Rosefield Solar Farm

Preliminary Environmental Information Report

Volume 1
Chapter 16: Glint and Glare

September 2024

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16. Glint and Glare

16.1. Introduction

16.1.1. This chapter presents the preliminary assessment of the likely significant effects of glint and glare during the operation (including maintenance) of Rosefield Solar Farm and should be read in conjunction with the following figures and appendix in **Volume 2** and **Volume 3**, respectively:

- **Figure 16.1: Solar PV areas and receptors – 10 km**;
- **Figure 16.2: Solar PV areas and receptors – 1 km;** and
- **Appendix 16.1: Glint and Glare assessment results.**

16.1.2. Whilst solar panels are specifically designed to absorb and not to reflect solar irradiation, the sun's rays may be reflected at certain angles, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel[1].

16.1.3. Glint and glare could be triggered as panels are installed during construction, but the likely worst case of any glint and glare impacts would be once the whole solar farm is constructed (i.e. operational). For this reason, this preliminary assessment focuses on the operational (including maintenance) phase.

16.2. Stakeholder engagement

16.2.1. No specific consultation has been undertaken to inform this preliminary assessment. The Applicant will seek to agree the proposed Study area and receptors that will inform the glint and glare assessment that will be undertaken and appended to the ES in support of the DCO application with Buckinghamshire Council.

16.3. Legislative framework, planning policy and guidance

16.3.1. This preliminary assessment has been undertaken with regard to the following legislation, planning policy and guidance.

[1] National Policy Statement for Renewable Energy Infrastructure NPS EN-3 (2023), Section 2.10.102.

Legislation

16.3.2. There is no legislation of relevance to the glint and glare assessment.

National planning policy

- Overarching National Policy Statement for Energy (NPS EN-1) (2023)[2] – provides the basis for decisions regarding nationally significant energy infrastructure. Section 5.5.55 is related to the planning policy for glint and glare regarding civil and military aviation.
- National Policy Statement for Renewable Energy Infrastructure (NPS EN-3) (2023)[3] – Sections 2.10.102-106 set out general considerations for the assessment of impacts of glint and glare in relation to solar panels. Sections 2.10.134-136 give advice on possible mitigation measures to address the impacts of glint and glare. Sections 2.10.158-159 state "*Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes, motorists, public rights of way, and aviation infrastructure (including aircraft departure and arrival flight paths). Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms.*".
- Planning Practice Guidance for Renewable and Low Carbon Energy[4]. Paragraph 013 sets out guidance for large scale ground-mounted solar photovoltaic farms. It details particular factors a local planning authority will need to consider, including the effect on landscape of glint and glare on neighbouring uses and aircraft safety.

[2] Department for Energy Security and Net Zero. (2023). Overarching National Policy Statement for Energy (EN-1). Available online: https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1

[3] Department for Energy Security and Net Zero (2023). National Policy Statement for Renewable Energy Infrastructure (EN-3). Available online: https://www.gov.uk/government/publications/national-policy-statement-for-renewable-energy-infrastructure-en-3

[4] Planning Practice Guidance for Renewable and Low Carbon Energy (2023). Available online: https://www.gov.uk/guidance/renewable-and-low-carbon-energy

Local planning policy

16.3.3. Vale of Aylesbury Local Plan (VALP) 2013 – 2033 Adopted Plan (2021)[5], specifically Policy C3 Renewable Energy, which states that planning permission will normally be granted for off-site renewable energy (including solar) where it has been demonstrated that certain criteria have been met including that there is no significant adverse impact on local amenity, health, quality of life as a result of outlook through unacceptable visual intrusion and that there is no adverse impact on highway safety.

Guidance

16.3.4. There is no provision on glint and glare from the European Aviation Safety Authority. The UK CAA (Civil Aviation Authority) guide (Renewable energy developments: solar photovoltaic developments CAST Aerodrome Safeguarding 2023)[6] only provides high-level guidance regarding safety considerations (Air Traffic Service personnel and pilots) and the Study area, but it does not prescribe a specific methodology for assessing glint and glare effects.

16.3.5. Many aviation stakeholders refer to the US Federal Aviation Administration (FAA) guide (Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports 2013)[7]. This document recommends undertaking the technical assessments using the Solar Glare Hazard Analysis Tool, developed by Sandia National Laboratories.

16.3.6. In addition to the FAA guide, this preliminary assessment has also been carried out in accordance with industry best practice and the 4th edition of the Solar Photovoltaic and Building Development Glint and Glare Guidance, published by Pager Power in 2022[8].

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[5] Vale of Aylesbury Local Plan (VALP) 2013 – 2033 Adopted Plan (2021). Available online: https://buckinghamshire-gov-uk.s3.amazonaws.com/documents/Aylesbury_local_plan_L46JWaT.pdf

[6] Renewable energy developments: solar photovoltaic developments CAST Aerodrome Safeguarding Guidance Note (2023). Available online: https://www.caa.co.uk/media/hlsmmmoi/cast-renewable-energy-developments-solar-july-2023.pdf

[7] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (2013). Available online: https://www.govinfo.gov/app/details/FR-2013-10-23/2013-24729/context

[8] Pager Power. Solar Photovoltaic and Building Development – Glint and Glare Guidance. Fourth Edition (2022). Available online: https://www.pagerpower.com/wp-content/uploads/2022/09/Solar-Photovoltaic-Glint-and-Glare-Guidance-Fourth-Edition.pdf

16.4. Study area

16.4.1. There is little formal guidance with regard to the maximum distance at which glint and glare should be assessed. However, based on industry best practice and past assessment experience, the Study area applied to this preliminary assessment comprises:

- 1 km from the Site boundary for ground-based receptors including residential dwellings, roads and railway signals and drivers. This is due to the reduced visibility (shielding by obstructions), and lower impact that occurs with distance (smaller size of reflections); and
- 10 km from the Site boundary for aviation receptors. The approach for determining the receptor locations on the approach path is undertaken by selecting locations along the runway centre line from 50 ft (approx. 15.24 m) above the runway threshold out to a distance of 2 miles (approx. 3.2 km) as outlined in the US Federal Aviation Administration (FAA) guide (Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports 2013)[9]. The approach phase (arrival flight paths) is considered in the estimation of impact as this is deemed to be the most sensitive phase of a flight. Departing aircraft will have the nose pointing upwards and the visibility of objects (i.e. reflective panels) located on the ground will be reduced and therefore this has not been considered.

16.5. Establishing baseline conditions

16.5.1. Existing glint and glare conditions have been determined through a desktop study. A site visit will be undertaken to the agreed Study area for the full glint and glare assessment, the findings of which will be submitted in support of the DCO application.

16.6. Environmental baseline

16.6.1. There are no operational solar developments within the Study area.

16.6.2. None of the typical glare sources in rural environments are causing adverse instances of glint or glare around the Site at present. These sources include:

- Rainwater collected on rooves, fields, and roads;
- Bodies of water e.g. ponds/lakes/rivers; and

[9] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (2013). Available online: https://www.govinfo.gov/app/details/FR-2013-10-23/2013-24729/context

- Building/greenhouse windows.

Future baseline conditions

16.6.3. It is considered feasible that new (natural) glint and glare sources (such as new bodies of water) could be introduced to the Study area in the future.

16.7. Mitigation embedded into the design

16.7.1. This preliminary assessment has been based on the principle that measures have been 'embedded' into the design of Rosefield Solar Farm to remove potential likely significant effects as far as practicable, for example by the considered placement of infrastructure and landscape screening buffers. Embedded (primary) environmental mitigation measures that are considered to be an inherent part of Rosefield Solar Farm are detailed within **Chapter 5: Approach to the EIA**. The embedded mitigation measures relevant to glint and glare and the benefits these provide are outlined in **Table 12.6** below.

Table 16.1 – Embedded mitigation measures relevant to glint and glare

Embedded mitigation measures relevant to glint and glare	Benefit
Removal of Knowlhill (Field B17) and half of Field B9 from Solar PV development. Removal of fields south-west of Botolph Claydon (Fields D1, D2, D3 North, and D5) from Solar PV development. No Solar PV development will occur within the centre/north of the Site (between Parcels 1, 1a and 2).	This reduces the areas identified as having the potential to cause adverse effects and as such will reduce the overall impact of Rosefield Solar Farm in relation to glint and glare.
Any vegetation cleared to facilitate the construction of Rosefield Solar Farm will be compensated during operation by a planting scheme that equals or exceeds the current levels of vegetation. Landscape screening as shown in **Figure 3.4: Landscape and Ecological Mitigation and Enhancements Plan** in **Volume 2**.	The landscape screening buffers block the reflected light from sensitive receptors, thus reducing adverse glint and glare effects.

16.7.2. Solar PV modules are specifically designed to absorb light rather than reflect it. Light reflecting from Solar PV modules results in reduced energy

output. Solar PV modules are dark in colour due to their anti-reflective coatings and are manufactured with low-iron, ultra-clear glass with specialised coatings and textures to enable maximum absorption. The combination of these factors increases electrical energy production of the panels and reduces reflected rays at the same time.

16.8. Optionality

16.8.1. **Chapter 5: Approach to the EIA** sets out those elements of Rosefield Solar Farm for which optionality is present within the current design and sets out the scenarios assessed for the purpose of this PEIR.

16.8.2. The preliminary design principles as outlined in **Chapter 5: Approach to the EIA** and preliminary parameter plans (**Figure 3.1** to **3.5** in **Volume 2**) set out the reasonable 'worst case scenario' of the extent of Solar PV modules that has been assessed within this chapter. The 'worst case scenario' in relation to this preliminary glint and glare assessment are described in **Table 16.2** below

Table 16.2 – Optionality scenerios assessed

Project element	Scenario assessed for this preliminary assessment
Solar PV modules	The worst-case extent of Solar PV modules as detailed on **Figure 3.1 to 3.5** in **Volume 2** has been assessed within this chapter.
Satellite Collector Compounds Construction Compounds BESS Rosefield Substation and Main Collector Compound	These other elements would not cause material levels of glint and glare, therefore, optionality testing is not required for the preliminary glint and glare assessment as this considers the worst case scenario with embedded mitigation (as detailed in **Table 16.1**).

16.9. Approach to the preliminary assessment

16.9.1. The methodology for this preliminary assessment has been developed based on industry best practice, available guidance and professional

experience. It comprises the following stages, utilising glint and glare guidance, published by Pager Power in 2022[10]:

- Identification of key sensitive receptors;
- Use of modelling and geometric annual calculations to determine solar reflections that are visible from each receptor;
- Where visible reflections are predicted, determination of the glint and glare impact using the Solar Glare Hazard Analysis Tool, in line with Sandia National Laboratories' Federal Aviation Administration methodology[11];
- Determination of the significance of the potential effects upon each receptor, following the specific criteria for each type of receptor; and
- Where significant effects are anticipated, consideration is afforded to proposing mitigation (screening) between the receptor and the reflecting solar panels.

Key receptors

16.9.2. Within the Study area, there are a number of sensitive receptors which include road users, railway operations and infrastructure, residential properties, and aerodromes (see **Figures 16.1** and **16.2** in **Volume 2**).

16.9.3. Roads users within 1 km of the Site boundary comprise (receptor references in brackets, as outlined in **Figures 16.1** and **16.2** in **Volume 2**):

- Werner Terrace/Brackley Lane (OP12);
- Calvert Road/Addison Road (OP13);
- Calvert Road (OP14);
- Orchard Way/Botyl Road (OP27); and
- Quainton Road/Granborough Road (OP28).

16.9.4. Railway signals and driver receptors within 1 km of the Site boundary comprise (receptor references in brackets, as outlined in **Figures 16.1** and **16.2** in **Volume 2**):

[10] Pager Power. Solar Photovoltaic and Building Development – Glint and Glare Guidance. Fourth Edition (2022). Available online: https://www.pagerpower.com/wp-content/uploads/2020/12/Solar-Photovoltaic-Glint-and-Glare-Guidance-Third-Edition.pdf

[11] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports 2013. Available online: https://www.govinfo.gov/app/details/FR-2013-10-23/2013-24729/context

- Receptor points along the Aylesbury Vale - Milton Keynes line (OP37), based on a train driver's eye level typically 2.75 m above rail.

16.9.5. Occupants or residential dwellings within 1 km of the Site boundary comprise 33 receptors (receptor references OP1-OP11, OP15-OP26, OP27-OP36, as outlined in **Figures 16.1** and **16.2** in **Volume 2**).

16.9.6. Aerodromes (with no control towers) and their east and west approaching flying paths within 10 km from the Site boundary comprise:

- Finmere Aerodrome (OP39): 7 km to the north-west, with flying paths FR39 east and west; and
- Thornborough Ground Airstrip (OP40): 10 km to the north-east, with flying paths FR40 east and west.

Assessment tools

16.9.7. The Solar Glare Hazard Analysis Tool is based on the Retinal Glare Hazard Ocular Plot (**Plate 16.1**). This is the standard metric for measuring the ocular impact of any proposed solar energy system. Retinal Glare Hazard Ocular Plot is a function of the retinal irradiance (brightness) and the subtended angle (size) of the glare source. The results are classified as:

- Green glare: Low potential to cause after-image;
- Yellow glare: Potential to cause an after-image; and
- Red glare: Potential for permanent eye damage.

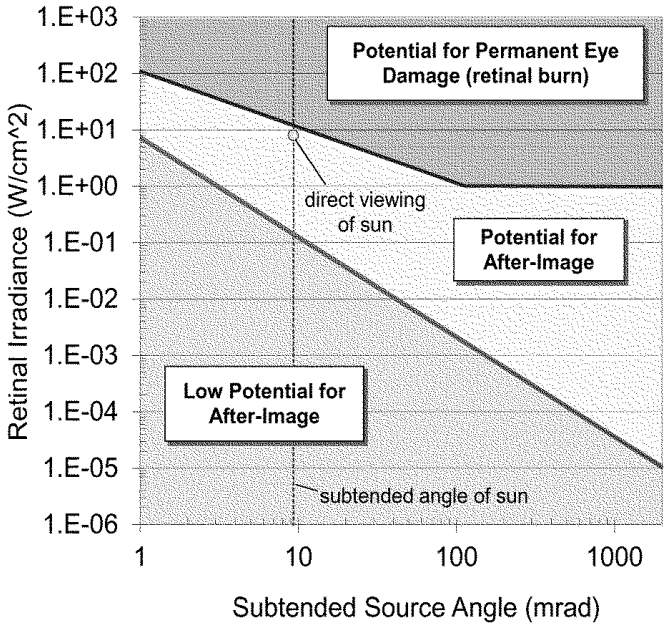

Plate 16.1 Retinal Glare Hazard Ocular Plot

16.9.8. The simulated test environment has been taken from Forge Solar, which uses information from Google Maps, which defines the location, extents and elevation for the receptors, terrain levels and obstructions.

16.9.9. Forge Solar follows the Solar Glare Hazard Analysis Tool method with the following assumptions:

- Clear and sunny sky for the entire year, as a worst-case scenario;
- Fixed intensity within the cone of reflection, including the slope error;
- No obstructions considered between the reflection and the receptor;
- No consideration for Solar PV overshadowing between rows of panels, gaps between them or supporting structures;
- The combined effects of several Solar PV modules are considered cumulatively, without consideration for simultaneity; and
- The topographic profile of each Solar PV array is simplified to a single plane.

Significance criteria

16.9.10. Impact significance is based on published glint and glare guidance (Pager Power, 2022)[12]. This includes general glint and glare significance and specific criteria tailored by receptor type (flying paths, railways, roads, etc.).

16.9.11. In general, the significance criteria for glint and glare effects are as follows:

- No impact: A solar reflection is not geometrically possible or will not be visible from the assessed receptor. No mitigation required;
- Low: A solar reflection is geometrically possible; however, any impact is considered to be small such that mitigation is not recommended e.g. intervening screening will limit the view of the reflecting solar panels significantly or the glare time per year is considered negligible. No mitigation recommended;
- Moderate: A solar reflection is geometrically possible and visible; however, it occurs under conditions that do not represent a worst case

[12] Pager Power. Solar Photovoltaic and Building Development – Glint and Glare Guidance. Fourth Edition (2022). Available online: https://www.pagerpower.com/wp-content/uploads/2020/12/Solar-Photovoltaic-Glint-and-Glare-Guidance-Third-Edition.pdf

scenario e.g. a solar reflection originates from a less sensitive location. Mitigation recommended;

- High impact: A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation will be required if the proposed development is to proceed.

16.9.12. Specific significance criteria for different receptors are presented in **Table 16.2**.

Table 16.2 – Specific significance criteria for different receptors

Glare condition	Significance and mitigation
Approaching aircraft	
Green glare or yellow glare with screened reflections	No mitigation (Low impact). Federal Aviation Administration guidance[13] allows for green glare along the final approach.
Yellow glare without screening	Mitigation required (Moderate impact).
Red glare	Mitigation required (High impact).
ACT Towers	
Green glare with screened reflections	Mitigation not required (Low impact).
Green or yellow glare without screening	Mitigation recommended (Moderate impact).
Red glare	Mitigation required (High impact).
Railways	
Solar reflections within the driver's field of view.	Mitigation not required (Low impact).
Solar reflections directly in front of the train driver with mitigating factors	Mitigation not required (Low impact) or recommended (Moderate impact), depending on the remaining factors.
Solar reflections directly in front of the train driver without mitigating factors	Mitigation required (High impact).
Railway Signals	
Solar reflections do not intercept a railway signal (within 180 degrees from the signal)	Mitigation not required (Low impact).

[13] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports (2013). Available online: https://www.govinfo.gov/app/details/FR-2013-10-23/2013-24729/context

Glare condition	Significance and mitigation
Solar reflections intercept a signal with mitigating factors.	Mitigation not required (Low impact).
Solar reflections intercept a signal without mitigating factors	Mitigation recommended (Moderate impact).
Solar reflections illuminate an incandescent signal directly	Mitigation required (High impact).
Roads	
Local roads or reflections outside the driver's field of view	Mitigation not required (Low impact).
Major national or regional roads with reflections within the field of view	Mitigation not required (Low impact) or mitigation recommended (Moderate impact), depending on remaining factors.
Major national or regional roads with reflections directly in front of the driver	Mitigation required (High impact).
Note: The location of origin of reflection is more significant than its duration for roads, as the receptor is moving.	
Dwellings	
Reflections last for less than 3 months/year AND less than 60 min/day	Mitigation not required (Low impact).
Reflections last for less than 3 months/year OR less than 60 min/day	Mitigation not required (Low impact) or mitigation recommended (Moderate impact), depending on remaining factors.
Reflections exceed 3 months/year AND 60 min/day with mitigating factors	Mitigation not required (Low impact) or mitigation recommended (Moderate impact), depending on remaining factors.
Reflections exceed 3 months/year AND 60 min/day without mitigating factors	Mitigation required (High impact).

Assessment assumptions

16.9.13. This preliminary assessment has been undertaken in accordance with the current design of Solar PV modules as set out in **Chapter 3: Description of Rosefield Solar Farm**. This preliminary assessment considers fixed panels with:

- Orientation: due south;
- Tilt: 30 degrees;
- Material: smooth glass without anti-reflective coating; and

- Slope error: 6.55 milliradians.

16.9.14. A maximum 50 degree viewing angle has been considered for the Aylesbury Vale – Milton Keynes railway line (Receptor reference OP37, as outlined in **Figures 16.1** and **16.2** in **Volume 2**). For aviation receptors (Finmere Aerodrome (OP39) and Thornborough Ground Airstrip (OP40)), an additional maximum downwards viewing angle of 30 degree has been assumed for this preliminary assessment.

16.9.15. The following values have been assumed in the calculation:

- Peak Direct Normal Irradiance (DNI) 1kW/m^2;
- Ocular transmission coefficient 0.5;
- Pupil diameter 0.002 m; and
- Eye focal length 0.017 m.

16.10. Assessment of likely effects (without additional mitigation)

16.10.1. Multiple rounds of glint and glare testing of all arrays have been carried out during the design process undertaken so far, with the proposed Solar PV modules in place (**Appendix 16.1** in **Volume 3**), to optimise the proposal and to minimise any potential impacts to surrounding sensitive receptors. This included reduced Solar PV areas around receptor OP4 in Parcel 1, around receptor OP22/OP23 in Parcel 2, and around receptor OP30 in Parcel 3. Tree barriers were also incorporated around receptors OP11, OP7 and OP22/OP23. A tracking system was discarded.

16.10.2. The preliminary technical analysis has shown no visible reflections along the Aylesbury Vale - Milton Keynes railway line (receptor reference OP37, as outlined in **Figures 16.1** and **16.2** in **Volume 2**) or from Finmere Aerodrome (OP39) or Thornborough Ground Airstrip (OP40), or their approaching flying paths (FP39 and FP40). Therefore, there are no likely significant effects to either railways, aerodromes or flying paths.

16.10.3. With regards to roads, the preliminary results showed only a few hours of glare on road receptors. All these receptors correspond to local roads, and therefore these reflections are expected to have a **Low** impact with no likely significant effects, and therefore they do not require additional mitigation.

16.10.4. With regards to dwellings, the duration of glare is the key parameter. The preliminary assessment concludes that at present, no dwelling receives more than 60 minutes of glare per day and three months per year. The embedded mitigation is especially effective for receptors OP7, OP11, OP22 and OP23, as outlined in **Figures 2.1 to 2.4** in **Appendix 16.1** in **Volume 3**. Dwelling receptors are predicted to have no impact or **Low**

impacts, with no likely significant effects, and therefore they do not require additional mitigation.

16.11. Additional mitigation

16.11.1. No additional mitigation measures are required as there are no significant effects anticipated, taking into account the embedded mitigation measures which form an inherent part of Rosefield Solar Farm (refer to **Section 16.7**).

16.12. Assessment of residual effects (with additional mitigation)

16.12.1. Since no additional mitigation is required, there are no residual glint and glare effects, as outlined in **Section 16.10** above.

16.13. Opportunities for enhancement

16.13.1. No enhancement opportunities relating to glint and glare have been identified at this stage, and none are anticipated.

16.14. Difficulties and uncertainties

16.14.1. The information provided in this PEIR is preliminary and is based on the information available at the time of writing. The final assessment of impacts will be reported in the ES.

16.14.2. The preliminary assessment has been undertaken using high level modelling to determine the potential effects of the maximum extent of Solar PV development for Rosefield Solar Farm. The full glint and glare assessment will be informed by the design of Rosefield Solar Farm submitted in support of the DCO application and the parameters that will inform the ES.

16.15. Further work required to inform the ES

16.15.1. A full glint and glare assessment will be undertaken for Rosefield Solar Farm which will be submitted in support of the DCO application and will form a technical appendix to the ES, as required by the Planning Inspectorate's Scoping Opinion dated 21 December 2023.

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