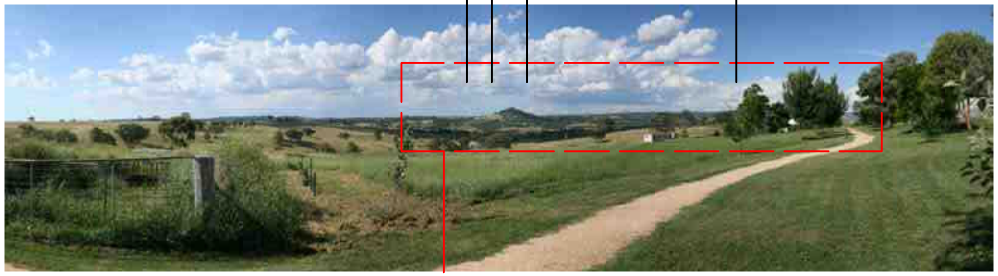
Indicative extent of visible Sapphire wind farm turbines within Sapphire turbine cluster

Indicative extent of visible Sapphire wind farm turbines within Swan Vale turbine cluster



Photomontage Location PM8
Danthonia, Church Communities Australia

Refer Detail A below

Photomontage Location PM8 - Detail A

SAPPHIRE WIND FARM - PM8 DANTHONIA

Photo A: Viewpoint PM9 Extended panorama
Existing view north west to north east from Gwydir Highway, Swan Vale

Photo B: Viewpoint PM9 Extended panorama
Proposed view north west to north east from Gwydir Highway, Swan Vale
Distance to nearest Sapphire turbine: 2.8km
Number of Sapphire turbines visible: 41

General Notes: Viewpoint PM9, Gwydir Highway Swan Vale

Coordinates: Easting 350658, Northing 6706029

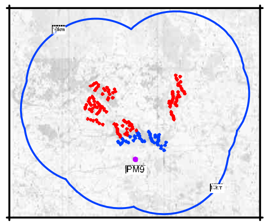
Photo date: 17th January 2011, 2.42pm

Elevation: 791m AHD (+/- 5m)

Camera: Canon EOS 4000, 30mm 1:1.4DC Lens (equivalent to 35mm SLR Camera with 50mm lens). F/16 at 1/160 sec

Original Page Format: A1 Landscape

This photomontage represents the likely view of the proposed Sapphire wind farm.



General location plan - PM9
(Turbine locations are indicative only)

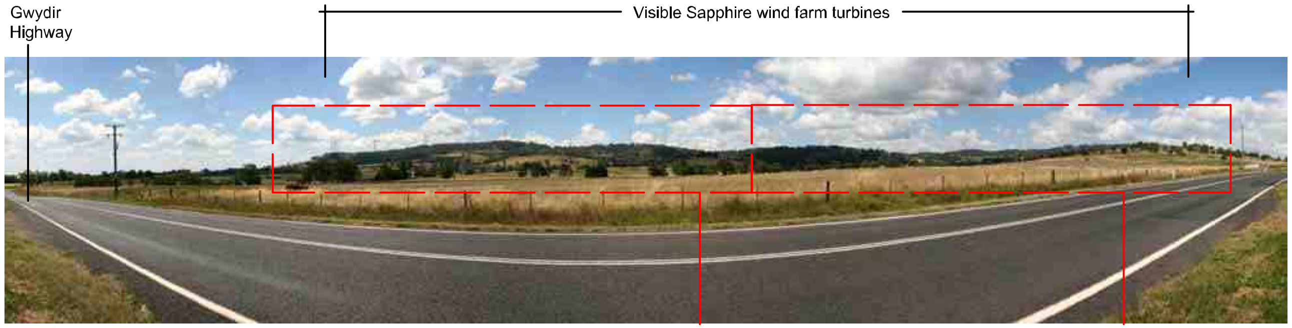
Legend

- Sapphire turbines likely to be visible from Photo Location PM9
- Sapphire turbines unlikely to be visible from Photo Location PM9

Figure 50
Photomontage PM9

SAPPHIRE WIND FARM - PM9 SWAN VALE

Figure 51 Photomontage PM9
Detail Sheet



Photomontage Location PM9
Gwydir Highway Swan Vale

Refer Detail A below

Refer Detail B below

Photomontage Location PM9 - Detail A

Photomontage Location PM9 - Detail B

SAPPHIRE WIND FARM - PM9 SWAN VALE

Ilparran Road

Photo A: Viewpoint PM10 Extended panorama
Existing view north to north west from Ilparran Road

Ilparran Road

Indicative extent of visible Sapphire wind farm turbines

Photo B: Viewpoint PM10 Extended panorama
Proposed view north to north west from Ilparran Road
Distance to nearest Sapphire turbine: 7km
Number of Sapphire turbines visible: 10

General Notes: Viewpoint PM10, Ilparran Road

Coordinates: Easting 362107, Northing 67064488

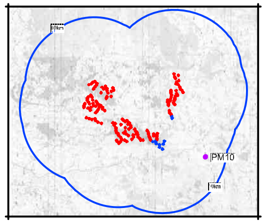
Photo date: 18th January 2011, 12.30pm

Elevation: 957m AHD (+/- 4m)

Camera: Canon EOS 4000, 30mm 1:1.4DC Lens (equivalent to 35mm SLR Camera with 50mm lens). F/16 at 1/400 sec

Original Page Format: A1 Landscape

This photomontage represents the likely view of the proposed Sapphire wind farm.



General location plan - PM10
(Turbine locations are indicative only)

Legend

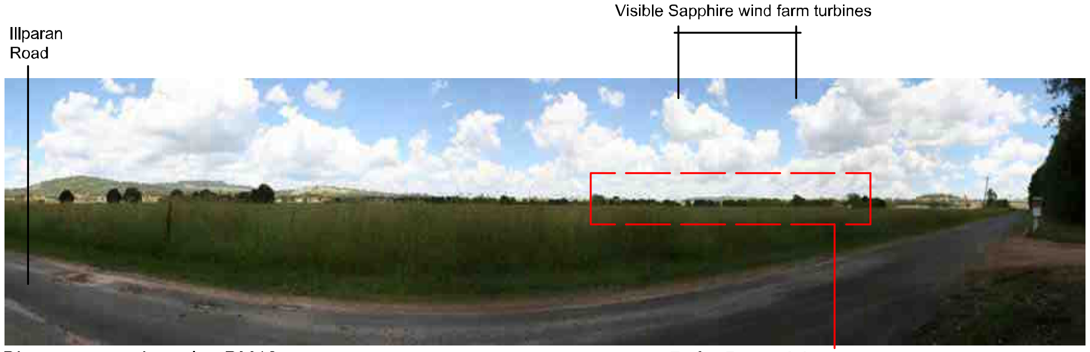
- Sapphire turbines likely to be visible from Photo Location PM10
- Sapphire turbines unlikely to be visible from Photo Location PM10

0km 5km 10km

Figure 52
Photomontage PM10

SAPPHIRE WIND FARM - PM10 ILPARRAN ROAD

Figure 53 Photomontage PM10
Detail Sheet



Photomontage Location PM10
Ilparran Road

Photomontage Location PM10 - Detail A

SAPPHIRE WIND FARM - PM10 ILPARRAN ROAD

GREEN BEAN DESIGN landscape architects
WIND PROSPECT CWP

Photo A: Viewpoint PM11 Extended panorama
Existing view north east to south from Krystal Blue

Indicative extent of visible Sapphire wind farm turbines

Photo B: Viewpoint PM11 Extended panorama
Proposed view north east to south from Krystal Blue
Distance to nearest Sapphire turbine: 1.8km
Number of Sapphire turbines visible: 44

General Notes: Viewpoint PM11, Krystal Blue

Coordinates: Easting 341144, Northing 6713550

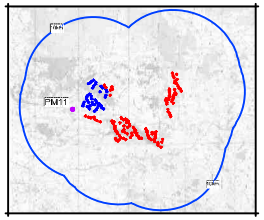
Photo date: 2nd August 2011, 4.20pm

Elevation: 769m AHD (+/- 4m)

Camera: Canon EOS 4000, 30mm 1:1.4DC Lens (equivalent to 35mm SLR Camera with 50mm lens). F/16 at 1/250 sec

Original Page Format: A1 Landscape

This photomontage represents the likely view of the proposed Sapphire wind farm.



General location plan - PM11
(Turbine locations are indicative only)

Legend

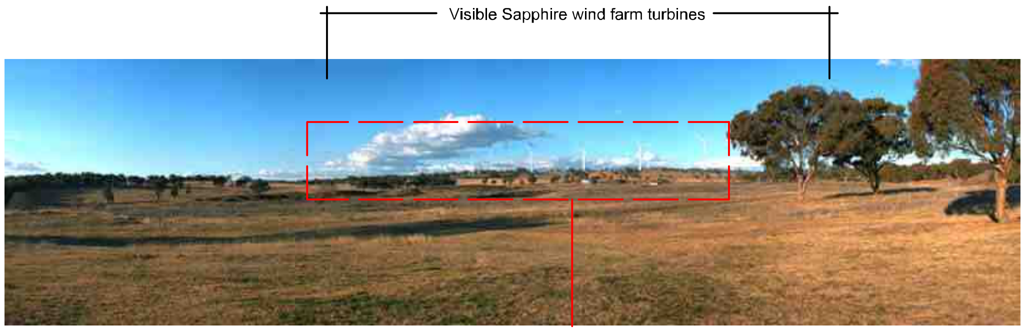
- Sapphire turbines likely to be visible from Photo Location PM11
- Sapphire turbines unlikely to be visible from Photo Location PM11

0km 5km 10km

Figure 54
Photomontage PM11

SAPPHIRE WIND FARM - PM11 KRYSTAL BLUE

Figure 55 Photomontage PM11
Detail Sheet



Photomontage Location PM11
Krystal Blue

Refer Detail A below

Photomontage Location PM11 - Detail A

SAPPHIRE WIND FARM - PM11 KRYSTAL BLUE

GREEN BEAN DESIGN landscape architects
WIND PROSPECT CWP

Shadow Flicker Assessment Summary SECTION 11

11.1 Introduction

Due to their height, wind turbines can cast shadows on surrounding areas at a significant distance from the base of the wind turbine tower. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position, the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. When the sun is low in the sky the length of the shadows increases, increasing the shadow flicker affected area around the wind turbine.

A shadow flicker assessment has been prepared by the Proponent to determine and illustrate the potential impact of shadow flicker on surrounding residential dwellings.

A shadow flicker assessment may over estimate the actual number of annual hours of shadow flicker at a particular location due to a number of reasons including:

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

11.2 Residents

The Proponent has adopted the Victorian Planning Guidelines which state:

"*The shadow flicker experienced at any dwelling in the surrounding area must not exceed 30 hours per year as a result of the operation of the wind energy facility*".

The results of the preliminary shadow flicker assessment for the Sapphire Wind Farm determined that none of the associated or non-associated residential dwellings surrounding the wind energy development would experience shadow flicker in excess of 30 hours per year.

The shadow flicker diagrams are illustrated in **Figures 56** and **57**.

11.3 Photosensitive Epilepsy

The Canadian Epilepsy Alliance (http://www.epilepsymatters.com) defines photosensitivity as '*a sensitivity to flashing or flickering lights, usually of high intensity, which are pulsating in a regular pattern – and people with photosensitive epilepsy can be triggered into seizures by them'*. Both the

Canadian Epilepsy Alliance and Epilepsy Action Australia (http://www.epilepsy.org.au) estimate that less than 5% of people with epilepsy are photosensitive.

Epileptic seizures caused by photosensitive epilepsy may be triggered by a range of electronic devices including material broadcast by televisions, computer screens or strobing and flashing lights in nightclubs. Seizures may also be triggered by natural light shining off water, through tree leaves or by flickering caused by travelling past railings. Not all flashing or flickering light will trigger a seizure in people with photosensitive epilepsy, and the potential to trigger a seizure may also be dependent on the frequency of flashing or flicker, and the duration and intensity of light.

Epilepsy Action Australia suggest that the frequency of flashing or flickering light most likely to trigger seizures occurs between 8 to 30Hz (or flashes/flickers per second), although this may vary between individuals. It also suggests that 96% of people with photosensitive epilepsy are sensitive to flicker between 15 to 20Hz.

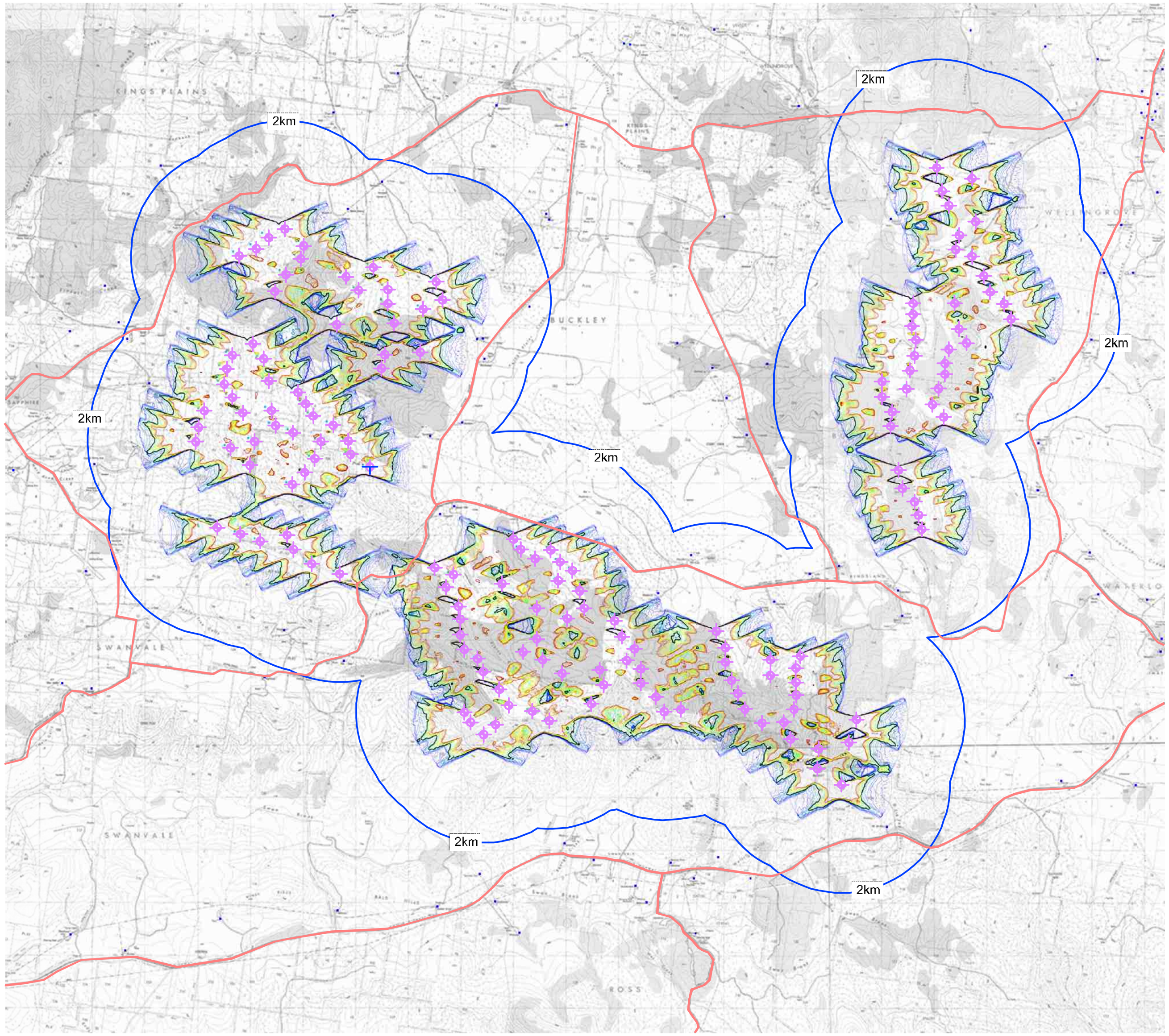
The majority of three bladed wind turbines are unlikely to create a flicker frequency greater than 1Hz (or 1 flicker per second). The flicker frequency for a three blade wind turbine can be calculated by multiplying the hub rotation frequency (in revolutions per second) by the number of blades. As the maximum rotational speed for the Sapphire Wind Farm wind turbines would be around 20 revolutions per minute (rpm), the hub rotation frequency would be 20rpm divided by 60 seconds resulting in 0.3 revolutions per second. Multiplying 0.3 revolutions per second by three blades equals around 1Hz (or 1 flicker per second).

Given the low flicker frequency associated with the Sapphire Wind Farm wind turbines, which falls below the range suggested by Epilepsy Action Australia as a potential trigger for photosensitive epileptic seizures, it is unlikely that the Sapphire Wind Farm wind turbines would present a risk to people with photosensitive epilepsy.

11.4 Motorists

Motorists can experience shadow flicker sensations whilst driving as a result of shadows cast on the road from roadside or overhead objects such as trees, poles or buildings. Under certain conditions the sensation of shadow flicker may cause annoyance and may impact on a driver's ability to operate a motor vehicle safely.

The photograph in **Plate 6** illustrates a typical situation where shadow flicker may be experienced whilst driving along a road where trees cast shadows.



Source: Copyright Department of Lands Panorama Avenue Bathurst 2795 (www.lands.nsw.gov.au)

Legend

0 - (Accumulated shadow flicker hours per year)
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60

'80m' Sapphire wind farm turbine layout

Local road or Highway

2km distance from proposed wind turbine

0km 1km 2km 3km 4km

Figure 56
Shadow Flicker '80m' layout

SAPPHIRE WIND FARM

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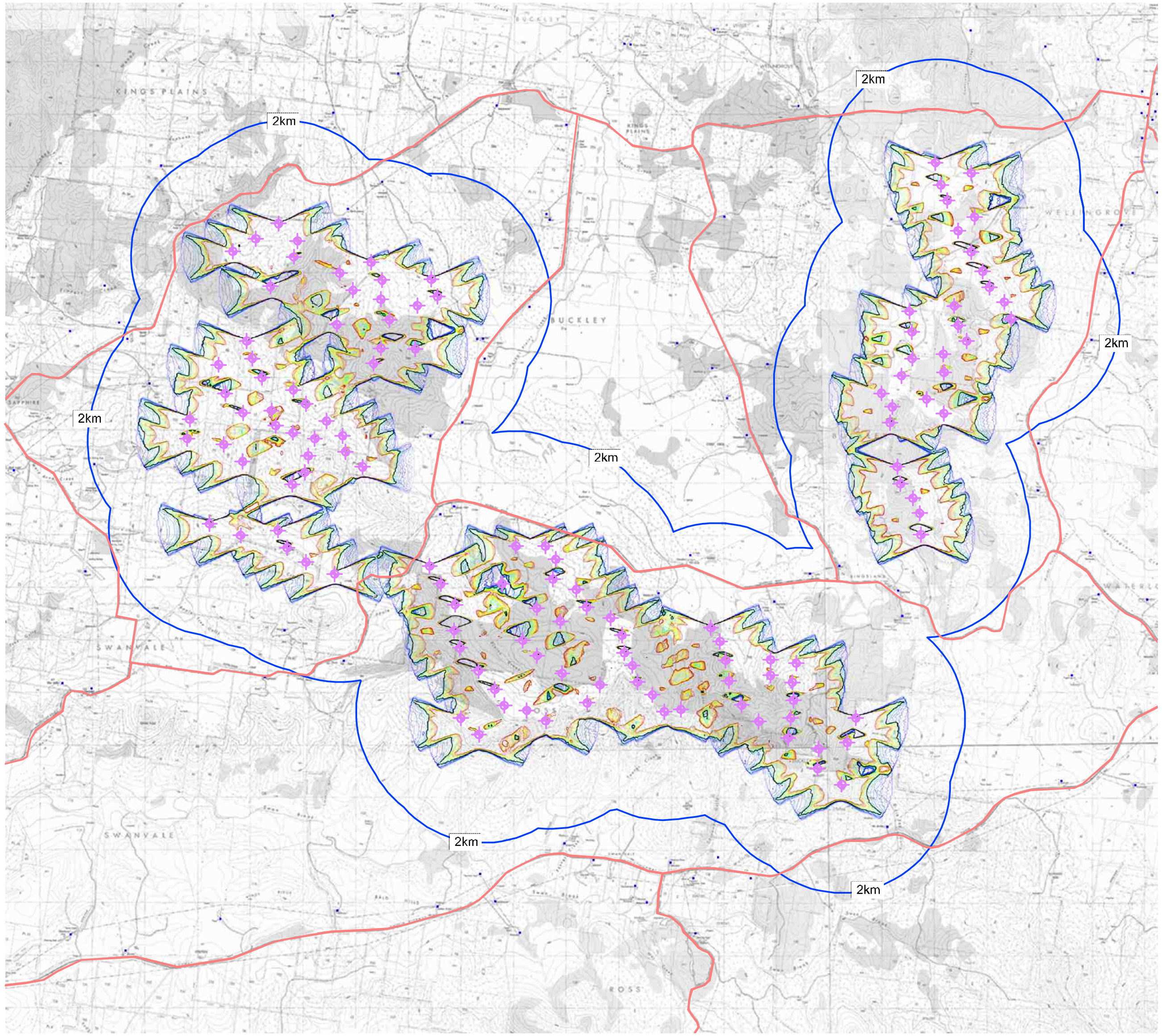
CWP

Source: Copyright Department of Lands Panorama Avenue Bathurst 2795 (www.lands.nsw.gov.au)



Legend

0 - (Accumulated shadow flicker hours per year)
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60

'110m' turbine layout

Local road or Highway

2km distance from proposed wind turbine

0km 1km 2km 3km 4km

Figure 57
Shadow Flicker '110m' layout

SAPPHIRE WIND FARM

GREEN BEAN DESIGN
landscape architects

WIND PROSPECT
CWP

Plate 6 *– Shadow flicker created by roadside tree planting (Kings Plains Road)*

There are no specific guidelines to address the potential impact of shadow flicker on motorists cast by wind turbines across roads, although there are lighting standards that can be applied to minimise the adverse effects of flicker caused by roadside or overhead objects. These standards include AS 1158:5:2007 (Lighting for roads and public spaces – Part 5: Tunnels and underpasses), section 3.3.8 and CIE 88:2004 (Guide for lighting of roads tunnels and underpasses, 2nd ed.), section 6.14. The standards suggest that the flicker effect will be noticeable and possibly cause annoyance between 2.5 and 15Hz (2.5 to 15 flickers per second), and that a flicker effect between 4 and 11Hz should be avoided for longer than 20 seconds.

As the potential flicker frequency for the Sapphire wind turbines is likely to be around 1Hz, it is unlikely that the flicker effect will cause annoyance or impact on a driver's ability to operate a motor vehicle safely whilst travelling along local roads surrounding the wind farm.

11.5 Blade Glint

Glint is a phenomenon that results from the direct reflection of sunlight (also known as specular reflection) from a reflective surface that would be visible when the sun reflects off the surface of the wind turbine at the same angle that a person is viewing the wind turbine surface. Glint may be noticeable for some distance, but usually results in a low impact.

The surfaces of the wind turbines, including the towers and blades, are largely convex, which will tend to result in the divergence of light reflected from the surfaces, rather than convergence toward a particular point. This will reduce the potential for blade glint.

Blade glint can also be further mitigated through the use of matt coatings which, if applied correctly, will generally mitigate potential visual impacts caused by glint.

Night Time Lighting SECTION 12

12.1 Introduction

The Sapphire wind farm may require obstacle marking and lighting at night time and during periods of reduced visibility. The requirement for lighting would be subject to the advice and endorsement of the Civil Aviation Safety Authority (CASA) and Department of Infrastructure and Transport (DIT). CASA is currently undertaking a safety study into the risk to aviation posed by wind farms to develop a new set of guidelines to replace the Advisory Circular with regard to lighting for wind turbines that was withdrawn by CASA in mid 2008.

However, in order to ensure that a full assessment was carried out, the Proponent proposes to commission an independent aviation safety expert to conduct an Aeronautical Impact Assessment, to first determine the risks posed to aviation activities by the wind farm. If recommended by the Aeronautical Impact Assessment expert, an Obstacle Lighting Assessment would be undertaken to stipulate the turbine lighting layout which would mitigate any risks to aviation. The outcomes of the Aeronautical Impact Assessment and the Obstacle Lighting Assessment would then be submitted to CASA for their comment.

Potential visual impacts associated with obstacle marking and lighting at night time have not been extensively researched or tested in New South Wales, although some site investigations have been carried out at existing wind farms in Victoria. Investigations have generally concluded that although night time lighting mounted on wind turbines could be visible for a number of kilometres from the wind farm project area, the actual intensity of the lighting appears no greater than other sources of night time lighting, including vehicle head and tail lights.

Previous investigations have also suggested that replacing the more conventional incandescent lights with light emitting diodes (LED) could help to minimise the potential visual impact of the wind turbine lights (Epuron 2008).

In order to illustrate the visual effect of turbine mounted lighting a series of night time photographs were taken of the Cullerin wind farm in the New South Wales Southern Tablelands. These were taken at distances of 500m, 3.5km and 17km from the turbines and are illustrated in **Figures 58, 59** and **60**. Each night time view is presented below a corresponding day time photograph taken from the same photo location. It should be noted that following community consultation, and the preparation of an aviation risk assessment, Origin Energy have removed night time obstacle lighting from the Cullerin wind turbines.

12.2 Existing light sources

A small number of existing night time light sources occur within the Sapphire wind farm viewshed. Localised lighting is associated with a small number of dispersed homesteads located within the project boundary, but lighting is unlikely to be visually prominent and does not emit any significant illumination beyond immediate areas surrounding residential and agricultural buildings.

Lights from vehicles travelling along the local roads provide dynamic and temporary sources of light.

Existing night time obstacle lights are located on the TV transmitter masts located on Carpenters Hill to the west of Glenn Innes. These night time obstacle lights are visible from Glen Innes as well as sections of the New England and Gwydir Highways.

12.3 Potential light sources

The main potential light sources associated with the Sapphire wind farm would include:

- Night lights of control and auxiliary buildings; and
- Night time obstacle lights mounted on some wind turbines.

In accordance with the withdrawn CASA Advisory Circular two red medium intensity obstacle lights were required on specified turbines at a distance not exceeding 900m and all lights were to flash synchronously. To minimise visual impact some shielding of the obstacle lights below the horizontal plane was permitted. Lighting for aviation safety could also be required prior to and during the construction period, including lighting for large equipment such as cranes.

In addition to the standard level of lighting required for normal security and safety, lighting could also be required for scheduled or emergency maintenance around the control building, substation and wind turbine areas.

As the visibility of the substation and control room would be largely contained by the surrounding landform, it is unlikely that light spill from these sources would be visible from the majority of surrounding view locations including surrounding residences.

12.4 Potential view locations and impact

The categories of potential view locations that could be impacted by night time lighting generally include residents and motorists.

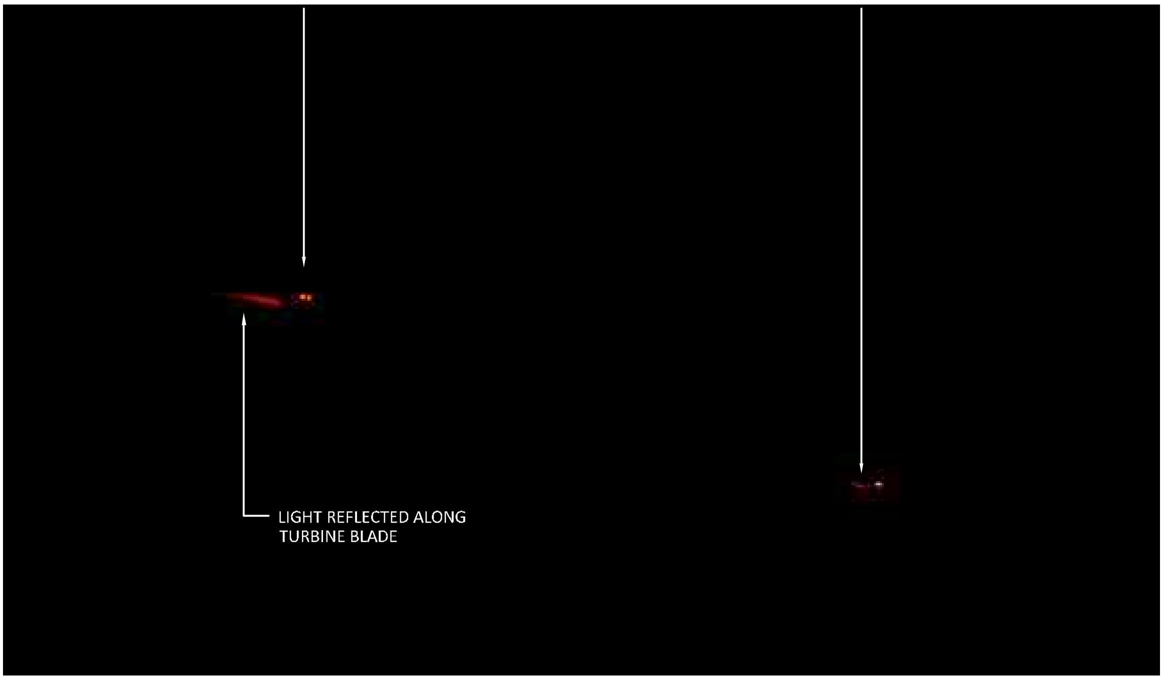
Night time lighting associated with the wind farm is unlikely to have a significant visual impact on the majority of public view locations. Whilst obstacle lighting would be visible to motorists travelling along the local roads, the duration of visibility would tend to be very short and partially screened by undulating landform along some sections of local road corridors and influenced by the direction of travel.

Night time obstacle lighting associated with the wind farm would be visible from a number of the residential view locations surrounding the Sapphire wind farm; however, topography and screening by vegetation and screen planting around residential dwellings would screen or partially obscure views toward night time obstacle lighting.

Irrespective of the total number of visible lights, obstacle lighting is more likely to be noticeable from exterior areas surrounding residences rather than from within residences, where internal lighting tends to reflect and mirror views in windows, or where exterior views would be obscured when curtains and blinds are closed.

Figure 58
Night Lighting Cullerin Wind Farm at 500m

DAY TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 500M

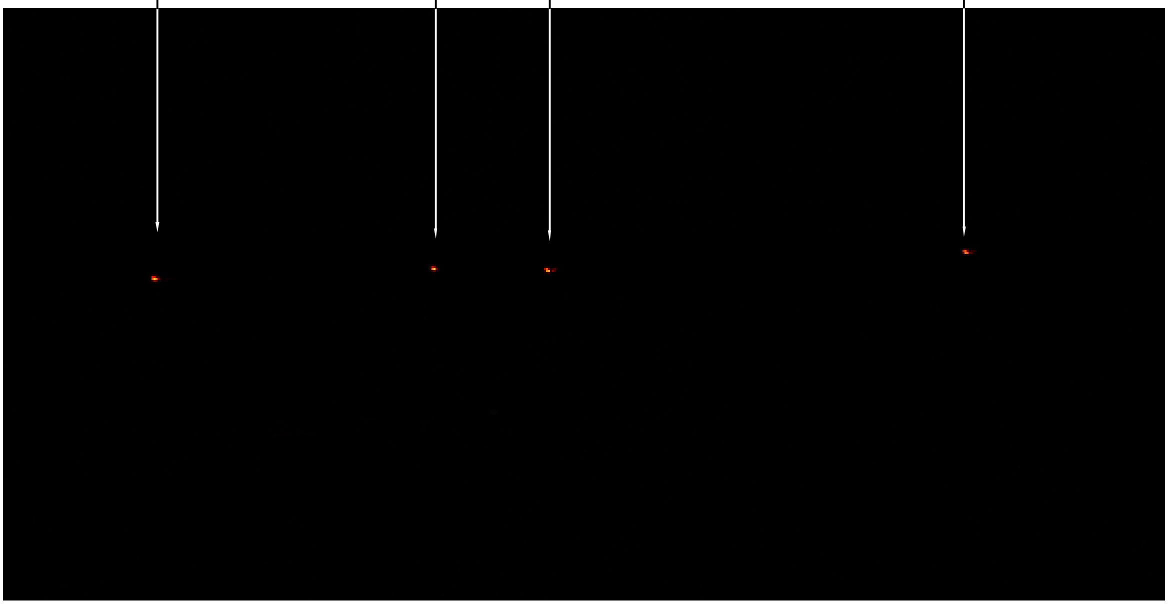


NIGHT TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 500M

CULLERIN WIND FARM NIGHT TIME LIGHTING . VIEW WEST
FROM HUME HIGHWAY AT AROUND 500M DISTANCE.

Figure 59
Night Lighting Cullerin
Wind Farm at 3.5km

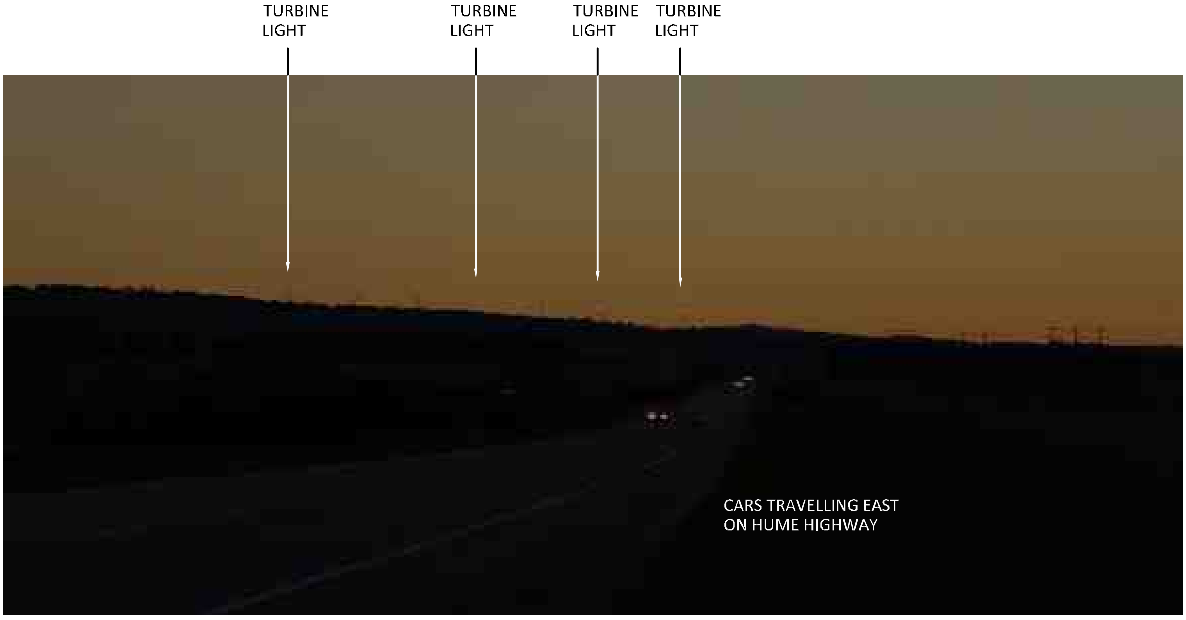
DAY TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 3.5KM



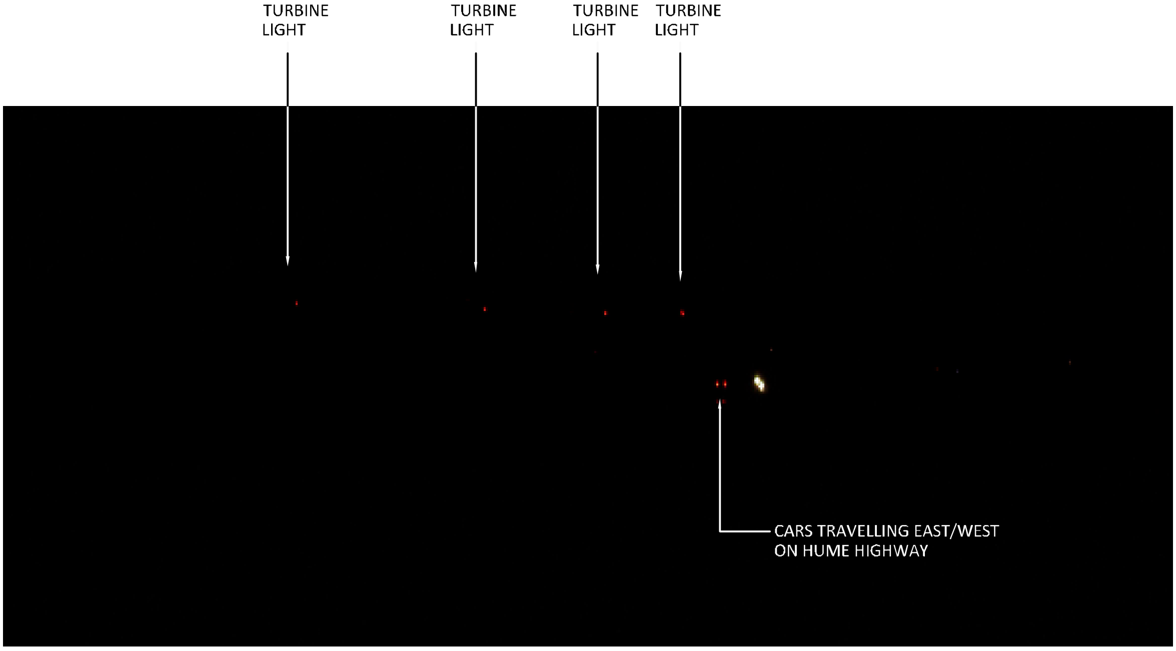
NIGHT TIME VIEW FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 3.5KM

CULLERIN WIND FARM NIGHT TIME LIGHTING . VIEW WEST
FROM HUME HIGHWAY AT AROUND 3.5KM DISTANCE.

Figure 60
Night Lighting Cullerin
Wind Farm at 17km



VIEW WEST AT DUSK FROM HUME HIGHWAY TOWARD
CULLERIN WIND FARM AT AROUND 17 KM



VIEW WEST AFTER DARK FROM HUME HIGHWAY
TOWARD CULLERIN WIND FARM AT AROUND 17 KM

CULLERIN WIND FARM NIGHT TIME LIGHTING .
VIEW WEST FROM HUME HIGHWAY AT AROUND
17KM DISTANCE.

Electrical Infrastructure Works

SECTION 13

13.1 Introduction

The Sapphire wind farm would incorporate a range of electrical infrastructure to collect and distribute electricity generated by the wind turbines to the grid. The proposed electrical works include an option to connect to the grid via an existing 132kV transmission line which follows the Gwydir Highway road corridor south of the Sapphire wind farm or the existing 330kV transmission line which extends north to south through the western portion of the Sapphire wind farm site. Each connection option would include associated substation facilities.

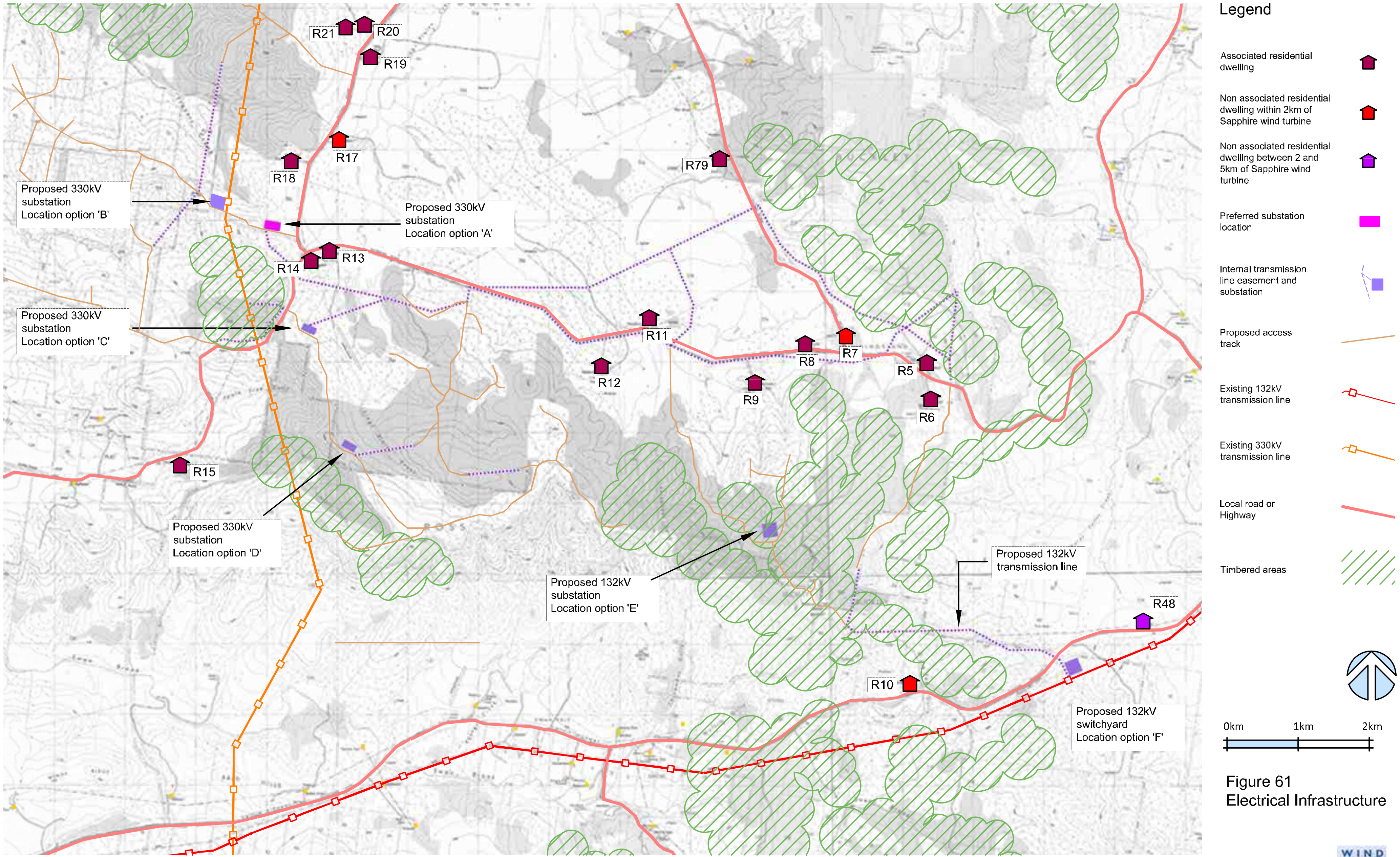
The existing 330kV transmission line and surrounding landscape context in the vicinity of the proposed 330kV substation sites is illustrated in **Plate 7**.

Plate 7 - Existing view north toward the 330kV transmission line from Waterloo Road

General electrical works associated with the Sapphire wind farm would include:

- The installation of generator transformers (these may be located within the wind turbine nacelle or at the base of the tower);
- One or more collector substations and a switching substation;
- Approximately 10km of 33kV, 66kV, 132kV or 330kV internal power line connections within the wind farm depending on the selected easement routes;
- Control cables (potentially located underground); and
- Operation facilities building.

The majority of internal electrical connections between the wind turbines would be via underground cabling within the project boundary. The potential substation sites, switching station location and indicative alignment for the internal transmission lines are illustrated in **Figure 61.**



Source: Copyright Department of Lands Panorama Avenue Bathurst 2795 (www.lands.nsw.gov.au)

Figure 61
Electrical Infrastructure

SAPPHIRE WIND FARM

13.2 Collector and Switching Substations

The potential 132kV and 330kV substation locations are illustrated in **Figure 61** and would be subject to the selection of the final connection option as well as detail engineering design. Potential substation locations for the 330kV transmission line connection would be located within or to the north west of the Swan Vale turbine cluster. The 132kV substation option would be located within the south east portion of the Swan Vale turbine cluster around 1.5km to the north west of Mount Buckley with a switchyard located next to the existing 132kV transmission line south of the Gwydir Highway.

The main visual components of a typical 132/330kV Substation would likely comprise:

- A single storey control building;
- An access road (or road utilising wind turbine maintenance access track);
- Various switch bays and transformers;
- A communications pole;
- Lightning masts;
- Water tank;
- Lighting for security and maintenance; and
- Security fencing including a palisade fence and internal chainmesh fence; and

Plate 8 illustrates a model for a typical 132kV and 330kV substation arrangement.

Plate 8

Each of the proposed substation locations would not be significantly visible from surrounding view locations, including residences and local roads, due to surrounding tree cover and undulating landform. The 132kV substation option would be located to the south of the Gwydir Highway road corridor and south east of the Swan Vale turbine cluster. Views from the Gwydir Highway toward the 132kV substation would be screened by trees either side of the road corridor which, together with scattered tree cover beyond the road corridor, would also screen views from a small number of residences located 1 to 2km from the substation.

A typical arrangement for a constructed wind farm substation is illustrated in **Plate 9** and demonstrates the relatively small scale development required for this component of the electrical infrastructure.

Plate 9 – Typical wind farm substation

13.3 132kV or 330kV Transmission Lines

Electricity generated by the Sapphire wind farm would be connected to the grid via an overhead 330kV or 132kV transmission line. The key visual components of the 132kV or 330kV transmission line would comprise:

- Single tapered concrete poles between 26m to 40m high (132kV transmission line);
- Concrete 'H' frame twin pole or steel lattice support structures between 28m to 50m high;
- Aluminium alloy 330kV or 132kV conductors; and
- An aerial earth wire and communications link.

A typical pole design for a 132kV transmission line supporting structure is illustrated in **Plate 10**.

Plate 10 - Typical 132kV twin supporting structure and angle pole

The design of supporting and tension structures is variable for 330kV transmission lines and is largely dependent on technical engineering requirements as well as site specific conditions. 330kV transmission conductors may be supported by single or dual 'H' frame structures, but if additional structural integrity is required, then a steel lattice support structure may be installed.

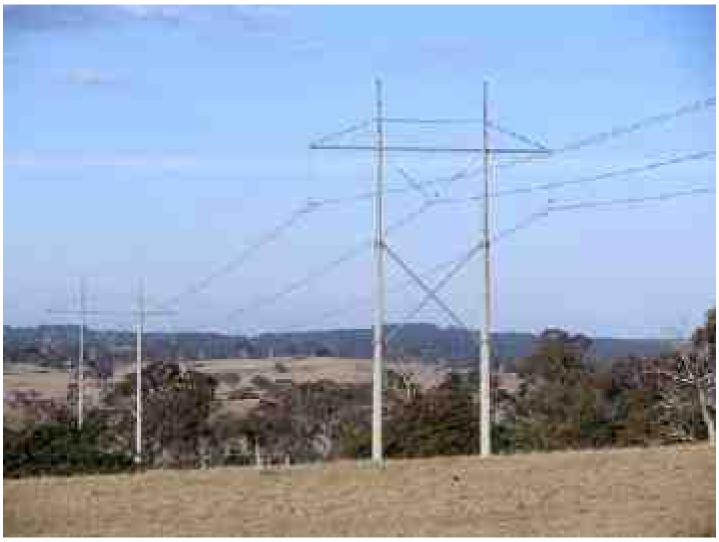


Plate 11 - Typical 330kV 'H' frame twin pole supporting structure

A typical 'H' frame concrete twin pole design for a 330kV transmission line supporting structure is illustrated in **Plate 11** and a steel lattice 330kV supporting structure in **Plate 12**.

Plate 12 - Typical 330kV lattice supporting structure

13.4 Visual Absorption Capability and View Catchment

Visual Absorption Capability (VAC) is a classification system used to describe the relative ability of the landscape to accept modifications and alterations without the loss of landscape character or deterioration of visual amenity. Whilst the VAC classification system has not been applied to the assessment of the landscapes ability to accept the wind turbines, it can be applied to smaller ancillary structures where their scale and form is more readily absorbed by elements within the surrounding landscape.

VAC relates to physical characteristics of the landscape that are often inherent and often quite static in the long term.

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

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

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

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

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

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

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

The determination of the VAC assessment is outlined in **Table 25** – Electrical Infrastructure Visibility Matrix.

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

For the purpose of this report, the view catchment has been determined within an approximate two kilometre offset from beyond the substation or each side of the transmission line, beyond which the views would have a greater tendency to be screened by undulating landform or the presence of vegetation for portions of the transmission line route. It is also considered that whilst the transmission line would be noticeable from areas beyond a 2km distance, the substation and transmission lines are unlikely to appear as a dominant visual element within the landscape beyond this distance.

The potential view catchment is a generalised assessment, where views toward the proposed transmission line could, in some situations, be blocked by buildings, vegetation or local landform features at specific points within the 1km offset, and similarly glimpses of the proposed transmission line would be available from isolated positions outside the view catchment area.

The photographs in **Plates 13** and **14** illustrate varying view distances toward 132kV and 330kV transmission line design options and the direct influence of distance on visibility.

Plate 13. View toward an existing 132kV twin pole transmission line and 330kV supporting structures north of the Armidale Substation

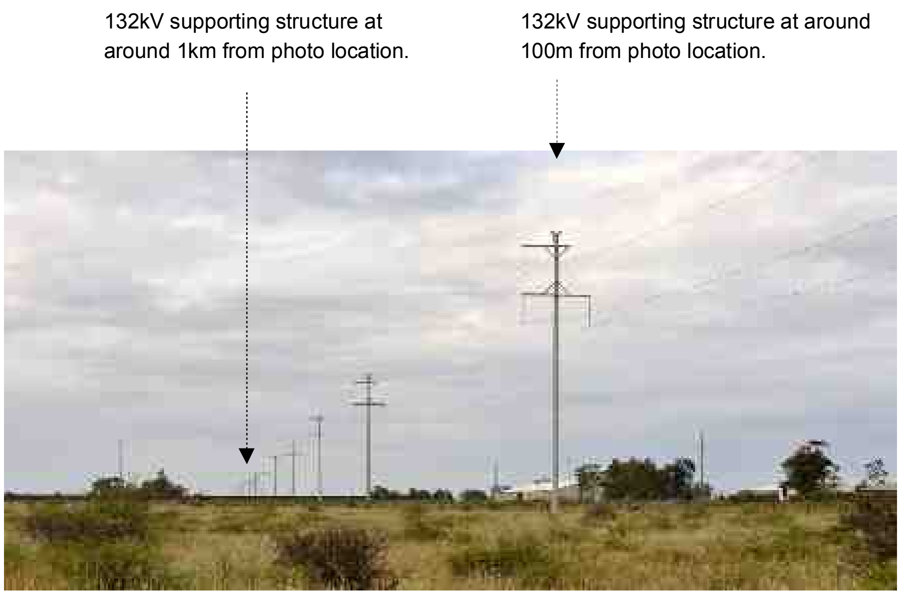


Plate 14 - Typical 132kV single pole supporting structure

13.5 Assessment of Visual Impact (Substation and Transmission Line Infrastructure)

Utilising a methodology very similar to the assessment of the wind turbine visual impact, the potential visibility and resultant visual impact of the substation and transmission line infrastructure would primarily result from the combination of two factors:

- The extent to which the substation and transmission line would be visible from surrounding areas; and
- The degree of visual contrast between the substation and transmission line and the surrounding landscape that would be visible from surrounding view locations.

The overall visual impact is generally determined by a combination of factors including:

- The category and type of situation from which people may view the components of the substation and transmission line (e.g. resident or motorist);
- The potential number of people with a view toward components of the substation and transmission line from any one view location;
- The distance between a person and components of the substation and transmission line; and
- The duration of time that a person may view components of the substation and transmission line.

Table 25 presents the Electrical Infrastructure Visibility Matrix for residential and public view locations. Potential residential and public view locations are illustrated in **Figures 23** and **24**.

Table 25 – Residential and Public View Locations Electrical Infrastructure

View Location and Category	Approximate Distance to electrical infrastructure element	Period of view and number of viewers	VAC and Visibility	Visual Impact
Electrical infrastructure element – 330kV Substation ‘A’ (Refer Figure 61)				
R19, R20, R21 Residents (Associated)	2.5km	Varies – potential long term Low number of viewers	VAC – Medium Partial screening provided by scattered tree cover and gentle landform sloping west to east.	Low and possibly Nil from residences.
R18 Resident (Associated)	1km	Varies – potential long term Low number of viewers	VAC – Medium Partial screening provided by scattered tree cover and gentle landform sloping up from south of residence	Low and possibly Nil from residence.
R17 Resident	1.5km	Varies – potential long term Low number of	VAC – High Substation would be screened by tree cover to the south of the residence.	Nil

Table 25 – Residential and Public View Locations Electrical Infrastructure				
View Location and Category	**Approximate Distance to electrical infrastructure element**	**Period of view and number of viewers**	**VAC and Visibility**	**Visual Impact**
		viewers		
R13, R14 Residents (Associated)	500 – 750m	Varies – potential long term Low number of viewers	VAC – High The substation would tend to be screened by tree planting alongside the western feeder as well as trees within the R14 property boundary alongside Waterloo Road.	Low and possibly Nil from residences.
Waterloo Road	500m	Very short term Low number of viewers	VAC – Medium to High Views toward the substation would tend to be screened by gently rising landform to the north west of Waterloo Road as well as tree cover at the Waterloo Road and Western Feeder junction.	Very low to Low
Western Feeder	500m	Very short term Low number of viewers	VAC – Medium to High Views toward the substation travelling north along the Western Feeder would tend to be screened by tree cover alongside the road corridor. Indirect views toward the substation would occur from a short section of the Western Feeder from vehicles travelling south.	Low
Electrical infrastructure element – 330kV Substation 'B' (Refer Figure 61)				
R13, R14 Residents (Associated)	1.4km	Varies – potential long term Low number of viewers	VAC – High Views north west toward the substation from the residences would be screened by vegetation and scattered tree cover surrounding and beyond the residences.	Low and possibly Nil from residences
R18 Resident	1km	Varies – potential long term	VAC – High Views south west toward the	Low and possibly Nil from residence

Table 25 – Residential and Public View Locations Electrical Infrastructure				
View Location and Category	**Approximate Distance to electrical infrastructure element**	**Period of view and number of viewers**	**VAC and Visibility**	**Visual Impact**
(Associated)		Low number of viewers	substation from the residence would be screened by scattered tree cover and a gently rising landform beyond the residence.	
R17 Resident	1.8km	Varies – potential long term Low number of viewers	VAC – High Views south west toward the substation from the residence would be screened by tree cover beyond the residence.	Nil
Electrical infrastructure element – 330kV Substation 'C' (Refer Figure 61)				
R13, R14 Residents (Associated)	1km	Varies – potential long term Low number of viewers	VAC – Low to Medium Views south toward the substation from the residences would be partially screened by vegetation and scattered tree cover surrounding and beyond the residences.	Low
Waterloo Road	500m	Very short term Low number of viewers	VAC – Low to Medium Views toward the substation would tend to be restricted to vehicles travelling south along a short section of Waterloo Road	Low
Electrical infrastructure element – 330kV Substation 'D' (Refer Figure 61)				
R13, R14 Residents (Associated)	2.5km	Varies – potential long term Low number of viewers	VAC – High Views south toward the substation from the residences would be partially screened by vegetation and scattered tree cover surrounding and beyond the residences.	Low
R15 Resident (Associated)	2.5km	Varies – potential long term Low number of viewers	VAC – High Views toward the substation would be screened by rising landform to the east of the residence as well as dense tree cover.	Nil

Table 25 – Residential and Public View Locations Electrical Infrastructure				
View Location and Category	**Approximate Distance to electrical infrastructure element**	**Period of view and number of viewers**	**VAC and Visibility**	**Visual Impact**
Waterloo Road	2km	Very short term Low number of viewers	VAC – High Views toward the substation would tend to be restricted and screened by dense tree cover and landform.	Nil
Electrical infrastructure element – Internal transmission line easements (Refer Figure 61)				
R17 Resident	2km	Varies – potential long term Low number of viewers	VAC – High Views toward internal transmission lines would be screened by dense and scattered tree cover to the south and west of the residence.	Low and possibly Nil from residence.
R18, R19, R20, R21 Residents (Associated)	1.5 to 2km	Varies – potential long term Low number of viewers	VAC – High Views west and south toward internal transmission lines will be largely screened by landform rising to the west of the residences together with scattered tree cover.	Low and possibly Nil from residences.
R5 Resident (Associated)	200m	Varies – potential long term Low number of viewers	VAC – Low Views would extend north from rear of residence toward an easement option spanning north west to south east for around 1km. Alternative easement options would have less direct visibility.	Medium to High
R6 Resident (Associated)	400m	Varies – potential long term Low number of viewers	VAC – Medium to High Views toward the internal transmission line easements would tend to be screened by tree planting around the residence.	Low and possibly Nil from residence.
R7 Resident	250-500m	Varies – potential long term Low number of	VAC – Medium to High Views toward the internal transmission line easements would tend to be screened by tree planting	Low and possibly Nil from residence.

Table 25 – Residential and Public View Locations Electrical Infrastructure				
View Location and Category	**Approximate Distance to electrical infrastructure element**	**Period of view and number of viewers**	**VAC and Visibility**	**Visual Impact**
		viewers	around and beyond the residence.	
R8 Resident (Associated)	80m	Varies – potential long term Low number of viewers	VAC – Low Views would extend south from front of residence toward the easement option along Waterloo Road. Alternative easement options would have less direct visibility.	Medium to High
R9 Resident (Associated)	150-500m	Varies – potential long term Low number of viewers	VAC – Low Indirect views would extend north from the residence toward the easement option along Waterloo Road. Alternative easement options would have less direct visibility.	Medium
R11 Resident (Associated)	100m	Varies – potential long term Low number of viewers	VAC – Low Views would extend south from front of residence toward the easement option along Waterloo Road. Alternative easement options would have less direct visibility.	Medium to High
R12 Resident (Associated)	500m	Varies – potential long term Low number of viewers	VAC – Low Views would extend north through to north east from the residence toward the easement option along Waterloo Road. Alternative easement options would have less direct visibility.	Medium
Waterloo Road	Adjacent	Very short term Low number of viewers	VAC – Low to Medium Views toward easement options would occur from some sections of the Waterloo Road corridor from vehicles travelling east and west. Some screening or partial screening would occur where tree planting adjoins the road corridor.	Low

Table 25 – Residential and Public View Locations Electrical Infrastructure				
View Location and Category	**Approximate Distance to electrical infrastructure element**	**Period of view and number of viewers**	**VAC and Visibility**	**Visual Impact**
Eastern Feeder	Adjacent	Very short term Low number of viewers	VAC – Low to Medium Views toward easement options would occur from some sections of the Eastern Feeder corridor from vehicles travelling north and south. Some screening or partial screening would occur where tree planting adjoins the road corridor.	Low
Electrical infrastructure element – 132kV transmission line (Refer Figure 61)				
R10 Resident	750m	Varies – potential long term Low number of viewers	VAC – High Views toward the 132kV transmission line will tend to be largely screened by dense tree planting upslope north east to east of the residence.	Low and possibly Nil from residence.
R48 Resident	1.5km	Varies – potential long term Low number of viewers	VAC – Medium Views toward the 132kV transmission line will tend to be screened by tree planting around and to the west of the residence.	Low
Gwydir Highway	132kV line would span the Highway	Very short term High number of viewers	VAC – High Views toward the 132kV transmission line would tend to be screened by tree planting either side of the road corridor, although views will occur as the line spans the Highway with indirect potential views along the easement north and south of the road corridor.	Low and possibly Nil from majority of road corridor
Electrical infrastructure element – 132kV substation 'E' (Refer Figure 61)				
The proposed location of the 132kV substation would be screened from the majority of surrounding view locations (including residences) by a combination of undulating landform and dense to scattered tree cover.				

Table 25 – Residential and Public View Locations Electrical Infrastructure				
View Location and Category	**Approximate Distance to electrical infrastructure element**	**Period of view and number of viewers**	**VAC and Visibility**	**Visual Impact**
Electrical infrastructure element – 132kV switchyard 'F' (Refer Figure 61)				
R10 Resident	2.5km	Varies – potential long term Low number of viewers	VAC – High Views toward the 132kV switchyard will be screened by rising landform and dense tree cover to the east of the residence.	Nil
R48 Resident	1.25km	Varies – potential long term Low number of viewers	VAC – High Views toward the 132kV switchyard will be screened by gently undulating landform and dense tree cover to the west and south west of the residence.	Nil
Gwydir Highway	250m	Very short term High number of viewers	VAC – High Views toward the 132kV switchyard will be screened by tree planting to the south of the road corridor.	Nil

The landscape surrounding the majority of the proposed electrical infrastructure works, including the potential substation sites and 330kV and 132kV transmission line connections to the grid, would be considered to have a relatively high visual absorption capability, and a relatively high ability to accept modifications and alterations without the loss of landscape character or deterioration of existing levels of visual amenity. The high visual absorption capability would largely result from the location of the electrical infrastructure relative to steep sided and timbered hill sides, more gently undulating landforms and scattered tree cover, including tree planting alongside road corridors.

The landscapes high visual absorption capability would also tend to reduce the potential for cumulative impacts to occur where views toward the existing 330kV transmission line included views toward proposed electrical infrastructure elements.

Overall, this LVIA has determined that the electrical infrastructure associated with the Sapphire wind farm would be unlikely to have a significant visual impact on the majority of surrounding view locations. It is noted that the level of resultant visual impact will vary according to the final selection of transmission line capacity as well as the selected easement route. Whilst the selection of the 132kV transmission line option would result in a lower overall visual impact, the majority of residents within proximity to the proposed electrical infrastructure works would be associated with the project and host the electrical infrastructure works within their property boundaries. The residential view locations determined to have a medium or medium to high visual impact would all be associated residences.

Pre-construction and construction

SECTION 14

14.1 Potential visual impacts

There are potential visual impacts that could occur during both pre-construction and construction phases of the project. The wind farm construction phase is likely to occur over a period of around 18 months, although the extent and nature of pre-construction and construction activities would vary at different locations within the project area.

Plate 15 **-** Illustrating typical general construction activities during turbine construction (*images courtesy of Wind Prospect CWP Pty Ltd*).

Plate 16 **-** Illustrating general construction activities at the Capital Hill wind farm site, including views toward cranes, partial construction of towers and laydown areas.

The key pre-construction and construction activities that would be visible from areas surrounding the proposed wind farm include:

- Ongoing detailed site assessment including sub surface geotechnical investigations;
- Various civil works to upgrade local roads and access point;
- Construction facilities, including portable structures and laydown areas;
- Various construction and directional signage;
- Mobilisation of rock crushing and concrete batching plant (if required);
- Excavation and earthworks; and
- Various construction activities including erection of wind turbines, monitoring masts and substation with associated electrical infrastructure works.

The majority of pre-construction and construction activities, some of which would result in physical changes to the landscape (which have been assessed elsewhere in this LVIA report), are generally temporary in nature and for the most restricted to various discrete areas within or beyond the immediate wind farm project area. The majority of pre-construction and construction activities would be unlikely to result in an unacceptable level of visual impact for their duration and temporary nature.

Perception and Public Consultation SECTION 15

15.1 Perception

People's perception of wind farms is an important issue to consider as the attitude or opinion of individuals adds significant weight to the level of potential visual impact.

The opinions and perception of individuals from the local community and broader area were sought and provided through a range of consultation activities. These included:

- Public Open Day;
- Dedicated project website including feedback facility (http://sapphirewindfarm.com.au/);
- Leaflet drops and local media presentations; and
- Individual stakeholder meetings.

The attitudes or opinions of individuals toward wind farms can be shaped or formed through a multitude of complex social and cultural values. Whilst some people would accept and support wind farms in response to global or local environmental issues, others would find the concept of wind farms completely unacceptable. Some would support the environmental ideals of wind farm development as part of a broader renewable energy strategy but do not consider them appropriate for their regional or local area. It is unlikely that wind farm projects would ever conform or be acceptable to all points of view; however, research within Australia as well as overseas consistently suggests that the majority of people who have been canvassed do support the development of wind farms.

Wind farms are generally easy to recognise in the landscape and to take advantage of available wind resources are more often located in elevated and exposed locations. The geometrical form of a wind turbine is a relatively simple one and can be visible for some distance beyond a wind farm, and the level of visibility can be accentuated by the repetitive or repeating pattern of multiple wind turbines within a local area. Wind farms do have a significant potential to alter the physical appearance of the landscape, as well as change existing landscape values.

15.2 Public Consultation

The Sapphire design layout is the culmination of several meetings with residents in the local community, and has taken into account a number of issues and concerns relating to potential visual impacts from individual view locations.

The Proponent held a number of meetings with stakeholders in the area surrounding the wind farm, including individual meetings with adjoining landowners potentially impacted by the wind farm development, and carried out neighbouring consultation at all residential dwellings within a 5km radius of the Sapphire wind farm.

Two public consultation 'open days' were held in February 2011 in Glen Innes and Inverell which were attended by around 30 people on each day. Details of the proposed wind farm project were placed on display and included maps showing the planned locations of wind turbines and other associated infrastructure including substations, power lines and access tracks. Photomontages illustrating the likely view of the completed wind farm from a number of locations around the site were on display.

Visitors to the open day also had the opportunity to complete a landscape values questionnaire prepared for the open day. A brief summary of the feedback received from the community is presented below:

From a total of 20 Public Opinion Surveys received by the Proponent:

- 13 respondents supported the Sapphire wind farm development;
- Five respondents did not support the Sapphire wind farm development; and
- Two respondents did not answer.

The five respondents who did not support the wind farm development cited issues with views, spoiling the landscape/wildlife issues and spoiling the scenery.

From a total of 10 Landscape Values Questionnaires received by the Proponent:

- Five of the respondents considered the Sapphire wind farm development would have either a neutral of positive impact on the landscape;
- Four of the respondents considered that the Sapphire wind farm development would have a negative impact on the landscape; and
- One of the respondents did not provide an answer on what impact the Sapphire wind farm development would have on the landscape.

Whilst the number of returned surveys and questionnaires are statistically too small to determine any trend in overall positive or negative support for the wind farm development amongst the wider community, they do provide a 'snap shot' into local community attitudes.

15.3 Specific Stakeholder Consultation

Two specific consultations with local stakeholders resulted in modifications to the Project, and the wind farm turbine arrangements for the '80m' and '110m' design layouts currently proposed for development.

15.3.1 Danthonia

Church Communities Australia (CCA) operates an integrated community at the 'Danthonia' property where approximately 175 people currently reside. The site includes community facilities, school, medical centre, church and religious premises, a sign-making factory as well as other community and agricultural uses. The CCA main facilities and buildings are approximately 8 km to the west south west of the Project and the Swan Vale Cluster.

CCA were contacted in June 2009, along with other neighbouring landowners, during preparation of the LVIA report and expressed concern about the visual impact of the wind farm on their community. Photomontages were prepared and provided to CCA by the Proponent in order to illustrate the view of the wind farm from the CCA's main facilities.

Following discussions between CCA and the Proponent, CCA engaged landscape consultants Spackman Mossop Michaels to prepare a LVIA of the Wind Prospect Sapphire Wind Farm Project in August 2010.

Following subsequent discussions, and in order to address concerns about the visual impact on CCA, the Proponent removed 22 turbines from the south west lower ridgelines of the wind farm site. Revised photomontages were also prepared by the Proponent and provided to CCA in order to illustrate the difference that the removal of these turbines would make for CCA's consideration as a proactive measure to address CCA concerns.

15.3.2 Wellingrove

Wellingrove is a small collection (approximately 10 houses) of residential properties 2km to the north east of the Project and the Wellingrove turbine cluster in particular. Residents were contacted in June 2009 during the stakeholder consultation process to discuss the proposed development.

Several residents expressed concern regarding the project as a whole, but in particular four wind turbines which crossed the Wellingrove Hill to the south west of the community. Photomontages were prepared to illustrate the views toward the proposed development from the centre of Wellingrove (Polhill Road), with the closest turbine being approximately 2km away.

Following several discussions with the Wellingrove residents, the Proponent removed the four turbines from the Project, placing the closest turbine some 3.6 km from the community as a result. A revised photomontage was prepared to highlight the difference, which was considered a more acceptable outcome by the Wellingrove residents.

Further details of stakeholder consultation are included in the EA Chapter 6 Stakeholder Consultation.

15.4 Quantitative Research

Whilst published Australian research into the potential landscape and visual impacts of wind farms is limited, there are general corresponding results between the limited number that have been carried out when compared with those carried out overseas.

A recent survey was conducted by ARM Interactive on behalf of the NSW Department of Environment, Climate Change and Water (September 2010). The survey polled 2022 residents across the six Renewable Energy Precincts established by the NSW Government, including the New England Tablelands. The key findings of the survey indicated that:

- *97% of people across the Precincts had heard about wind farms or turbines, and 81% had seen a wind farm or turbine (in person or the media);*
- *85% of people supported the construction of wind farms in New South Wales, and 80% within their local region; and*
- *79% supported wind farms being built within 10km of residences and 60% of people surveyed supported the construction of wind turbines within 1 to 2kmfrom their residences. This level of support for wind farms within 1 to 2km dropped to 54% in the New England Precinct.*

These results are reflected in other surveys including the community perception survey commissioned by Epuron for the Gullen Range Wind Farm Environmental Assessment (August 2008). The results of the survey, which targeted a number of local populations within the Southern Tablelands, suggested that around 89 % of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71 % of respondents accepting the development of a wind farm within one kilometre from their residential dwelling.

These general levels of support for wind farm developments have also been recorded for a number of wind farm developments around Australia as well as overseas.

Auspoll research carried out in February 2002 on behalf of a wind farm developer for a wind farm project in Victoria included just over 200 respondents. The results indicated that:

- *Over 92% of respondents agreed that wind farms can make a difference in reducing greenhouse emissions and mitigating the effects of global warming;*
- *Over 88% disagreed with the statement that wind farms are ugly;*
- *Over 93% of respondents identified 'interesting' as a good way to describe wind farms, over 73% nominating 'graceful' and over 55% selecting attractive;*

- *Over 79% of respondents thought that the wind farm would have a good impact on tourism, with 15% of respondents believing that the wind farm would make no difference; and*
- *Over 40% of respondents believed that the impact of the wind farm on the visual amenity of the area would be good, with 40% believing that it would make no difference.*

A September 2002 MORI poll of 307 tourists conducted in Argyll (United Kingdom) indicated that:

- *43% maintained that the presence of wind farms had a positive impression of Argyll as a place to visit;*
- *43% maintained that the presence of wind farms had an equally positive or negative effect;*
- *Less than 8% maintained it had a negative effect; and*
- *91% of tourists maintained that the presence of wind farms in Argyll made no difference to the likelihood of them visiting the area.*

There is no published Australian research on community attitudes to the impact of wind farms on landscape and visual issues before and after construction. However, overseas research in the United Kingdom conducted by MORI in 2003 indicated that:

- *Prior to construction 27% of people polled thought problems may arise from wind farm impact on the landscape; and*
- *Following construction the number of people who thought the landscape has been spoiled was 12%.*

The majority of research carried out to date has focussed on public attitudes to wind farms and does not provide any indication for acceptable or agreed thresholds in relation to numbers and heights of turbines, and the potential impact of distance between turbines and view locations.

15.5 The Broader Public Good

Whilst visual perceptions and attitudes of local communities toward wind farm developments are an important issue, and need to be assessed locally in terms of potential landscape and visual impacts, there is also an issue of the greater potential public benefit provided by renewable energy production. Wind farms are expected to make a contribution toward meeting the Government's commitment that 20% of Australia's electricity supply comes from renewable energy sources by 2020.

In the 2006 Land and Environment Court decision to confirm, on an amended basis, consent for the construction of a wind farm at Taralga, Chief Judge Justice Preston said in his prologue to the judgement:

"The insertion of wind turbines into a non-industrial landscape is perceived by many as a radical change which confronts their present reality. However, those perceptions come in different hues. To residents, such as members of the Taralga Landscape Guardians Inc. (the Guardians), the change is stark and negative. It would represent a blight and the confrontation is with their enjoyment of their rural setting".

"To others; however, the change is positive. It would represent an opportunity to shift from societal dependence on high emission fossil fuels to renewable energy sources. For them, the confrontation is beneficial – being one much needed step in the policy settings confronting carbon emission and global warming".

"Resolving this conundrum – the conflict between the geographically narrower concerns of the guardians and the broader public good of increasing the supply of renewable energy – has not been easy. However, I have concluded that, on balance, the broader public good must prevail".

Whilst the exact circumstances between the Taralga wind farm and the proposed Sapphire wind farm may differ, the comments provided by the Chief Judge make it clear that, in the circumstances of that case, there was a need for the broader public good to be put before the potential negative impacts on some members of the local community. Similar reasoning can be applied to the Sapphire wind farm.

Mitigation Measures

SECTION 16

16.1 Mitigation Measures

The purpose of mitigation, where reasonable and feasible, is to avoid, reduce, or where possible remedy or offset any significant negative impact arising from the Sapphire wind farm development. In general mitigation measures would reduce the potential visual impact of the Sapphire wind farm in one of two ways:

- Firstly, by reducing the visual prominence of the wind turbines and associated structures by minimising the visual contrast between the wind turbines and the landscape in which they are viewed; and
- Secondly, by screening views toward the wind turbines from specific view locations.

In relation to the first form of mitigation, the design of the turbine structures has been highly refined over a number of years to maximise their efficiency. The height of the supporting towers and dimensions of the rotors are defined by engineering efficiency and design criteria. Consequently, modification of the turbine design to mitigate potential visual impacts is not considered a realistic option.

Colour is one aspect of the wind turbine design that does provide an opportunity to reduce visual contrast between the turbine structures and the background against which they are viewed. The white colour that is used on a majority of turbine structures provides the maximum level of visual contrast with the background. This maximum level of visual contrast could be reduced through the use of an appropriate off white or grey colour for the turbines where the visual contrast would be reduced when portions of the turbine were viewed against the sky as well as for those portions viewed against a background of landscape. The final colour selection would, however, be subject to the availability of turbine models on the market at the time of ordering and to aviation safety requirements.

The potential visual impact of the Sapphire wind farm from specific view locations could be mitigated by planting vegetation close to the view locations. For instance, tree or large shrub planting close to a residence can screen potential views to individual or clusters of turbines. Similarly roadside tree planting can screen potential views of turbines from particular sections of road provided the turbine is not located some distance from the road.

The location and design of screen planting used as a mitigation measure is very site specific and requires detailed analysis of potential views and consultation with surrounding landowners. Planting vegetation would not provide effective mitigation in all circumstances and can reduce the extent of existing views available from residences or other view locations.

There is greater potential to mitigate the visual prominence for some of the ancillary structures and built elements associated with the wind farm through the appropriate selection of materials and colours, together with consideration of their reflective properties.

The potential visual impacts of vehicular tracks providing access for construction and maintenance can be mitigated by:

- Minimising the extent of cut and fill in the track construction;
- Re-vegetating disturbed soil areas immediately after completion of construction works; and
- Using local materials as much as possible in track construction to minimise colour contrast.

16.2 Summary of Mitigation Measures

A summary of the mitigation measures for the wind farm and transmission line is presented in **Tables 26** and **27**.

Table 26 Wind farm summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
Consider options for use of colour to reduce visual contrast between turbine structures and background, e.g. use of off white rather than white, and use matt finish to avoid reflected sunlight.	✓			
Avoid use of advertising, signs or logos mounted on turbine structures, except those required for safety purposes.			✓	✓
If necessary, design and construct site control building and facilities building sympathetically with nature of locality.	✓		✓	
If necessary, locate substations away from direct views from roads and residences, to minimise additional line needed, and to 'blend in' with existing transmission infrastructure.	✓		✓	
Enforce safeguards to control and minimise fugitive dust emissions.		✓	✓	
Restrict the height of stockpiles to minimise		✓	✓	

Table 26 Wind farm summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
visibility from outside the site.				
Minimise activities that may require night time lighting, and if necessary use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the site to minimise glare at night.			✓	✓
Minimise cut and fill for site tracks and revegetate disturbed soils as soon as possible after construction.		✓	✓	
Maximise revegetation of disturbed areas to ensure effective cover is achieved.				✓
Consider options for planting screening vegetation in vicinity of nearby residences and along roadsides to screen potential views of turbines. Such works to be considered in consultation with local residents and authorities.	✓	✓		
Undertake revegetation and off-set planting at areas around the site in consultation and agreement with landholders.	✓	✓	✓	

Table 27 – Substation and transmission line summary of mitigation measures

Safeguard	Implementation			
	Design	Site Preparation	Construction	Operation
A careful and considered route selection process to avoid sensitive view locations and loss of existing vegetation where possible.	✓		✓	
Wherever possible, select angle positions in strategic locations to minimise potential visual impact (e.g. avoiding, where possible, skyline views) and to provide a maximum setback from	✓		✓	

Table 27 – Substation and transmission line summary of mitigation measures

Safeguard	Implementation			
	Design	**Site Preparation**	**Construction**	**Operation**
residential dwellings and road corridors.				
Selection of suitable component materials with low reflective properties.	✓		✓	✓
Selection of suitable storage areas for materials or plant with minimum visibility from residences and roads with screening where necessary.			✓	
Design for strategic tree or shrub planting between view locations and the transmission line.			✓	✓

Conclusion

SECTION 17

17.1 Summary

In summary, this LVIA concludes that the Sapphire wind farm would have an overall low visual impact on the majority of non-associated residential view locations as well public view locations, including the Gwydir Highway as well as sections of the local road network identified in this LVIA.

This LVIA determined the overall landscape character sensitivity to be medium with some characteristics of the landscape likely to be altered by the wind farm development, although the landscape would have some capability to accommodate change. This capability is largely derived from the large scale and open landscape character identified in this part of the New England Tablelands, together with the relatively low density of residential view locations within the immediate area of the Sapphire wind farm viewshed.

The LCA's identified and described in this LVIA are generally well represented throughout the Glen Innes Severn and Inverell Shire Council areas and more generally within other regions across the New England Tablelands. This LVIA has determined that the landscape surrounding the Sapphire wind farm will have some ability to accommodate the physical changes associated with the wind farm and its associated structures.

This LVIA determined that the Sapphire wind farm would have a high visual impact on three of the one hundred and thirty nine residential view locations within the 10km viewshed. The high visual impact would largely result from the proximity of wind turbines to the residential dwellings or orientation of dwellings relative to the wind turbines. Of the three residential view locations with a high visual impact one would be an associated landowner and two non-associated.

The majority of residential dwellings surrounding the wind farm are strategically situated within the landscape to mitigate exposure to inclement weather, or have adopted measures to reduce these impacts by planting and maintaining windbreaks around residential dwellings. The extent of windbreak planting reduces the potential visibility of the wind farm from a number of residential view locations in the surrounding landscape.

This LVIA identified and assessed thirteen public view locations, including road corridors and public lookouts, and determined that the Sapphire wind farm would have a low visual impact on twelve of the public view locations and nil on one. The low visual impact would be largely due to the proximity of the wind turbines relative to the view location as well as the combined screening influence of undulating landform and tree cover. The majority of the public view locations are dynamic (motorists travelling along local roads) and include contextual views that would potentially change in reasonably quick succession within the spatial qualities of the surrounding landscape.

The Sapphire wind farm would be visible from a number of local roads including the Gwydir Highway. This LVIA has determined that views toward the Sapphire turbines would generally result in a Low impact for the majority of motorists travelling through the area.

This LVIA has determined that the construction of the Sapphire wind farm would not result in significant 'direct', 'indirect' or 'sequential' cumulative impacts when considered against any existing or proposed wind farm developments, including the Glen Innes and White Rock wind farm projects. Intervisibility between approved and proposed wind farms is influenced by undulating landform and tree cover within and beyond the Sapphire 10km viewshed.

The potential 330kv and 132kV substation locations and transmission line options are unlikely to result in a significant visual impact for the majority of surrounding residential or public view locations. The five residences with a medium or medium to high visual impact were all noted as associated properties. A combination of distance, undulating landform and tree cover between substation and transmission line components to surrounding view locations would tend to reduce visibility.

Both pre-construction and construction activities are unlikely to result in an unacceptable level of visual impact due to the temporary nature of these activities together with proposed restoration and rehabilitation strategies. The preferred location for some of the construction activities, including the on-site concrete batch plant and rock crusher, would generally be located away from publicly accessible areas, with the closest residential view locations generally comprising associated landowners.

Night time obstacle lighting would have the potential to be visible from surrounding view locations, as well as areas beyond the Sapphire wind farm 10km viewshed. The level of visual impact would diminish when viewed from more distant view locations, with a greater probability of night time lighting being screened by landform and/or tree cover. It should also be noted that the night time lighting installed on the Cullerin wind farm (as illustrated in this LVIA) has been decommissioned by Origin Energy following a risk based aviation assessment. A number of recent wind farm developments in New South Wales have also been approved without a requirement for night time lighting, including the Gullen Range and Glen Innes wind farms.

Although some mitigation measures are considered appropriate to minimise the visual effects for a number of the elements associated with the wind farm, it is acknowledged that the degree to which the wind turbines would be visually mitigated is limited by their scale and position within the landscape relative to surrounding view locations. Despite this, the Proponent has engaged in ongoing consultation with local residents and made a number of adjustments to the location of individual turbines to minimise visual impacts where possible.

Subject to DoPI determination, and any conditions of approval, the proponent would consider implementing landscape treatments to screen and mitigate the potential visual impact of the wind farm for individual neighbouring properties within an appropriate and agreed distance from the wind farm project area, subject to consultation and agreement with individual property owners.

Appendix A – Civil Aviation Safety Authority Advisory Circular AC139-18(0) July 2007 (Withdrawn)

References and Bibliography

Wind Farms and Landscape Values National Assessment Framework, June 2007, Australian Wind Energy Association and Australian Council of National Trusts.

National Wind Farm Development Guidelines – Public Consultation Draft, July 2010, Environment Protection and Heritage Council.

New South Wales Department of Planning & Infrastructure, Major Projects Assessment: http://majorprojects.planning.nsw.gov.au/page/project-sectors/transport--communications--energy---water/generation-of-electricity-or-heat-or-co-generation/

Wikipedia Glen Innes Severn Council, http://en.wikipedia.org/wiki/Glen_Innes_Severn_Council

Wikipedia Inverell Shire Council, http://en.wikipedia.org/wiki/Inverell Shire Council

Wikipedia Wellingrove New South Wales http://en.wikipedia.org/wiki/Wellingrove,_New_South_Wales

Kings Plains National Park, NSW Office of Environment and Heritage, http://www.environment.nsw.gov.au/nationalparks/parkHome.aspx?id=N0067

Office of Environment and Heritage, Nandewar Bioregion http://www.environment.nsw.gov.au/bioregions/NandewarBioregion.htm

Bureau of Meteorology, Climate Statistics for Glen Innes, 2009: http://reg.bom.gov.au/climate/averages/tables/cw_056011.shtml

The Countryside Agency and Scottish Natural Heritage (2002) Landscape Character Assessment Topic Paper 6.

Landscape Sensitivity and Capacity Study for Wind Farm Development on the Shetland Islands, March 2009, Land Use Consultants.

Guidelines for Landscape and Visual Impact Assessment 2nd ed. The Landscape Institute & Institute of Environmental Management & Assessment, 2002.

Photography and photomontage in landscape and visual impact assessment, Advice Note 01/11, British Landscape Institute, March 2011.

Visual Representation of Wind Farms, Good Practice Guidance, Scottish Natural Heritage March 2006.

Visual Assessment of Windfarms: Best Practice. Scottish Natural Heritage Commissioned Report F01AA303A, University of Newcastle 2002.

Community Attitudes to Wind Farms in NSW, September 2010, AMR Interactive.

Sapphire Wind Farm Landscape and Visual Impact Assessment of Wind Prospect CWP Pty Ltd, Church Communities Australia, August 2010.

Wind Farms in New South Wales, Wind in the Bush, David Clarke 2009: (http://www.geocities.com/daveclarkecb/Australia/WindNSW.htlm)

Sapphire Wind Farm, Referral of proposed action, Wind Prospect CWP & Ecological Australia, February 2011.

White Rock Wind Farm Landscape and Visual Impact Assessment, Epuron Pty Ltd 2011.

Glen Innes Wind Farm Visual Impact Assessment, Connell Wagner Pty Ltd 2008.

Gullen Range Wind Farm Pty Ltd, ERM Landscape and Visual Impact Assessment 2008.

Limitations

GBD has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Wind Prospect CWP Pty Ltd and only those third parties who have been authorised in writing by GBD to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the GBD Proposal dated 7th December 2010.

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

This report was prepared between December 2010 and September 2011 and is based on the conditions encountered and information reviewed at the time of preparation. GBD disclaims responsibility for any changes that may have occurred after this time.

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

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Mr Adrian Maddocks
Senior Development Manager
Wind Prospect CWP Pty Ltd
PO Box 1708, 45 Hunter Street
NEWCASTLE NSW2300

7th November 2011

Dear Adrian

Re Sapphire Wind Farm Landscape and Visual Impact Assessment – turbine modification for a 1m increase to tip of blade height

Thank you for your email (20th October 2011). Further to the preparation of our Landscape and Visual Impact Assessment (LVIA) for the Sapphire Wind Farm Project, we understand that Wind Prospect CWP Pty Ltd (the Proponent) propose to consider an additional wind turbine model extending to a tip height of 157m (comprising a 94m tower and 126m rotor diameter) for the Project.

The LVIA originally determined levels of impact for the '80m' and '110m' wind turbine design layouts. The parameters for the '80m' and '110m' design layouts, together with the proposed '157m tip of blade' wind turbine are outlined in the following table.

Element	80m Design Layout	110m Design Layout	157m tip of blade
Tower Height	100m	100m	94m
Rotor Diameter	92m	112m	126m
Overall height to tip of blade	146m	156m	157m
Total number of turbines	**159**	**125**	**125**

We understand that each of the proposed '157m tip height' wind turbines would be located in the same position as the previously assessed '110m' design layout wind turbine and include a total of 125 wind turbines. In addition to a proposed 1m increase in tip of blade height we have also considered the resultant decrease in tower height from 100m to 94m (a difference of 6m) as well as an increase in the total rotor swept area from approximately 9,847m^2 to 12,462m^2.

As requested we have reviewed the Sapphire Wind Farm LVIA (V9 – Final Issue September 2011) to identify any additional level of landscape or visual impact that might result from a 1m increase to the wind turbine tip of blade height. Our review included an assessment of potential changes:

- in wind turbine visibility within the Sapphire Wind Farm 10km viewshed;
- to levels of visual impact determined for residential and public view locations;
- to the shadow flicker assessment; and
- to the extent of cumulative impact.

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Our review of the Sapphire Wind Farm LVIA has determined that:

- A 1m increase in wind turbine tip height would not result in any significant increase in the level of visibility of wind turbines over and above that originally determined in the Sapphire Wind Farm LVIA for the 156m tip of blade (110m design layout). There would be no significant or discernable difference to the ZVI Diagrams prepared for the '110m design layout' (Figures 8 and 9 ZVI Diagrams 5 and 6 within the LVIA). Lowering the height of the nacelle by around 6m may, in some circumstances, remove the nacelle from view depending on the influence of surrounding topography and vegetation when compared to the results of the '110m design layout' ZVI.

- A 1m increase in wind turbine tip height would not result in any changes to the level of visual impact over and above that determined for the 139 residential dwellings or 13 public view locations identified and assessed in the Sapphire Wind Farm LVIA Tables 17 and 18.

- In accordance with the shadow flicker diagram provided by the Proponent, a 1m increase in tip height would not result in any associated or non associated residential dwelling experiencing shadow flicker in excess of 30 hours per year.

- A 1m increase in tip height would not result in any additional level of cumulative impact over and above that determined in the Sapphire Wind Farm LVIA.

Further to the production and receipt of an additional photomontage and a shadow flicker diagram we have prepared 3 additional figures to illustrate the proposed '157m tip of blade', these include:

- Figure 62 Photomontage Location PM11A Comparative Photomontage;
- Figure 63 Photomontage Location PM11A Detail Sheet Comparative Photomontage; and
- Figure 64 Shadow Flicker 157 tip of blade layout.

The additional photomontage (PM11A) illustrates the '157m' tip of blade wind turbine on the '80m design layout'. The '80m design layout' was adopted in order to provide a direct comparison with the original LVIA photomontages which are also based on the '80m design layout'. The LVIA photomontage are based on a 146m tip of blade, with a 100m tower and 92m diameter rotor and are indicative of a scale of turbine which would be suitable for the '80m' layout, but larger turbines, such as the 157m tip height, would use the 125 turbine '110m' layout.

Photomontage Location PM11 (Krystal Blue residential property) was selected to provide a proximate and non associated residential view comparison between the '80m design layout' photomontage and the proposed turbine to '157m tip height'.

Yours sincerely,

GREEN BEAN DESIGN
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Andy Homewood, AILA
Registered Landscape Architect

Indicative extent of visible Sapphire wind farm turbines

Photo A: Viewpoint PM11A Extended panorama (tower height 100m, rotor diameter 92m and turbine tip height 146m)
Proposed view north east to south from Krystal Blue
Distance to nearest Sapphire turbine: 1.8km
Number of Sapphire turbines visible: 44

Indicative extent of visible Sapphire wind farm turbines

Photo B: Viewpoint PM11A Extended panorama (tower height 94m, rotor diameter 126m and turbine tip height 157m)
Proposed view north east to south from Krystal Blue
Distance to nearest Sapphire turbine: 1.8km
Number of Sapphire turbines visible: 44

General Notes: Viewpoint PM11A, Krystal Blue

Coordinates: Easting 341144, Northing 6713550

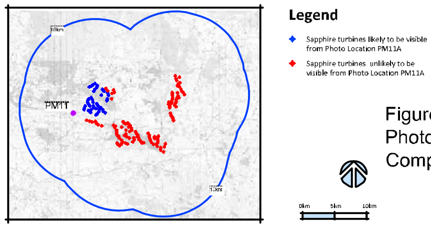
Photo date: 2nd August 2011, 4.20pm

Elevation: 769m AHD (+/- 4m)

Camera: Canon EOS 4000, 30mm 1:1.4DC Lens (equivalent to 35mm SLR Camera with 50mm lens). F/16 at 1/250 sec

Original Page Format: A1 Landscape

This photomontage represents the likely view of the proposed Sapphire wind farm.

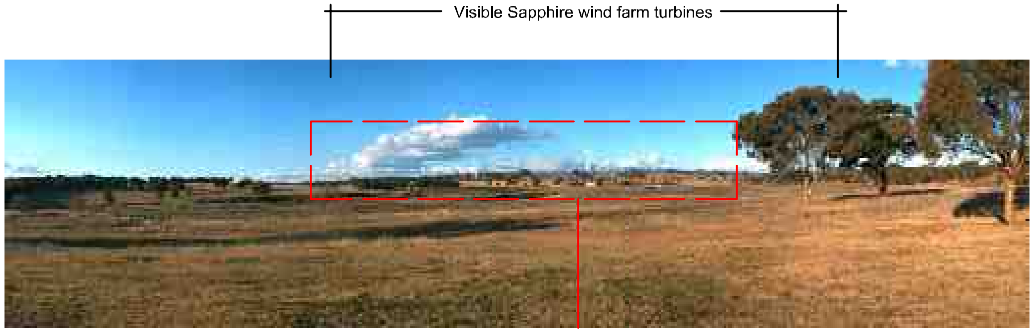


General location plan - PM11A
(Turbine locations are indicative only)

Figure 62
Photomontage PM11A
Comparative Photomontage

SAPPHIRE WIND FARM - PM11A KRYSTAL BLUE

Figure 63 Photomontage PM11A
Detail Sheet
Comparative Photomontage



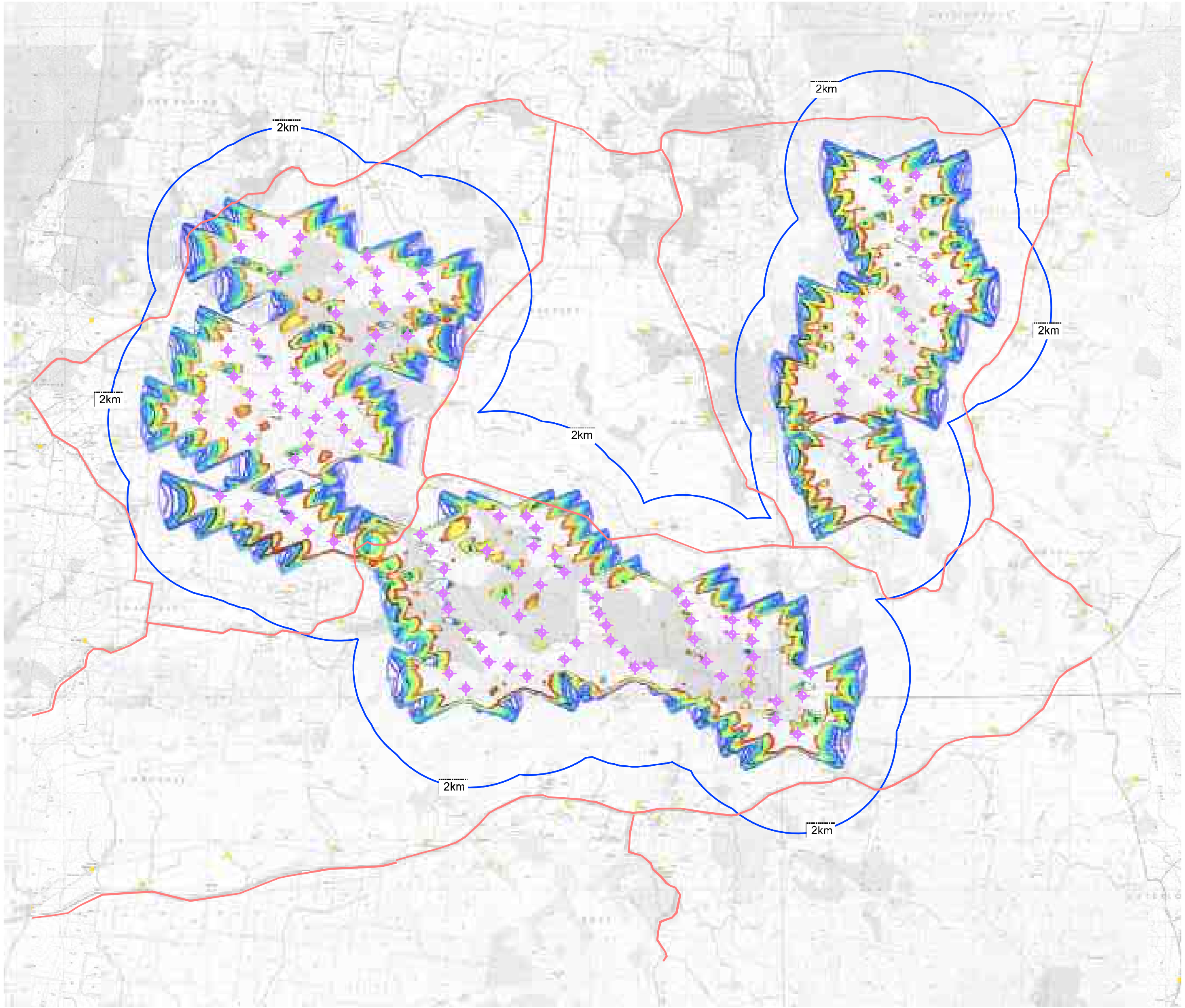
Photomontage Location PM11A
Krystal Blue

Refer Detail A and B below

Photomontage Location PM11A - Detail A (turbine 146m to tip of blade, tower height 100m and rotor diameter 92m)

Photomontage Location PM11A - Detail B (turbine 157m to tip of blade, tower height 94m and rotor diameter 126m)

SAPPHIRE WIND FARM - PM11A KRYSTAL BLUE



Source: Copyright Department of Lands Panorama Avenue Bathurst 2795 (www.lands.nsw.gov.au)

Figure 64
Shadow Flicker '157 tip of blade' layout

SAPPHIRE WIND FARM