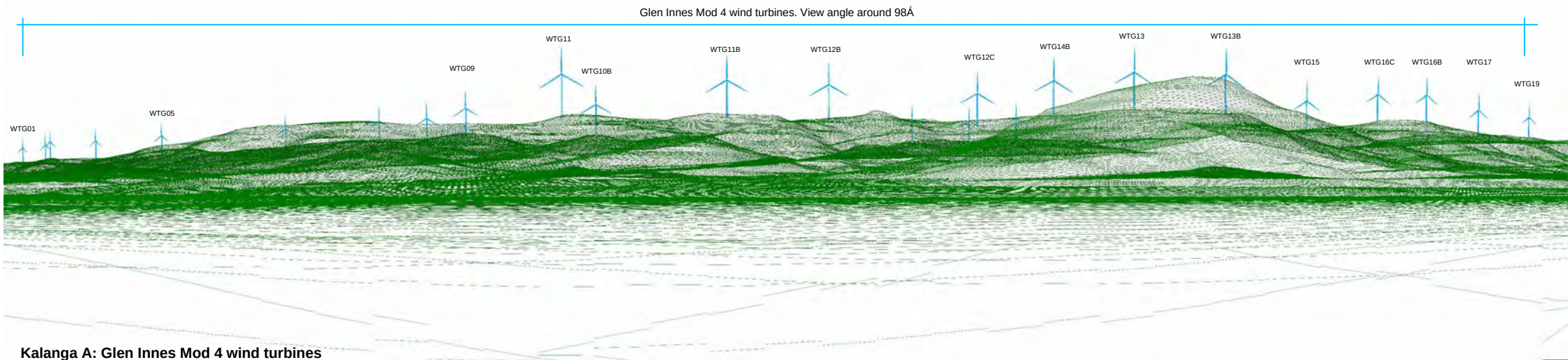
Figure 34 -
Wireframe 28 Kalanga C

GREEN BEAN DESIGN

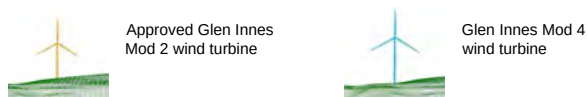
landscape architects



Kalanga A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.16 kilometres. Tips visible 25, Hubs visible 19
 Distance to closest Glen Innes Mod 4 wind turbine 2.31 kilometres. Tips visible 25, Hubs visible 23

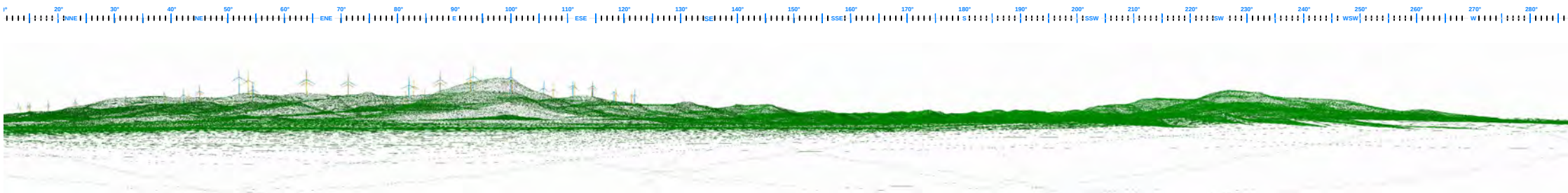


Kalanga A: Glen Innes Mod 4 wind turbines



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

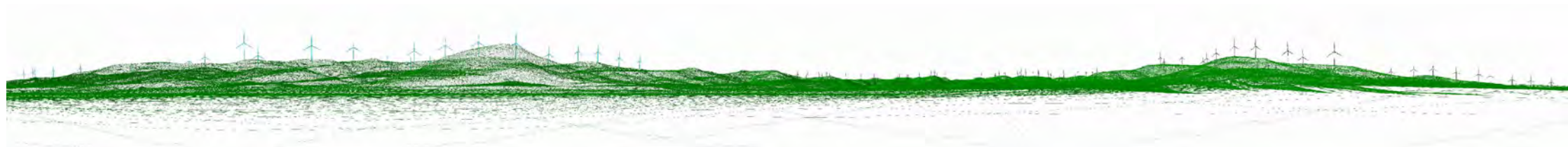
The wireframe model does not account for existing tree cover and/or planting which may screen views toward the wind turbines.



Kalanga A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.16 kilometres. Tips visible 25, Hubs visible 21
 Distance to closest Glen Innes Mod 4 wind turbine 2.13 kilometres. Tips visible 25, Hubs visible 23

Glen Innes Mod 4 wind turbines. View angle around 98°

Approved Stage 1 and 2 White Rock wind turbines
 View angle around 140°



Kalanga A: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines
 Distance to closest Glen Innes Mod 4 wind turbine 2.13 kilometres. Tips visible 25, Hubs visible 23
 Distance to closest White Rock wind turbine 2.06 kilometres. Tips visible 87, Hubs visible 72



Approved Glen Innes Mod 2 wind turbine

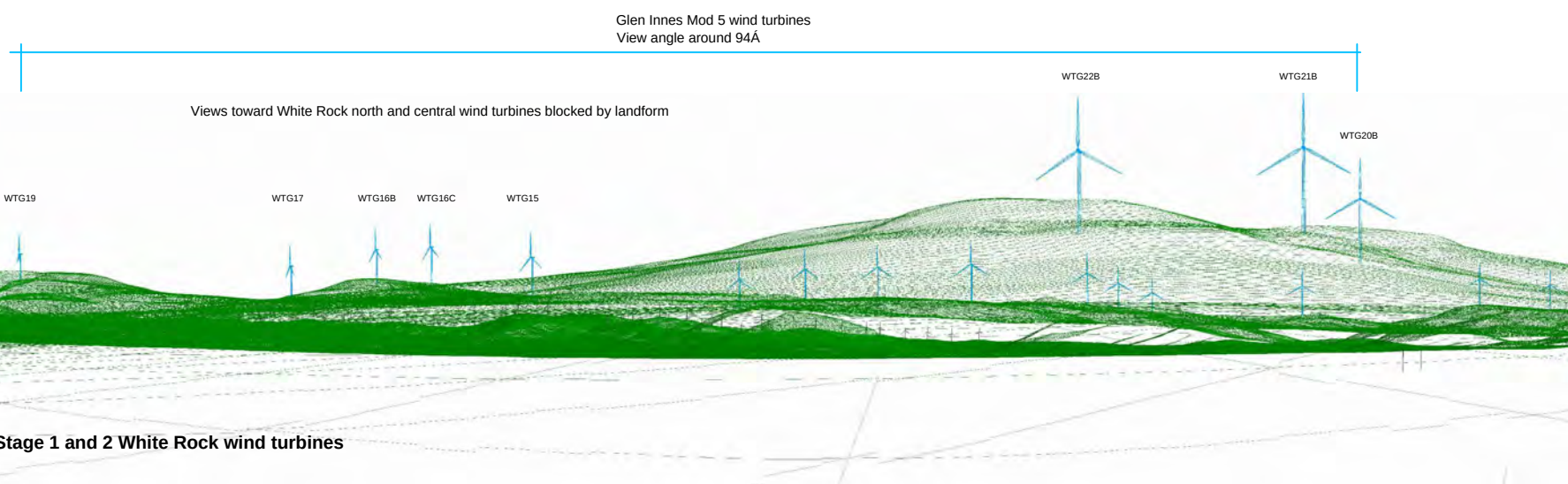
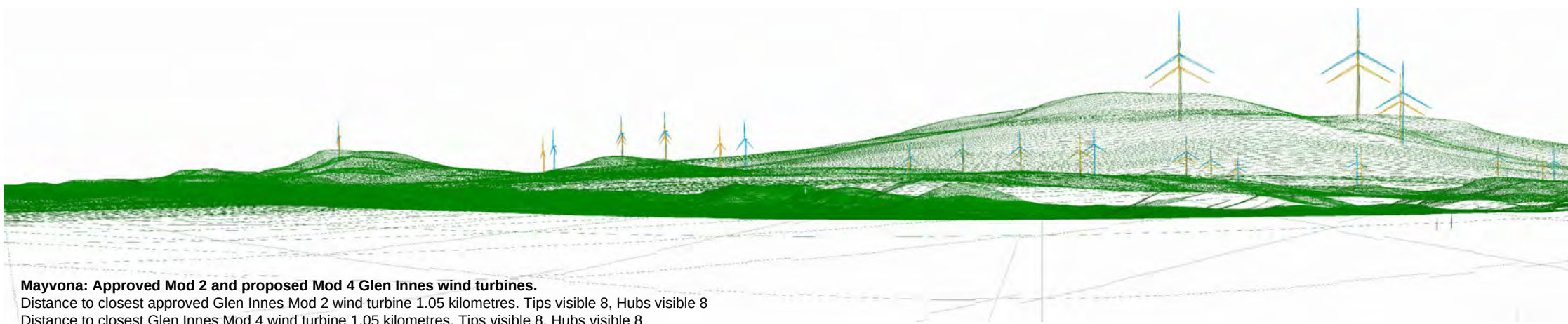


Glen Innes Mod 4 wind turbine



Approved Stage 1 and 2 White Rock wind turbine

Figure 36 - Wireframe 30 Kalanga A



Mayvona: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines



Approved Glen Innes Mod 2 wind turbine



Glen Innes Mod 4 wind turbine

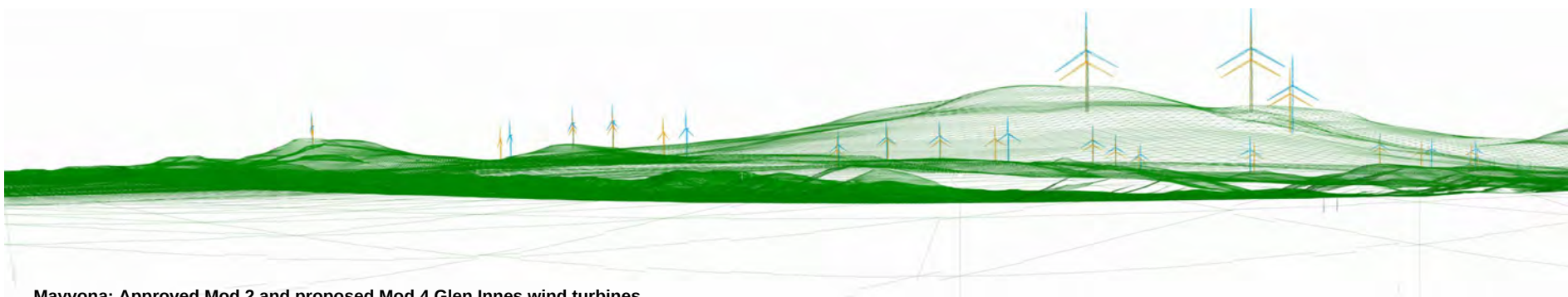
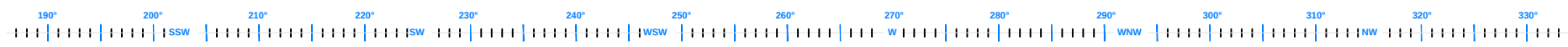


Approved Stage 1 and 2 White Rock wind turbine

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 37 - Wireframe 31 Mayvona



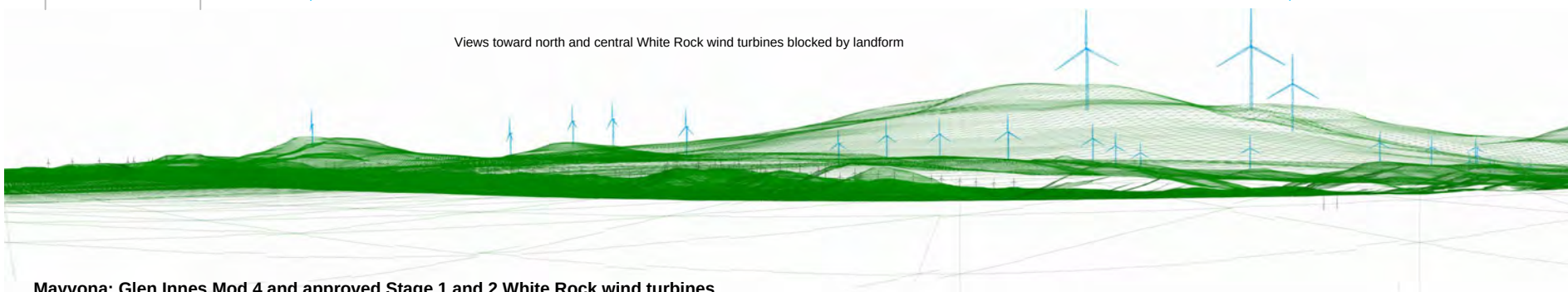
Mayvona: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines
Distance to closest approved Glen Innes Mod 2 wind turbine 1.05 kilometres. Tips visible 8, Hubs visible 8
Distance to closest Glen Innes Mod 4 wind turbine 1.05 kilometres. Tips visible 8, Hubs visible 8

Approved Stage 1 and 2 White Rock wind turbines. View angle around 154°

Glen Innes Mod 4 wind turbines
View angle around 94°



Views toward north and central White Rock wind turbines blocked by landform



Mayvona: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines
Distance to closest Glen Innes Mod 4 wind turbine 1.05 kilometres. Tips visible 8, Hubs visible 8
Distance to closest White Rock wind turbine 6.16 kilometres. Tips visible 13, Hubs visible 7



Approved Glen Innes Mod 2 wind turbine



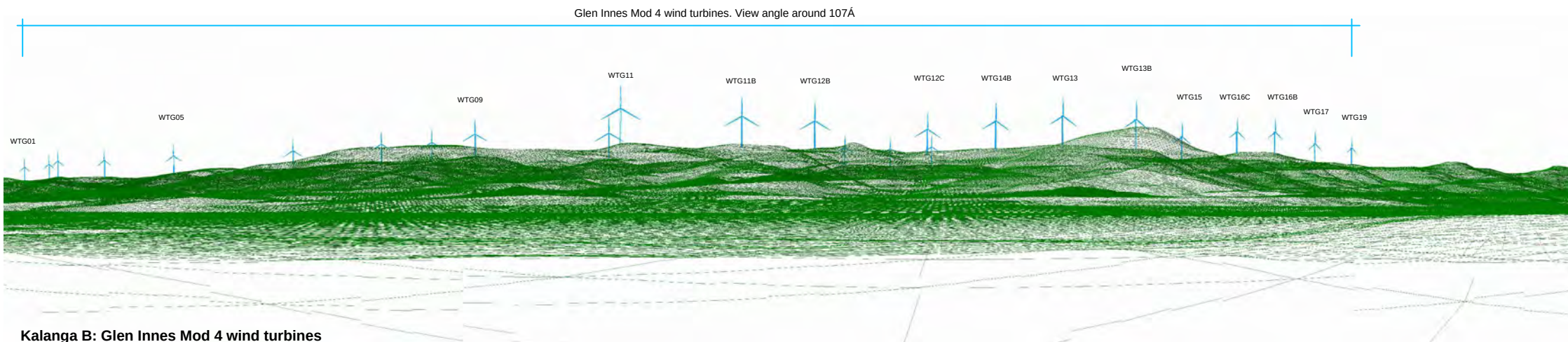
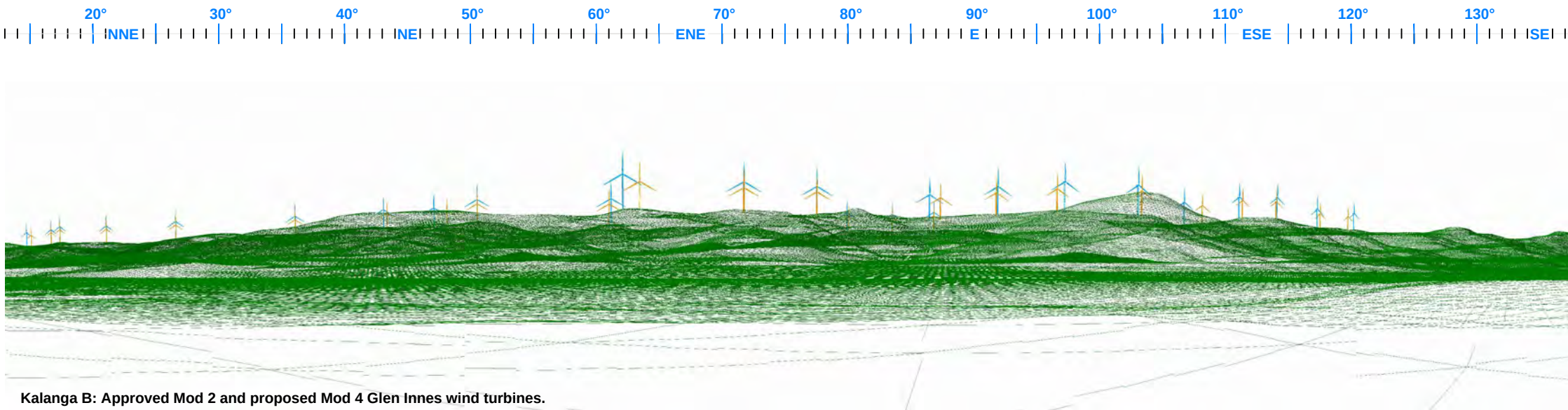
Glen Innes Mod 4 wind turbine



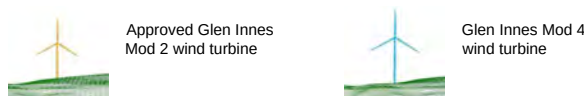
Approved Stage 1 and 2 White Rock wind turbine

Figure 38 - Wireframe 32 Mayvona

Glen Innes Wind Farm Modification 4

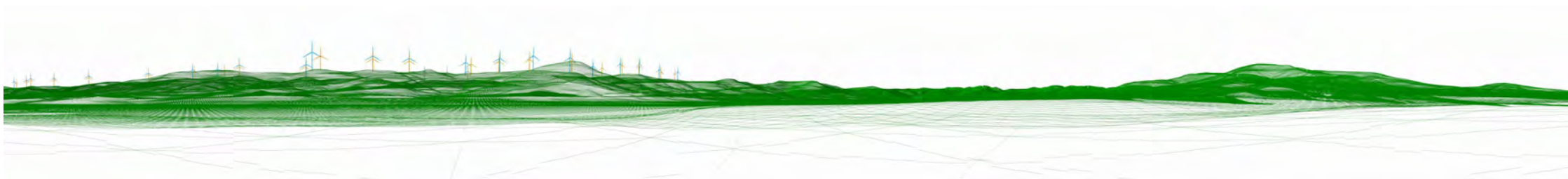


Kalanga B: Glen Innes Mod 4 wind turbines



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.

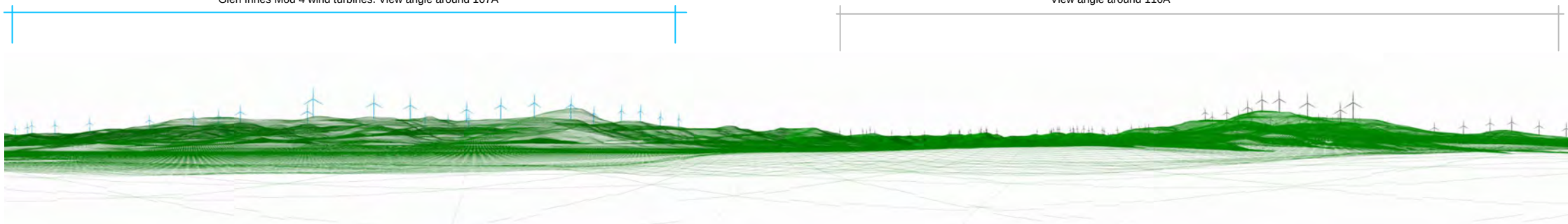


Kalanga B: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.31 kilometres. Tips visible 25, Hubs visible 21
Distance to closest Glen Innes Mod 4 wind turbine 2.26 kilometres. Tips visible 25, Hubs visible 24

Glen Innes Mod 4 wind turbines. View angle around 107°

Approved Stage 1 and 2 White Rock wind turbines
View angle around 116°



Kalanga B: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.26 kilometres. Tips visible 25, Hubs visible 24
Distance to closest White Rock wind turbine 1.95 kilometres. Tips visible 88, Hubs visible 72



Approved Glen Innes
Mod 2 wind turbine

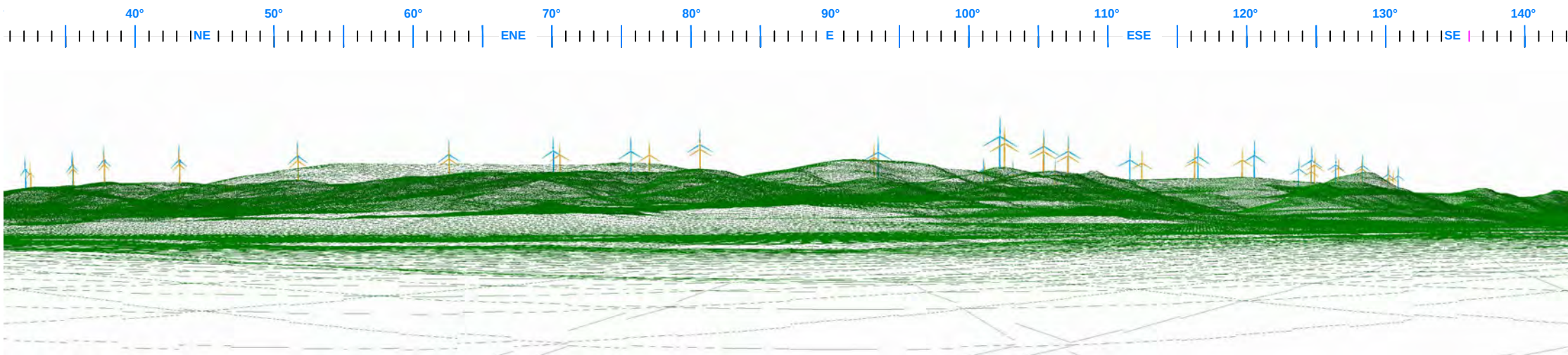


Glen Innes Mod 4
wind turbine

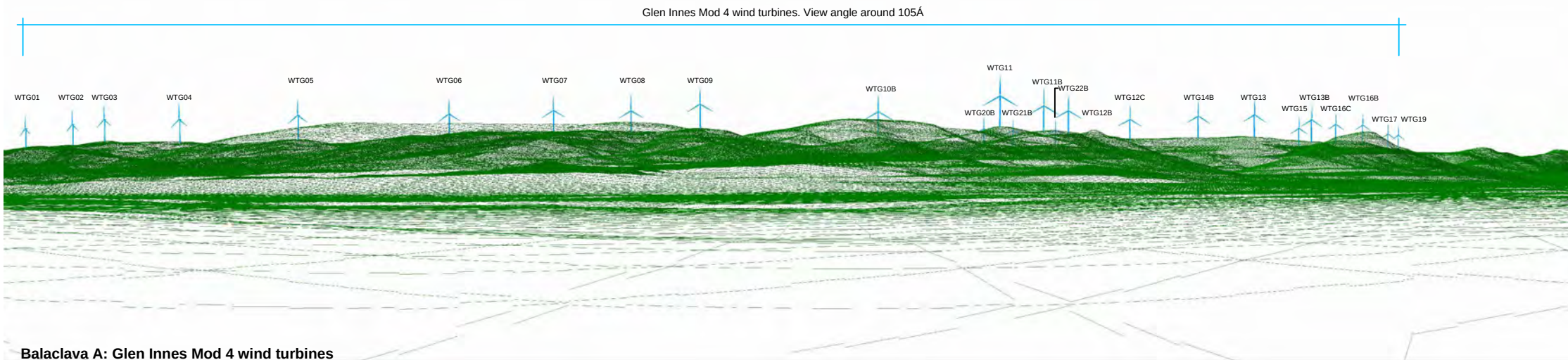


Approved Stage 1 and 2
White Rock wind turbine

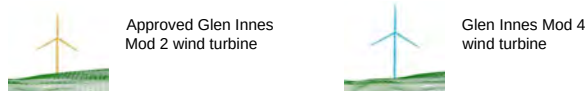
Figure 40 -
Wireframe 34 Kalanga B



Balaclava A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.90 kilometres. Tips visible 25, Hubs visible 22
 Distance to closest Glen Innes Mod 4 wind turbine 2.83 kilometres. Tips visible 25, Hubs visible 24

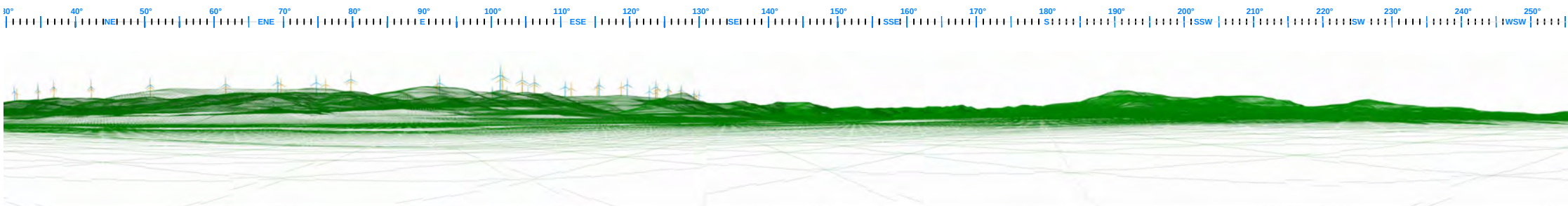


Balaclava A: Glen Innes Mod 4 wind turbines



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.



Balaclava A: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

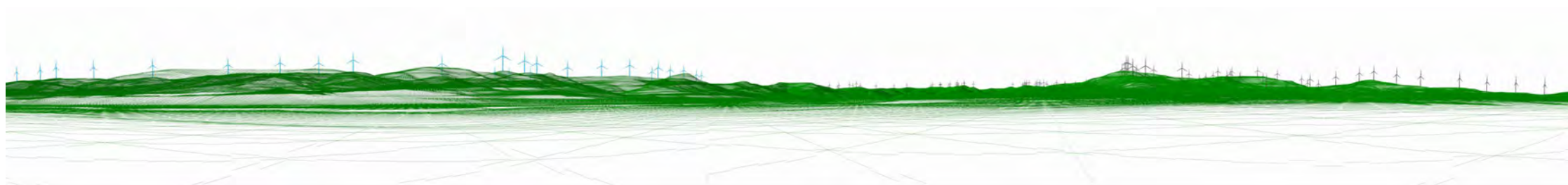
Distance to closest approved Glen Innes Mod 2 wind turbine 2.90 kilometres. Tips visible 25, Hubs visible 22

Distance to closest Glen Innes Mod 4 wind turbine 2.83 kilometres. Tips visible 25, Hubs visible 24

Glen Innes Mod 4 wind turbines. View angle around 105°

View angle around 140°

Approved Stage 1 and 2 White Rock wind turbines



Balaclava A: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.83 kilometres. Tips visible 25, Hubs visible 24

Distance to closest White Rock wind turbine 2.95 kilometres. Tips visible 87, Hubs visible 78



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine

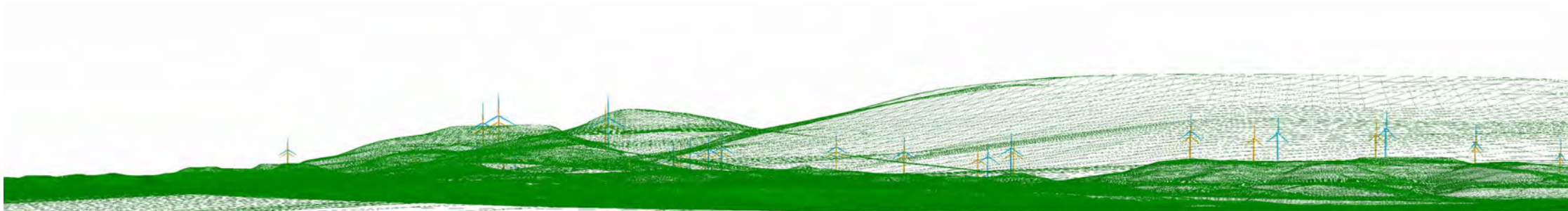


Approved Stage 1 and 2
White Rock wind turbine

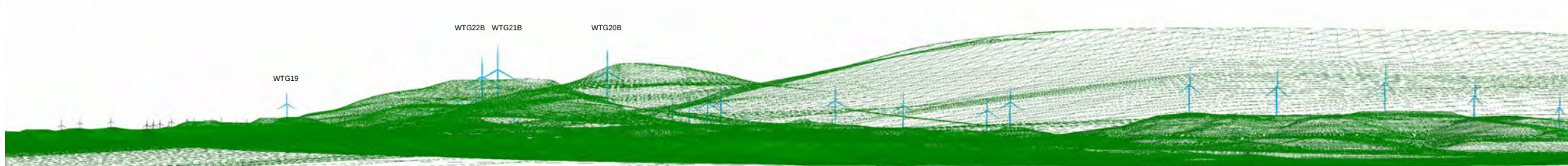
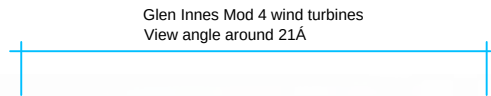
Figure 42 -
Wireframe 36 Balaclava A

GREEN BEAN DESIGN

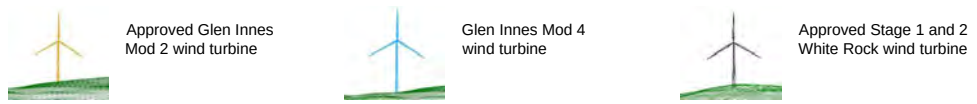
landscape architects



Glengarry: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
 Distance to closest approved Glen Innes Mod 2 wind turbine 2.81 kilometres. Tips visible 4, Hubs visible 2
 Distance to closest Glen Innes Mod 4 wind turbine 2.81 kilometres. Tips visible 4, Hubs visible 3



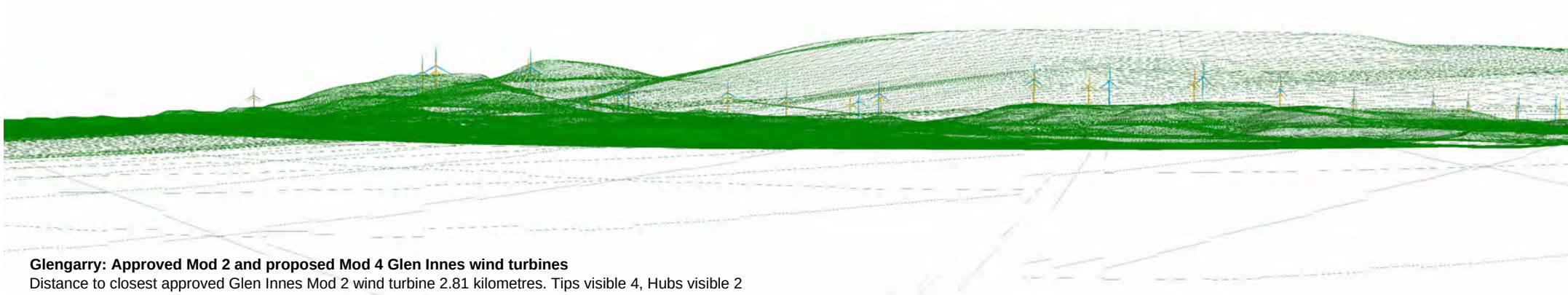
Glengarry: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines



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 43 - Wireframe 37 Glengarry



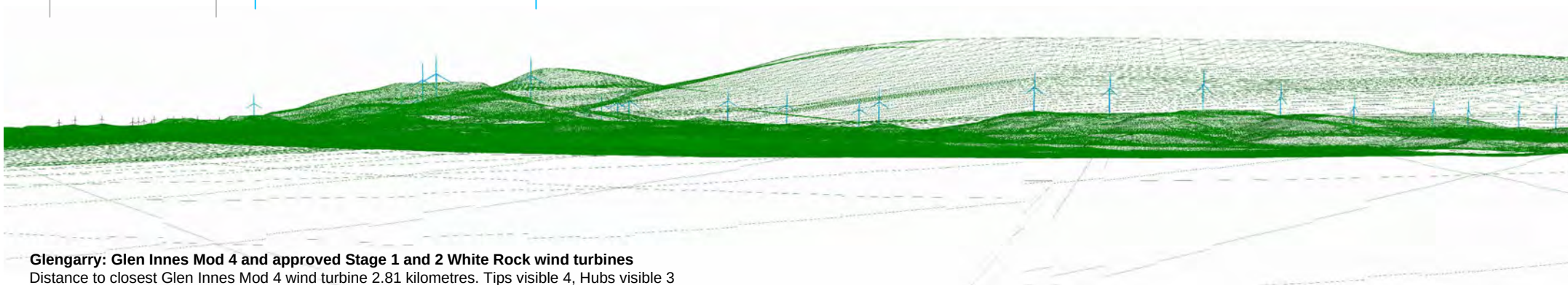
Glengarry: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines

Distance to closest approved Glen Innes Mod 2 wind turbine 2.81 kilometres. Tips visible 4, Hubs visible 2

Distance to closest Glen Innes Mod 4 wind turbine 2.81 kilometres. Tips visible 4, Hubs visible 3

Approved Stage 1 and 2 White Rock
wind turbines. View angle around 18A

Glen Innes Mod 4 wind turbines
View angle around 21A



Glengarry: Glen Innes Mod 4 and approved Stage 1 and 2 White Rock wind turbines

Distance to closest Glen Innes Mod 4 wind turbine 2.81 kilometres. Tips visible 4, Hubs visible 3

Distance to closest White Rock wind turbine 8.64 kilometres. Tips visible 18, Hubs visible 9



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine



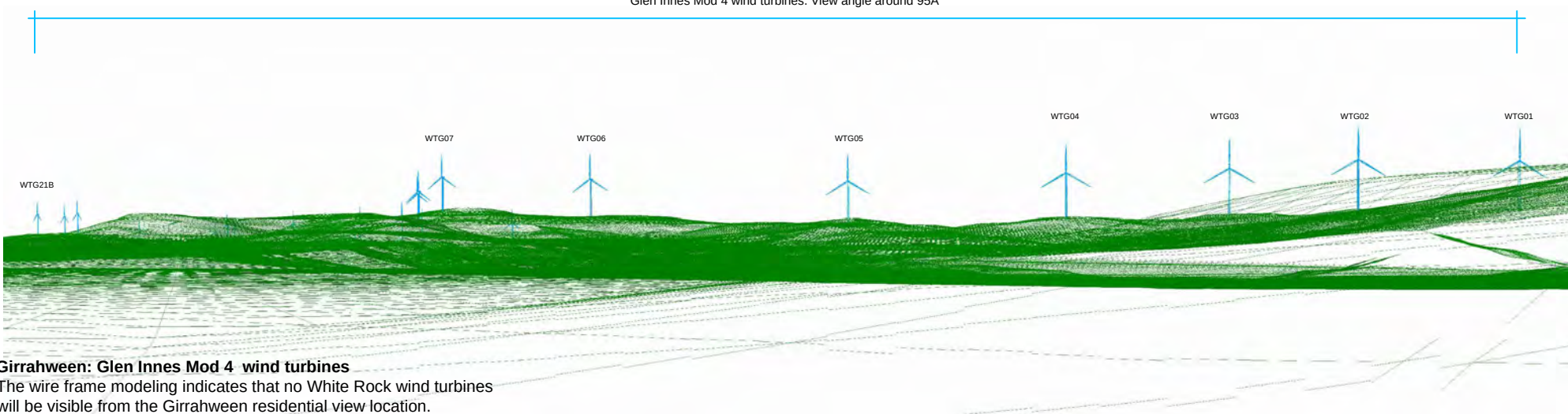
Approved Stage 1 and 2
White Rock wind turbine

Figure 44 -
Wireframe 38 Glengarry



Girraheen: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.
Distance to closest approved Glen Innes Mod 2 wind turbine 2.07 kilometres. Tips visible 14, Hubs visible 12
Distance to closest Glen Innes Mod 4 wind turbine 2.11 kilometres. Tips visible 22, Hubs visible 12

Glen Innes Mod 4 wind turbines. View angle around 95°



Girraheen: Glen Innes Mod 4 wind turbines
The wire frame modeling indicates that no White Rock wind turbines will be visible from the Girraheen residential view location.



Approved Glen Innes Mod 2 wind turbine

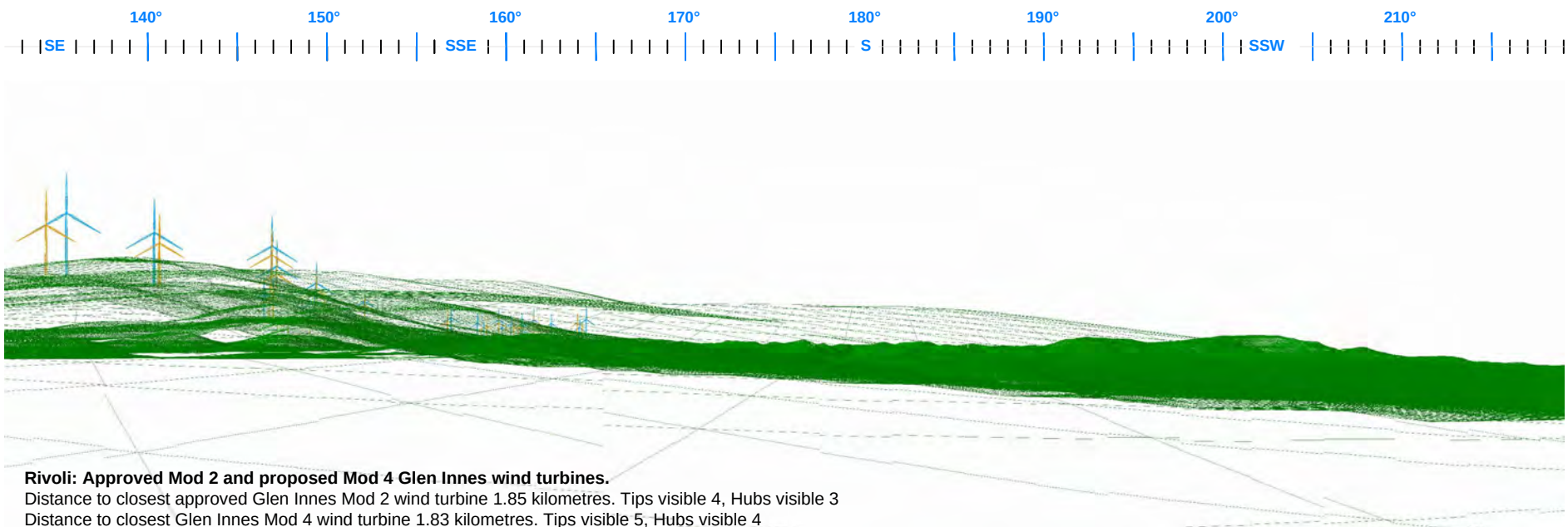


Glen Innes Mod 4 wind turbine

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 45 - Wireframe 39 Girraheen



Approved Glen Innes Mod 2 wind turbine



Glen Innes Mod 4 wind turbine

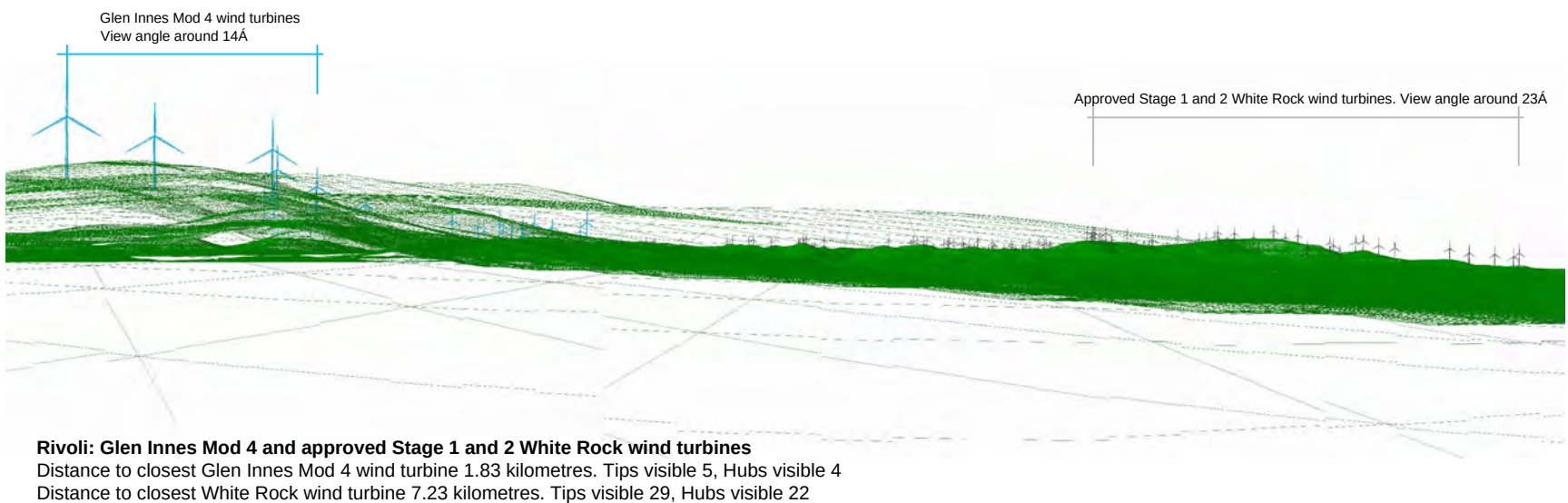
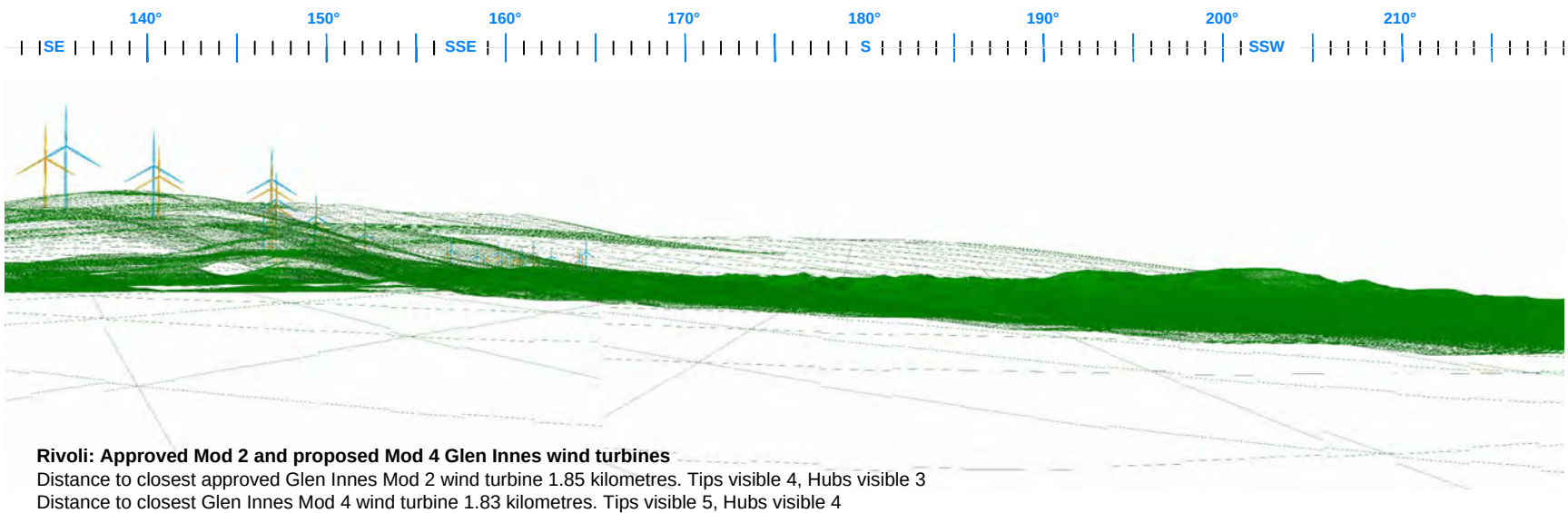


Approved Stage 1 and 2 White Rock wind turbine

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 46 - Wireframe 40 Rivoli



Approved Glen Innes
Mod 2 wind turbine

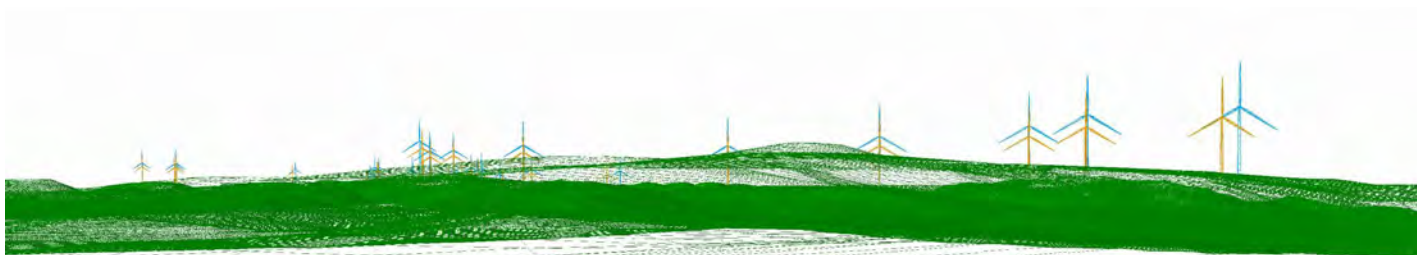


Glen Innes Mod 4
wind turbine



Approved Stage 1 and 2
White Rock wind turbine

Figure 47 -
Wireframe 41 Rivoli

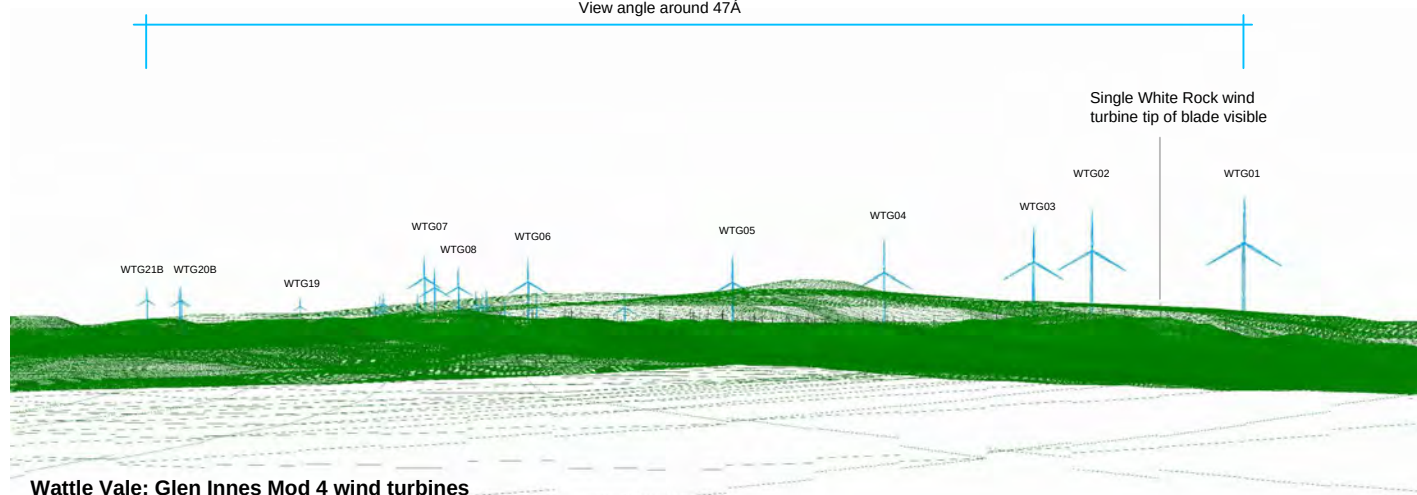


Wattle Vale: Approved Mod 2 and proposed Mod 4 Glen Innes wind turbines.

Distance to closest approved Glen Innes Mod 2 wind turbine 1.90 kilometres. Tips visible 22, Hubs visible 15

Distance to closest Glen Innes Mod 4 wind turbine 1.94 kilometres. Tips visible 25, Hubs visible 18

Glen Innes Mod 4 wind turbines
View angle around 47A



Single White Rock wind
turbine tip of blade visible

WTG02

WTG01

WTG03

WTG04

WTG05

WTG06

WTG07

WTG08

WTG19

WTG21B

WTG20B

Wattle Vale: Glen Innes Mod 4 wind turbines



Approved Glen Innes
Mod 2 wind turbine



Glen Innes Mod 4
wind turbine

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 48 -
Wireframe 42 Wattle Vale

10 Review of Conditions of Consent

10.1 Introduction

The GIWF consolidated Mod-2 and Mod-3 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.

10.2 Review of Conditions of Consent

The following Table outlines the existing Conditions relevant to mitigate the potential visual effects of the GIWF proposed Mod-4.

Table 9 Conditions of Consent

Condition	Description	Comment
Condition 2.1	Prior to the commencement of construction, the Proponent shall notify in writing the owner/s of non-associated residences within 4 kilometres of any wind turbine that they have the right to request implementation of visual impact mitigation measures at their residence if the wind turbines would be visible from the residence (including its curtilage). Note: If the construction of the development is being staged, the Proponent is only required to notify those owners that would be within 4 kilometres of any wind turbine that forms part of the relevant stage.	This condition remains valid.
Condition 2.1A	If following the commencement of construction, the Proponent receives a written request from the owner of any residence referred to in condition 2.1 above for the implementation of visual impact mitigation measures, then the Proponent shall implement measures such as landscaping treatments or vegetation screens at the residence (including its curtilage) in consultation with the landowner. These mitigation measures must be reasonable and feasible, directed towards reducing the visual impacts of the wind turbines on the residence (including its curtilage), and commensurate with the level of visual impact. The 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	This condition remains valid.

Condition	Description	Comment
	implementation of these measures, then either party may refer the matter to the Secretary for resolution. Notes: • To avoid any doubt, the visual impact mitigation measures must be aimed at reducing the visibility of the wind turbines from the residence and its curtilage. Mitigation measures are not required to be implemented to reduce the visibility of wind turbines from other locations on the property. • In some cases, mitigation measures may not be warranted as the wind turbines would not be visible from the residence and its curtilage. • The identification of appropriate visual impact mitigation measures will be easier following the construction of the wind turbines. While landowners may ask for the implementation of visual impact mitigation measures shortly after the commencement of construction, they should consider the merits of delaying this request until the wind turbines are visible from their residence.	
Condition 2.2	Prior to the commencement of operation, the Proponent shall consult with Council and the RMS in relation to the need to provide landscaping screening measures along public road reserves including but not limited to the Gwydir Highway and shall report to the Secretary on the outcomes of this consultation. The Proponent shall implement landscaping screening measures in accordance with the Secretary's requirements.	This condition remains valid.
Conditions 2.3	Wind turbine generators shall be painted matt off-white/grey. The blades shall be finished with a surface treatment that minimises any potential for glare or reflection.	These conditions remain valid.
Condition 2.4	No advertising, signs or logos shall be mounted on the turbines, except where required for safety purposes. A corporate logo may be placed on the turbines provided it is not distinguishable by the naked eye from any publicly accessible location or from any, properties not associated with the project.	This condition remains valid.

Condition	Description	Comment
Condition 2.7	Prior to the commencement of construction, the Proponent shall in consultation with Council and/or the RMS, investigate the potential for a wind farm viewing site, interpretive signage and associated facilities to be installed and maintained in the locality. If required by Council and/or the RMS, the Proponent shall install a viewing site, signage and associated facilities. Responsibilities for maintenance of the viewing site shall be agreed to between the Proponent and Council and/or the RMS.	This condition remains valid.
Condition 6.5	As part of the Operational Environmental Management Plan required under condition 6.4, the Proponent shall prepare and implement the following management plans: b) a Landscape Management Plan to outline measures to ensure appropriate development and maintenance of landscaping on the site to address the visual impacts arising from the project including, turbines, site access roads, substation and control and facilities building, as far as is reasonable and feasible. The Plan shall be prepared by a qualified landscape architect and meet the requirements of Council.	This condition remains valid.
Condition 25	<i>"No external lighting other than low intensity security night lighting of infrastructure associated with the project, including wind turbine generators is permitted on site unless otherwise agreed or directed by the Secretary."</i>	It is requested that GIWF consent condition 25 be replaced with the following, or similar: <i>"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</i>

Condition	Description	Comment
		<i>intrusion to surrounding non-associated residences as far as reasonable and feasible."</i>

11 Conclusion

A determination for potential increases to the visual effects associated with the approved GIWF Mod-2 has been based upon professional judgement in consideration of:

- the proposed Mod-4 amendments to the wind turbine layout
- the blade length (and tip height difference) between approved GIWF Mod-2 and proposed Mod-4 wind turbines
- the overall visibility and visual scale of the GIWF Mod-4 wind turbines and
- the GIWF Mod-4 magnitude of visual effect compared to the approved Mod-2 wind turbines.

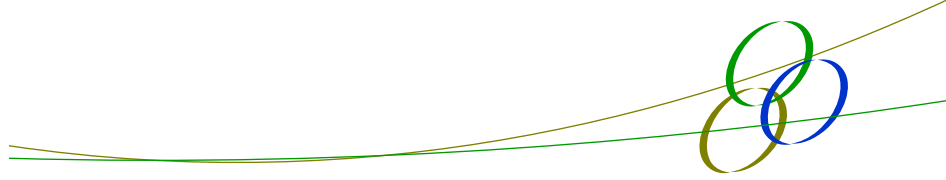
This VIA has illustrated and compared the approved GIWF Mod-2 project against the proposed GIWF Mod-4 wind turbine design and layout. This VIA concludes that the proposed increase in wind turbine tip height would be discernible from some surrounding and proximate view locations where views toward the approved GIWF Mod-4 wind turbines exist. Additional levels of visibility would be limited to two or three wind turbine hubs and/or blade tips. The GIWF 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 GIWF Mod-2 development.

This VIA has addressed the Guidelines and established Visual Influence Zones for residential dwellings located within 3.6 kilometres in accordance with the Guideline requirements.

Whilst the approved GIWF Mod-2 and the proposed Mod-4 wind turbines would be visible (in whole or in part) from the majority of residential dwellings within 3.6 kilometres of wind turbine locations, overall visibility would be partially restricted from many areas (including from dwellings and associated curtilage) due to tree cover and/or the influence of surrounding landforms. The implementation of landscape works would provide visual mitigation for a number of dwellings surrounding the approved wind farm site in accordance with the Conditions of Consent.

Appendix 4

Shadow Flicker Assessment



Shadow Flicker Assessment

Glen Innes Wind Farm, NSW

AU-GLEI-WT-03-002-A-2

Document Revisions

Rev	Issued/ Date	Checked/ Date	Approved/ Date	Description of change
A-0	15/11/2016	18/11/2016	25/01/2017	Initial Issue
A-1	25/05/2017	16/05/2017	31/05/2017	Updated layout (02-000) and hub height
A-2	13/06/2017	14/06/2017	14/06/2017	Update of Assessment Criteria

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Table of Contents

1	Introduction	3
2	Assessment Criteria	4
2.1	NSW Wind Energy: Visual Assessment Bulletin (DPE, 2016)	4
2.2	NSW Planning Guidelines: Wind Farms (Draft for Consultation December 2011)	4
2.3	Section 75J Project Approval	4
3	Methodology.....	5
4	Results.....	5
4.1	Shadow Flicker caused by Turbines within 2,000 m of a neighbouring residence	5
5	Mitigation Measures.....	7
6	Blade Glint.....	8
7	Conclusion	9
Appendix A.	Senvion 3.6M 140 Wind Turbine Dimensions	10
Appendix B.	Layout (02-000)	11
Appendix C.	Doc. no.: PD-0.0-WT.PO.00-B-B-EN	12

1 Introduction

Shadow flicker is the fluctuation of light levels that can appear to flicker to an observer at a fixed ground location or by movement of an observer relative to stationary shadows. The effect will occur under circumstances where the wind turbine location and orientation is such that at certain times of the day, the sun's rays pass behind the swept area of the rotating blades and affect the viewpoint.

A shadow flicker study was completed in the 2008 Environmental Assessment based upon Turbine Layout Revision 31 August 2007. The turbine details on which the assessment was based upon had the following characteristics:

- A turbine rotation speed varying up to about 18 rpm and a three-bladed turbine;
- An 80 m hub height; and
- A rotor diameter of 100 m (130 m maximum blade tip height)

In 2013 this was amended in a report by Aurecon which included minor revisions of the layout and a turbine model with the following specifications:

- Maximum blade tip height of up to 150 m
- Tower height of 89 m
- Blade length of 59.3 m
- Maximum blade cord length of 3.95 m
- Rotor diameter of 122 m
- Rated rotor speed of 12.25 rpm.

A number of further revisions have been made and this report assesses the use of the Servion 3.6M140 turbine model which has the following specifications:

- Hub height of 110 m
- Blade length of 70m
- Max blade tip height of 180 m
- Max blade chord length of 4.257 m
- Rotor diameter of 140 m

See Appendix 1: Servion 3.6M 140 Wind Turbine Dimensions.

The layout has also been updated (layout 02-000), see Appendix B.

2 Assessment Criteria

2.1 NSW Wind Energy: Visual Assessment Bulletin (DPE, 2016)

This Bulletin provides the current NSW guideline for the assessment of shadow flicker as follows:

Shadow, Flicker & Blade Glint

The shadow flicker caused by certain sun angles in relation to the rotation of wind turbine blades on dwellings will be limited to 30 hours per year, and may require mitigation measures such as amended siting and design of turbines to minimise the amount of shadow flicker.

The 30 hours limit is used for this assessment.

2.2 NSW Planning Guidelines: Wind Farms (Draft for Consultation December 2011)

The now repealed December 2011 draft Planning Guidelines required:

Shadow flicker

The impact of 'shadow flicker' from wind turbines on neighbours' houses within 2 km of a proposed wind turbine should be assessed. The shadow flicker experienced at any dwelling should not exceed 30 hours per year as a result of the operation of the wind farm. Specialist modelling software should be used to model shadow flicker impacts prior to the finalisation of the turbine layout.

A 2km extent has been adopted as a reasonable area within which to consider shadow flicker which also aligns with the projects previously approved assessments.

2.3 Section 75J Project Approval

Project approval for Glen Innes Wind Farm was granted by the NSW Minister for Planning, subject to the conditions outlined in Schedule 2. The Conditions of Approval associated with Shadow flicker effects state:

"2.6 Shadow Flicker arising from the operation of the project shall not exceed 30 hours/annum at any residence not associated with the project.

Within 6 months of the commencement of operation of the project (or such other period agreed to by the Director-General), the Proponent shall prepare a Shadow Flicker Report for the approval of the Director-General which assesses the impact of blade flicker at Cherry Tree, being Lot 89 DP 753270 and Highfields, being Lot 2 DP 229974."

This was also amended in January 2016 to include the addition at the end of the condition of:

"Mayvona, being Lot 45 DP 3191 and Ilparran B, being Lot 1 DP 225300"

The 30 hours limit in the project approval aligns NSW Wind Energy: Visual Assessment Bulletin discussed above and is used for this assessment. The four lots identified in the project approval are included in the assessments.

3 Methodology

Senvion has undertaken a shadow flicker assessment using the EMD WindPRO 3.0 software package. The model simulates the path of the sun during the year and can calculate the relative positions of the sun, wind turbines, dwellings and terrain to predict the possible shadow flicker durations in the vicinity of the wind farm development from a purely geometrical standpoint. This calculation gives the theoretical number of hours of shadow flicker experienced at the dwelling.

The shadow flicker model was calculated to a distance of 2,000 m and calculations were performed at 10-minute time intervals with a resolution of 10 m. The turbine orientation was set with the rotor plane facing the azimuth at 180° relative to all receivers. A digital terrain model based on <0.15m accurate LiDAR was used to calculate turbine and sun visibility with visibility line-of-sight algorithm checks set at every 10 m. Window height of 2 m, and 2016 was used as the modelling year for sun position calculation.

All Dwelling locations were confirmed using a 15cm resolution ortho-image captured by aerial survey completed Thursday, 11 February 2016.

4 Results

4.1 Shadow Flicker caused by Turbines within 2,000 m of a neighbouring residence

The results of the shadow flicker analysis are shown in Figure 1 and represent the worst-case theoretical hours per year and locations of shadow flicker effects. Table 1 below provides the locations of residential dwellings within 2000 m of either the approved turbine layout or proposed modification layout. There are 11 dwellings in total, three are associated with the project and eight are not involved.

Residence	Type	Nearest WTG (m)	Shadow Flicker hours/annum (Theoretical)
Hillside	vacant windfarmer residence	814	-
Mayvona	vacant surrounding residence	1,060	58.5
Glengyle	windfarmer residence	1,116	72.0
Ilparran B	vacant surrounding residence	1,299	48.4
Ilparran A	surrounding residence	1,383	42.4
Highfields	surrounding residence	1,420	29.95
Wattle Vale	surrounding residence	1,821	-
Cherry Tree (Eungai)	surrounding residence	1,932	-
Rose Hill B	windfarmer residence	1,932	9.3
Green House	vacant surrounding residence	1,941	-
Rivoli	surrounding residence	1,982	-

Table 1: Theoretical Shadow Flicker Durations

With consideration of condition 2.6 of approval, the maximum theoretical shadow flicker duration is predicted to exceed 30 hours per annum at the occupied Ilparran A and Glengyle residences (along with the vacant Ilparran B and Mayvona residences).

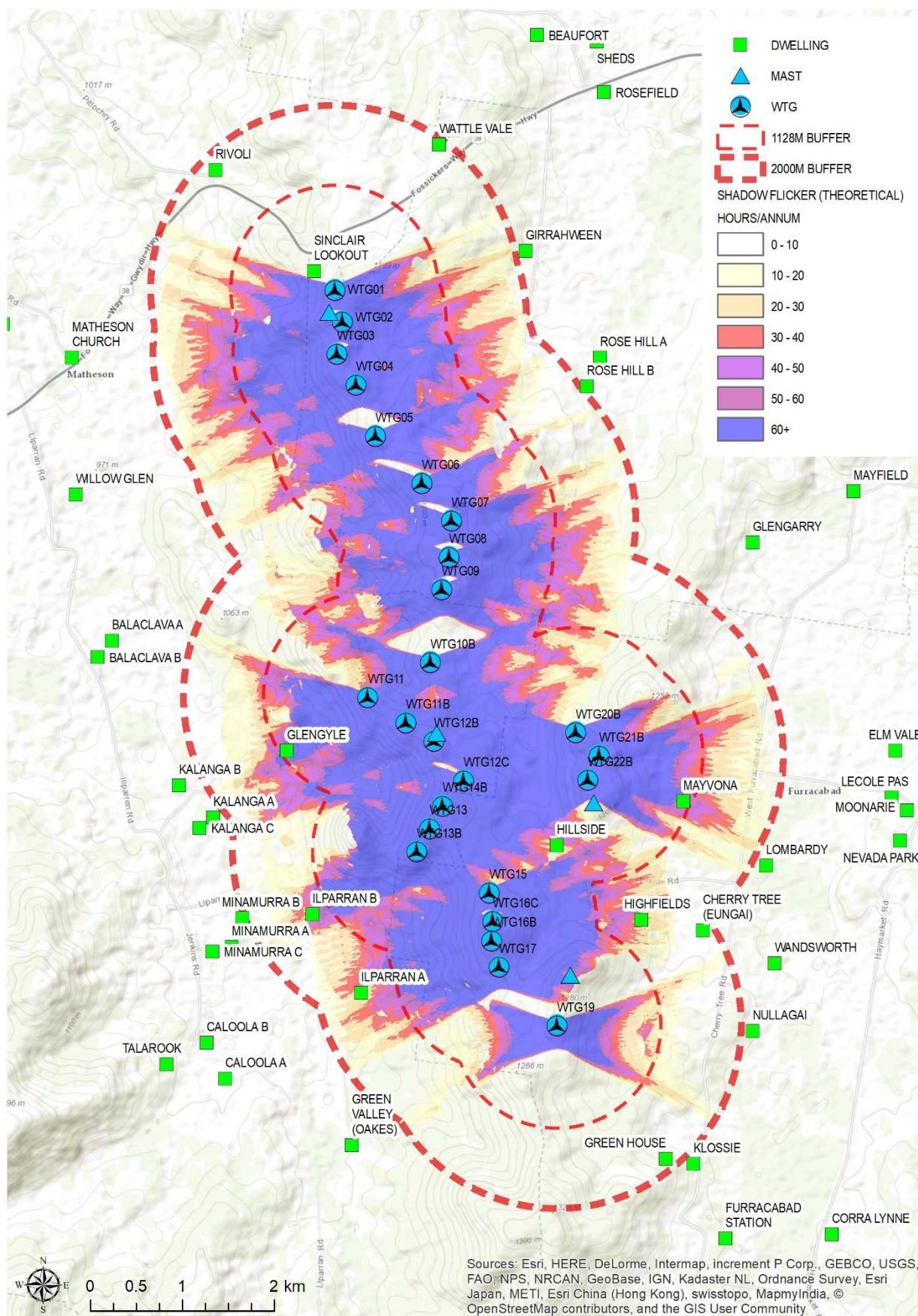


Figure 1: Calculated Theoretical Shadow Flicker

5 Mitigation Measures

Senvion offers an optional product on all wind turbines called Shadow Management. This system has been proven in Europe as an effective measure for limiting shadow flicker.

Senvion Shadow Management Advanced (see appendix C: Doc. no.: PD-0.0-WT.PO.00-B-B-EN) can be used for the control of the wind turbines to comply with the relevant shadow flicker reference values through the intelligent shutdown of turbines.

This technology incorporates a light sensor on a nearby mast or top of relevant turbines and a site-specific configuration to allow certain turbines to automatically shut-off turbines during known shadow flicker events.

It is proposed to use a configuration to limit the operations of the turbines at the following occupied dwellings:

Residence	Active Management WTGs	Resulting theoretical hours per year, after management
Glengyle	10B, 11B, 12C, 14B	29.4
Ilparran A	17, 19	28.0

Table 2: Theoretical Shadow Flicker Durations, after management

Residence	Approved 2013	Resulting theoretical hours per year, after management	Change
Hillside	7.0	-	-7.0
Mayvona	42.0	58.5	16.5
Glengyle	42.0	29.4	-12.6
Ilparran B	37.0	48.4	11.4
Ilparran A	29.0	28.0	-1.0
Highfields	20.0	29.95	9.95
Wattle Vale	-	-	-
Cherry Tree	-	-	-
Rose Hill B	N/A	11.4	N/A
Green House	-	-	-
Rivoli	-	-	-

Table 3: Comparison with Aurecon 2013 Assessment

6 Blade Glint

Blade glint refers to the reflection of the sun's light from the surface of wind turbine blades. Blade glint has the potential to be a distraction to drivers if roads are aligned towards turbines. This can be a temporary effect at any particular location. The occurrence of blade glint depends on a number of conditions including the orientation of the nacelle, angle of the blade, and the angle of the sun. The reflectivity of the surface of the blades is also most important, and is influenced to some extent by colour and age of the blade.

Blade glint is an aspect that could be a potential distraction to drivers if roads are aligned towards turbines, particularly where the road is located at a higher altitude to the turbine hub and can be noticed over some distance, as much as 10 km if high reflectivity paint were to be utilised.

This issue is generally managed by ensuring that the finish on the turbine blades will reduce the extent of the effect. To this end, condition 2.3 of the consent for the approved project requires that:

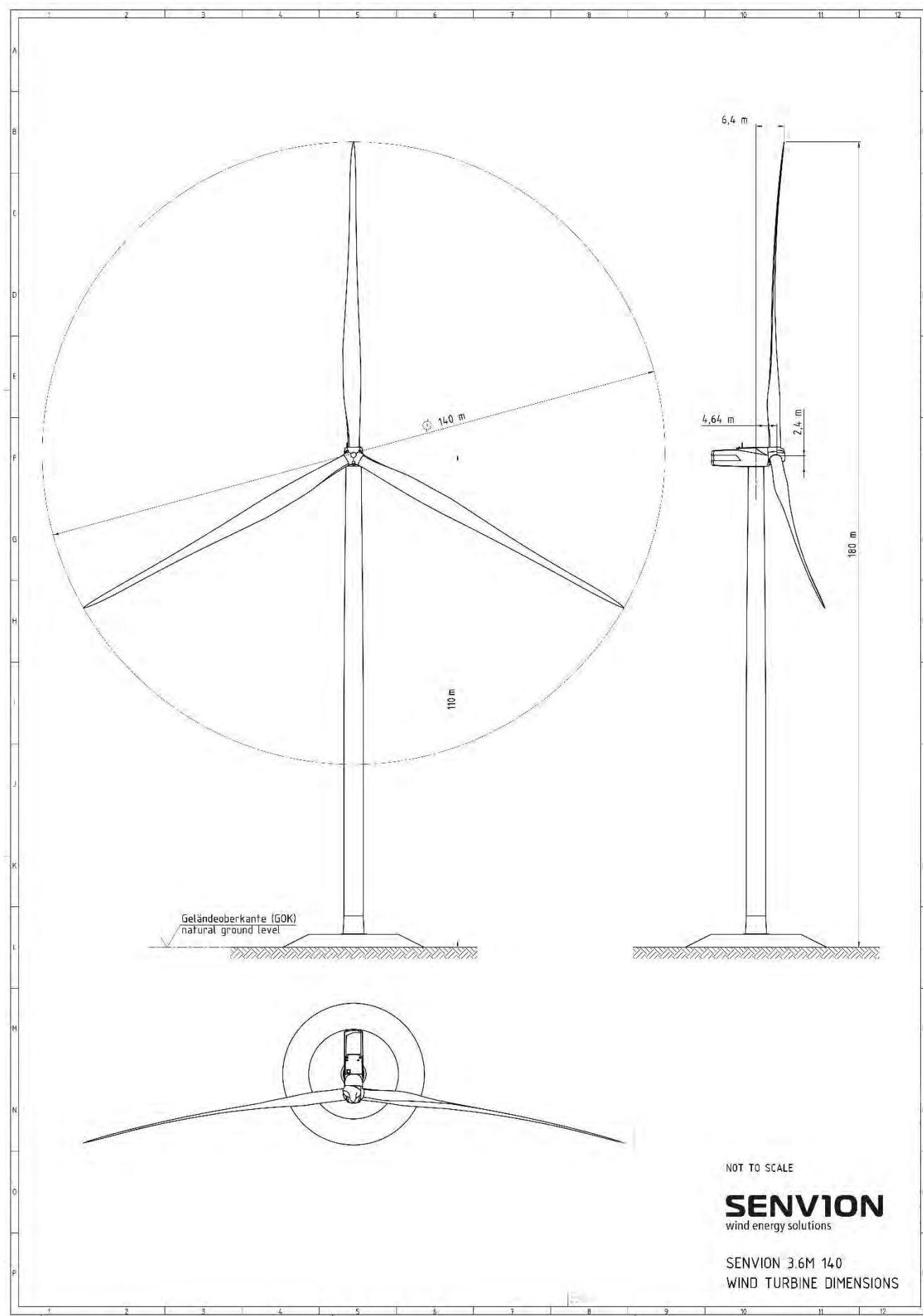
“generators shall be painted matt-off-white/grey. The blades shall be finished with a surface treatment that minimises any potential for glare or reflection”.

The Senvion 3.6M140 blades, nacelle and tower are coloured light grey (RAL 7035) to reduce the effects of reflections.

7 Conclusion

- This report has undertaken a calculation of shadow flicker using the EMD WindPRO 3.0 software package.
- A digital terrain model based on <0.15m accurate LiDAR was used to calculate turbine and sun visibility with visibility line-of-sight.
- All Dwelling locations were confirmed using a 15cm resolution ortho-image captured by aerial survey completed Thursday, 11 February 2016.
- The results of which have been assessed against the NSW Wind Energy: Visual Assessment Bulletin (DPE, 2016), the current NSW guideline for the assessment of shadow flicker.
- A 2km extent has been adopted from the NSW Planning Guidelines: Wind Farms (Draft for Consultation December 2011) as a reasonable area within which to consider shadow flicker which also aligns with the projects previously approved assessments.
- Consideration was also give Section 2.6 of the Conditions of Approval for the project.
- Based on the initial calculation of annual Theoretical Shadow Flicker Durations some Mitigation Measures were required. A control strategy, Shadow Management Advanced, has been proposed that would implement an intelligent shutdown of turbines 10B, 11B, 12C, 14B, 17 and 19.
- After the implementation of Shadow Management Advanced, in all cases Shadow Flicker arising from the operation of the project shall not exceed 30 hours/annum at any occupied residence.

Appendix A. Senvion 3.6M 140 Wind Turbine Dimensions



Appendix B. Layout (02-000)

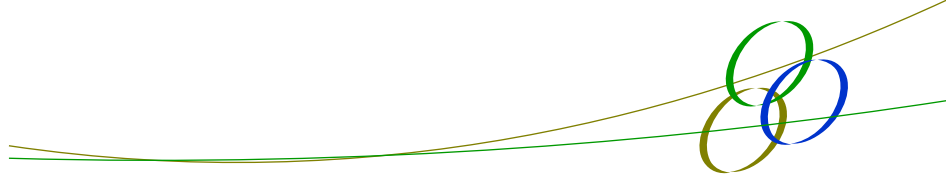
Coordinate in GDA94 Zone 56

WTGID	Easting	Northing
WTG01	364902.3	6710276
WTG02	364985	6709936
WTG03	364926	6709583
WTG04	365131	6709251
WTG05	365343	6708692
WTG06	365850	6708179
WTG07	366170.3	6707771
WTG08	366146	6707375
WTG09	366063	6707025
WTG10B	365939.9	6706230
WTG11	365258.4	6705851
WTG11B	365675	6705575
WTG12B	365980	6705375
WTG12C	366301.9	6704947
WTG13	365933.2	6704425
WTG13B	365792.7	6704174
WTG14B	366071.3	6704671
WTG15	366579.8	6703727
WTG16B	366605.2	6703206
WTG16C	366618.7	6703416
WTG17	366686	6702920
WTG19	367318.4	6702281
WTG20B	367521	6705469
WTG22B	367651	6704952
WTG21B	367774	6705217

Appendix C. Doc. no.: PD-0.0-WT.PO.00-B-B-EN

Appendix 5

Aviation Impact Statement



FINAL REPORT

AVIATION IMPACT STATEMENT

GLEN INNES WIND FARM

LB 00100

Report to:

Environmental Property Services Pty Ltd



16 June 2017



The Ambidji Group
(A Division of Landrum & Brown)
Level 5, 114 Flinders Street, Melbourne
VIC 3000, Australia

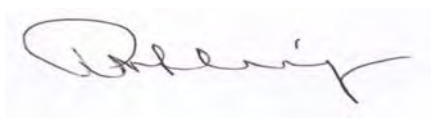
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DOCUMENT RELEASE APPROVAL

Approved for Final Release: Final Report V2.0



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TABLE OF CONTENTS

1. Introduction	1
2. Summarised Results.....	1
3. Wind Farm Location.....	2
4. Obstacles	2
5. Drawings	3
6. Aerodromes Within 30 Nautical Miles – OLS Surfaces	4
6.1 Glen Innes OLS	4
6.2 Inverell OLS	4
7. PANS-OPS Surfaces	5
7.1 Glen Innes.....	5
7.2 Inverell	9
8. Air Routes and Lowest Safe Altitudes (LSALTs)	11
9. Airspace	12
10. Navigation Aids and Communication Facilities	12
11. Radars	12
12. Conclusions.....	13
 Appendix A:	 Airservices Australia, Aviation Assessments for Wind Farm Developments
Appendix B:	Glen Innes Wind Farm, Site identification, Coordinates and Elevations
Appendix C:	Glossary of Terms and Abbreviations

1. INTRODUCTION

Aviation Risk Assessments for the Glen Innes Wind Farm (GIWF) have been prepared by Aurecon in 2013 and 2014. However, since then several changes have occurred including an increase in the turbine tip height from 150 m AGL to 180 m AGL, withdrawal of the Glen Innes (GLI) Non Directional Beacon (NDB), NDB Approach and the GNSS Arrival procedure, and amendments to the air route structure and Lowest Safe Altitudes (LSALTs).

As a result of these changes, The Ambidji Group has been contracted by Environmental Property Services Pty Ltd (EPS) to prepare an updated Aviation Impact Statement (AIS) in accordance with the terms of the Airservices Australia (AsA) letter of 19th August 2014. A copy of this letter is shown at Appendix A.

The proposed GIWF will comprise 25 wind turbines with a tip height of 180 m AGL. The highest turbine tip is WTG19 at 1446 m AHD rounded up to 4745 ft AHD.

The main purposes of the AIS are to determine any infringements or impacts by the proposed Wind Farm:

- on the Obstacle Limitation Surfaces (OLS) and the Procedures for Air Navigation Services Operations (PANS-OPS) surfaces at any registered or certified aerodrome within 30nm of the wind farm boundary;
- on the Lowest Safe Altitudes (LSALT) for Air Routes in the vicinity; and
- on the performance of Navigation Aids and Airspace Surveillance Systems.

Details of Aerodromes, OLS, PANS-OPS procedures, Lowest Safe Altitudes, Navigation and Airspace Surveillance facilities were obtained from the Australian Information Publications (AIP), AsA sources and CASA publications.

2. SUMMARISED RESULTS

The AIS shows that the GIWF development will NOT impact upon the following:

- The OLS published for any registered or certified aerodrome;
- The operation of any Navigation Aids and Communication facilities; and
- The operation of any Airspace Surveillance facility.

However the GIWF WILL impact upon the following:

- The 25 nm Minimum Sector Altitude (MSA) for Glen Innes Aerodrome.

Requests to increase the Glen Innes 25 nm MSA from 5500 ft to 5600 ft will need to be considered by Airservices Australia (AsA) and the Civil Aviation Safety Authority (CASA) for approval.

As the 10 nm MSA is 6100 ft, and the altitude at the Initial Approach Fixes (IAF) and holding for the RNAV approaches is 6200 ft, aircraft would be required to be no lower than 6100 ft within 10 nm of the ARP or 6200 ft for the IAF for RNAV approaches. It is considered that the increase in the 25 nm MSA to 5600 ft will have minimal impact on flight operations.

3. WIND FARM LOCATION

GIWF is located on the Waterloo Range about 12 kilometres to the west of Glenn Innes as shown in Figure 3.1. The project area spans approximately 8.5 kilometres from north to south and about 3 kilometres from east to west. The topography across the project site generally decreases in height from the south towards the north.

The Aerodrome Reference Points (ARP) for Glen Innes (YGLI) and Inverell (YIVL) are also shown in Figure 3.1.



Figure 3.1 General Location of the Proposed GIWF

4. OBSTACLES

A list of the proposed wind turbine locations and heights is shown in Appendix B.

Coordinates are in WGS 84, accurate to 0.1 second of arc and elevations Above Mean Sea Level (AMSL) are accurate to 0.3 metres.

The highest obstacle, turbine WTG 19 at 1446 m or 4745 ft AHD is shown in yellow shading (Appendix B.)

5. DRAWINGS

A basic drawing in a Google Earth image of the proposed wind turbine locations is shown in Figure 5.1 below. The highest turbine tip WTG 19 and height of 4745 ft are shown in yellow.

A detailed drawing showing final turbine locations in electronic format compatible with Microstation version 8i will be forwarded separately.

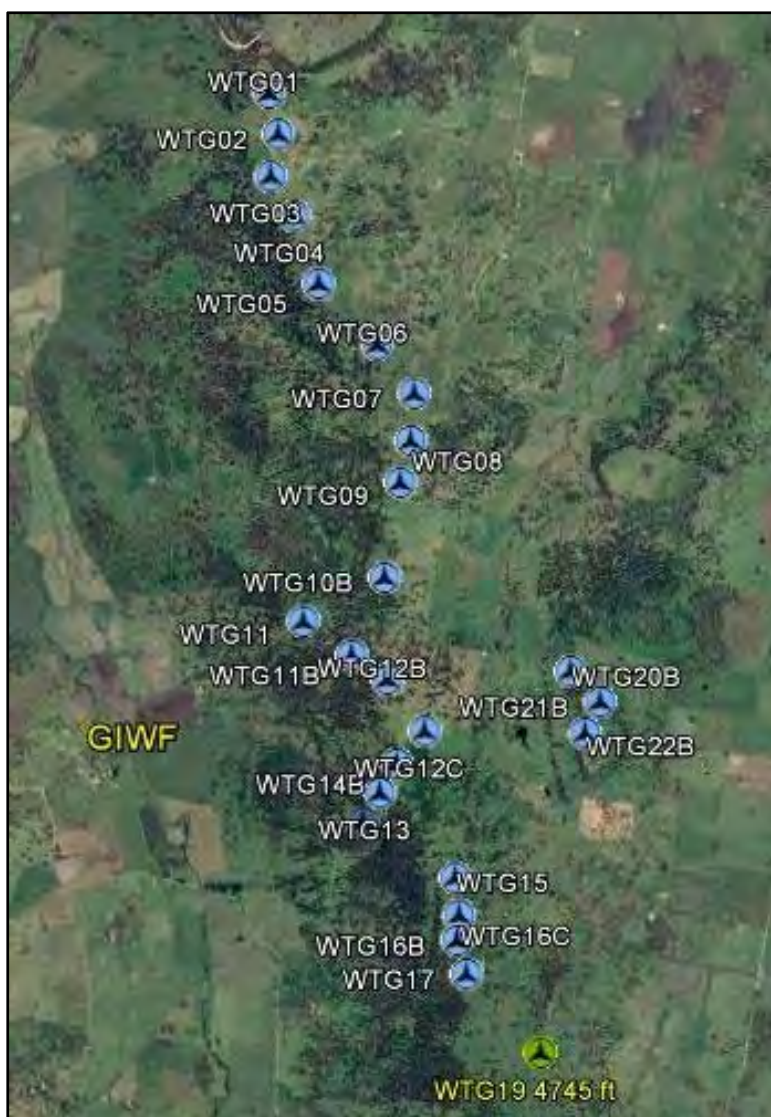


Figure 5.1 Layout of the GIWF showing Wind Turbine Locations

6. AERODROMES WITHIN 30 NAUTICAL MILES – OLS SURFACES

There are two registered or certified aerodromes within 30 nm of the nearest wind farm turbine:

- Glen Innes (YGLI) 5.67 nm (10.5 km) to the North East of the nearest turbine; and
- Inverell (YIVL) 25.15 nm (46.6 km) to the South West of the nearest turbine.

Figure 6.1 shows the locations of the nearest turbines and distances to the YGLI and YIVL Aerodrome Reference Points (ARPs).



Figure 6.1 Glen Innes and Inverell ARPs in relation to the GIWF

6.1 Glen Innes OLS

OLS surfaces for Glen Innes aerodrome extend to 5.5 km from the runway thresholds. As the nearest runway threshold is 9.7 km from the nearest GLI turbine boundary, the wind farm is clear of the OLS.

6.2 Inverell OLS

OLS surfaces for Inverell aerodrome extend to 5.5 km from the runway thresholds. As this airfield is 46.5 km from the nearest GIWF turbine, the wind farm is clear of the OLS.

The OLS surfaces for Glen Innes and Inverell aerodromes will not be impacted by the GIWF.

7. PANS-OPS SURFACES

All altitudes in PANS-OPS procedures are in feet (ft) AHD, distances are in Nautical Miles (nm) and bearings are in degrees magnetic (M). The magnetic variation in the area is 11° east. Aircraft performance category (CAT) is published in the CASA MOS Part 173.

All PANS-OPS calculations in this report are made in accordance with ICAO doc 8168 PANS-OPS and CASA MOS Part 173.

7.1 Glen Innes

There are two instrument approach procedures published in the AIP DAP for Glen Innes. These are:

- RWY 14 RNAV (GNSS); and
- RWY 32 RNAV (GNSS).

The proposed GIWF has a possible impact on the RWY 14 RNAV procedure, and a copy of the procedure is shown in Figure 7.1. The approximate boundary of the GIWF is also shown.



Figure 7.1 YGLI RWY 14 RNAV (GNSS) Approach Procedure

MINIMUM SECTOR ALTITUDE (MSA)

The MSA is shown in Figure 7.1 and is common to both RWY RNAV procedures. As can be seen in Figure 7.1, the 25 nm MSA divided into two sectors with the bearings of 065°(M) and 185° (M) to the ARP being the dividing lines.

To the north and west of the dividing line the MSA is 5500 ft AHD, and 6200 ft from the north east through to south west. Within 10 nm of the ARP the MSA is 6100 ft.

Whilst the GIWF is nominally within the 10 nm MSA of 6100 ft., 5 nm buffers need to be applied to the B-065°(M) line boundary and to the 25 nm sector boundary, which means that the 5500 ft MSA extends over part of the GIWF. This is shown in Figure 7.2.

As can be seen in Figure 7.2 many turbines are within the 5500 ft MSA, and the highest of these is WTG 9 at 4594 ft AHD (yellow text in the figure). When the Minimum Obstacle Clearance of 1000 ft is applied, the result is 5594 ft, which exceeds the 5500 ft MSA by 94 ft. This means that the sector MSA will need to be raised by the nearest 100 ft. to 5600 ft.

It will be recommended that AsA is requested to increase the 25 nm sector MSA to 5600 ft.

As the 10 nm MSA is 6100 ft, and the altitude at the Initial Approach Fixes (IAF) and holding for the RNAV approaches is 6200 ft, aircraft would be required to be no lower than 6100 ft within 10 nm of the ARP, or 6200 ft for RNAV approaches. It is considered that the increase in the 25 nm MSA to 5600 ft will have minimal impact on flight operations.

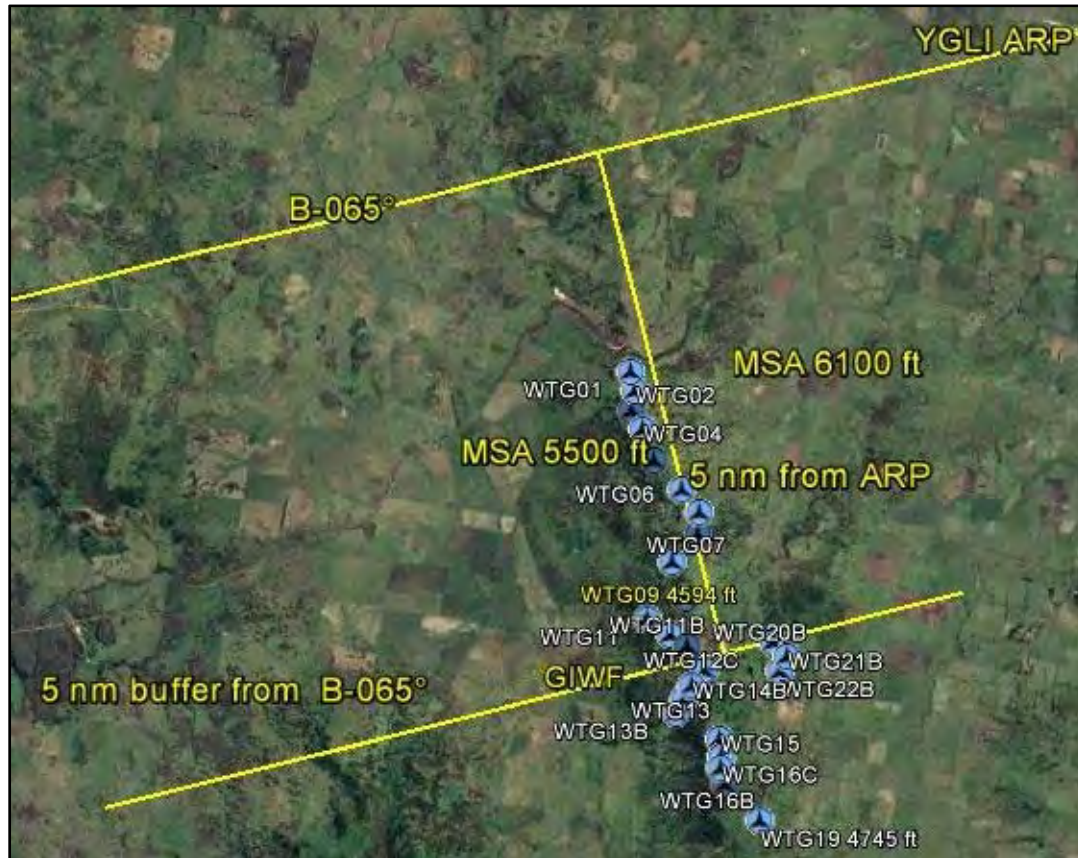


Figure 7.2 MSA BUFFER AREAS AND THE GIWF

INSTRUMENT APPROACH PROCEDURES

RNAV (GNSS) RWY 14 (see Figure 7.1)

Holding and Final Approach

These segments are well clear of the GIWF.

Missed Approach

(Note that all calculations for the missed approach area were made in accordance with ICAO Doc 8168 PANS-OPS Volume 2 Part 1 Section 4 Chapter 6.)

The missed approach commences at GLINM and tracks straight ahead to GLINH, then turns right to track 313° M.

CAT C aircraft conducting this manoeuvre will fly over the GIWF area as far west as 10.32 nm from GLINH (turn diameter 8.23 nm plus waypoint area width of 2 nm).

Figure 7.3 shows the navigation tolerances for the missed approach segment of the approach (in red), the start of climb (SOC) point, and the shortest distances to significant turbines (01, 07, 21B and 19) from GLINH.

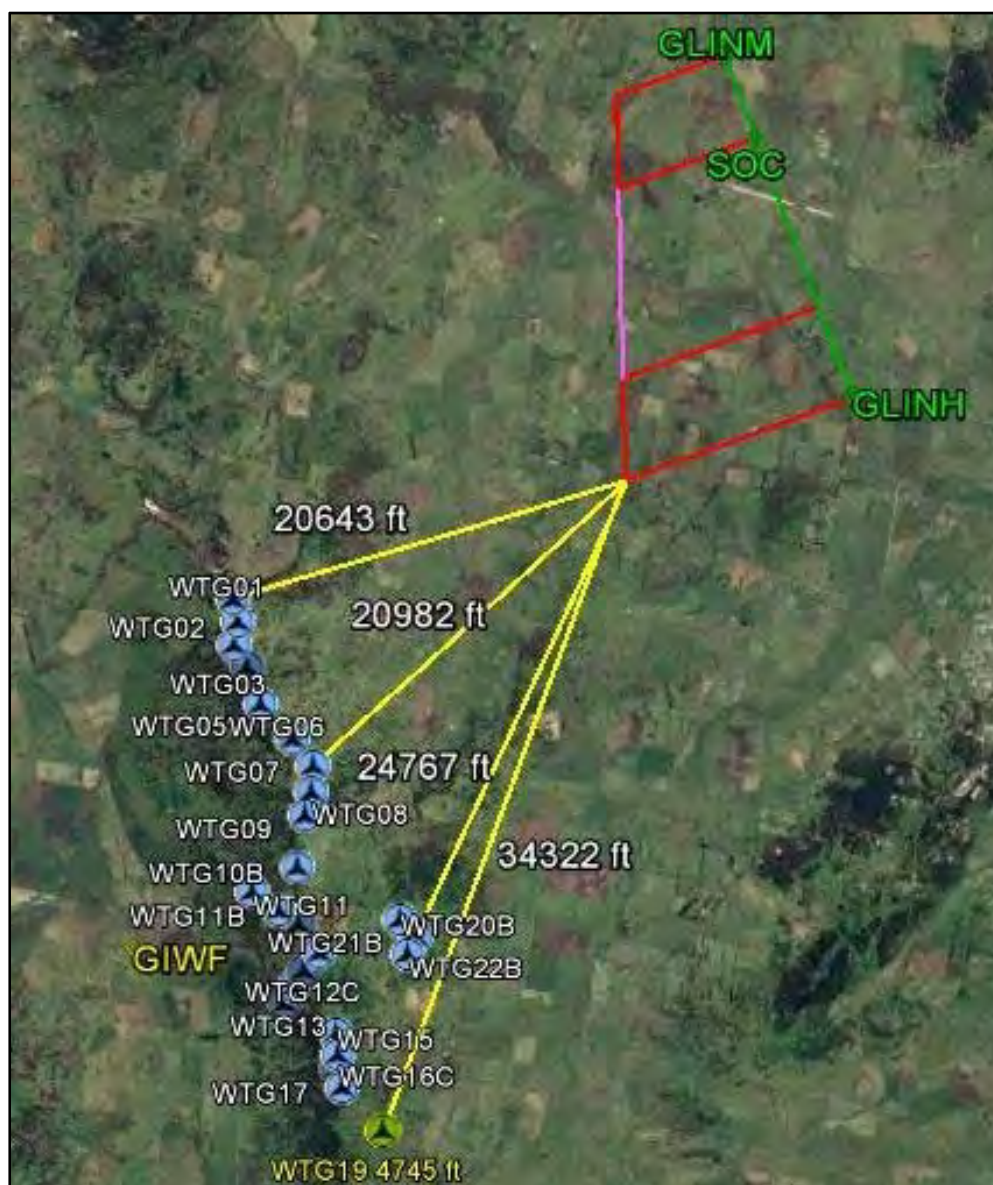


Figure 7.3 RWY 14 RNAV (GNSS) MISSED APPROACH and the GIWF

Table 7.1 below shows the calculations of the aircraft altitude over the turbines minus the MOC of 164 ft which is the PANS-OPS surface at the turbine location. The turbine heights are all below the PANS-OPS surface as shown by negative values in the last column.

Turbine	Turbine AHD ft	Dist from GLINH ft	ACFT Height Gain from GLINH	ACFT Height Gain from SOC to GLINH	MAPt MDA ft	Height AHD at Turbine	164 ft MOC	Penetration?
1	4469	20346	509	346	4040	4895	4731	-262
7	4640	20982	525	346	4040	4911	4747	-107
21B	4636	24767	619	346	4040	5005	4841	-205
19	4745	34322	858	346	4040	5244	5080	-335

Table 7-1 RWY 14 RNAV Missed Approach Calculations

The RWY 14 RNAV (GNSS) approach is not impacted by the GIWF.

RNAV (GNSS) RWY 32

The applicable heights and navigation tolerances for this approach procedure are well clear of the GIWF.

7.2 Inverell

MINIMUM SECTOR ALTITUDE (MSA)

The MSA is 6200 ft within 25 nm of the IVL NDB in the sector over the GIWF (see Figure 7.4).

When the Minimum Obstacle Clearance of 1000 ft is applied to the highest tip AHD of 4745 ft, the result is 5745 ft which is below 25 nm MSA.

The MSA is not impacted by the GIWF.

GNSS ARRIVAL

A copy of this procedure extracted from the AIP DAP is shown in Figure 7.4. All of the GIWF turbines are located more than 25 nm from the IVL NDB which is beyond the start of the procedure.

The GIWF turbines are beyond the Inverell GNSS ARRIVAL PROCEDURE.

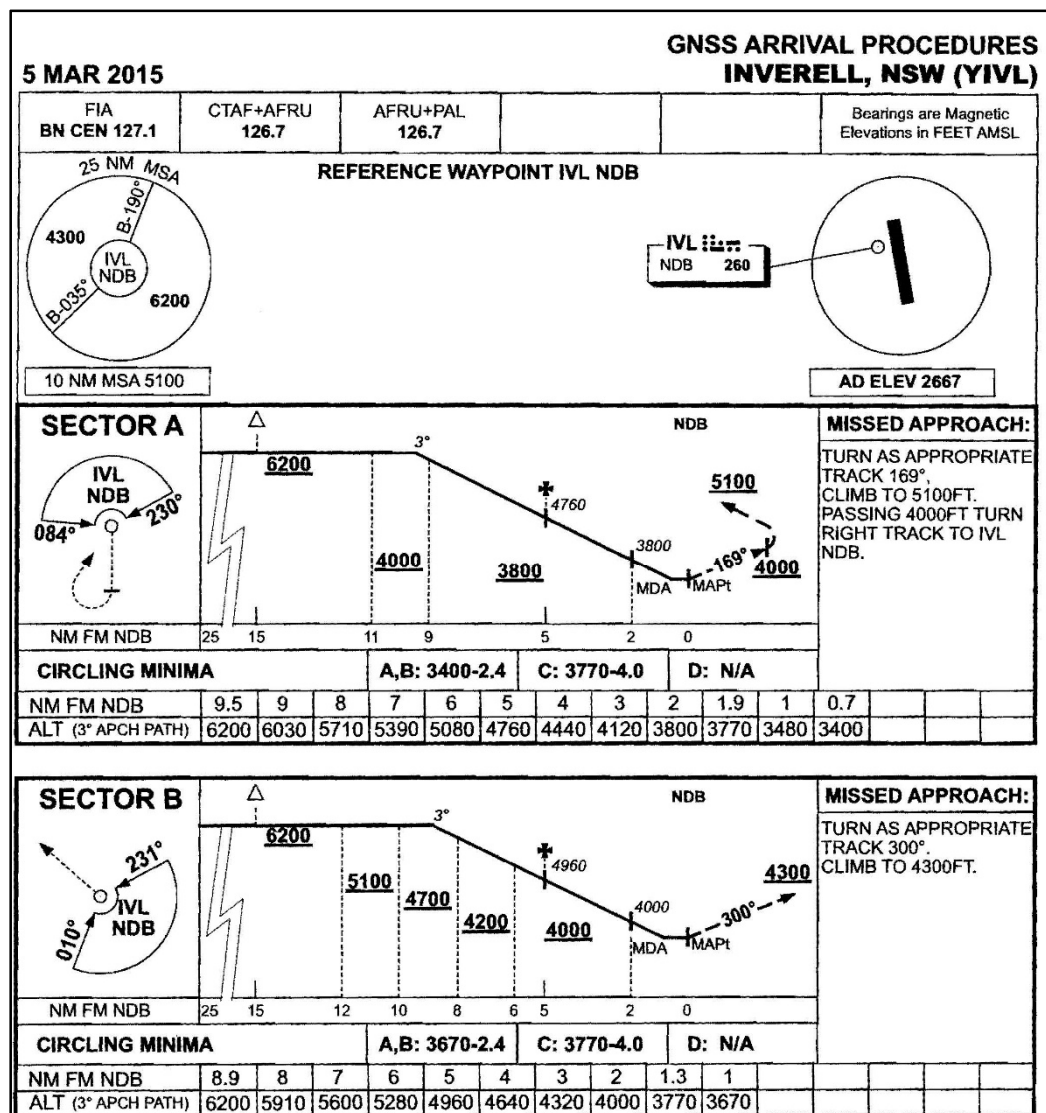


Figure 7.4 YIVL GNSS Arrival Procedure

RNAV (GNSS) RWY 34 and NDB RWY 16

The applicable navigation tolerances for these approach procedures are well clear of the GIWF.

8. AIR ROUTES AND LOWEST SAFE ALTITUDES (LSALTs)

Several published air routes are in the vicinity of the GIWF and are shown in Figure 8.1 below.

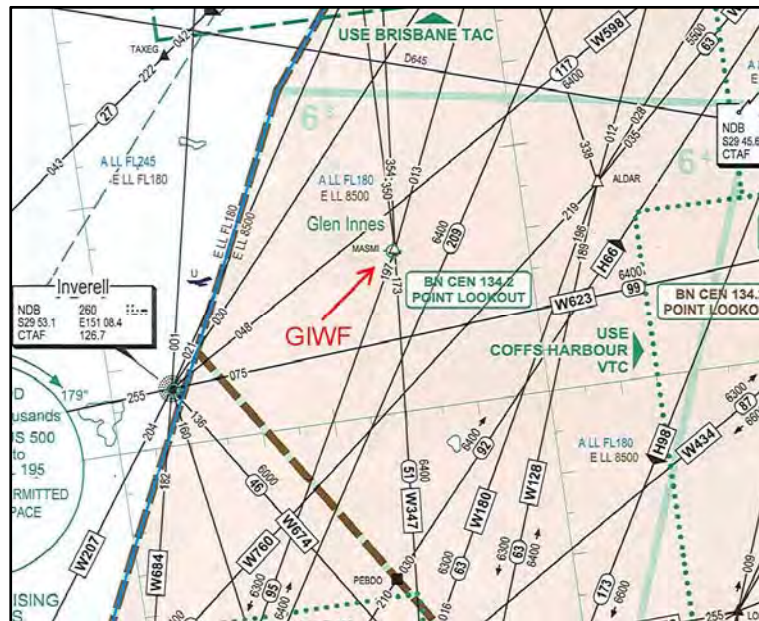


Figure 8.1 Air routes in the vicinity GIWF (approximate location)

The GRID LSALT and significant air routes and LSALTs are shown in Table 8.1.

Route	Section	LSALT ft
GRID		6300
W347	ARM-MASMI-OK	6400
W598	IVL-GAMBL	6400
W623	IVL-GFN	6400
W169	HUUGO-TW	6400
W267	IVL-VILLA	6400
W326	VONDO-MASMI-TW	6400/6300

Table 8.1 LSALTs

The highest turbine tip is 4745 ft, and when the MOC of 1000 ft is applied the result is 5745 ft, which is below the lowest LSALT of 6300 ft on W326 and the grid LSALT.

The GIWF will not impact the LSALTs of the nearby Air Routes.

9. AIRSPACE

The GIWF is situated in Class G airspace, beneath Class E airspace with a lower limit of 8500 ft. There are no Military Restricted airspaces in the vicinity.

10. NAVIGATION AIDS AND COMMUNICATION FACILITIES

NAVIGATION AIDS

CASR Part 139 Manual of Standards – Aerodromes, Chapter 11, sets out the general requirements for navigation aid sites and air traffic control (ATC) facilities, including the clearance planes for planned and existing facilities.

There is one Navigation Aid in the vicinity, the Inverell (IVL) NDB, located 46.7 km to the south west of the nearest wind turbine.

The restricted area applicable to an NDB is 150m (Part 139 MOS, paragraph 11.1.13.1 refers).

As the GIWF is well beyond the above restricted area, it will not impact on the performance of the IVL NDB.

COMMUNICATION FACILITIES

There are no AsA communication facilities located within 30 nm of the wind farm.

The GIWF will not impact on the performance of any communication facilities.

11. RADARS

The nearest AsA Radar installations are an SSR at The Round Mountain, 100 km to the South East, and a combined PSR/SSR at Mt Somerville, 240 km to the north east.

Both of these radars are too far from the GIWF for the wind turbines to have any impact on radar performance.

12. CONCLUSIONS

This Aviation Impact Statement for the GIWF has made the following conclusions:

The GIWF development will NOT impact upon the following:

- The OLS published for any registered or certified aerodrome;
- The operation of any Navigation Aids and Communication facilities; and
- The operation of any Airspace Surveillance facility.

However the GIWF WILL impact upon the following:

- The 25 nm Minimum Sector Altitude (MSA) for Glen Innes Aerodrome;

It will be recommended that AsA is requested to increase the 25 nm MSA to 5600 ft.

As the 10 nm MSA is 6100 ft, and the altitude at the Initial Fix (IF) for the RWY 14 and RWY 32 RNAV approaches is 6200 ft, aircraft would be required to be no lower than 6100 ft within 10 nm of the ARP and no lower than 6200 ft before commencing either of the RNAV approaches.

It is considered that the increase in the 25 nm MSA to 5600 ft will have minimal impact on flight operations.

APPENDIX A

***Airservices Australia
Aviation Assessments for Wind Farm Developments
19 August 2014***



To Whom It May Concern

Airservices Aviation Assessments for Wind Farm Developments

Guidelines to manage the risk to aviation safety from wind turbine installations (Wind Farms/Wind Monitoring Towers) are under development by the National Airports Safeguarding Advisory Group (NASAG). NASAG is comprised of high-level Commonwealth, State and Territory transport and planning officials and has been formed to develop a national land use planning regime to apply near airports and under flight paths.

The wind farm guidelines will provide information to proponents and planning authorities to help identify any potential safety risks posed by wind turbine and wind monitoring installations from an aviation perspective.

Potential safety risks include (but are not limited to) impacts on flight procedures and aviation communications, navigation and surveillance (CNS) facilities which require assessment by Airservices.

To facilitate these assessments all wind farm proposals submitted to Airservices must include an Aviation Impact Statement (AIS) prepared by an aeronautical consultant in accordance with the AIS criteria set out below.

AIS must be undertaken by an aeronautical consultant with suitable knowledge and capabilities to provide a reliable and comprehensive report. All data is to be supplied in electronic form. If you are not familiar with any aeronautical consultants, you may wish to view the list on the Civil Aviation Safety Authority (CASA) website:

http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90412

AIS Criteria

The AIS must provide a detailed analysis covering, as a minimum:

Airspace Procedures:

1. Obstacles
 - Co-ordinates in WGS 84 (to 0.1 second of arc or better)
 - Elevations AMSL (to 0.3 metres)
2. Drawings
 - Overlaid on topographical base not less than 1:250,000. Details of datum and level of charting accuracy to be noted.
 - Electronic format compatible with Microstation version 8i.
3. Aerodromes
 - Specify all registered/certified aerodromes that are located within 30nm (55.56km) from any obstacle referred to in (1) above.
 - Nominate all instrument approach and landing procedures at these aerodromes.
 - Confirmation that the obstacles do not penetrate Annex 14 or OLS for any aerodrome. If an obstacle does penetrate, specify the extent.
4. Air Routes
 - Nominate air routes published in ERC-L & ERC-H which are located near/over any obstacle referred to in (1) above.
 - Specify two waypoint names located on the routes which are located before and after the obstacles.
5. Airspace
 - Airspace classification – A, B, C, D, E, G etc where the obstacles are located.

Navigation/Radar:

1. Detect the presence of dead zones
2. False target analysis
3. Target positional accuracy
4. Probability of detection
5. Radar coverage implications
6. We would expect the analysis to follow the guidelines outlined in the EUROCONTROL Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors.

http://www.eurocontrol.int/sites/default/files/field_tabs/content/documents/events/guidelines-to-assess-potential-impact-of-wind-turbines.pdf

NOTE: Within the Eurocontrol Guidelines there are specific assumptions about the type of Wind Turbine for which the Guidelines are applicable (i.e. 3 blades, 30-200 m height, and horizontal rotation axis). For any deviations to the Wind Turbine characteristics listed within the Eurocontrol Guidelines, the proponent should justify to Airservices why the Eurocontrol Guidelines are still applicable.

Airservices Review of AIS

Airservices will review the quality and completeness of an AIS and will undertake limited modelling and analysis to confirm the findings and recommendations of the report.

Provided the AIS is of sound quality and is complete in accordance with the above criteria, there will be no charge for the review or limited modelling and analysis.

If the AIS is not of sound quality or is not complete in accordance with the above criteria, no modelling or analysis will be undertaken. Airservices will advise the proponent that the AIS does not meet the requirements and that the proposal cannot be assessed by Airservices.

If Airservices review of an AIS confirms impacts identified in the report (or identifies additional impacts), Airservices will advise the proponent of the impacts and the required mitigating actions (where mitigation is feasible). The proponent will also be advised that there will be charges for any mitigation actions to be undertaken by Airservices.

These charges may be advised at the time but it is likely that a detailed quote will be needed and this will only be provided on request from the proponent.

Please contact Airport Relations on 02 6268 4725 or airport.developments@airservicesaustralia.com if you have any questions.

Current as at 19 August 2014

APPENDIX B

***Glen Innes Wind Farm
Site Identification, Coordinates and Elevations***

ID	MGA Z56 Co-ords (m)		WGS 84 GEO Co-ords		Tower base m AHD (from Nexif data)	Plus 180m tip height m AHD	TIP height ft AHD
	X	Y	LAT	LON			
WTG01	364902.339	6710276.477	-29.730351	151.603097	1181.3954	1,362	4,469
WTG02	364985.000	6709936.000	-29.733432	151.603909	1182.6178	1,363	4,472
WTG03	364925.999	6709583.000	-29.736611	151.603255	1182.7997	1,363	4,472
WTG04	365131.000	6709251.000	-29.739628	151.605333	1179.6116	1,360	4,462
WTG05	365343.000	6708692.000	-29.744695	151.607455	1172.0839	1,353	4,439
WTG06	365850.000	6708179.000	-29.749378	151.612633	1194.7612	1,375	4,512
WTG07	366170.300	6707771.398	-29.753091	151.615894	1233.8423	1,414	4,640
WTG08	366146.000	6707375.000	-29.756664	151.615594	1204.7406	1,385	4,544
WTG09	366063.000	6707025.000	-29.759813	151.614692	1219.5165	1,400	4,594
WTG10B	365939.915	6706230.070	-29.766972	151.613320	1174.1710	1,355	4,446
WTG11	365258.421	6705850.535	-29.770322	151.606226	1171.5490	1,352	4,436
WTG11B	365675.000	6705575.000	-29.772853	151.610499	1184.7694	1,365	4,479
WTG12B	365980.000	6705375.000	-29.774691	151.613629	1199.0703	1,380	4,528
WTG12C	366301.929	6704947.001	-29.778587	151.616905	1194.0323	1,375	4,512
WTG13	365933.188	6704425.169	-29.783256	151.613026	1206.2001	1,387	4,551
WTG13B	365792.702	6704174.023	-29.785506	151.611542	1199.7919	1,380	4,528
WTG14B	366071.337	6704670.751	-29.781055	151.614486	1203.7742	1,384	4,541
WTG15	366579.833	6703727.169	-29.789623	151.619628	1209.7784	1,390	4,561
WTG16B	366605.155	6703206.227	-29.794326	151.619826	1256.0276	1,437	4,715
WTG16C	366618.681	6703415.791	-29.792437	151.619991	1254.3728	1,435	4,708
WTG17	366686.034	6702920.347	-29.796914	151.620627	1211.5657	1,392	4,567
WTG19	367318.371	6702281.338	-29.802747	151.627089	1265.6647	1,446	4,745
WTG20B	367521.000	6705469.000	-29.774009	151.629577	1223.9825	1,404	4,607
WTG22B	367651.000	6704952.000	-29.778688	151.630858	1235.4357	1,416	4,646
WTG21B	367774.000	6705217.000	-29.776310	151.632163	1232.9926	1,413	4,636

APPENDIX C

Glossary of Terms and Abbreviations

APPENDIX C

Glossary of Terms and Abbreviations

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies. A full list of terms and abbreviations used in this report is included in this Appendix. It should be noted that, within aviation, the International standard unit for altitude is feet (ft.) and distance is nautical mile (nm).

AC (Advisory Circulars) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

AHD (Australian Height Datum) is the datum to which all vertical control for mapping is to be referred. The datum surface is that which passes through mean sea level at the 30 tide gauges and through points at zero AHD height vertically below the other basic junction points.

AIP (Aeronautical Information Publication) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, the AIP may be issued by CASA or Airservices Australia.

Air routes exist between navigation aid equipped aerodromes or waypoints to facilitate the regular and safe flow of aircraft operating under Instrument Flight Rules (IFR).

Airservices Australia is the Australian government-owned corporation providing safe and environmentally sound air traffic management and related airside services to the aviation industry.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

AMSL (Above Mean Sea Level) is the elevation (on the ground) or altitude (in the air) of any object, relative to the average sea level datum. In aviation, the ellipsoid known as World Geodetic System 84 (WGS 84) is the datum used to define mean sea level.

ATC (Air Traffic Control) service is a service provided for the purpose of:

- a. preventing collisions:
 - 1. between aircraft; and
 - 2. on the manoeuvring area between aircraft, vehicles and obstructions; and
- b. expediting and maintaining an orderly flow of air traffic.

CASA (Civil Aviation Safety Authority) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation safety standards. As Australia is a signatory to the ICAO *Chicago Convention*, CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

CASR (Civil Aviation Safety Regulations) are promulgated by CASA and establish the regulatory framework (*Regulations*) within which all service providers must operate.

Civil Aviation Act 1988 (the Act) establishes the CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

ICAO (International Civil Aviation Organization) is an agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the *Chicago Convention*. Australia is a signatory to the *Chicago Convention*.

IFR (Instrument Flight Rules) are rules applicable to the conduct of flight under IMC. IFR are established to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals. It is also referred to as, “a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying,” such as an IFR or VFR flight plan.

IMC (Instrument Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, less than the minimum specified for visual meteorological conditions.

LSALT (Lowest Safe Altitudes) are published for each air route segment. Their purpose is to allow pilots of aircraft that suffer a system failure to descend to the LSALT to ensure terrain or obstacle clearance in IMC where the pilot cannot see the terrain or obstacles due to cloud or poor visibility conditions. It is an altitude that is at least 1,000 feet above any obstacle or terrain within a defined safety buffer region around a route that a pilot might fly.

MOS (Manual of Standards) comprises specifications (*Standards*) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation.

NASAG (National Airports Safeguarding Advisory Group) set up in May 2010 to implement the Australian Government’s National Aviation Policy White Paper, *Flight Path to the Future* initiatives relating to safeguarding airports and surrounding communities from inappropriate development. NASAG comprises representatives from state and territory planning and transport departments,

the Civil Aviation Safety Authority (CASA), Airservices Australia, the Department of Defence and the Australian Local Government Association (ALGA) and is chaired by the Department of Infrastructure and Regional Development (DIRD).

NOTAMs (Notices to Airmen) are notices issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.

Obstacles. All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

OLS (Obstacle Limitation Surfaces) are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.

PANS-OPS (Procedures for Air Navigation Services - Aircraft Operations) is an Air Traffic Control term denominating rules for designing instrument approach and departure procedures. Such procedures are used to allow aircraft to land and take off under Instrument Meteorological Conditions (IMC) or Instrument Flight Rules (IFR). ICAO document 8168-OPS/611 (volumes 1 and 2) outlines the principles for airspace protection and procedure design which all ICAO signatory states must adhere to. The regulatory material surrounding PANS-OPS may vary from country to country.

PANS-OPS Surfaces. Similar to an Obstacle Limitation Surface, the PANS-OPS protection surfaces are imaginary surfaces in space which guarantee the aircraft a certain minimum obstacle clearance. These surfaces may be used as a tool for local governments in assessing building development. Where buildings may (under certain circumstances) be permitted to penetrate the OLS, they cannot be permitted to penetrate any PANS-OPS surface, because the purpose of these surfaces is to guarantee pilots operating under IMC an obstacle free descent path for a given approach.

Prescribed airspace is an airspace specified in, or ascertained in accordance with, the Regulations, where it is in the interests of the safety, efficiency or regularity of existing or future air transport operations into or out of an airport for the airspace to be protected. The prescribed airspace for an airport is the airspace above any part of either an OLS or a PANS OPS surface for the airport and airspace declared in a declaration relating to the airport.

Regulations (Civil Aviation Safety Regulations)

VFR (Visual Flight Rules) are rules applicable to the conduct of flight under VMC. VFR allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to maintain visual contact with the terrain and to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minima. If the weather is worse than VFR minima, pilots are required to use instrument flight rules.

VMC (Visual Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima

ABBREVIATIONS

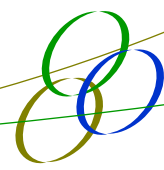
Abbreviations used in this report, and the meanings assigned to them for the purposes of this report are detailed in the following table:

Abbreviation	Meaning
AC	Advisory Circular (document support CASR 1998)
ACFT	Aircraft
AD	Aerodrome
AHD	Australian Height Datum
AHT	Aircraft height
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALA	Aeroplane Landing Area
Alt	Altitude
AMSL	Above Mean Sea Level
A(PofA)R	Airports (Protection of Airspace) Regulations, 1996 as amended
APARs	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
DAP	Departure and Approach Procedures (charts published by AsA)
DER	Departure End of (the) Runway
DEVELMT	Development
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIRD	Department of Infrastructure and Regional Development. (Formerly Department of Infrastructure and Transport)

Abbreviation	Meaning
DoIT	Department of Infrastructure and Transport. Also called “Infrastructure”. (Formerly Department of Infrastructure, Transport, Regional Development and Local Government (DITRD LG) and previously the Department of Transport and Regional Services (DoTARS))
DITRD LG	See DoIT above
DOTARS	See DITRD LG above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix
FAP	Final Approach Point
ft	feet
GA	General Aviation
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LONG	Longitude
LSALT	Lowest Safe Altitude
m	metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards, published by CASA
MSA	Minimum Sector Altitude
SSR	Monopulse Secondary Surveillance Radar
MVA	Minimum Vector Altitude

Abbreviation	Meaning
NASAG	National Airports Safeguarding Advisory Group
NDB	Non Directional Beacon
NE	North East
NM or nm	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North North East
NOTAM	NOtice To AirMen
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface
OIS	Obstacle Identification Surface
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PRM	Precision Runway Monitor
PROC	Procedure
PSR	Primary Surveillance Radar
QNH	An altimeter setting relative to height above mean sea level
Rnnn	Restricted Airspace – promulgated in AIP as R with 3 numbers
REF	Reference
RL	Relative Level
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
SSR	Secondary Surveillance Radar
STAR	Standard ARrival
TAR	Terminal Area Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VFR	Visual Flight Rules

Abbreviation	Meaning
V _n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart



Appendix 6

Community Consultative Committee Minutes

GLEN INNES COMMUNITY CONSULTATION COMMITTEE (GCCC)

Minutes of the Committee Members Meeting

Held Wednesday 26th April 2017

at the New England Club

West Avenue, Glen Innes at 6.00pm

Present: Dave Brown (Senior Dev Officer Glen Innes Wind Power.), Max Elphick (Chairman), Jane Newsome , Allan Fletcher (Project Landowners rep) Jim Ritchie and John Lynn.

Apologies: G Putland.

Previous Minutes: It was resolved on a motion of Allan Fletcher and Jane Newsome that the Minutes of the Meeting held on 14th Sept 2016 be adopted.

Business Arising: Nil

Correspondence: Nil

General Business

Progress Report from Dave Brown.

Dave advised that construction had started prior to the end of January with Geotech work being done.

A Principal Contractor (Senvion) has been appointed for the project. They are putting together a tender process for interested sub contractors.

Dave is preparing a submission to increase the height of the turbines. Office of Environment & Heritage (OEH) has recommended blade tips be 20 to 25 metres above ground level to provide safety for migrating birds. The original height was 10 metres above ground level. Consequently the towers will be raised to increase the height of the blades.

Dave pointed out that Saphire wind project towers will be a similar height.

The blades to be 67 metres long and towers approximately 110 metres high.

Meeting requested Dave to ensure local contractors are given the opportunity to tender for work on the project.

It was moved on a motion of J Newsome and A Fletcher that the Committee support the increase in tower height. Motion Carried.

Community Enhancement Program;

Dave distributed a copy to all present. He advised that Council had endorsed the Program.

The program was approved on a motion moved J Ritchie, Sec J Newsome.

Fund guidelines on spending areas;

Meeting agreed to leave as is until Wind Farm is commissioned.

Site Visit;

Visit to site to be left until September when next CCC meeting to be held.

New Mod 4.

David to send out the new updated Mod 4 with the increase in Tower heights.

There being no further business the meeting closed at 6.55 pm.

Next meeting September.

Signed as a true record

Chairman