RE Future

Swansons Lane Wind Farm

Application for Planning Permit

Appendix F – Shadow Flicker Assessment

May 2025

Version History

Version	Author	Reviewer	Date	Description
1	VM	SS	28/04/21	Revision 1
2	VM	SS	19/03/23	Revision 2
3	VM	SS	28/07/23	Revision 3
4	AM	VM	13/02/24	Revision 4

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1 Introduction

Under the provisions of the Corangamite Planning Scheme and Moyne Planning Scheme, proponents of wind farms are required to consider the effect of the proposal on the surrounding area in terms of shadow flicker. Shadow flicker occurs when the movement of wind turbine blades creates a rotating shadow that appears as an intermittent, or flickering, shadow when experienced from a single vantage point in the vicinity of a wind turbine. Shadow flicker does not pose any risk of causing health effects; however, it does have the potential to adversely impact the amenity of nearby dwellings by subjecting residents to sharp contrasts of shade and light in short succession.

2 Planning Policy Context

Clause 52.32 of the Corangamite Planning Scheme and Moyne Planning Scheme sets out the application requirements for planning permit applications for wind energy facilities. Among other matters for consideration, Clause 52.32 stipulates that permit applications must address the potential impact of the wind farm in terms of shadow flicker.

Clause 52.32 does not specifically address the criteria against which wind farm shadow flicker is to be assessed, however it does list the *Policy and Planning Guidelines for the Development of Wind Energy Facilities in Victoria 2019* (Policy and Planning Guidelines) as a document which must be considered by the responsible authority in assessing a wind farm planning permit application. The Policy and Planning Guidelines list a single criterion for the assessment of shadow flicker caused by wind farms, namely:

> *The shadow flicker experienced immediately surrounding the area of a dwelling (garden fenced area) must not exceed 30 hours per year as a result of the operation of the wind energy facility.*

Neither Clause 52.32 nor the Policy and Planning Guidelines address the theory of shadow flicker or its assessment in detail. However, the Draft National Wind Farm Development Guidelines 2010 (National Guidelines) contain an in-depth discussion of shadow flicker theory and address a number of aspects of shadow flicker modelling and assessment. While the National Guidelines are not referenced in either Clause 52.32 or the Policy and Planning Guidelines, they nevertheless describe the phenomenon of shadow flicker and guide best practice modelling and impact assessment.

The National Guidelines distinguish two kinds of receptors of shadow flicker, namely participating landowners and neighbouring landowners. Participating landowners are those landowners who have entered into an agreement with the wind farm to host wind turbines and/or associated infrastructure, and who therefore have an interest in its successful development. Neighbouring landowners are the owners of land in the vicinity of the wind farm which may experience impacts from the wind energy facility.

The National Guidelines also list a number of best practice modelling assumptions which are addressed in the following section.

3 Shadow Flicker Modelling

In order to determine the amount of shadow flicker that will be experienced by dwellings surrounding the wind farm, shadow flicker modelling was conducted using industry standard software, namely WindPro. Modelling was conducted on the basis of worst-case assumptions listed in the National Guidelines. These assumptions are listed in the Table 1 below.

Table 1: Modelling Assumptions

Modelling Parameter	Description
Zone of influence of shadows	265 x maximum chord length
Receptor height	1.5 m
Minimum angle of the sun	3 degrees
Acceptance criteria	Modelled – maximum of 30 hours per year
Cloud cover correction	Modelled – no

The resulting shadow flicker map is presented in Figure 1. The levels of shadow flicker predicted at dwellings located within 2 km of a turbine are summarised in Table 2.

Table 2: Modelled Shadow Flicker Levels at Dwellings Within 2 km (Hours/Year)

Dwelling Number	Dwelling Type	Modelled flicker	Cloud correction	Final Flicker
65	Participating	26:56	0.441	11:53
62	Participating	22:49	0.441	10:06
63	Participating	0:00	0.441	0:00
49	Neighbouring	0:00	0.441	0:00
53	Neighbouring	0:00	0.441	0:00
51	Neighbouring	0:00	0.441	0:00
123	Neighbouring	0:00	0.441	0:00
69	Participating	0:00	0.441	0:00
57	Neighbouring	0:00	0.441	0:00
74	Neighbouring	0:00	0.441	0:00
64	Neighbouring	0:00	0.441	0:00

These results represent a worst-case scenario in which it is assumed the sun is always shining, there are no intervening obstacles, wind turbines are always facing perpendicular to the line of sight between the point of observation and the turbine, and shadow receptors face all directions. Accordingly, it is important to note that actual shadow flicker will be lower than the levels predicted below.

Shadow flicker modelling was based on the worst-case shadow candidate turbine model, namely the Vestas V172 HH166. In the event that the ultimate choice of turbine differs from the Vestas V172 HH166, all modelling will be redone on the basis of the final model selected and the wind farm will comply with all conditions of development approval.

One simple method for determining a closer estimate of actual shadow flicker is to subtract the proportion of cloudy days from the annual prediction of shadow flicker using weather data from the nearest Bureau of Meteorology weather station. In the case of the present wind farm this weather station is located at Warrnambool Airport, approximately 30 km from the wind farm site. According to this data Garvoc experiences on average 204.1 cloudy days per year, which equates to a reduction in annual shadow flicker of 55.9%. Cloud cover corrected predictions for shadow flicker are included in the table above.

4 Potential Impact on Road Users

While it is not directly addressed by either Clause 52.32 or the Policy and Planning Guidelines, the potential impact of wind farm shadow flicker on major roads has recently emerged as a potential planning consideration for proposed wind farms. The proposed wind farm is located in the vicinity of one major road, namely the Princes Hwy. However, while the wind farm is located near the Princes Hwy, its zone of influence of shadows does not stretch to the highway itself, and as such the proposed wind farm will not have any impact on road users on the Princes Hwy.

5 Conclusion

Shadow flicker modelling has been carried out in accordance with best practice industry guidelines. The resulting levels of shadow flicker at non-participating dwellings are all below the acceptable limit of 30 hours per year. A WindPro shadow flicker report has been included as an appendix to this report.

Swansons Lane Wind Farm

Predicted Shadow Flicker

Legend

Dwellings

Host

HIGHWAY

ROAD

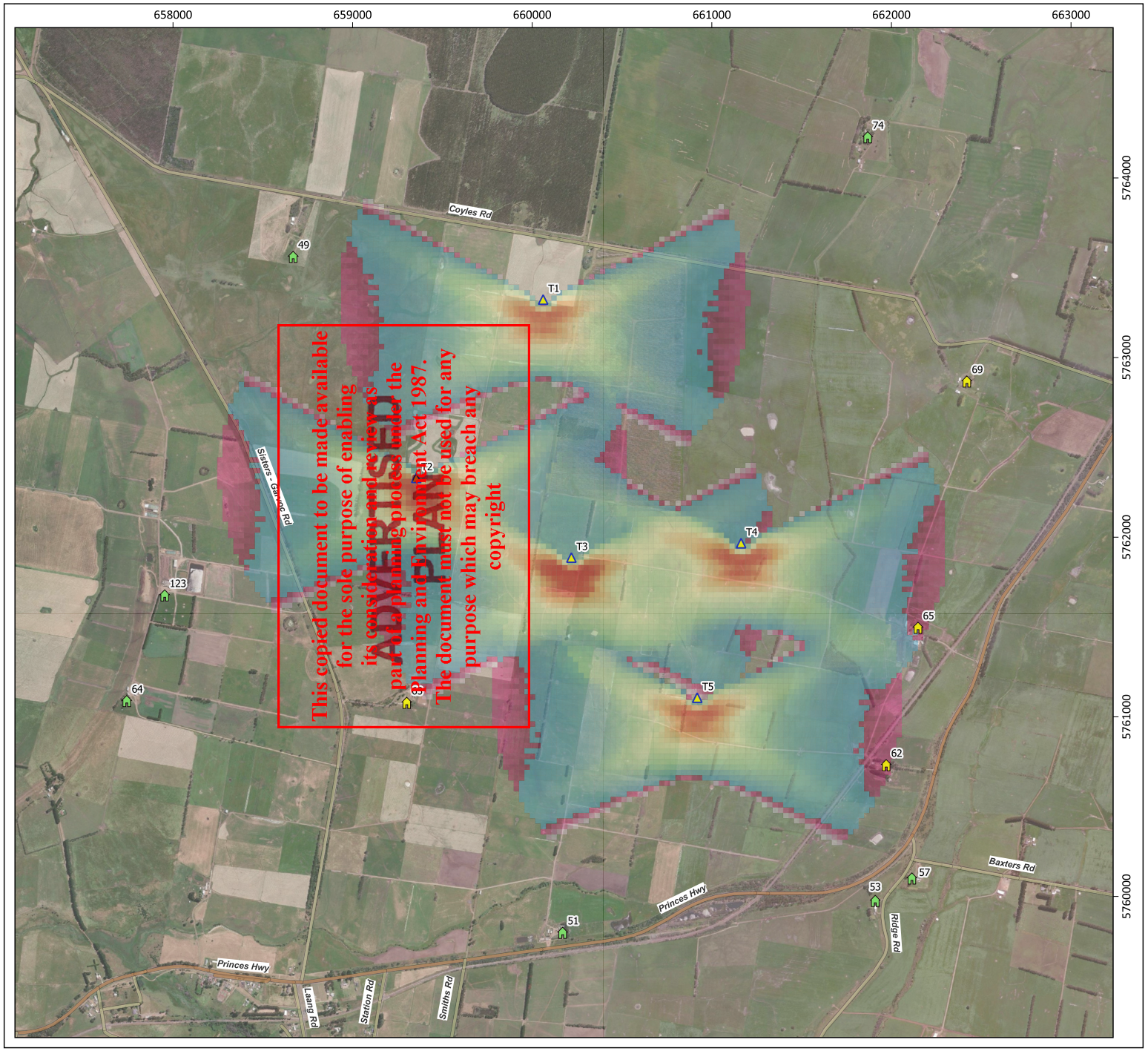
Above 30 hrs per annum

Below 30 hrs per annum

Drawn: VM	Scale when printed at A3: 1:20,000
Checked: SS	Date: 11-01-2024
Approved: SS	Figure 1

0 0.5 1 km

RE Future



Appendix: WindPro Shadow Flicker Report

Project:
20230219 SWA Rev 2

Description:
Swansons Lane 6 WTG

Licensed user:
RE Future Pty Ltd
21 Langridge St
AU-NEWTOWN VIC 3220
03 9429 5629
Vaughan Mitchell / vaughan.mitchell@refuture.com.au
Calculated:
20/01/2024 12:21 PM/4.0.531

SHADOW - Main Result

Calculation: 20240120 SWA Shadow Flicker

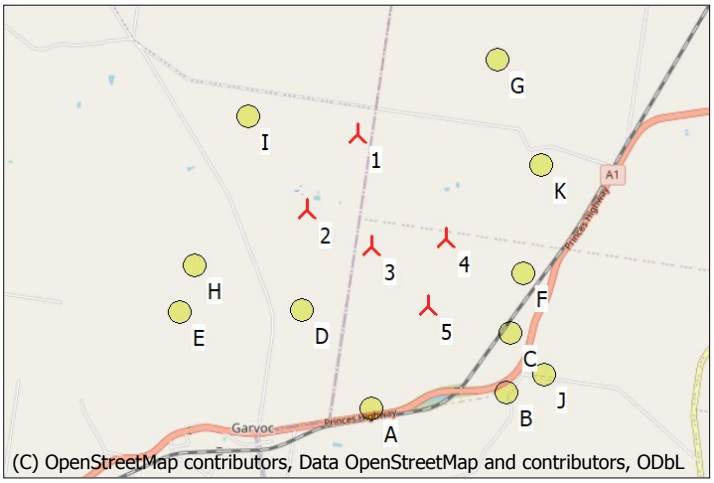
Assumptions for shadow calculations

Maximum distance for influence	1,140	m
Minimum sun height over horizon for influence	3	°
Day step for calculation	1	days
Time step for calculation	1	minutes

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: SRTM elevation
Receptor grid resolution: 1.0 m

All coordinates are in
UTM (south)-WGS84 Zone: 54



Scale 1:100,000

New WTG Shadow receptor

WTGs

	Easting	Southing	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Shadow data Hub height [m]	Calculation distance [m]	RPM [RPM]
1	660,061	5,763,323	109.5	WTG 1	Yes	VESTAS	V172-7.2-7,200	7,200	172.0	166.0	1,140	-
2	659,397	5,762,362	108.0	WTG 2	Yes	VESTAS	V172-7.2-7,200	7,200	172.0	166.0	1,140	-
3	660,218	5,761,886	104.1	WTG 3	Yes	VESTAS	V172-7.2-7,200	7,200	172.0	166.0	1,140	-
4	661,163	5,761,966	106.7	WTG 4	Yes	VESTAS	V172-7.2-7,200	7,200	172.0	166.0	1,140	-
5	660,919	5,761,106	102.2	WTG 5	Yes	VESTAS	V172-7.2-7,200	7,200	172.0	166.0	1,140	-

Shadow receptor-Input

No.	Name	Easting	Southing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
A	Dwelling 51	660,173	5,759,812	100.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
B	Dwelling 53	661,910	5,759,979	112.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
C	Dwelling 62	661,971	5,760,735	108.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
D	Dwelling 63	659,301	5,761,082	106.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
E	Dwelling 64	657,742	5,761,092	124.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
F	Dwelling 65	662,148	5,761,500	106.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
G	Dwelling 74	661,868	5,764,231	119.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
H	Dwelling 123	657,953	5,761,680	115.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
I	Dwelling 49	658,669	5,763,565	109.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
J	Dwelling 57	662,394	5,760,205	97.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
K	Dwelling 69	662,420	5,762,871	117.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case: Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
A	Dwelling 51	0:00	0	0:00
B	Dwelling 53	0:00	0	0:00
C	Dwelling 62	22:49	48	0:36
D	Dwelling 63	0:00	0	0:00
E	Dwelling 64	0:00	0	0:00
F	Dwelling 65	26:56	56	0:37
G	Dwelling 74	0:00	0	0:00
H	Dwelling 123	0:00	0	0:00
I	Dwelling 49	0:00	0	0:00
J	Dwelling 57	0:00	0	0:00
K	Dwelling 69	0:00	0	0:00

Licensed user:
RE Future Pty Ltd
21 Langridge St
AU-NEWTOWN VIC 3220
03 9429 5629
Vaughan Mitchell / vaughan.mitchell@refuture.com.au
Calculated:
20/01/2024 12:21 PM/4.0.531

SHADOW - Main Result

Calculation: 20240120 SWA Shadow Flicker

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]
1	WTG 1	0:00
2	WTG 2	0:00
3	WTG 3	0:00
4	WTG 4	26:56
5	WTG 5	22:49

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.