ITP Renewables

25065 – Majors Creek 1A

Glint and Glare Study
Draft Report

2025

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We acknowledge the First Peoples of Australia, and their Elders past, present and emerging. We pay our respects to the traditional storytellers, designers, artists and custodians of the land on which we live and work.

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Executive Summary

ITP Renewables assessed the glare impact of the proposed Majors Creek 1A solar farm, Ballalaba, NSW.

The results of the GlareGauge analysis indicated three observation points and two road routes received green glare over the course of one year, which has a low potential to cause after image for observers. One road route received yellow glare over the course of one year, which has the potential to cause after image to observers.

Wallaces Gap Road (RT01) received up to 11 minutes of yellow glare between 4:54am and 6:12am, from 25th September to 17th March.

The glare impact to the Wallaces Gap Road (RT01) is believed to be minimal due to the constrained region of exposure and the relatively short duration of glare. As such, we do not expect additional mitigation measures are required for this site, beyond the already-proposed vegetation screening along the west fence line.

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1. Introduction

1.1. Overview

EDPR Australia has requested a glint and glare assessment for a proposed solar photovoltaic (PV) installation located at Majors Creek, Ballalaba, NSW. This assessment will be submitted as part of the development application for the project. It includes:

- Identification of potential receptors of glint and glare from the proposed solar farm.
- Assessment of the glint and glare hazard using the Solar Glare Hazard Analysis Tool (SGHAT) GlareGauge analysis.

1.2. Glint and Glare

The United States Federal Aviation Administration (FAA) defines glint and glare as follows:[1]

- Glint is a momentary flash of bright light
- Glare is a continuous source of excessive brightness relative to ambient lighting.

Glint and glare can occur when light reflected off a surface (reflector) is viewed by a person (receptor). Glint typically occurs when either the receptor or the reflector is moving, while glare typically occurs when the reflector and receptor are completely, or nearly, stationary. For a transparent material (e.g., glass, water) the quantity of light reflected depends on the surface itself (i.e., material and texture), and the angle at which the light intercepts it (angle of incidence). More light is reflected at higher angles of incidence as shown in Figure 1.

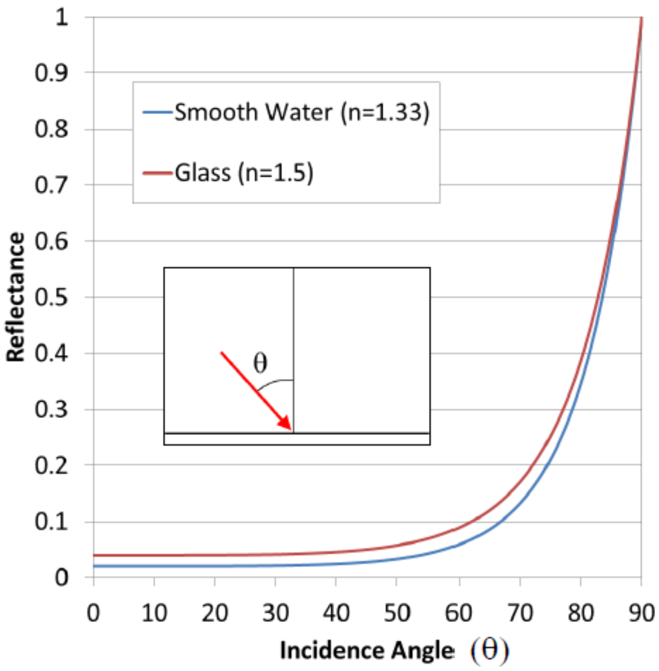

Figure 1: Angles of incidence and increased levels of reflected light

[1] Federal Aviation Administration (2018)

Potential visual impacts from glint and glare include distraction and temporary afterimage; at its worst, it can cause retinal burn. The ocular hazard caused by glint or glare is a function of:

- The intensity of the glare upon the eye (retinal irradiance)
- The subtended angle of the glare source (i.e., the extent to which the glare occupies the receptor's field of vision; dependent on size and distance of the reflector).

The severity of the ocular hazard can be divided into three levels, as shown in Figure 2:

- Green glare, which has low potential to cause temporary afterimage
- Yellow glare, which has potential to cause temporary afterimage
- Red glare, which can cause retinal burn and is not expected for PV.

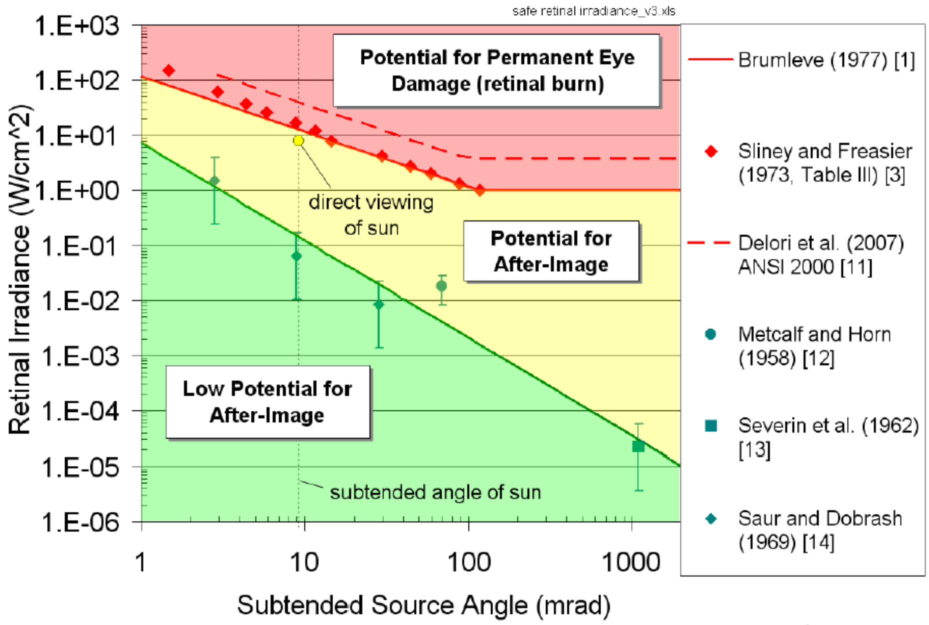

Figure 2: Classification of glare based on severity of ocular effects.

1.3. Glare from Solar PV

Solar photovoltaic (PV) cells are designed to absorb as much light as possible to maximise efficiency (generally around 98% of the light received). To limit reflection, solar cells are constructed from dark, light-absorbing material and are treated with an anti-reflective coating. PV modules generate less glare than many other surfaces, as shown in Figure 3.

The small percentage of light reflected from PV modules varies depending on the angle of incidence. Figure 4 shows an example of this with a solar module. A larger angle of incidence will result in a higher percentage of reflected light.

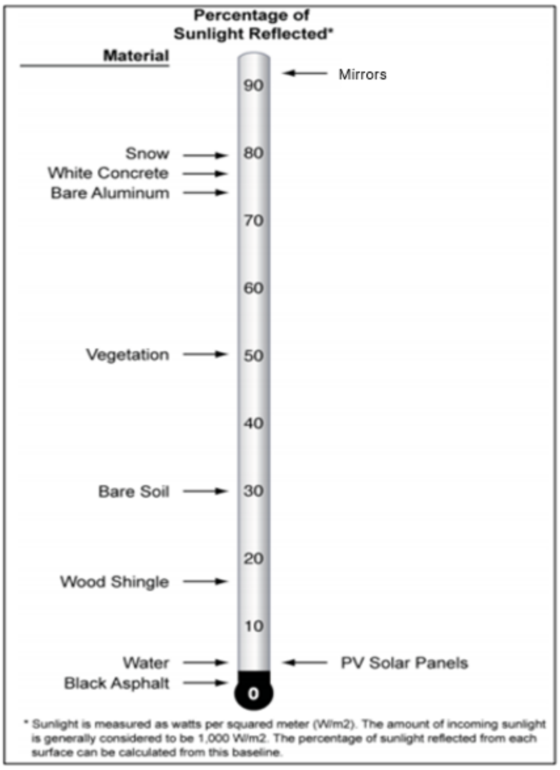

Figure 3: Typical percentage of sunlight reflected from different surfaces.[2]

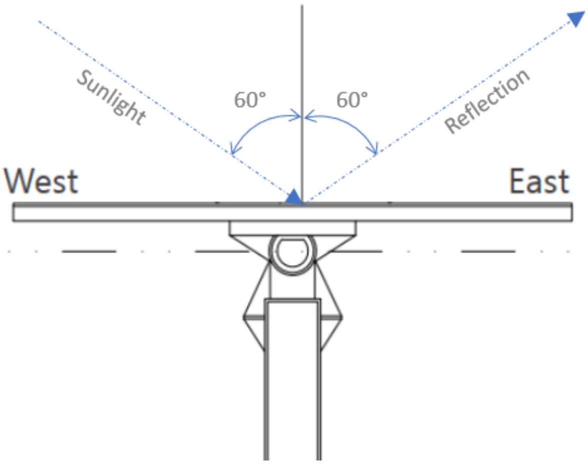

Figure 4: Typical sunlight reflection off the surface of a PV module

The two most common PV mounting structures are fixed tilt and single axis tracking. Fixed tilt arrays are stationary, while single axis tracking arrays rotate the receiving surface of the modules from east to west throughout the day as the sun moves across the sky.

In a fixed tilt PV array, since the sun is moving but the modules are stationary, the angle of incidence varies as the sun moves across the sky. It is smallest around noon when the sun is overhead and largest in

[2] Journal of Airport Management, 2014

the early morning and late afternoon when the sun is near the horizon. There is therefore a higher potential for glare at these times.

The angle of incidence for a single axis tracking system varies less as the reflective surface of the modules rotates on a horizontal axis to follow the sun. Single axis tracking arrays therefore generate less glare than fixed tilt arrays. The tracking varies throughout the year to match seasonal changes in the sun's path (see Figure 5).

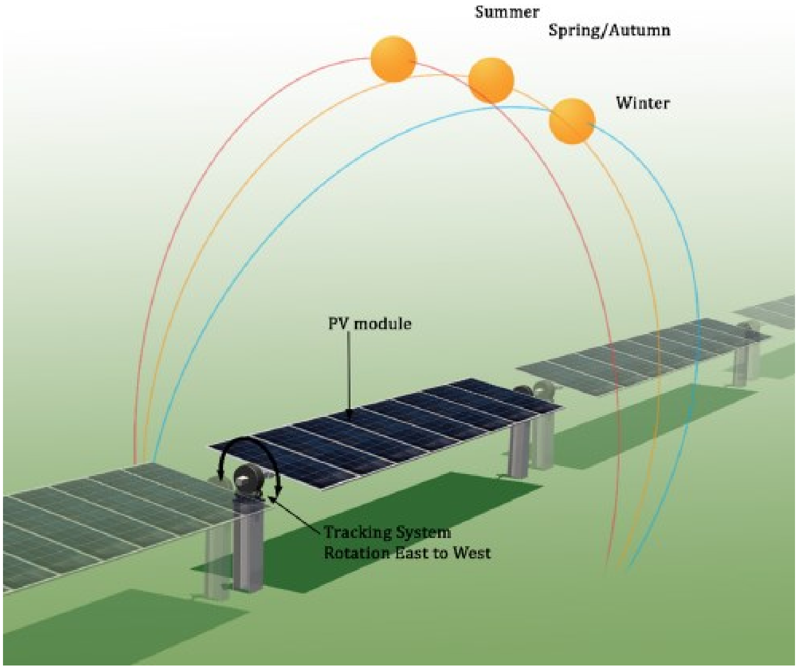

Figure 5: Sun position relative to PV modules on a horizontal single-axis tracking system

2. Project Description

2.1. Site Overview

EDPR Australia is proposing a solar farm at the location described in Table 1. The site is located in Majors Creek, Ballalaba, NSW. The location is shown in Figure 6.

Table 1: Site information

Item	Description
Land Title	81 / DP755905
Address	873 Wallaces Gap Road, Ballalaba, NSW 2622
Council	Queanbeyan-Palerang Regional Council

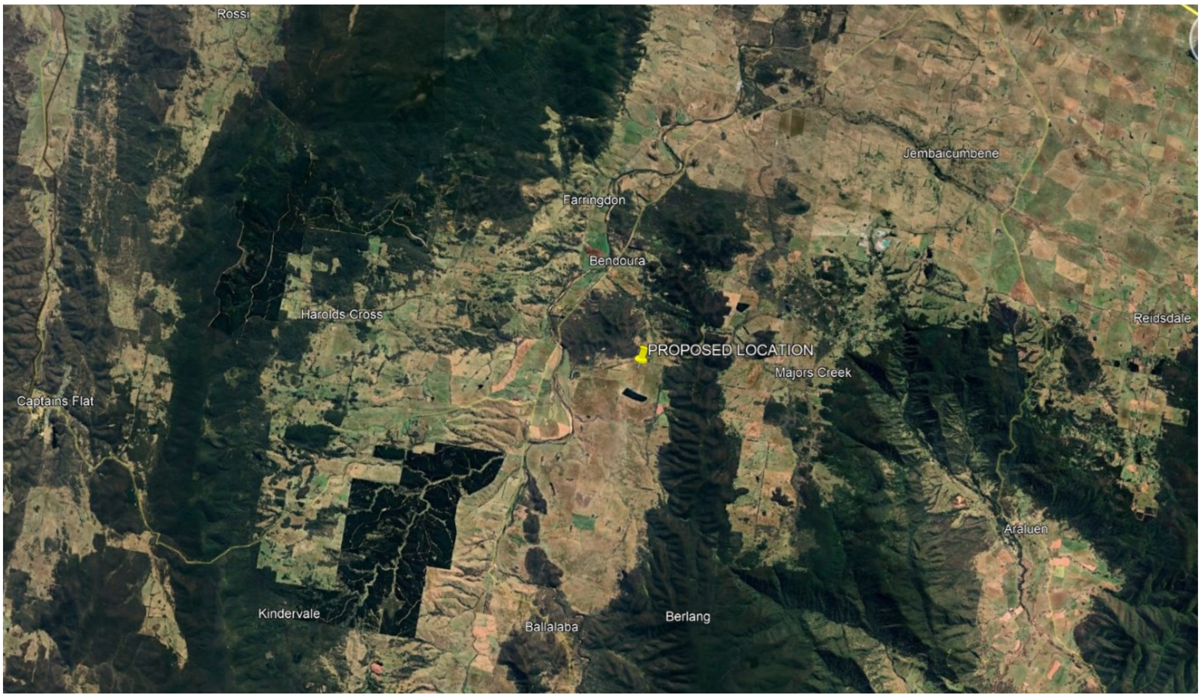

Figure 6: Proposed location of the solar farm

2.2. Solar Farm Details

Table 2 summarises the details of the proposed solar farm. An indicative layout is shown in Figure 7.

Table 2: Basic solar farm information

Item	Description
Project name	Majors Creek 1A – Solar Farm & BESS
Capacity	4.99 MW_{AC}
Mounting system	Single-axis tracking tables running north to south
Project area	14.1 ha

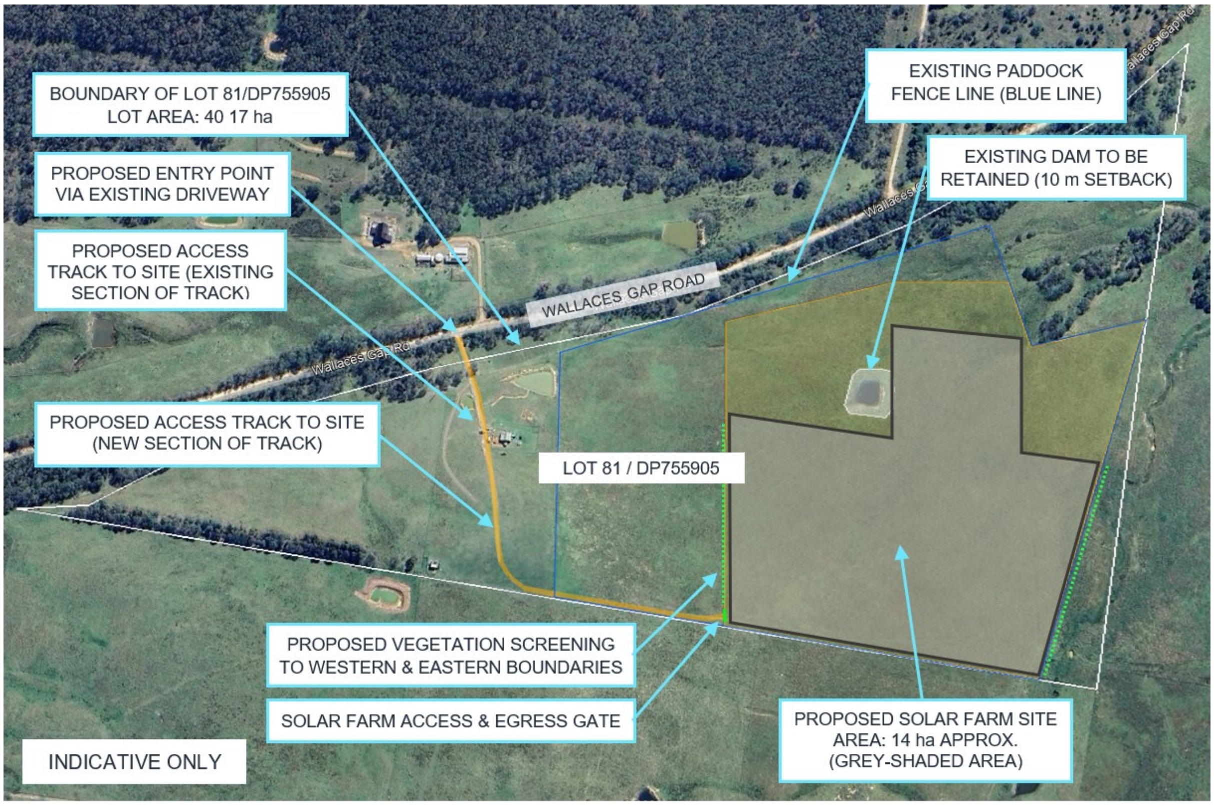

Figure 7: Indicative Layout of Proposed Site

3. Analysis

The Solar Glare Hazard Analysis Tool (SGHAT) was developed by Sandia National Laboratories to evaluate glare resulting from solar farms at different viewpoints, based on the location, orientation, and specifications of the PV modules. This tool was required by the United States FAA for glare hazard analysis near airports until 2021 and is also recognised by the Australian Government Civil Aviation Safety Authority (CASA).

ForgeSolar's GlareGauge tool uses SGHAT to provide an indication of the type of glare expected at each potential receptor. It runs with a simulation timestep of one minute. Glint lasting for less than one minute is unlikely to occur from the sun on PV modules due to their slow movement.

3.1. Assumptions

Atmospheric conditions such as cloud cover influence light reflection and the resulting impact on visual receptors. GlareGauge does not model varying atmospheric conditions; instead, the model assumes clear sky conditions, with a peak direct normal irradiance (DNI) of 1,000 W/m^2 which varies throughout the day.

Table 3 lists key input parameters for the SGHAT model. GlareGauge default settings were adopted for the analysis time interval, direct normal irradiance, observer eye characteristics and slope error.

Table 3: SGHAT specification inputs

Parameter	Value
Time zone	UTC+10:00
Module surface material	Smooth glass with ARC (anti-reflective coating)
Module tracking	Single-axis tracking with backtracking
Maximum tilt angle	±60 °
Module axis orientation	0°
Height of modules above ground	1.70 m
Height of observation point	1.65 m
Car driver eye level	1.10 m[3]

3.2. Model Construction

3.2.1. Study area

This assessment considers potential visual receptors (e.g., residences and road users) within 2 km of the site. There is no formal guidance on the maximum distance for glint and glare assessments; however, the significance of a reflection decreases with distance for two main reasons:

[3] Austroads (2021), Guide to Road Design Part 3: Geometric Design, Table 5.1, pp. 130

- The solar farm appears smaller (smaller subtended angle), and glare has less impact
- Visual obstructions (e.g., terrain, vegetation) may block the view of the solar farm.

Glint and glare impacts beyond 2 km are highly unlikely. This choice of distance is conservative and is based on existing studies and assessment experience.

3.2.2. Model components

The model—shown in Figure 8—was constructed as follows:

- The array was analysed as one PV object based on the general arrangement.
- Receptors were placed at 12 observation points and 5 road routes.
- One observation point (OP01) was excluded as it forms part of the Project.
- One obstruction (OB01) was included along the western boundary of the , .

In some instances, a single OP is used in the model to denote a few buildings located close together, as the received glare is generally not very sensitive to precise locations (assuming that line of sight is not impacted by obstructions). We also usually exclude buildings in towns that are not on the edge facing the solar farm, as their line of sight is obstructed by surrounding buildings.

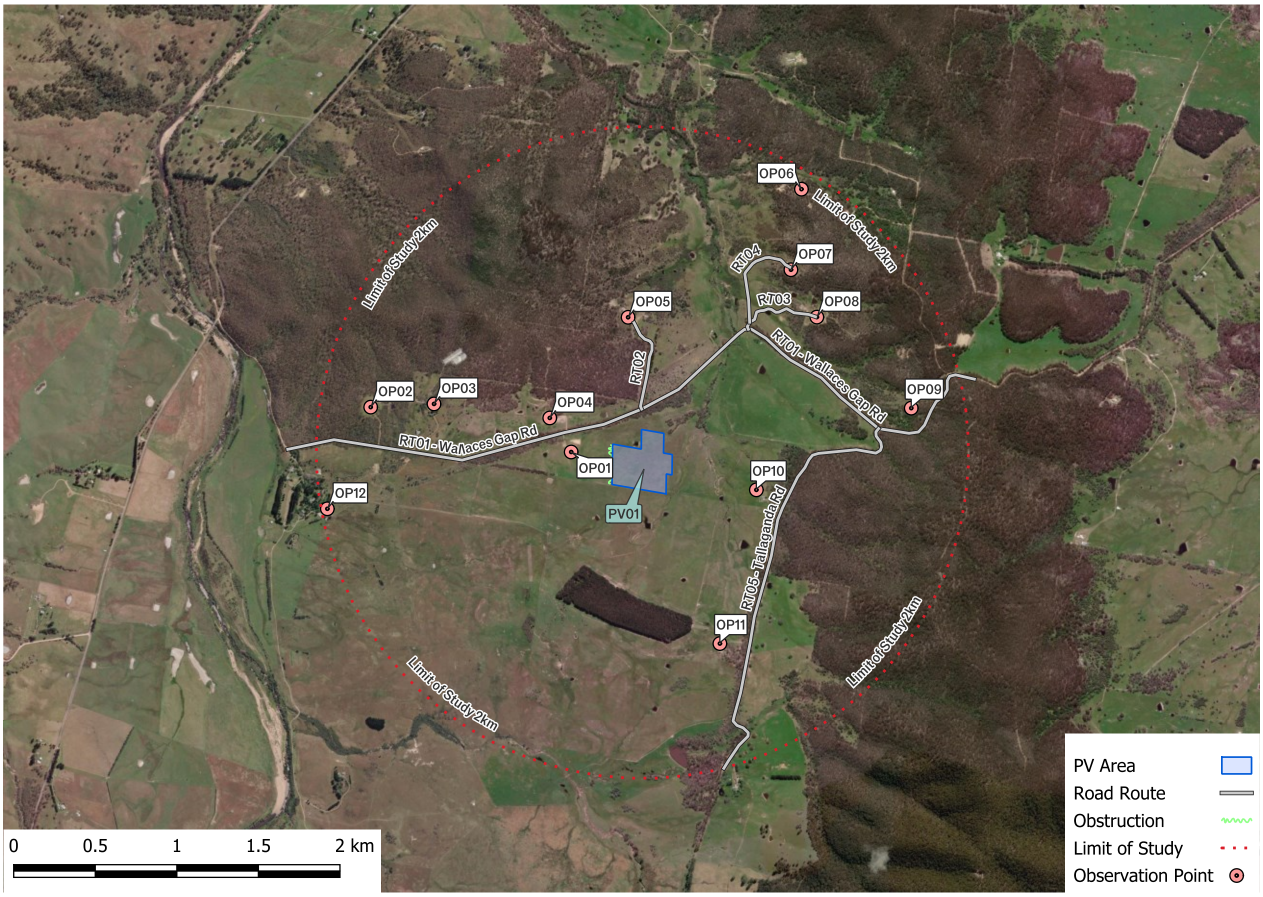

Figure 8: Model construction overview

3.3. Results

The results of the GlareGauge analysis are summarised in Table 4. The glare received each day varied across the year. For observation points where some glare occurred, we have described the impact qualitatively. The time of day at which glare was observed varied between observation points and across the year. In general, most glare occurred in the early mornings or late evenings, when the array is backtracking.

Over one year, the analysis identified ~53 hours of cumulative green glare, and ~20 hours of cumulative yellow glare spread across two routes and three observation points.

No observation points or routes received more than 20 minutes of glare in any single day.

Wallaces Gap Road (RT01) received the most yellow glare, with up to 11 minutes in a single day.

Table 4: Glare potential at each receptor

Receptor	Location	Green (hr/yr)	Yellow (hr/yr)	Daily glare potential
OP02	-35.577, 149.6414	0.0	0.0	N/A
OP03	-35.5768, 149.6457	0.0	0.0	N/A
OP04	-35.5776, 149.6535	0.8	0.0	Up to 5 minutes of green glare between 5:12 am and 5:22 am, from 3 January to 7 January. Up to 5 minutes of green glare between 5:29 am and 5:47 am, from 1 October to 12 October.
OP05	-35.572, 149.6588	0.0	0.0	N/A
OP06	-35.565, 149.6705	0.0	0.0	N/A
OP07	-35.5694, 149.6698	0.0	0.0	N/A
OP08	-35.572, 149.6716	0.0	0.0	N/A
OP09	-35.577, 149.6779	5.1	0.0	Up to 11 minutes of green glare between 5:54 pm and 6:26 pm, from 24 September to 3 November.
OP10	-35.5815, 149.6675	0.5	0.0	Up to 4 minutes of green glare between 5:53 pm and 6:03 pm, from 23 September to 2 October.
OP11	-35.59, 149.665	0.0	0.0	N/A
OP12	-35.5826, 149.6384	0.0	0.0	N/A
RT01	Wallaces Gap Rd	33.5	20.6	Up to 11 minutes of yellow glare between 4:54 am and 6:12 am, from 25 September to 17 March.
RT02	2	0.0	0.0	N/A
RT03	3	0.0	0.0	N/A
RT04	4	0.0	0.0	N/A

Receptor	Location	Green (hr/yr)	Yellow (hr/yr)	Daily glare potential
RT05	Tallaganda Rd	13.3	0.0	Up to 10 minutes of green glare between 5:50 pm and 6:57 pm, from 1 February to 4 April. Up to 10 minutes of green glare between 5:45 pm and 6:27 pm, from 8 September to 9 November.
	TOTAL	53.1	20.6	Hours / Year

3.4. Mitigation Measures

The analysis indicates that Wallaces Gap Road (RT01) may experience yellow glare for up to 11 minutes in a single day. Mitigation measures are not recommended for this site, due to the following factors:

- The limited length of the road section that is subject to yellow glare
- The brief duration of potential glare occurrences (maximum 20 minutes a day of green glare, maximum 11 minutes a day of yellow glare)
- The section of the road subjected to yellow glare is lined with trees, which will obstruct road users' view of the solar farm.

The timing and location of the potential glare experienced by Wallaces Gap Road (RT01) is shown below in Figure 9 and Figure 10.

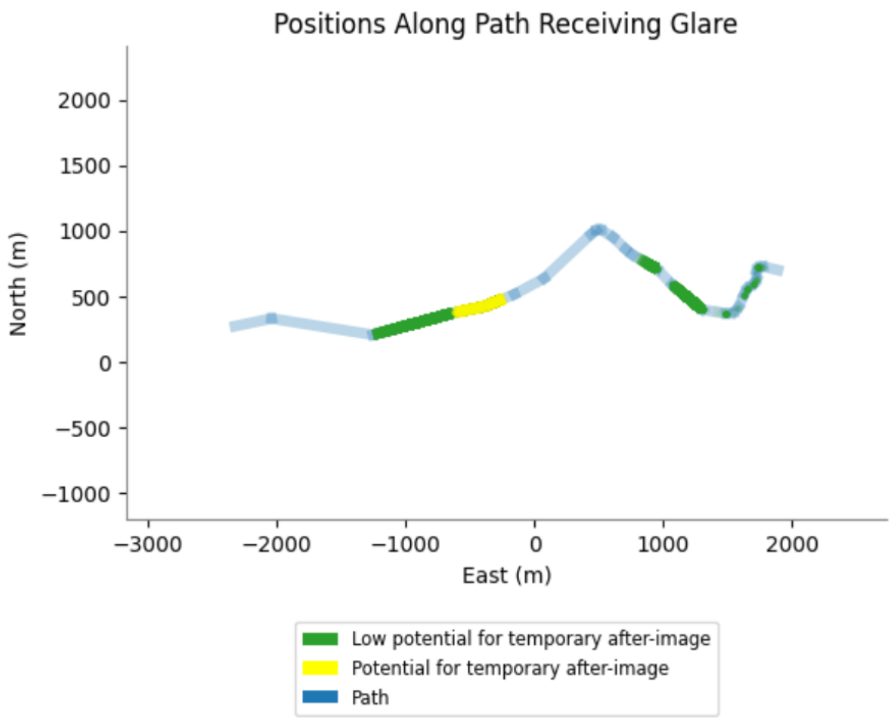

Figure 9: Glare reception points along Wallaces Gap Road

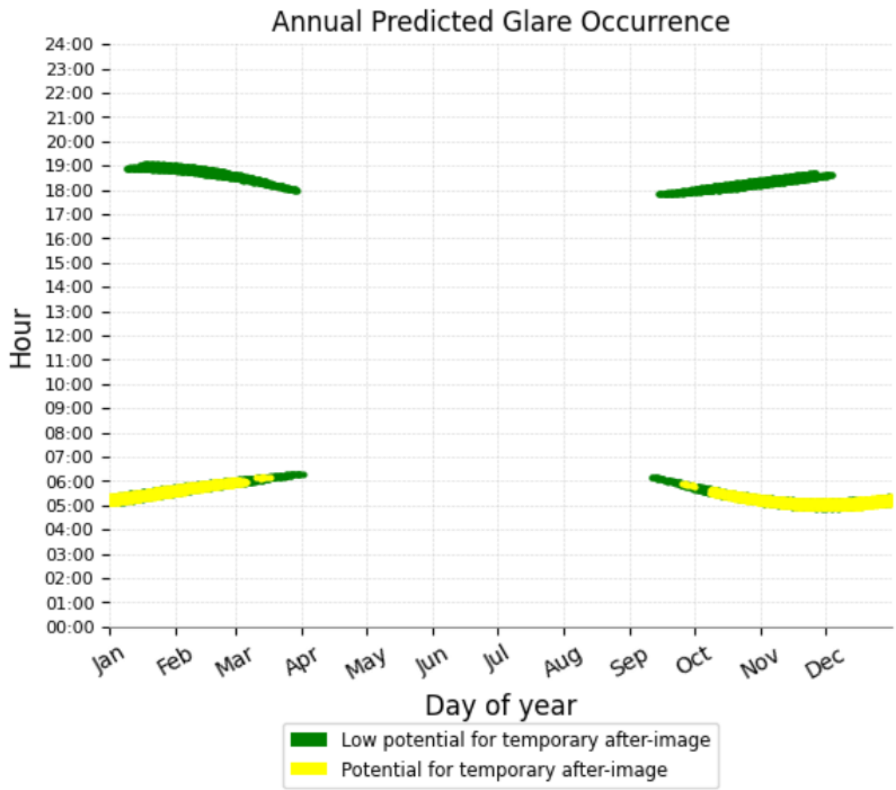

Figure 10: Glare reception times on Wallaces Gap Road

4. Conclusions

The results of the GlareGauge analysis indicates OP04, OP09, OP10, RT01 & RT05 received green glare over the course of one year, which has a low potential to cause after image for observers. RT01 received yellow glare over the course of one year, which has the potential to cause after image to observers.

Among all assessed receptors, Wallaces Gap Road (RT01) experienced the highest glare exposure, with a maximum predicted duration of 11 minutes of yellow glare per day. The section of road subject to potential glare impacts is confined to one discrete section of the road corridor immediately west of the RT02 junction. Further, given the limited duration of exposure per day (maximum 11 minutes of yellow glare), the overall risk to road users is expected to be very low. As such, we do not expect additional mitigation measures are required.

Abbreviations

ATCT	Air traffic control tower
AUD	Australian Dollar
CASA	Civil Aviation Safety Authority
FAA	Federal Aviation Administration (United States)
FP	Flight path receptor
ha	Hectare
ITP	IT Power (Australia) Pty Ltd
kW	Kilowatt, unit of power
kWh	Kilowatt-hour, unit of energy (1 kW generated/used for 1 hour)
kWp	Kilowatt-peak, unit of power for PV panels tested at STC
MW	Megawatt, equivalent to 1,000 kW
MWh	Megawatt-hour, equivalent to 1,000 kWh
MWp	Megawatt-peak, equivalent to 1,000 kWp
OP	Observation point receptor
PV	Photovoltaic
RT	Route receptor
STC	Standard Test Conditions for PV panels (irradiance 1,000 W/m2, cell temperature 25 °C, Atmospheric Mass 1.5)
SGHAT	Solar Glare Hazard Analysis Tool

Appendix A. Excluded Receptors

- OP01 has been excluded from consideration in this study as the property is located on the Project Site and is associated with the project.

Appendix B. ForgeSolar Analysis

We have provided the following analysis reports exported from ForgeSolar separately:

1. ForgeSolar-analysis-report-majors-260302-2006-917.pdf

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