Preliminary Environmental Information Report

Chapter 12: Glint and Glare Assessment

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Future Energy Llanwern Limited

Contents

12.0 Glint and Glare

12.1 Introduction

12.1.1 This Chapter presents the preliminary assessment of the likely significant effects of the Proposed Development of the Future Energy Llanwern Solar Farm on glint and glare and the extent to which this may affect the relevant surrounding sensitive receptors.

12.1.2 This Chapter should be read in conjunction with **Chapter 2: Description of the Proposed Development**.

12.1.3 Glare or dazzle can occur when sunlight is reflected from building or Solar Panel surfaces onto buildings, pedestrians, vehicles, trains, and aircraft. The problem can occur when the surfaces have significant areas of reflective material and when the bright area caused by the incident sunlight is within the observer's field of view.

12.1.4 Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car. Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the relative slow movement of the sun, reflect sunlight for a longer duration.

12.1.5 This Chapter describes:

- The legislation, policy and technical guidance that has informed the assessment (**Section 12.2**);
- Limitations and assumptions (**Section 12.3**);
- Stakeholder Engagement (**Section 12.4**);
- Description of the methodology used to assess the potential for glint and glare, including the use of modelling tools (**Section 12.5**);
- Description of the Study Area (**Section 12.6**);
- Description of the baseline conditions (**Section 12.7**);
- Information on the glare assessment modelling (**Section 12.8**);

- Identification of the potential sensitive receptors within the vicinity of the Site (**Section 12.9**);
- Description of the EIA Significance Criteria (**Section 12.10**);
- Results of the assessment, identifying any receptors potentially affected by glint and glare and quantifying the potential impacts (**Section 12.11**);
- Consideration for the potential mitigation and enhancement measures to reduce the impact of glint and glare (**Section 12.12**);
- A summary of significant residual effects (**Section 12.13**);
- A summary of significant cumulative effects (**Section 12.14**);
- Glint and Glare Assessment Summary (**Section 12.15**); and
- References (**Section 12.16**).

12.1.6 The appendices that accompany this Chapter are set out in **Table 12-1** below:

Table 12-1 Appendices associated with the Glint and Glare assessment

Drawing number / Document reference	Drawing description
Appendix 12A	Analysis PV Array Data
Appendix 12B	Routes Receptors and Dwelling Receptors Group 1-4: Analysis Results Summary
Appendix 12C	Routes Receptors and Dwelling Receptors Group 1-4: Analysis Components Data
Appendix 12D	Routes Receptors and Dwelling Receptors Group 1-4: Glare Analysis Results
Appendix 12E	Dwelling Receptors Group 5-7: Analysis Results Summary
Appendix 12F	Dwelling Receptors Group 5-7: Analysis Components Data
Appendix 12G	Dwelling Receptors Group 5-7: Glare Analysis Results
Appendix 12H	Tool Assumptions and Limitations
Appendix 12I	PVsyst - Simulation Report

12.1.7 These appendices contain the extensive volume of baseline information and detailed assessments with summaries included in **Section 12.11** in order to present a clear

and succinct Chapter.

12.1.8 The figures in **Table 12-2** below also accompany this glint and glare assessment:

Table 12-2 Figures which has informed the Glint and Glare assessment

Figure number / Document reference	Drawing description
Figure 12-1	Ocular Hazard Plot
Figure 12-2	Proposed PV Array
Figure 12-3	Study Area Covering 1km from the Proposed PV Array
Figure 12-4	Identified Sensitive Locations for Vehicle Drivers on roads
Figure 12-5	Identified Dwelling Groups Locations Within 1km of the Site
Figure 12-6	Dwelling Receptors – Groups 1-4
Figure 12.7	Dwelling Receptors – Groups 7-7

12.2 Legislation, Planning Policy and Technical Guidance

12.2.1 This section identifies the legislation, planning policy and technical guidance that has informed the assessment of effects with respect to glint and glare. Further information relating to policies relevant to the Proposed Development is provided in **Chapter 4: Legislation and Policy**.

Legislation and Policy

12.2.2 No specific legislation in relation to glint and glare affecting vehicle and train drivers exists in the United Kingdom (UK). However, the following National Policy, listed in **Table 12-3**Table 12-3 below, refers to glint and glare.

Table 12-3 Policy relevant to the Glint and Glare assessment

Policy	Reference to the G&G assessment
National Policy Statement for Renewable Energy	Paragraphs 2.10.102- 2.10.106 set out the requirements of the applicant's assessment and includes reference to glint and glare assessment. Setting out that *"applicants should map receptors*

Policy	Reference to the G&G assessment
Infrastructure (EN-3) (Ref 12-1)	*qualitatively to identify potential glint and glare issues and determine if a glint and glare assessment is necessary as part of the application."* Whilst further stating that "*When a quantitative glint and glare assessment is necessary, applicants are expected to consider the geometric possibility of glint and glare affecting nearby receptors, and provide an assessment of potential impact and impairment based on the angle and duration of incidence and the intensity of the reflection".*
The National Planning Policy Framework Guidance for 'Renewable and Low Carbon Energy (2015) (Ref 12-2)	In paragraph 013: *"The deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively. Particular factors a local planning authority will need to consider include:* *…* • *the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on neighbouring uses and aircraft safety.* • *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun.* *The potential to mitigate landscape and visual impacts through, for example, screening with native hedges.* *The approach to assessing cumulative landscape and visual impact of large scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of*

Policy	Reference to the G&G assessment
	ground mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero."

Technical guidance

12.2.3 There is technical guidance available which is widely applied for glint and glare assessments in the UK. The following documents listed in **Table 12-4** below, have been used to inform the glint and glare assessment.

Table 12-4 Planning Policy relevant to the Glint and Glare assessment

Technical guidance document	Reference to the G&G assessment
The British Research Establishment's (BRE) publication "Site Layout Planning for Daylight and Sunlight - A Guide to Good Practice," by J Littlefair et al. (2022) (Ref 12-3)	Section 5.8 Solar dazzle: *"5.8.2 The problem can occur either when there are large areas of reflective glass or cladding on the façade, or when there are areas of glass or cladding that slope back so that high altitude sunlight can be reflected along the ground (Figures 42 and 43). Thus solar dazzle is only a long-term problem for some heavily glazed (or mirror clad) buildings. Photovoltaic panels generally tend to cause less dazzle because they are designed to absorb light.* *5.8.3 If it is likely that a building may cause solar dazzle the exact scale of the problem should be evaluated. This is done by identifying key locations such as road junctions and railway signals, and working out the number of hours of the year that sunlight can be reflected to these points. BRE Information Paper IP 3/87[21] gives details.* *5.8.4 Where solar reflection can happen, the next step is to calculate the angle between the driver's line of view and the reflected sun. For vertically mounted clear double glazing facing a driver on a level*

Technical guidance document	Reference to the G&G assessment
	road, solar dazzle could be a significant issue if this angle is less than 10°. With a sloping façade or high reflectance glazing or cladding, solar dazzle might be a problem at higher angles of view as well. Sunlight that reflects off the façade at a glancing angle might also be bright enough to cause problems at higher angles of view. *5.8.5 If the reflected sun would be visible close to the driver's line of sight, even if this only happens for a small numbers of hours per year, then either a more detailed calculation of solar glare is required, or measures should be taken to reduce the glare."*
This links to the BRE information Paper IP 3/87 which provides further guidance. (1987) (Ref 12-4)	The BRE Information Paper IP 3/87 provides guidance on calculating solar glare reflected from sloping glazed facades. It offers a method to assess whether a proposed building's facade will cause glare for pedestrians, motorists, or occupants of nearby buildings.
US Federal Aviation Agency (FAA) Guidance: Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (2013) (Ref 12-5)	The FAA acknowledges the fact that solar energy systems have the potential to cause glint and glare that could result in ocular impact to pilots or air traffic controllers, compromising the safety of the air transportation system.

Technical guidance document	Reference to the G&G assessment
Technical Guidance for Evaluating Selected Solar Technologies on Airports (2018) (Ref 12-6)	This document updated the previous version of the guidance issued in 2010. In this version and in relation to glint and glare analyses, the FAA updated Section 3.1.2 '*Reflectivity'* to incorporate the latest information about evaluating solar glint and glare and corresponding references to glare throughout the document.
Pager Power, 'Solar Photovoltaic and Building Development – Glint and Glare Guidance (2022) (Ref 12-7)	Pager Power has developed a document with the aim to provide guidance for assessing the impact of glint and glare from Solar Panels and building developments with large reflective façades upon surrounding receptors to dwellings, roads, rail, and aviation receptors. The Guidance 'Solar Photovoltaic and Building Development – Glint and Glare Guidance' was updated in 2022.
Detailed guidance on quantification of glare and criteria is provided in Hassall, D. N. H. (1991) (Ref 12-8) Reflectivity: Dealing with Rogue Solar Reflections. University of South Wales.	Hassall's research provides a crucial foundation for assessing glare impact on drivers. By defining a specific threshold for uncomfortable or disabling glare, it allows for quantitative analysis of how solar reflections might affect driving conditions. This helps determine when and where glare could be a significant issue for road safety.
Aerodrome Safeguarding	Solar farms near airports pose a glare risk to aircraft. The UK Civil

Technical guidance document	Reference to the G&G assessment
Advice Note (Feb 2024) (Ref 12-9)	Aviation Authority advises a glare assessment for solar developments within a certain distance of airports. *"It is essential to conduct an aviation perspective glint and glare assessment when a reflective surface is to be located on or immediately adjacent to an aerodrome. In most cases, an assessment should be undertaken for a solar energy development which is being proposed within a specific distance from an aerodrome as determined by the aerodrome authority. For many aerodromes, 5km is the distance of choice but it could be considered out to 10km. In exceptional circumstances assessments may be required beyond 10km."*

12.3 Assessment Assumptions and Limitations

12.3.1 To ensure transparency within the Environmental Impact Assessment (EIA) process, the following assumptions and limitations have been identified following a review of the comments provided by the Planning Inspectorate and consultees as part of the scoping process (**Table 12-5):**

- All calculations have been based on best practice guidance and on information and drawings of the proposed Solar Panels provided by the design team. Where required, estimations have been made with regards to the surrounding terrain elevations, based on available satellite photographs and mapping. Assumptions, estimations and simplifications have been made also regarding the Solar Panels and the receptors used in this assessment and height of existing obstructions within proximity to the Site, if applicable.
- The scope of this report focuses on glint and glare due to solar reflections only, as such, glare from artificial lighting is not included.

- The limitations and assumptions of the Forge Solar tool can be found in **Appendix 12H**.

12.4 Stakeholder Engagement

12.4.1 An EIA Scoping Report (**Appendix 1C**) for the Proposed Development was submitted in December 2024, **Table 12-5** presents a summary of comments provided by the Planning Inspectorate and consultees (**Appendix 1D**) as part of the scoping process and the Applicant's response, highlighting where relevant how these comments have been addressed within this Chapter.Following the consultation response by the Planning Inspectorate regarding the exclusion of the construction and decommissioning phases from the assessment, aerodromes and railway lines remain scoped out of the assessment.

Table 12-5 Stakeholder Engagement

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
Planning Inspectorate	The Planning Inspectorate agrees that glint and glare can be scoped out of the ES on the basis that effects are unlikely to occur until the Solar Panels have been erected.	The Construction and Decommission phases have been scoped out of this assessment.	**Section 12.1**
Planning Inspectorate	The Planning Inspectorate agrees that assessment of glint and glare on railway lines during operation can be scoped out of the ES on the basis that effects on railway lines are unlikely to occur.	The assessment of glint and glare effects on train drives on railways has been scoped out of this assessment.	**Section 12.5**
Planning Inspectorate	The Planning Inspectorate agrees that assessment of glint and glare on aerodromes during operation can be	The assessment of glint and glare effects on aerodromes has	**Section 12.5**

Consultee	Main matter raised	How has the concern been addressed	Location of response in chapter
	scoped out of the ES on the basis that effects on aerodromes are unlikely to occur as the nearest aerodrome is located approximately 20km from the development.	been scoped out of this assessment.	
Planning Inspectorate	The Zone of Theoretical Visibility (ZTV) developed for LVIA should be used to identify sensitive receptors with potential views of the Site which may therefore be affected by glint and glare. The locations of the sensitive receptors should be shown on an accompanying plan.	All relevant sensitive receptors within the Study Area with the possible line of view to the Site have been identified and assessed.	**Section 12.9**
Planning Inspectorate	Any assumptions made or relied upon should be clearly set out and justified within the ES.	Assumptions have been clearly set out.	**Section 12.3**

12.5 Assessment Methodology and Criteria

Scope of the Assessment

12.5.1 The scope of this assessment has been established through the scoping process. Further information can be found in **Chapter 5: Environmental Impact Assessment (EIA) Methodology**. **Table 12-6** defines the scope of the assessment, following consultation with the Planning Inspectorate, and provides the evidence base for scoping in and out elements of the assessment.

Table 12-6 Elements scoped in or out of the Glint and Glare assessment

Receptor	Phase	Scoped In	Scoped Out	Justification
Direct effects upon aircraft pilots and air traffic control	Construction, Operation and Decommissioning		✔	The Proposed Development is not anticipated to result in any potential significant effects on pilots during the operational phase.
Direct effects upon train drivers on tracks	Construction, Operation and Decommissioning		✔	The Proposed Development is not anticipated to result in any potential significant effects on railways during the construction, operation and decommissioning phases.
Direct effects upon dwellings	Operation	✔		There is the potential for significant direct effects upon on dwellings during the operational phase of the Proposed Development.
Direct effects upon dwellings	Construction and Decommissioning		✔	The Proposed Development is not anticipated to result in any potential significant effects on dwellings during the construction, and decommissioning phases.
Direct effects on road users	Operation	✔		There is the potential for significant direct effects

Receptor	Phase	Scoped In	Scoped Out	Justification
				upon road users during the operational phase of the Proposed Development.
Direct effects on road users	Construction and Decommissioning		✔	The Proposed Development is not anticipated to result in any potential significant effects on dwellings during the construction, and decommissioning phases.

Methodology

12.5.2 The assessment methodology and significance criteria were based on the FAA guidance (Ref 12-6). While this guidance was developed specifically for aviation, which is highly sensitive to glare, it was conservatively applied also to all other identified receptors in this assessment, such as road users and residents of dwellings. This methodology is widely adopted in the UK for glare assessments from solar developments.

12.5.3 This Chapter follows from the EIA Scoping Report (**Appendix 1C**) submitted in December 2024. As a result of the scoping process, construction and decommissioning phases as well as aviation and rail sensitive receptors have been excluded from this assessment (**Table 12-5**).

12.5.4 As defined in **paragraph 12.1.4**, glint refers to a momentary incidence and therefore this assessment considers the impact of glare from the Proposed Development.

12.5.5 The methodology of the glint and glare assessment includes the following key steps and tasks:

- Identify sensitive receptors within the Study Area including residential buildings, main roads, railways, and aerodromes where applicable.

- Create a 3D model of the Site and the identified sensitive receptors.
- For building receptors: assess windows facing the Site at a height of 1.8 metres (m) from the floor to consider eye level of a standing person.
- For route receptors: assess roads at a height of 1.5m from the ground.
- Undertake the analysis to determine whether a solar reflection is geometrically possible between the proposed Solar Panels and the receptors.
- Identify the potential glint and glare at the receptors and the time and duration of occurrence, if applicable.
- Determine whether the identified solar reflection is significant.
- Consider mitigation, if required.

12.5.6 The above methodology is in line with the Solar Photovoltaic and Building Development – Glint and Glare Guidance (2022) (Ref 12-7) which provide methods for quantifying potential glare and have also been used as a reference and further guidance.

Annual Computational Analysis Methodology

12.5.7 An annual solar simulation is required to identify potential occurrences of reflected glare at any point in time and at any receptors. The Solar Glare Hazard Analysis Tool technology (SGHAT) (Ref 12-10) is a validated tool developed by Sandia National Laboratories specifically designed to assess glint and glare. The SGHAT tool public use is now restricted and replaced by Forge Solar. Based on the SGHAT methodology, this assessment uses modelling software developed by Forge Solar, a widely recognized tool used internationally for the assessment of glint and glare.

12.5.8 The ocular impact of solar glare is quantified into three categories:

- Green - low potential to cause after-image (flash blindness).
- Yellow - potential to cause temporary after-image.
- Red - potential to cause retinal burn (permanent eye damage).

12.5.9 The above categories of ocular impacts of solar glare can be visualized with the

Ocular Hazard Plot (**Figure 12-1**) which represents a universal Hazard Plot and displays the ocular impact as a function of glare-subtended source angle and retinal irradiance. Each minute of glare is displayed on the chart as a small circle in its respective hazard zone. A reference point is provided that illustrates the hazard from viewing the sun without filtering, i.e., staring at the sun.

12.5.10 The Forge Solar tool uses an interactive map interface, where the locations of the Site and the receptors modelled are all recorded (latitude, longitude and elevation) allowing the calculation of the sun and vectors positions specific to them.

12.5.11 Solar Panels are represented by a planar polygon footprint and a set of customizable parameters. Each Solar Panel has been modelled and positioned at the proposed height above ground level. The solar reflectivity of the Solar Panels has also been introduced.

12.5.12 During the annual computational analysis, sunlight reflected over each Solar Panel has been calculated on a minute-by-minute basis according to the specified tilt and orientation of the modules. The analysis then checks whether the resulting solar reflections intersect with the receptors.

12.5.13 The analysis does not consider obstructions such as vegetation and buildings. And focuses only on the line of view between the reflector surfaces and the receptors. This approach considers the worst-case scenario. However, obstructions such as those created by existing and proposed vegetation and buildings are considered if the results show that an unacceptable level of glare is likely to occur. This is judged on a case-to-case basis, in which the results for both scenarios are reported.

12.6 Assessment Study Area

The Site

12.6.1 This glint and glare assessment was conducted for the Proposed Development (**Figure 12-2**) located approximately 13km east of Newport. The Site encompasses an area of approximately 547.69 hectares (ha). and is located in proximity to the villages of Redwick and Undy, within the local authority jurisdiction areas of Monmouthshire County Council and Newport City Council. The Site is currently used primarily for agricultural purposes including pasture and arable farming, and it is

surrounded mainly by other farms and fields as well as several villages, including Goldcliff and Whitson to the west, Redwick to the north, Undy and Magor to the north-east.

12.6.2 Further detail regarding the description of the Proposed Development is provided in **Chapter 2: Description of the Proposed Development.**

Study Area

12.6.3 The Study Area for the glare assessment encompasses the solar farm area of approximately 149.05ha, as shown in **Figure 12-2** (this covers the area to be covered by Solar Panels). In accordance with the CAA's guidance, the extent of the Study Area should cover a radius of 10km from the centre of the Site, to ensure that potential glare impacts on aircraft are adequately assessed. However, as aviation and rail receptors have been excluded as detailed in **Table 12-6**, the Study Area includes roads and dwellings within 1km of the PV Array, defined in **Figure 12-3**. This is in accordance with the Pager Power Guide (Ref 12-7).

12.7 Baseline Conditions

Current Baseline

12.7.1 The baseline conditions reflect the existing environmental conditions within the Site, as described in **Section 12.5**. This baseline data forms the foundation for the glare model to predict the potential impacts of the Proposed Development on identified sensitive receptors. By comparing the baseline conditions to the modelled conditions with the solar farm in place, the increase in glint and glare caused by the development was determined.

12.7.2 Information to establish the baseline model was collected from available sources including existing mapping data and aerial photographic data.

12.8 Glint and Glare Assessment Modelling

Solar Panel modelling

12.8.1 The PV Array has been modelled based on design information and drawings and supplemented with available aerial photographic data for the area. The drawing sets

used to model the Proposed Development are listed in **Table 12-7.**

12.8.2 The area within the PEIR Assessment Boundary, proposed to be covered by Solar Panels is 149.05ha, which forms the Study Area for the modelling. The PV Array is comprised of a detailed Solar Panel layout design. As such, some simplifications to the layout have been applied to ensure a successful assessment in the Forge Solar software.

Table 12-7 Information sets used to construct the Proposed Development model

File name	Note
Figure 2-1a and Figure 2-1b Layout of the PV Array	PV Array Layout
Figure 2-2: Solar Panel Details	Solar Panel Details
Appendix 12I: PVsyst - Simulation Report	Solar Panel Details

12.8.3 The details for the modules' orientation, tilt, height, and surface material are based on the drawings and information provided by the design team, as follows:

- The orientation of the Solar Panels is set to be south oriented, i.e., 180 degrees.
- The tilt angle is set to be 18 degrees.
- The height from the ground is measured from the drawings as 2.125m from the centre of the Solar Panels.

12.8.4 The design team confirmed that the Solar Panels will consist of deeply textured glass with anti-reflection coating. A lightly textured glass with anti-reflection coating has been selected as a modules' material for this assessment, as the closest available match.

12.9 Sensitive Receptors

Typology of the potential receptors

12.9.1 Sensitive receptors were selected based on approved industry guidelines and on the basis of their likelihood to be affected by the impact of glare from the Proposed

Development. In this Study Area, sensitive receptors include:

- vehicle users on routes within the Study Area defined in **Figure 12-3** ; and
- dwellings located within the Study Area defined in **Figure 12-3.**

12.9.2 While pedestrians may experience discomfort from glare, the potential for severe accidents is significantly lower compared to other identified sensitive receptors. Therefore, pedestrians were not included in the detailed glare assessment.

Receptors sensitivity

12.9.3 Disability glare, caused by excessive brightness in the field of vision, can significantly impair visual performance and increase the risk of accidents. Receptors within the Study Area susceptible to potential glare impacts from the Proposed Development were divided into high, medium or low sensitivity, as described and outlined in **Table 12-8** below.

12.9.4 The glare impact is particularly critical for transportation modes such as aviation, road, and rail, where rapid decision-making and visual acuity are paramount for safety. However as detailed in **Table 12-6**, aviation and railway receptors have been scoped out of the assessment. Even low levels of glare can compromise visibility and reaction times, potentially leading to serious consequences. Therefore, plane pilots, train drivers and road users at main roads (especially around junctions and roundabouts) are considered to be highly sensitive to glare. Road users on local roads are considered to have a low sensitivity to glare, due to a lower risk of accidents.

12.9.5 Residents are considered to have a medium sensitivity to glare, as while discomfort may occur, the potential for severe accidents is significantly lower compared to road users at junctions and roundabouts.

Table 12-8 Receptors sensitivity

Receptor	Sensitivity
Road users on main routes (especially around junctions, round abouts, and traffic light locations)	High
Road users on local and side roads	Low
Dwellings	Medium

Roads

12.9.6 As discussed in the above sections, solar farms have the potential to cause glare on vehicle users on roads within 1km, based on the Pager Power Guidelines (Ref 12-7).

12.9.7 The BRE 2022 Guide (Ref 12-3) recommends glare assessments for sensitive locations such as junctions and areas around traffic signals, where glare may pose high risk to drivers and impair their vision.

12.9.8 The main major road which could be impacted by the Proposed Development is A4810 (Queen's Way). The Site, however, is surrounded by local roads which are not typically assessed for glare, with the Solar Panel set back from the majority of these roads. As a conservative approach some of these roads were assessed especially where junctions are located.

12.9.9 **Table 12-9** below and **Figure 12-4** show the names and locations which were assessed for potential glare effects on road users. Details of all route receptors are available in **Appendix 12C**.

Table 12-9 Route receptors for the Glare assessment

Route Receptor Number	Description	Sensitivity
1	Junction of The Ramp, The Causeway, W End, and Church Road	High
2	Junction of The Whitewall and Mill reen	High
3	Junction of Green Street and S Row	High
4	Junction of N Row and Green Street	High
5	Junction of Bryn Road and Church Row	High
6	Junction of Church Row and S Row	High
7	Junction of Bryn Road, Mead Lane, and S Row	High
8	Junction of Broadway St Common, N Row, and Rush Wall	High
9	Roundabout connecting Queen`s Way (A4810) and Llanwern Road	High

Route Receptor Number	Description	Sensitivity
10	Roundabout connecting Queen`s Way with the side road leading to Tata Steel Llanwern House	High
11	Junction of Whitson Common Road and Porton Road	High
12	Junction of Whitson Common Road and Goldcliff Road	High

Dwellings

12.9.10 The Study Area does not contain high density residential areas given its location. However, there are several residential dwellings and farmhouses scattered within 1km from the PEIR Assessment Boundary which have been considered as sensitive receptors for this assessment. Each of these residential dwellings or a group of dwellings, where relevant, has been represented by a number of receptors and observation points as listed in **Table 12-10**.

12.9.11 Dwelling receptors are considered at a height of 1.8m from the ground floor. This is because ground floors typically contain living rooms, which are considered more sensitive compared to bedrooms, which are assumed to be on the upper floors. These assumptions follow standard practice and are generally adopted for this type of assessments.

12.9.12 Due to the large number of dwelling receptors, the assessment has been divided into 2 sub-models. Sub-model 1 includes Dwelling Groups 1 to 4, with Observation Point numbers 1 to 53, and Sub-model 2 includes Dwelling Groups 5 to 7 with Observation Points1 to 60. Hence, all dwelling receptors are referred to with both their Receptor Group number and the Observation Point (OP) number to provide clarity e.g. Receptor Group 1 OP 1 or Receptor Group 5 OP 1.

12.9.13 All identified dwelling receptors are listed in **Table 12-10** and shown in **Figure 12-5** to **12-12.** Details of all dwelling receptors are available in **Appendix 12C** and **12F.**

Table 12-10 Dwelling receptors for the Glare assessment

Dwelling Receptor Group	Observation Point Number	Description	Sensitivity
1	1-13	Houses in and around Undy village, along W End and Church Rd	Medium
2	14-23	Few Houses along The Causeway	Medium
3	24-42	Houses along Whitewall	Medium
4	43-53	Houses in and around Summerleaze village	Medium
5	1-20	Houses in and around Redwick village	Medium
6	21-33	Houses along and around N Row	Medium
7	34-60	Houses in and around Whitson Village, along Whitson Rd and Porton Rd	Medium

12.10 EIA Significance Criteria

Impact Level

12.10.1 The assessment of glare impacts employs the methodology described in **Section 12.4** which categorises the potential ocular impact of solar glare into three levels - green, yellow or red. The impact category is then correlated with the sensitivity of an affected receptor, as described in **Section 12.8**, to establish if the glare level is considered acceptable.

12.10.2 For route and building receptors, which are considered moderate to highly sensitive as described in **Section 12.8**, the following impact acceptability criteria, has been adopted based on the Pager Power Guidelines (Ref 12-7).

- Any red glare with potential to cause retinal burn is not acceptable.
- Yellow glare, which can cause a temporary after-image, is not acceptable if it persists for 60 minutes or more per day, for three months or more per year.
- Green glare with 'low potential for after-image' is acceptable.

12.10.3 No criteria have been adopted for the aviation and rail receptors as these were

scoped out of the glint and glare assessment (Table **12-5**).

Significance of effect

12.10.4 Based on the above, the following significance criteria for route and building receptors has been set based on FAA methodology, as show in **Table 12-11** below.

12.10.5 Where assessment identifies areas of glare levels exceeding acceptable thresholds, appropriate mitigation measures are proposed in **Section 12.12** to reduce the potential impact on the receptors.

Table 12-11 Significance criteria

Glare Category	Glare Duration	Significance of Impact	Mitigation Required
Red	Any duration	Major Adverse and **Significant**	Yes
Yellow	More than 60 minutes per day, for more three or more months per year	Moderate Adverse and **Significant**	Yes
	Less than 60 minutes per day, for less than three months per year	Minor Adverse	No
Green	Any duration	Negligible	No
No impact	-	No impact	No

12.11 Assessment Results of likely Impacts and Effects

12.11.1 The potential occurrences of glint and glare have been determined via solar geometry identifying the reflections and the intensity for the whole year. The annual analysis accounts for the reflected sunlight over each Solar Panel on a minute-by-minute basis for the entire year. The results of the assessment are summarised below in **Table 12-12** and **Table 12-13** and details of the results are presented in **Appendix 12A** to **12G**.

Roads

12.11.2 As detailed in **Table 12-12** the assessment demonstrated that within the context of all assessed route receptors (**Figure 12-4**) no significant glare requiring mitigation will be created as a result of the Proposed Development.

12.11.3 Specifically, for route receptors 1, the assessment showed no periods of glare as a result of the Proposed Development, which is therefore, considered to have **no impact**.

12.11.4 With regard to route receptors 9 and 10, the assessment showed periods of green glare as a result of the Proposed Development, which is considered **negligible**, and therefore not significant, indicating that no mitigation is required.

12.11.5 Therefore, based on the above, the effect on the route receptors 1, 9 and 10 is considered **negligible** and therefore not significant, indicating that no mitigation is considered necessary.

12.11.6 For route receptors 2 to 8 and 11 and 12 the assessment showed several periods of yellow glare as a result of the Proposed Development. As discussed in **Section 12.4** yellow glare has a potential to cause a temporary after-image and therefore it is considered unacceptable for route drivers if it persists for 60 minutes or more per day, for three months or more per year.

12.11.7 As shown in the detailed results in **Appendix 12D** and **12G**, out of all these receptors, the maximum time per day that yellow glare occurs is for approximately 19 minutes e.g. on the 5th of May at route receptor 8. Therefore, this falls below the set criteria described above and is considered **negligible** and not significant, with no mitigation required.

12.11.8 Therefore, based on the above findings, the effect of the Proposed Development, on the route receptors 2 to 8 and 11 and 12 is considered to be, at worst, **minor adverse** and therefore not significant, indicating that no mitigation is considered necessary.

12.11.9 This assessment is representative of the worst-case scenario. The topography, vegetation and buildings will provide additional obstruction and will further reduce the potential for glint and glare impacts.

Table 12-12 Summary of glare assessment results for route receptors

Route Receptor Number	Sensitivity	Results	Glare criteria exceeded	Impact	Significance of Impact	Mitigation Required
1	High	No glare	-	-	No impact	No
2	High	Yellow Glare	No	Acceptable	Minor adverse	No
3	High	Yellow Glare	No	Acceptable	Minor adverse	No
4	High	Yellow Glare	No	Acceptable	Minor adverse	No
5	High	Yellow Glare	No	Acceptable	Minor adverse	No
6	High	Yellow Glare	No	Acceptable	Minor adverse	No
7	High	Yellow Glare	No	Acceptable	Minor adverse	No
8	High	Yellow Glare	No	Acceptable	Minor adverse	No
9	High	Green Glare	-	Acceptable	Negligible	No
10	High	Green Glare	-	Acceptable	Negligible	No
11	High	Yellow Glare	No	Acceptable	Minor adverse	No
12	High	Yellow Glare	No	Acceptable	Minor adverse	No

Dwellings

12.11.10 The results of the assessment, summarised in **Table 12-13** below, demonstrated that within the context of the dwelling receptors assessed (**Figure 12-5** to **Figure 12-12**) no significant glare requiring mitigation will be created as a result

of the Proposed Development.

12.11.11 For dwelling receptors Group 1 Observation Point (OP) 1-13; Group 2 OP 14-20; Group 3 OP 24-34 the assessment showed no periods of glare as a result of the Proposed Development, which is considered to have **no impact**.

12.11.12 With regards to dwelling receptors Group 3 OP 35-37 and 42; Group 4 OP 43 and 52-53; Group 5 OP 13; Group 6 OP 22-23 and 32; Group 7 OP 34-48 and 50-56 the assessment showed periods of green glare as a result of the Proposed Development, which is considered acceptable with **negligible impact** and therefore **not significant**, indicating that no mitigation is considered necessary.

12.11.13 Therefore, based on the above, the effect on the dwelling receptors Group 1 OP 1-13; Group 2 OP 14-20; Group 3 OP 24-37 and 42 (**Figure 12-7**); Group 4 OP 43 and 52-53 (**Figure 12-8** and **12-9**); Group 5 OP 13; Group 6 OP 22-23 and 32 (**Figure 12-10**); Group 7 OP 34-48 and 50-56 (**Figure 12-12** and **12-13**) is considered to be **negligible** and therefore **not significant**, indicating that no mitigation is considered necessary. .

12.11.14 For all the other receptors (**Figure 12-6 to Figure 12-13**), as summarised in **Table 12-13** below, the assessment showed several periods of yellow glare as a result of the Proposed Development. As discussed in **Section 12.4**‘ yellow glare has a potential to cause a temporary after-image and therefore it is considered unacceptable for dwelling residents if it persists for 60 minutes or more per day, for three months or more per year.

12.11.15 As shown in the detailed results in **Appendix 12D and 12G**, out of all remaining receptors, the maximum time per day that yellow glare occurs is for approximately 14 minutes e.g. on the 31st of May at dwelling receptor Group 2 OP 22 (**Figure 12-8**). Therefore, this falls below the set criteria described above and is considered acceptable with no further mitigation required.

12.11.16 Therefore, based on the above findings, the effect of the Proposed Development, on the remaining dwelling receptors is considered to be, at worst, **minor adverse** and therefore **not significant**, indicating that no mitigation is considered necessary.

12.11.17 It should be noted that this assessment is representative of the worst-case scenario. The topography, vegetation and buildings will provide additional obstruction and will further reduce the potential for glare impacts identified in this assessment.

Table 12-13 - Summary of glare assessment results for dwelling receptors

Dwelling Receptor Group	Observation Point Number	Sensitivity	Results	Glare criteria exceeded	Impact	Significance of Impact	Mitigation Required
1	**1-13**	Medium	No Glare	-	-	No impact	No
2	**14-20**	Medium	No Glare	-	-	No impact	No
	21-23	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
3	**24-34**	Medium	No Glare	-	-	No impact	No
	35-37	Medium	Green Glare	-	Acceptable	Negligible	No
	38-41	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
	42	Medium	Green Glare	-	Acceptable	Negligible	No
4	**43**	Medium	Green Glare	-	Acceptable	Negligible	No
	44-51	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
	52-53	Medium	Green Glare	-	Acceptable	Negligible	No
5	**1-12**	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
	13	Medium	Green Glare	-	Acceptable	Negligible	No
	14-20	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
6	**21**	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
	22-23	Medium	Green Glare	-	Acceptable	Negligible	No
	24-31	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
	32	Medium	Green Glare	-	Acceptable	Negligible	No
	33	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
7	**34-48**	Medium	Green Glare	-	Acceptable	Negligible	No

Dwelling Receptor Group	Observation Point Number	Sensitivity	Results	Glare criteria exceeded	Impact	Significance of Impact	Mitigation Required
	49	Medium	Yellow Glare	No	Acceptable	Minor adverse	No
	50-56	Medium	Green Glare	-	Acceptable	Negligible	No
	57-60	Medium	Yellow Glare	No	Acceptable	Minor adverse	No

Additional assessments

12.11.18 Additional scenarios have been assessed to further investigate material variations of the Solar Panels including:

12.11.19 **Best-case scenario**: Which includes assuming the Solar Panels material is deeply textured glass with no anti-reflective coating (ARC), the assessment results showed that no significant glare effect will be created for all assessed route and dwelling receptors, as a result of the Proposed Development. Therefore, the effect of such scenario will be considered **negligible** for all assessed receptors and therefore no mitigation will be considered necessary.

12.11.20 **Worst-case scenario**: Which includes assuming the Solar Panels material is smooth glass with no ARC, the results showed that, for all assessed route and dwelling receptors, glare effects as a result of the Proposed Development, although higher than those reported in this assessment, will still fall below the set criteria, based on the Pager Power Guidelines (Ref 12-7). Therefore, based on the above, the effect of the Proposed Development on the route and dwelling receptors, even assuming worst-case scenario of Solar Panels material as smooth glass with no ARC, will remain, at worst, minor adverse and therefore no mitigation will be considered necessary.

12.12 Design, Mitigation and Enhancement Measures

12.12.1 Given the specific focus of this assessment on potential glare impacts on dwellings, as well as main and local roads, opportunities for enhancing the environment are limited. The primary focus of the project is to generate clean energy while minimising adverse impacts.

12.12.2 The results of the assessment, summarised in **Section 12.10**, showed that for all of

the assessed receptors no significant glare requiring mitigation will be created as a result of the Proposed Development. Therefore, no design, mitigation or enhancement measures have been included within this glint and glare assessment.

12.13 Residual Effects

12.13.1 The results of the assessment, summarised in **Section 12.10**, demonstrated that with regards to all of the assessed receptors, no significant glint and glare requiring mitigation will be created as a result of the Proposed Development. Hence, no design, mitigation or enhancement measures have been suggested as a result of this glint and glare assessment. Therefore, the residual effects remain the same as effects described in **Section 12.10**.

12.14 Cumulative Effects

12.14.1 The cumulative schemes located, both existing and proposed within 1km of the PEIR Assessment Boundary have been considered as part of the cumulative assessment, as presented in **Table 12-14**.

12.14.2 This glint and glare assessment only considers the impact of the Proposed Development on the dwellings and route users and therefore all other types of cumulative developments have been excluded from this review.

12.14.3 The review identified that the only residential cumulative developments within the potential glint and glare impact zone of the Proposed Development is application reference DM/2023/00161 constituting a residential barn conversion at Lower Grange Farm in Whitewall, Magor, Caldicot, Monmouthshire. The location of Lower Grange Farm has already been assessed as a dwelling sensitive receptor Group 3 OP 42 (**Figure 12-8**). The results presented in **Table 12-13** show that for this receptor the assessment showed periods of green glare as a result of the Proposed Development, therefore the cumulative effect is considered acceptable with **negligible impact** and therefore **not significant**, indicating that no mitigation is considered necessary.

12.14.4 For the remaining residential cumulative schemes, the review identified that the nearest residential cumulative scheme (Application reference: DM/2021/00357) would be located approximately 1.6km from the closest Solar Panel within the

Proposed Development, which is beyond the considered glare and glint impact zone of 1km (**Section 12.6**). Therefore, this study shows that no significant impact in terms of glint and glare is anticipated at these cumulative schemes as a result of the Proposed Development. Based on the above, the cumulative effects at the rest of the residential cumulative schemes are considered of **no impact** and therefore **not significant**, indicating that no mitigation is considered necessary.

12.14.5 In addition to the existing solar developments in the close proximity of the Site, two other planning applications have been identified within the Study Area during the cumulative review process. At the time of this assessment in October 2025, application ref. DNS CAS-01960-J2H3X5 - Magor Net Zero status is 'researching' and application ref. DNS/3220457 - Rush Wall Solar Park Ltd status is 'examination' (**Table 12-14**).

12.14.6 Glint and glare effects are highly dependent on specific factors such as orientation, tilt, elevation of the Solar Panels, solar position and movement as well as geometrical line of view from the solar farm to the receptor. Therefore, considering the variability of these factors for each solar farm, the presence of other future consented solar schemes is not likely to create any significant cumulative effects to the receptors assessed. The glint and glare effects identified would not be affected by the presence of other solar farms in the surrounding area and, equally, the glint and glare effects identified by other solar developments would not be affected by the Proposed Development.

12.14.7 Therefore, it can be concluded that it is unlikely that the cumulative effects will add significant impacts to those already reported in this assessment.

Table 12-14 Cumulative Schemes considered in glint and glare assessment

Application reference	Use type	Sensitivity	Approx. distance to the closest Solar Panel	Potential for significant glint and glare impact	Significance of Impact	Mitigation Required
24/0301	Residential	Medium	3 km	No	No impact	No

Application reference	Use type	Sensitivity	Approx. distance to the closest Solar Panel	Potential for significant glint and glare impact	Significance of Impact	Mitigation Required
22/0349	Industrial	-	-	-	-	-
23/0440	Residential	Medium	4 km	No	No impact	No
25/0052	Industrial	-	-	-	-	-
25/0176	Industrial	-	-	-	-	-
25/0177	Industrial	-	-	-	-	-
25/0152	Residential	Medium	4 km	No	No impact	No
DM/2023/01479	Landscape	-	-	-	-	-
DM/2023/00161	Residential	Medium	350 m	Yes	Negligible	No
DM/2022/01490	Administrative	-	-	-	-	-
DM/2020/01639	Industrial	-	-	-	-	-
DM/2021/00293	Administrative	-	-	-	-	-
DM/2022/00690	Industrial	-	-	-	-	-
DM/2023/00387	Non-mat amendment	-	-	-	-	-
DM/2023/01031	Industrial	-	-	-	-	-
DM/2021/00358	Commercial	-	-	-	-	-
DM/2024/01492	Commercial	-	-	-	-	-
DM/2025/00147	Non-residential	-	-	-	-	-
DM/2021/00357	Residential	Medium			No impact	No
DNS CAS-01960-J2H3X5	Industrial	-	-	-	-	-
DNS/3220457	Industrial	-	-	-	-	-

12.15 Summary

12.15.1 This Chapter presents the assessment of the likely significant effects of the Proposed Development on glint and glare and the extent to which this may affect

the relevant surrounding sensitive receptors, such as roads, railways, and aerodromes, during the operational phase.

12.15.2 The assessment has been conducted using the methodology and guidance developed by Sandia National Laboratories (Ref 12-10), which is widely used by UK aviation stakeholders through the FAA-approved tool, Forge Solar.

12.15.3 Aviation receptors and train tracks were excluded from this assessment in the Scoping Report due to their distance from the PEIR Assessment Boundary (**Table 12-5**). Therefore, the identified receptors for this glare assessment were the vehicle users on roads and residents of dwellings within 1km of the proposed PV Array, comprising of 125 sensitive receptors.

12.15.4 The potential occurrences of solar glint and glare have been determined via solar geometry and intensity, identifying the glare effects for the whole year. The annual analysis accounts for the reflected sunlight over each Solar Panel on a minute-by-minute basis for the entire year.

12.15.5 For all of the assessed route receptors the results of the assessment showed that no significant glare requiring mitigation will be created as a result of the Proposed Development. For 1 route receptor (8%) the assessment showed **no impact**; for 2 route receptors (17%) the assessment showed **negligible** impact; and for 9 route receptors (75%) the assessment showed **minor adverse** impact and therefore **not significant**.

12.15.6 With regards to the dwelling receptors assessed the results demonstrated that no significant glare requiring mitigation will be created as a result of the Proposed Development. For 31 dwelling receptors (27.4%) the assessment showed **no impact**; for 33 dwelling receptors (29.2%) the assessment showed **negligible** impact; and for 49 dwelling receptors (43.4%) the assessment showed **minor adverse** impact and therefore **not significant**.

12.15.7 The assessment concludes that no significant glint and glare impacts from the Proposed Development have been identified for the assessed receptors. The results indicated that the potential impacts remain within acceptable criteria, and no design, mitigation or enhancement measures have been considered necessary.

12.15.8 The cumulative schemes located within 1km of the PEIR Assessment Boundary have been considered as part of the cumulative assessment. The review identified that in terms of glint and glare impacts as a result of the Proposed Development, the potential effects at cumulative schemes are considered acceptable with either **no impact** or **negligible impact** and therefore **not significant**, indicating that no mitigation is considered necessary.

12.15.9 The analysis was carried out considering no obstructions such as vegetation or buildings, as recommended by the FAA guidance (Ref 12-6). Therefore, this assessment is representative of the worst-case scenario. The topography, vegetation and buildings will provide additional obstruction which will further reduce the potential for glare impacts identified in this assessment.

12.16 References

Ref 12-1 Department for Energy Security and Net Zero (2024). National Policy Statement for Renewable Energy Infrastructure (EN-3). [Online] Available at: National Policy Statement for renewable energy infrastructure (EN-3) (publishing.service.gov.uk) [Accessed October 2025].

Ref 12-2 Ministry of Housing, Communities & Local Government, 2015, Renewable and low carbon energy, Available online at: https://www.gov.uk/guidance/renewable-and-low-carbon-energy [Accessed October 2025].

Ref 12-3 Littlefair, P.J. (2022) Site Layout and Planning for Daylight and Sunlight: a guide to good practice. BRE Construction Research Communications, Garston, UK. 2022 edition. [Accessed October 2025].

Ref 12-4 Littlefair, P.J.(1987) Solar dazzle reflected from sloping glazed facades BRE IP 3/87,Bracknell, IHS BRE Press. [Accessed October 2025].

Ref 12-5 Department of Transportation, Federal Aviation Administration (FAA), 2013, Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, Available at: https://www.govinfo.gov/content/pkg/FR-2013-10-23/pdf/2013-24729.pdf [Accessed October 2025].

Ref 12-6 Federal Aviation Administration (FAA), 2018, Technical Guidance for Evaluating Selected Solar Technologies on Airports, Available at: https://www.faa.gov/sites/faa.gov/files/airports/environmental/FAA-Airport-Solar-Guide-2018.pdf [Accessed October 2025].

Ref 12-7 Scrivener, D. et al. (2022). Solar Photovoltaic and Building Development – Glint and Glare Guidance, Fourth Edition. Pager Power Urban and Renewable. Available at: https://www.pagerpower.com/wp-content/uploads/2022/09/Solar-Photovoltaic-Glint-and-Glare-Guidance-Fourth-Edition.pdf [Accessed October 2025].

Ref 12-8 Hassall, D. N. H. (1991). Reflectivity: Dealing with Rogue Solar Reflections. University of South Wales. [Accessed October 2025].

Ref 12-9 Civil Aviation Authority (CAA). (2024, April). CAST Advice Note 5: Renewable

Energy Developments - Renewable Energy. https://www.caa.co.uk/combined-aerodrome-safeguarding-team-cast/cast-publications/cast-advice-notes/ [Accessed October 2025].

Ref 12-10 ForgeSolar tool, based on the Solar Glare Hazard Analysis Tool ("SGHAT") licensed from Sandia National Laboratories. [Accessed October 2025].