

# PALING YARDS WIND FARM SHADOW FLICKER & FIRE

## SHADOW FLICKER

### PURPOSE

Garrad Hassan Pacific Pty Ltd (Garrad Hassan) was engaged by UFWA to assess the potential impact of shadow flicker arising from the proposed wind turbines. The assessment describes the shadow flicker effect 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).
- 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.
- 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 adopted the Victorian Planning Guidelines, Policy and planning guidelines for development of wind energy facilities in Victoria, which recommend a shadow flicker limit of 30 hours per year in the immediate area of a dwelling.

This recommendation is also reflected in the Draft NSW Planning Guidelines Wind Farms Guidelines (Draft Guidelines), which also recommend a shadow flicker limit of 30 hours per year to be experienced at any dwelling as a result of the operation of a wind farm. The Draft Guidelines also recommend assessment of the impact of shadow flicker on all houses within 2km of a proposed wind turbine.

## KEY FINDINGS & IMPACTS

The results of the shadow flicker assessment, visible in Figure 56, for the project determined that the following seven residential view locations may be subject to levels of shadow flicker above the recommended limit of 30 shadow flicker hours per year: House ID 7, House ID 7A, House ID 8, House ID 8A, House ID 9, House ID 9A, and House ID 9B.

The residences listed above are project-involved landowners, and UFWA will negotiate an agreement with the owners of these dwellings.

### Traffic

Motorists may experience shadow flicker sensations whilst driving. However as the potential flicker frequency for the Paling Yards wind turbines is likely to be around 1Hz, it is unlikely that the flicker effect would cause annoyance or impact on a driver's ability to operate a motor vehicle safely whilst travelling along local roads surrounding the wind farm.

### Blade Glint

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

## RESPONSE TO FINDINGS

The report concluded that several options are available for mitigation of shadow flicker and blade glint on the view locations such as the noted dwellings, based on the owner's approval. These options are as follows:

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

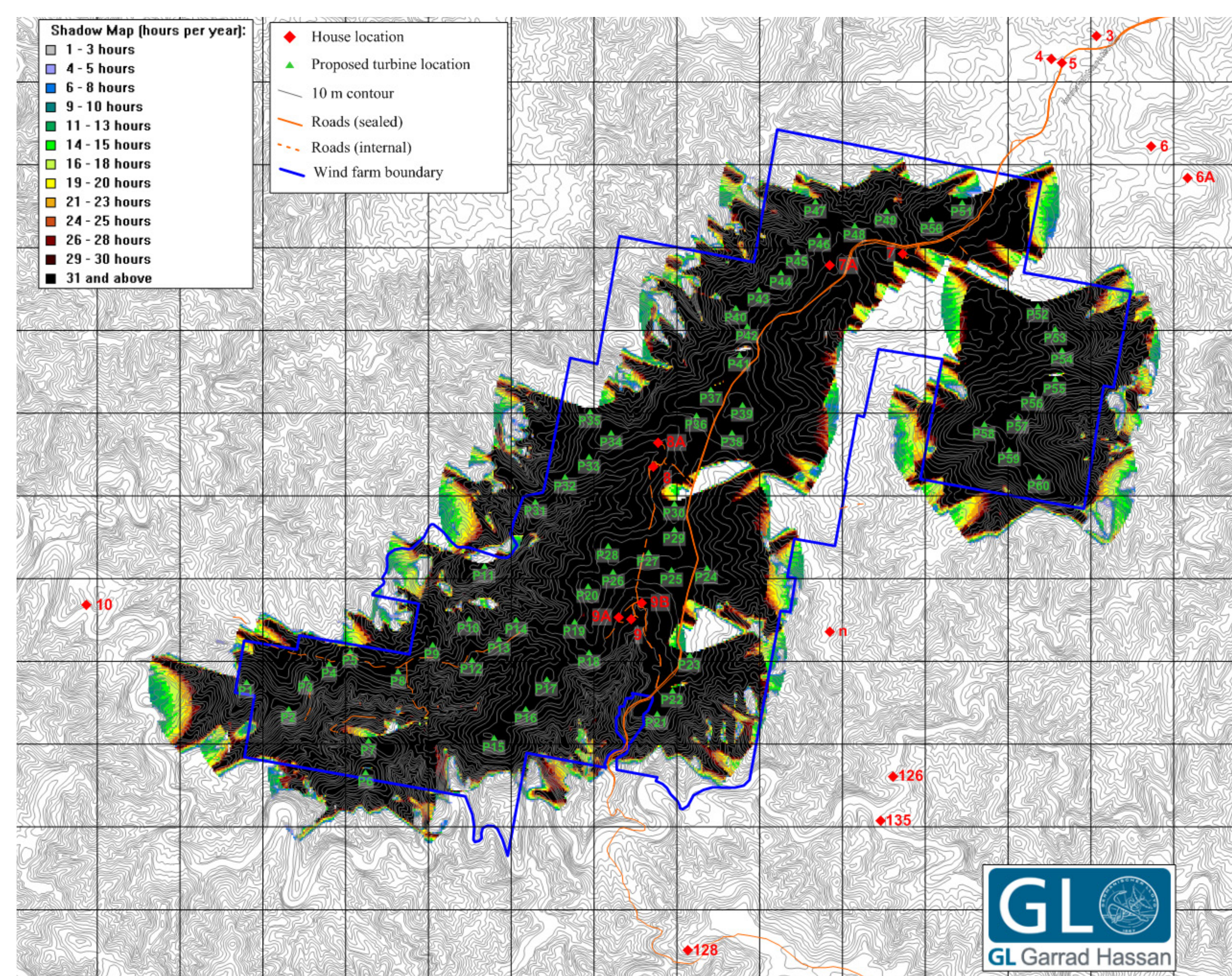


FIGURE 56 Theoretical Annual Shadow Flicker Duration At 2 Metres (Option 2)

## FIRE

### PURPOSE

A wind farm in a rural area, as with many large scale developments, can increase the risk of bushfire to nearby people and property. This includes fire caused by the turbines (and associated components) themselves, impacts on the turbines caused by fire sparked elsewhere, and impacts on the ability to fight fires in and around a wind farm site.

The potential risk to people and property depends on a number of factors, including the inherent flammability of the turbine generators, the landscape in which the turbines sit, and the capability and methods used by local fire services to fight fires in the area.

The Draft NSW Wind Farm Guidelines specify that assessment must detail bushfire hazards and risk, including recommending consultation with the NSW Rural Fire Service.

As a result of increased wind farm development in Victoria and NSW, the Victorian Country Fire Authority (CFA) and the RFS have extensively studied the implications of wind farms on fire, and the possible mitigation measures to reduce the risk.

## KEY FINDINGS & IMPACTS

Wind turbines manufactured today incorporate the highest quality and safety standards. Despite this, the risk of fire always exists when electronics and flammable oils and hydraulic fluids exist in the same enclosure. The risk of fire at a wind farm can be associated with nacelle fires, electrical faults during construction or from connection lines, fire fighting limitations within and adjoining the wind farm footprint, access to water sources and air fields, operation of winches and machinery during maintenance tasks, and impacts from downwind air turbulence on fire behaviour.

The CFA considers that the risk of wildfire resulting from the wind farm operations is not unduly greater than that resulting from other agricultural and industrial practices which operate within the country area. Furthermore, the risk of fire is considered to be in fact minimised by wind farm developments and their associated permit conditions because they introduce more intensive fire planning.

Due to modern day manufacturing, the risk of fire at wind farms is 'very low' in terms of both fire damage to wind turbines and fire caused by the turbines. This is because modern turbines are equipped with safety devices to reduce the risk of fire. It is also because:

- the flammable components are located high above the ground;
- there is normally no vegetation around the base of the turbine towers;
- medium-voltage connections are underground;
- access tracks act as fuelbreaks and provide fire fighting access;
- comprehensive lightning protection devices are installed on every wind turbine, including internal lightning conductor rods running all the way to the blade tips; and
- dedicated monitoring and control systems shut down the wind turbines when the threshold temperatures of critical components are reached.

Additionally, wind turbines must comply with the Building Code of Australia and Australian Standards, and vegetation around transformers are generally kept below 100 mm. While it is possible for an electrical failure to cause fire within a wind turbine, the system is designed to contain fire rather than spread it to the surrounding area (Fenwick 2009). The wind farm can also be shut down in the event of a fire situation.

Oberon Council considers that the whole of the Rural 1(a) zone in Oberon is susceptible and or liable to bush fires, including the subject site. The presence of dense areas of native vegetation to the west (Abercrombie National Park) and to the east on private land, combined with the steep topography to the south of the site, increase the risk of bushfire in this region.

However, several site factors assist in reducing the potential for fire or enhance the ability to control existing fires. These include a ready supply of water through the Abercrombie River, local dams, and smaller waterways, and the fact that the majority of the turbine locations are cleared of tree native vegetation. The taller native vegetation has been replaced by lower pasture grasses which present much lower flammability.

A further factor reducing the risk of fire is the accessibility of the majority of the site from the sealed Abercrombie Road and the internal network of farm tracks. Properly constructed, these allow the free passage and direct access to the turbines and all parts of the site. All these factors are likely to reduce the severity and duration of any fire.

Whilst the site is susceptible to bushfire, the risk of either the wind farm igniting a fire, or that the wind farm significantly affecting the ability to control a fire started elsewhere, is considered low.

## RESPONSE TO FINDINGS

The mitigation measures that will be implemented as part of this project will be detailed in a Fire Management Plan, prepared in consultation with State and local RFS, and the State Planning Department, in accordance with Planning for Bushfire Protection 2006.

This would address safety, communication, site access and emergency response protocols. Other mitigation measures proposed by this Environmental Assessment which are to be implemented as part of the project include:

- Consultation and training with the NSW Rural Fire Service in regard to the adequacy of bushfire prevention measures to be implemented on site during construction, operation and decommissioning.
- Consultation with the NSW PWS on the management of bushfires in the adjacent National Park
- Consult with the RFS during periods of high fire danger
- Inform RFS and any aerial agriculture operators on the location of the wind turbines, transmission lines and monitoring masts.
- Development of workplace health and safety protocols to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities.
- On-site vegetation management during construction and operation to minimise potential sources of fuel.
- Re-organisation of construction activities during periods of high fire danger, including ceasing use of explosives, and management of hot work activities such as welding or cutting.
- Use of materials and equipment during operation that minimise the likelihood of fire.
- Maintenance of vehicles to minimise sparking from exhaust systems.
- Automatic shutdown of any overheating turbine mechanism.
- Shut down of turbines during a bush fire in the area.
- Lightning protection on each turbine.
- Under-grounding of electrical and communication cables where practicable.
- Access to adequate water supply, with water access points be located in safe, easily identifiable areas and accessible in all weather conditions by equipment up to 15 tonnes
- A turning circle with a minimum radius of 10 metres will be provided for fire appliances at all water access points.
- The location and number of tanks or other water supply points will be determined in consultation with the NSW RFS.
- Careful storage and handling of flammable materials and ignition sources brought onto the site, as per manufacturer's instructions.
- Storage of appropriate fire fighting equipment onsite during the construction phase, ensuring that a minimum of one person on site is trained in its use.
- Periodical inspection of overhead transmission easements to monitor any regrowth of encroaching vegetation.
- Vehicle turn-around facilities to be provided at every turbine tower site.
- At least 5-metres wide internal access tracks to be provided that are driveable and permanently clear of vegetation for heavy fire-fighting equipment up to 15 tonnes
- Provision of wind turbine access tracks that continue onto adjacent paddocks and are not dead-ended (where possible).
- Implementing a wide fuel break in accordance with RFS, Council and State Government recommendations to slow the spread of fire.
- Any vegetation plantings to have low fire resistance.

**THE CFA CONSIDERS THAT THE RISK OF WILDFIRE RESULTING FROM THE WIND FARM OPERATIONS IS NOT UNDULY GREATER THAN THAT RESULTING FROM OTHER AGRICULTURAL AND INDUSTRIAL PRACTICES WHICH OPERATE WITHIN THE COUNTRY AREA.**