# Glint and Glare Assessment

# Uranquinty Solar Farm

**Bison Energy Company**

**Revised – August 2022**

# Contents

# 1. Introduction

## 1.1. Overview

Bison Energy proposes to construct and operate a 5MW Renewable Energy Facility (Solar Facility) at 1268 Oxley Bridge Road, Uranquinty. This facility is to comprise the installation of solar photovoltaic panels mounted in arrays on single-axis trackers, cabling from the solar arrays to panel inverter and substation and connection to the local electricity network.

As part of the development application, a Glint and Glare assessment must be undertaken to determine the likely impact of glint and glare from the proposed development on nearby sensitive receptors and identify appropriate, feasible and reasonable mitigation strategies if required.

This assessment has been prepared by Engineers Patrick Lau and Ming Zhang of Bison Energy with input from planning and urban design consultants Habitat Planning. This report details the key inputs, methodology and the results of this glare assessment.

The objectives of this study are as follows:

- Carry out an analysis of glare from the proposed single axis tracking system;
- Identify observation points surrounding the proposed solar facility
- Identify and summarise potential glare impacts at various observation points;
- Recommend any mitigation to reduce glare issues

## 1.2. Glint and Glare

Glint refers to the momentary flash of bright light that can be caused by the reflectivity of solar panels and glare refers to the continuous source of light and is generally associated with stationary objects. Glint and glare from PV panels can have potential safety or amenity impacts to surrounding sensitive receivers, including potential to impair observers through inducing an after image.

## 1.3. PV Panels Reflectivity

As construction of PV panels primarily utilises glass and steel there is a perception of glint and glare from the reflectivity of solar panels. This leads to potential issues of distractions to motorists, aircraft and eye damage.

Generally, solar panels will not create significant glint or glare compared with other surfaces. PV panels are designed to collect sunlight to convert to energy and therefore absorb the majority of light received. The panels are designed using anti-reflective coatings during manufacture to reduce reflection and will typically absorb 80-90% of the light received.

PV panels are also generally less reflective than other naturally occurring elements such as soils and crops and have been found to be generally less reflective that general rural environments and far less reflective that open water[1].

The angle of incidence of the sunlight is also relevant in considering the reflection of solar development. A fixed axis solar facility will have panels that do not move throughout the day and therefore the angle incidence varies with the time of day. A tracking system, such as that proposed for this development, will follow the sun through the day and can have the angle of incidence reduced. It is also possible to 'back track' panels at certain periods of the day to reduce potential impacts.

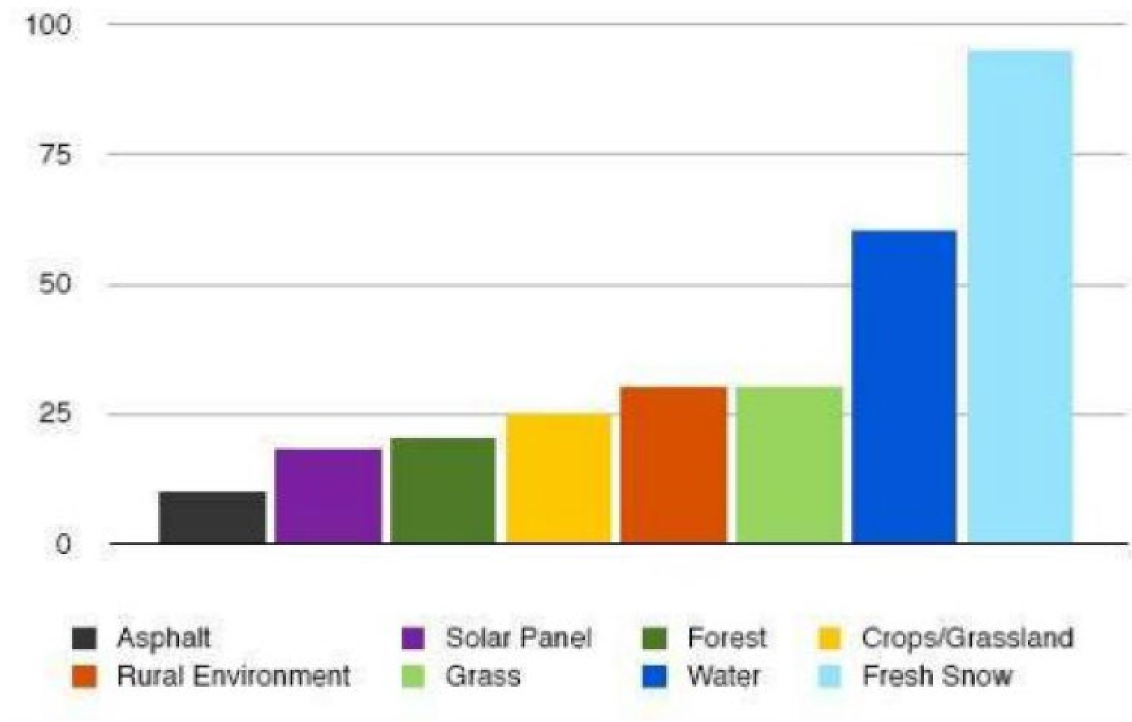


**Figure 1 Comparative reflection analysis of PV panels to other surfaces (Spaven Consulting 2011, p.5)**

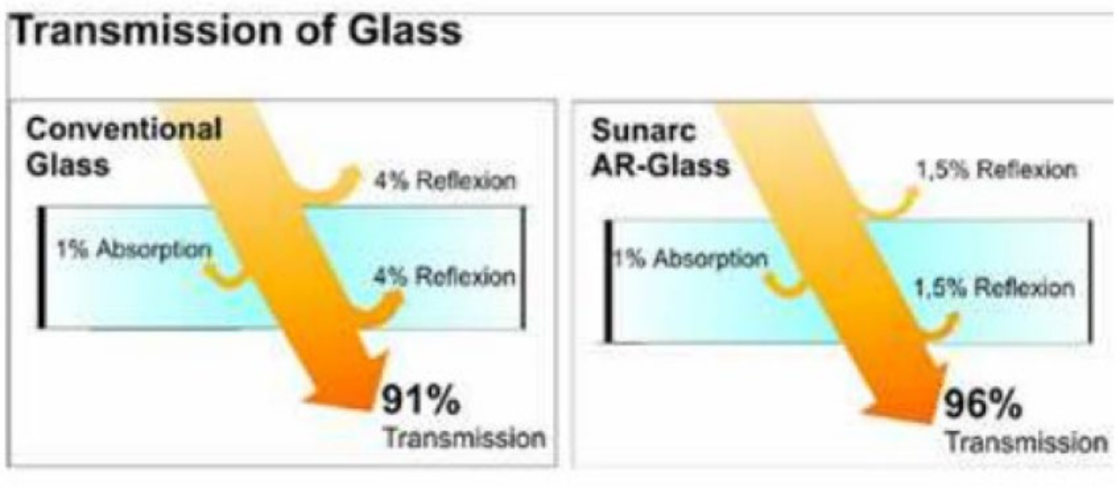


**Figure 2 Reflective values of conventional glass and typical treated glass (Spaven Consulting 2011, p.5)**

## 2. Subject Site

### 2.1. Site description

The subject land to which this application relates is described as Lot 43 in DP754565 and addressed as 1268 Oxley Bridge Road, Uranquinty. It is located approximately two (2) kilometres south east of the township of Uranquinty. The location of the site is shown at **Figure 3**.

The land forms a rectangular lot with a depth of 980 metres and a width of 500 metres and a total area of 49.06ha.

The land is a cleared rural paddock and does not contain any existing structures or significant vegetation. It is used primarily for broad-acre agricultural purposes including grazing.

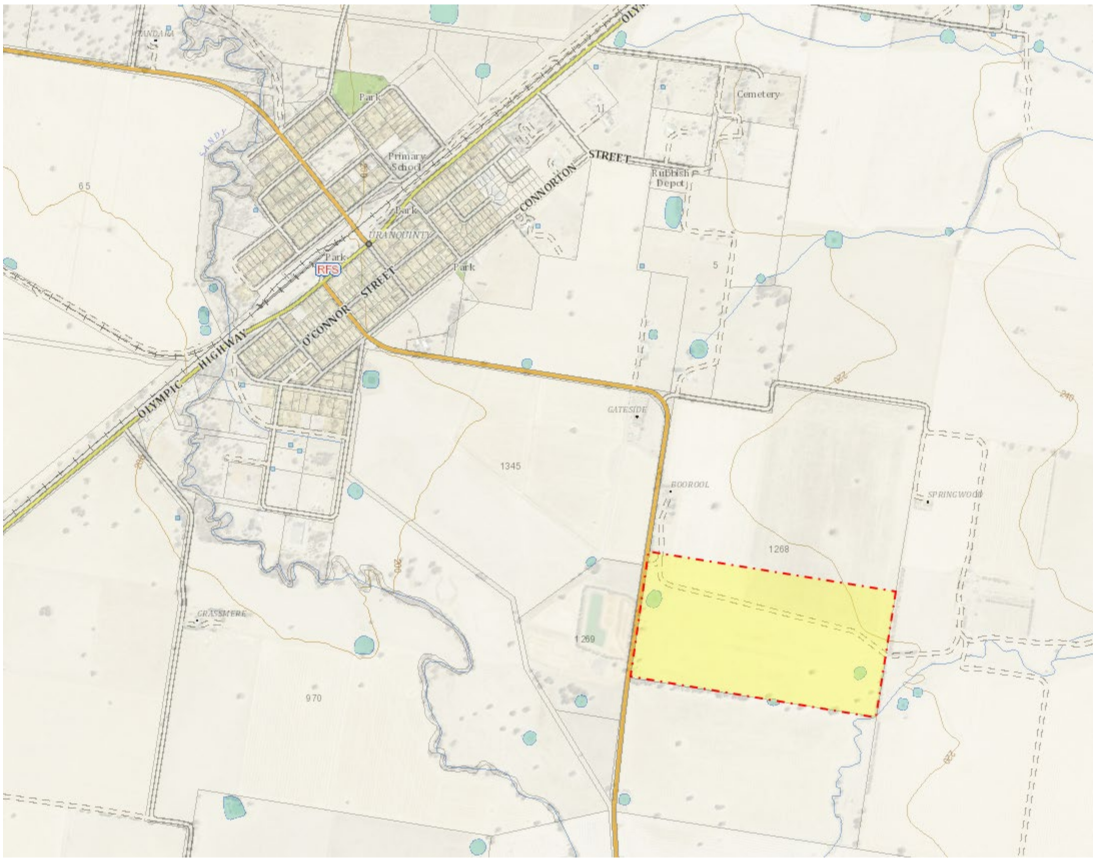


**Figure 3: Context Map**


**Figure 4: Aerial Imagery of the subject site (Source: Nearmap)**

## 3. Glint and Glare Assessment Methodology

The assessment methodology in this instance is based on guidance documents for Solar Facility design, studies in relation to glint and glare along with industry best practice modelling. The broad methodology followed for this study comprises:

- collate key data and model inputs for solar farm based on specifications and design
- identify primary receptors in the area surrounding the site;
- consider visibility of the panels from the receptor's location and whether or not panels are likely to be visible
- plot the location of all receptors in a Solar Glare Analyses Tool and input data for the proposed facility to model the expected impacts
- based on modelling, determine whether a reflection can occur to receptors and the extent/period of impact;
- determine whether a significant detrimental impact is expected.
- Recommend appropriate mitigation measures as required

### 3.1. Modelling Tool

This study has used the Glare Gauge modelling tool by ForgeSolar. This is an industry standard technical modelling tool, which utilises the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandia National Laboratories, to assess the potential glare to receptors around solar arrays. This tool is required by a number of international authorities including the United States Federal Aviation Administration for glint and glare analyses near airports, and it recognised by the UK Civil Aviation Authority, and the Australian Government Civil Aviation Safety Authority.

The Glare Gauge tool uses an interactive Google Maps interface to plot the arrangement of arrays and the location of sensitive receptors including static observation points, routes and flight paths. The elevation of the panels and receptors are automatically captured using ground elevation data of the respective locations. The modelling for consideration of this development utilises the specification and data of the proposed PV panels to be installed, the location of the panels relative to the receptors and the proposed angle of tilt for the panels.

The analysis also allows the user to input the location of each 'observer point' and 'paths' by identifying the location. The locational data for each of these points is also extracted from Google map data.

If glare is found, the analysis calculates the retinal irradiance and subtended angle (size/distance) of the glare upon each of the identified observer points or paths. This output predicts the potential impacts in a range of temporary after-image effects to retinal burn. The results are produced to show when glare will occur throughout the year and the time per day, as well as to show the impact of any glare.

### 3.2. Glare Hazard Rating

The SGHAT defines three levels of ocular hazard as a result of glare. The hazards are defined as low, moderate or high, depending on the potential to impact vision through producing glare with a potential for afterimage. The following definitions are provided for the glare hazard levels referred to in this report.

| | |
|---|---|
| **No glare** | No Glare - No glare predicted. |
| **Green** | **Low potential hazard** – Glare is present, however only a low potential for a temporary after-image. This hazard is shown green on the plots used by the GlareGuage tool, reproduced in **Figure 7** of this report. |
| **Yellow** | **Moderate potential hazard** -Glare present with the potential to leave temporary after-image of the glare. This hazard is shown green on the plots used by the GlareGuage tool, reproduced in **Figure 7** of this report. |
| **High** | **High potential hazard** – Glare is present with potential for permanent eye damage. This hazard is shown green on the plots used by the GlareGuage tool, reproduced in **Figure 7** of this report. |

### 3.3. Model inputs

The proposed solar array associated with the Uranquinty solar facility will consist of panels fixed on single axis tracking. An 'interval' backtracking strategy was also nominated for the project, which is described as a '*step-based method that discretely backtracks the PV modules over time*'.

To accurately determine the potential glare impact of the array, the following array details were input into the GlareGuage tool.

| Input | Unit | Value |
|---|---|---|
| Time zone | UTC | UTC +10 |
| Peak DNI | $kW/m^2$ | 1000 |
| Backtracking method | - | Interval |
| PV Panel surface material | - | Smooth glass with anti-reflective (AR) coating |
| Tracking axis tilt | Degrees | 0 |
| Resting angle | Degrees | 60 |
| Orientation of tracking axis | Degrees | 0 |
| Offset angle of panel | Degrees | 0 |
| Maximum tracking angle | Degrees | 60 |
| Height above ground (Panels) | Metres | 2.6 |
| Height (OPs) | Metres | 1.5 |

| | | |
|---|---|---|
| Height (Routes) | Metres | 2.4 |

### 3.4. Identification of Receptors

In addition to the array inputs outlined above, the locations of the identified receptors were plotted into the GlareGuage tool on the same Google Maps interface. These receptors were input from within a capture area of a radius of approximately 3 kilometres around the location of the proposed facility.

Observation Point receptors are identified as "OP" locations on the analysis. These simulate an observer at a single, discrete location, defined by a latitude, longitude, elevation, and height above ground, all of which are taken from automatically generated map data. Users select the location of a point receptor and the system automatically generates the latitude, longitude, ground elevation, observed height above ground/elevation. For any dwellings or sensitive uses, these are identified as point receptors and taken from the location in which the dwelling or feature is located. By default, the height above natural ground for modelling is 1.5 metres.

A number of Observation Points (OPs) were identified within proximity to the site. These OPs consisted entirely of surrounding dwellings and were measured from a height of 1.5 metres above the ground for a typical viewing angle.

**Figure 5** below illustrates the location of the OPs within proximity of the site.


**Figure 5 Observation points assessed for glint and glare within the immediate context of the subject site**

All surrounding routes were recorded for input into the GlareGuage tool similar to the OP's. The height above ground was input as 2.4 metres, which represents the eye height of drivers in larger trucks, being the most susceptible to potential glare. The input height was determined in accordance with the criteria set out in the *Austroads, Guide to Road Design Part 3: Geometric Design.*

The routes are indicated below in **Figure 6**.


**Figure 6 Routes assessed for glint and glare within the immediate context of the subject site**

### 3.5. Assessment of Impacts

As discussed, an assessment of the potential impact of the proposal has been undertaken using the GlareGuage Tool. The tool enables the proposed solar facility to be mapped along with relevant data inputs and then uses the data to consider the potential for temporary after-image or more significant retinal burn. The chart presented at **Figure 7** represents the possible severity of glare at receptor locations.

Red glare refers to potential for permanent eye damage from the observation location, yellow glare indicates the potential for after image effects and green glare refers to low potential for after image impacts.

The assessment relies on identifying the potential sensitive receptors surrounding the development and assessing the potential impacts on the receptors. The modelling for consideration of this development utilises the specification and data of the proposed PV panels to be installed, the location of the panels relative to the receptors and the proposed angle tilt for the panels.

It is also noted that the impact of a reflection can decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances.

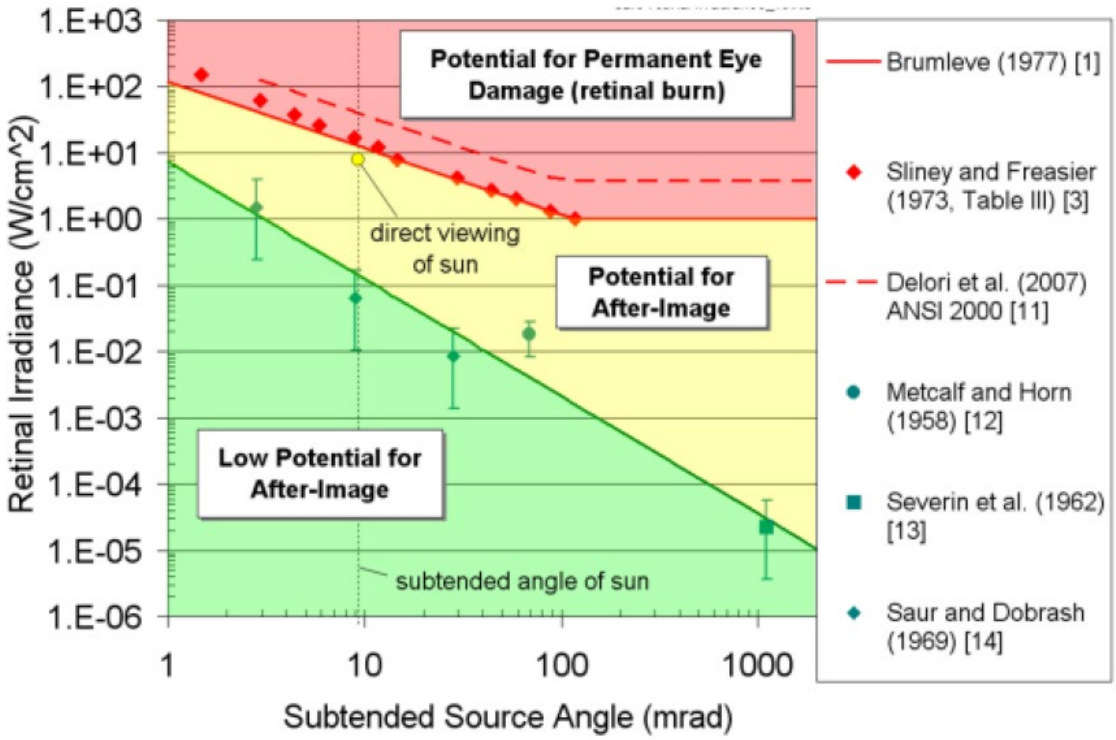


**Figure 7  Summary of potential glare impact with regard to total minutes of glare for receptor**

## 4. Results

Of the 40 OPs assessed and 5 routes assessed, none were calculated to be subject to glare. This is achieved because the panels will be single axis trackers and will follow the sun through the day and the proposed tracking system will be limited to only back-track which the panels are outside the reflective range of the sun.

By default, the glare assessment using Forge Solar analysis includes an assumption that the panel system would 'backtrack' to a flat resting position after sunset (when the sun left the angle of rotation of the panel) until sunrise (when the panel was in the angle of rotation of the panels). However, the proposed development will not backtrack. This means that at the end of the day, panels will remain fixed at 60 degree tilt facing west and will rotate back to 60 degrees facing east only when the sun is within the angle of rotation in the morning. Under this arrangement, the panels will not revert to resting flat when the sun is outside of the tracking range.

It should also be noted that based on the results that the use of single axis tracking avoids any potential glare impacts, irrespective of the height configurations analysed, if backtracking is disabled.

Having regard to the above, the modelling within this assessment has determined that the facility will not result in any significant glare on the receptor points provided that backtracking is disabled.

A summary of the receptors which recorded glare, is provided in the attached summary.  Note that receptors that did not record any glare are not included in this table.

## 5. Conclusion & Recommendations

The results indicate that no OPs and routes will be subject to glare. Based on the visual assessment prepared as part of the application, some surrounding Ops and routes may still be subject to a ‘visual impact’ and it is recommended that landscaping be established surrounding the facility.

Implementation of landscaping is proposed to the perimeter around the PV array around all boundaries which will also assist in avoiding potential for any glare from the property. This landscaping is to be provided in the form of perimeter plantings as detailed by the submitted landscape plans.

Additionally, a temporary screening mesh treatment may be installed along property boundary while perimeter landscaping is being established.

## Appendix A: Forge Solar Assessment Summary