

Crookwell 3 Wind Farm Shadow Flicker

Purpose

Garrad Hassan Pacific Pty Ltd was engaged to prepare a shadow flicker impact assessment to determine the potential impact of shadow flicker arising from the proposed Crookwell 3 Wind Farm.

The shadow flicker effect is described as follows:

"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".

The likelihood and duration of the shadow flicker effect depends upon a number of variable factors as follows:

- direction of the property relative to the turbine;
- distance from turbine (the further the observer is from the turbine, the less pronounced the effect would be);
- wind direction (the shape of the shadow would be determined by the position of the sun relative to the blades, which would be oriented to face the wind);
- turbine height and rotor diameter;
- time of year and day (the height of the sun in the sky); and
- weather conditions (cloud cover reduces the occurrence of shadow flicker).

It is important to note that the shadow flicker assessment may overestimate the actual number of annual hours of shadow flicker at a particular location due to a number of reasons including:

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

The shadow flicker assessment considered the Victorian Planning Guidelines and the EPHC Draft National Wind Farm Development Guidelines. The Victorian Planning Guidelines 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".

Key Findings and Impacts

Shadow flicker was calculated at dwellings at heights of 2 m, to represent ground floor windows, and 6m, to represent second floor windows.

The results of the of the shadow flicker assessment determined that the following four residential view locations may be subject to some levels of shadow flicker:

- House ID 18, Wollondilly (associated residence);
- House ID 79, Leeston (associated residence);

- House ID 66, Little Vale (non-associated residence); and
- House ID 63, Rocky Corner (non-associated residence).

The Leeston residence that adjoins the Crookwell 3 East site has been determined as the only residence that may be subject to levels of shadow flicker in excess of 30 hours per year (refer to Table 1). It is important to note that this residence is an associated landowner.

Table 1: Flicker Assessment Summary for the Crookwell 3 Wind Farm layout

House ID	Easting ¹ [m]	Northing ¹ [m]	Theoretical				Predicted Actual ³	
			At Dwelling [hr/yr]		Max Within 50m of Dwelling ² [hr/yr]		Max Within 50m of Dwelling ² [hr/yr]	
			At 2 m	At 6 m	At 2 m	At 6 m	At 2 m	At 6 m
Limit			30	30	30	30	10	10
18	736232	6171276	0	0	28	28	10	10
63	741181	6173622	0	0	13	13	4	4
66	743524	6174343	0	0	9	12	3	4
79	740830	6174323	28	32	36	38	11	12

¹ MGA Zone 54 (GDA94 datum)

² Dwellings with zero hours shadow flicker have been omitted from this table

³ Considering likely reductions in shadow flicker duration due to cloud cover and turbine orientation



International example of a wind farm

Traffic

Motorists may experience shadow flicker while driving, however the effects of shadow flicker are similar to other effects such as shadows from trees on the side of the road or passing vehicles. As such, it is unlikely that shadow flicker will impact upon a driver's ability to operate a motor vehicle safely along local roads.

Blade Glint

The potential for blade glint from wind farms is reduced by the surfaces on the turbine's blades, which are largely convex and typically treated with non-reflective paint.

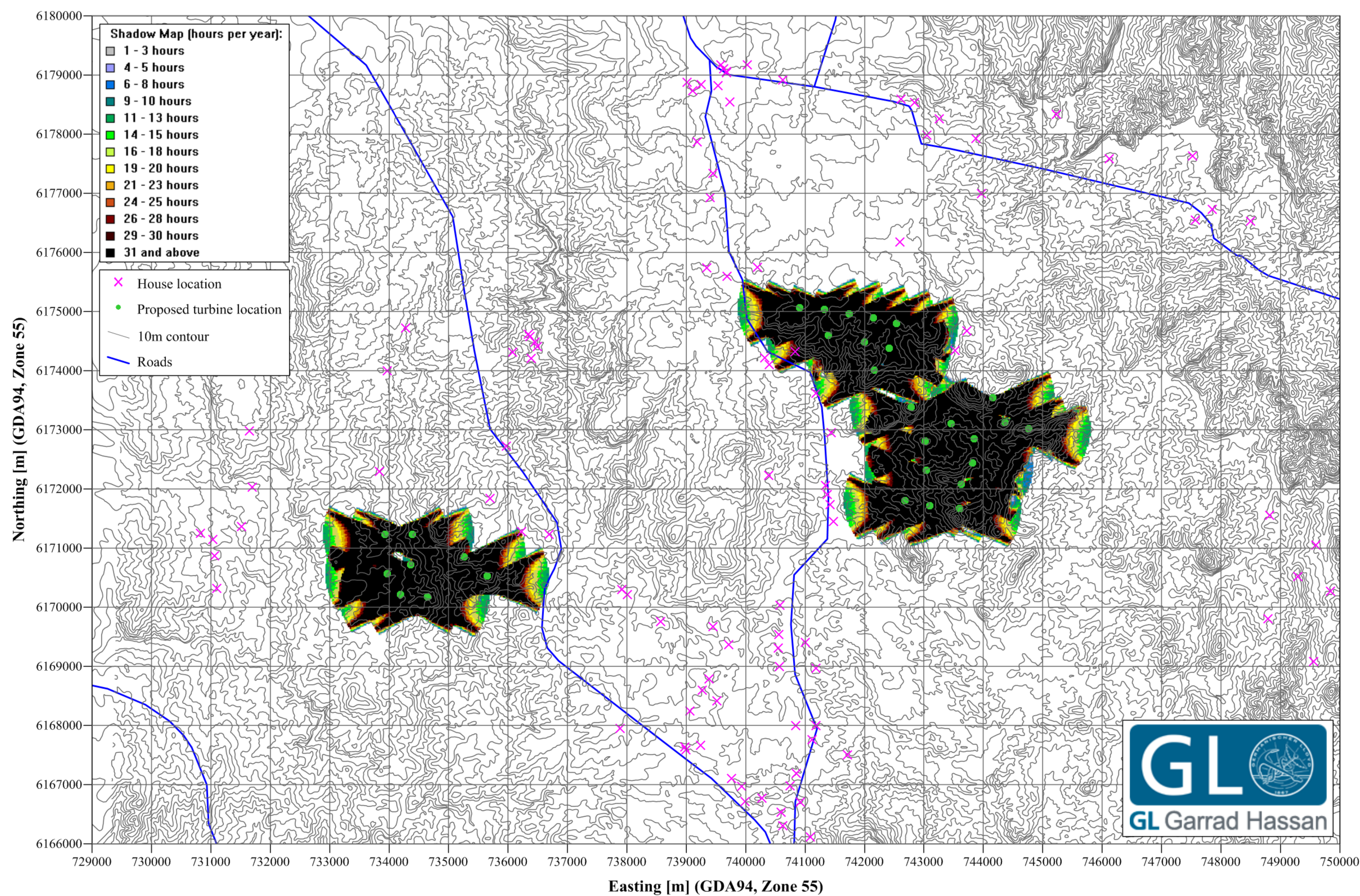


Figure 1: Map of Crookwell 3 Wind Farm showing turbine, house location and theoretical annual shadow flicker duration at 6m

Response to Findings

Several options are available for mitigation of shadow flicker and blade glint on the view locations, based on the owner's approval. These options are as follows:

- non-reflective paint on turbine blades;
- installation of screening structures or planting of trees to block shadows cast by the turbines; and
- the use of turbine control strategies which shut down turbines when shadow flicker is likely to occur.



Figure 2: Shadows cast by trees along a road may create an effect similar to shadow flicker for motorists.