6 SOLAR GLINT AND GLARE

6.1 INTRODCTION

6.1.1 This chapter addresses the issue of glint and glare from the Proposed Development. Glint and glare occur when sunlight is reflected by a surface towards an observer, which can present an effect on amenity or a safety hazard. The term 'glint' describes a fleeting effect whilst 'glare' relates to a more sustained effect. Both occur due to the same underlying physical mechanisms.

6.1.2 This chapter is supported by Appendix 6.1 – Solar Photovoltaic Glint and Glare Study Issue 3.

6.2 METHODOLOGY

6.2.1 Glint and glare effects have been considered for the relevant receptors (observer types). Full details are shown in Appendix 6.1, the assessed receptors are:

- Road users – specifically drivers of motor vehicles
- Occupants of surrounding dwellings

6.2.2 The assessment methodology is based on industry best-practice. This is largely informed by literature review and stakeholder engagement.

6.2.3 The methodology for this glint and glare assessment was as follows:

- Identify receptors in the area surrounding the Proposed Development.
- Consider direct solar reflections from the Proposed Development towards the identified receptors by undertaking technical modelling – simplistically this is a series of geometric calculations from each part of the Proposed Development towards each receptor based on the trajectory of the Sun throughout the year.
- Consider the visibility of the panels from each receptor's location. If the panels are not visible from the receptor, then no reflection can occur.
- Based on the results of the technical modelling, determine whether a reflection can occur, and if so, at what time it will occur.
- Consider both the solar reflection from the Proposed Development and the location of the direct sunlight with respect to the receptor's position.
- Consider the solar reflection with respect to the published studies and guidance.
- Determine whether a significant detrimental effect is expected in line with the process presented within the 'Significance of Effect' section.

Assessment of Significance

6.2.4 Each effect is assessed based on its magnitude of change and the sensitivity of the affected receptor.

Magnitude of Effect

6.2.5 The classifications of change magnitude are presented in Table 6.1 below.

Table 6.1: Defining Magnitude of Change

Magnitude of Change	Criteria for Assessing Effect

High	Total loss or substantial alteration to key features of the baseline conditions such that receptor attributes will be fundamentally changed.
Medium	Loss or alteration to one or more key features of the baseline conditions such that receptor attributes will be materially changed.
Low	A minor shift away from baseline conditions. Change arising from the alteration will be discernible but not material. The underlying attributes of the baseline condition will be largely unchanged.
Negligible	Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.

Sensitivity of Receptor

6.2.6 The classifications of receptor sensitivity are presented in Table 6.2 below.

Table 6.2: Defining Sensitivity of Receptor

Sensitivity	Examples of Receptor
High	The receptor has little ability to absorb change without fundamentally altering its present character or is of international or national importance.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character or is of high importance.
Low	The receptor is tolerant of change without detriment to its character or is of low or local importance.

Significance of Effect

6.2.7 The significance of an environmental effect is determined by the interaction of magnitude and sensitivity. The Effect Significance Matrix is set out in Table 6.3 below.

Table 6.3: Matrix for Assessing Significance of Effect

Magnitude of Change	Sensitivity of Receptor		
	High	Medium	Low
High	Major Adverse	Major Adverse	Moderate Adverse
Medium	Major Adverse	Moderate Adverse	Moderate Adverse
Low	Moderate Adverse	Minor Adverse	Minor Adverse
Negligible	Negligible	Negligible	Negligible

6.2.8 The level of effect is considered 'Significant' if the resultant significance of effect is 'Moderate Adverse' or 'Major Adverse'.

6.2.9 The classifications of duration of effects are presented in Table 6.4 below.

Table 6.4: Duration of Effects

Duration of Effect	Criteria for assessing effect

Permanent	Effects are possible for the entire lifetime of the Proposed Development.
Temporary	Effects are possible for a restricted period following introduction of the Proposed Development.

Application of Criteria to Road User Receptors

6.2.10 The magnitude of effect upon road user receptors is predominantly dependent on the following factors:

- The distance between the receptor and the panel area – a study area of one kilometre is applied
- The type of road – in the context of traffic speeds and likely densities
- Whether a solar reflection is predicted
- The location of the reflecting panels relative to a road user's direction of travel – a solar reflection directly in front of a driver is more hazardous than a reflection from a location off to one side

6.2.11 A 'Negligible' magnitude would occur if solar reflections are not geometrically possible, or are not predicted to be experienced by a road user.

6.2.12 A 'Low' magnitude would occur if solar reflections would all originate from outside a road user's main field of view. Reflections originating within a road user's main field of view can be of 'Low' magnitude based on consideration of the following mitigating circumstances:

- Whether visibility is likely for elevated drivers (applicable to dual carriageways and motorways only) – there is typically a higher density of elevated drivers along dual carriageways and motorways compared to other types of road
- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare
- The position of the Sun – effects that coincide with direct sunlight appear less prominent than those that do not

6.2.13 A 'Medium' magnitude would occur if solar reflections were experienced from within a driver's main field of view and there are insufficient mitigating factors.

6.2.14 A 'High' magnitude would occur if solar reflections were experienced from directly in front of a road user's direction of travel with no mitigating factors.

6.2.15 In terms of sensitivity for road user receptors, it is relevant to consider that road types can generally be categorised as:

- Major National – Typically a road with a minimum of two carriageways with a maximum speed limit of up to 70mph. These roads typically have fast moving vehicles with busy traffic
- National – Typically a road with a one or more carriageways with a maximum speed limit of up to 60mph or 70mph. These roads typically have fast moving vehicles with moderate to busy traffic density
- Regional – Typically a single carriageway with a maximum speed limit of up to 60mph. The speed of vehicles will vary with a typical traffic density of low to moderate
- Local – Typically roads and lanes with the lowest traffic densities. Speed limits vary

6.2.16 Local roads would be considered as 'Low' sensitivity and Regional, National, and Major National roads would be considered of 'Medium' sensitivity.

6.2.17 To determine the mitigation requirement, a general guidance is:

- A 'Major Adverse' effect would result in a requirement for mitigation
- A 'Moderate Adverse' effect would result in a recommendation for mitigation

6.2.18 The flowchart for determining the mitigation requirement for road receptors can be found in Appendix 6.1.

Application of Criteria to Dwelling Occupant Receptors

6.2.19 The magnitude of effect upon dwelling receptors is predominantly dependent on the following factors:

- The distance between the receptor and the panel area – a study area of one kilometre is applied
- Whether a solar reflection is predicted
- The duration of the predicted effects, relative to thresholds of three months per year and sixty minutes per day

6.2.20 A 'Negligible' magnitude would occur if solar reflections are not geometrically possible, or are not predicted to be experienced by an observer within a dwelling.

6.2.21 A 'Low' magnitude would occur when a solar reflection would be experienced for less than three months per year and for less than sixty minutes per day, or outside of these limits based on consideration of the following mitigating circumstances:

- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare
- The position of the Sun – effects that coincide with direct sunlight appear less prominent than those that do not
- Whether visibility is likely from all storeys – the ground floor is typically considered the main living space and has a greater significance with respect to residential amenity
- Whether the dwelling appears to have windows facing the reflecting area – factors that restrict potential views of a reflecting area reduce the level of impact

6.2.22 A 'Medium' magnitude would occur if solar reflections were experienced for more than three months per year or for more than three minutes per day and there are not sufficient mitigating factors.

6.2.23 A 'High' magnitude would occur if solar reflections were experienced for more than three months per year and for more than three minutes per day.

6.2.24 For receptor sensitivity, dwellings are 'Low' because they are of local importance.

6.2.25 To determine the mitigation requirement, a general guidance is:

- A 'Moderate Adverse' effect because of a 'High' magnitude would result in a requirement for mitigation
- A 'Moderate Adverse' effect because of a 'Medium' magnitude would result in a recommendation for mitigation

The flowchart for determining the mitigation requirement for dwellings can be found in Appendix 6.1.

Policy Framework

6.2.26 The National Planning Policy Framework under the planning practice guidance for Renewable and Low Carbon Energy (specifically regarding the consideration of solar farms, paragraph 013) states:

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 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 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 (our emphasis).'

6.2.27 The Department for Business, Energy & Industrial Strategy has published its Draft National Policy Statement for Renewable Energy Infrastructure (EN-3), which addresses glint and glare in sections 2.48.4 and 2.52. The document identifies the issue as one of two main impact issues in the context of visual influence and that in some instances a glint and glare assessment may be necessary as part of the planning application. Details pertaining to impact classification or a recommended strategy for quanityfing effects in any form are not given.

6.2.28 In a wider context, guidance of various kinds has been produced by industry stakeholders in the UK and internationally. Further information pertaining to the available guidance and how this has informed the assessment process is presented in Appendix 6.1.

6.2.29 There is no known local policy and guidance related to glint and glare.

Limitations to the Assessment

6.2.30 The techncail assessment that underpins the conclusions in this chapter is desk-based, relying on technical modelling and inputs from the design team. No site surveys have been undertaken which could provide supplementary or more accurate data. Available imagery and satellite mapping has been used to evaluate the level of visibility in the context of existing obstructions. In some cases, this imagery may not be up to date and may not give the full perspective of the installation from the location of the assessed receptor. The resulting limitations are minimal and are inherently minimised by taking a conservative approach, whereby the reasonable worst-case is assumed if there is a significant level of uncertainty around the associated parameters.

6.2.31 Coordinates of the Proposed Development and that of the identified receptors are based on the available imagery and sight drawings. This limitation is unlikely to meaningfully impact the conclusions of the analysis based on the likely level of error.

6.2.32 The altitude at each reference point is based on a digital elevation model. An additional figure is then added to represent the solar panel height above ground level. The same process has been undertaken for receptor locations. It is assumed that the panel elevation angle provided by the developer represents the elevation angle for all of the panels within each solar panel area defined. These assumptions are reasonable and do not significantly affect the robustness of the resulting conclusions.

6.2.33 Only a reflection from the face of the panel has been considered. The frame or the reverse or frame of the solar panel has not been considered. Reflections from the reverse of the panel are not significant because it is not directly illuminated by the sun. Any reflections from a frame would represent a small percentage of the panel surface area and moreover would be aligned with the reflector area that has already been modelled.

6.2.34 The model assumes that a receptor can view the face of every panel within the proposed development area whilst in reality this, in the majority of cases, will not occur. Therefore any predicted solar reflection from the face of a solar panel that is not visible to a receptor will not occur in practice. This limitation makes the results more conservative.

6.2.35 Any screening in the form of trees, buildings etc. that may obstruct the Sun from view of the solar panels is not considered within the model output. This makes the results conservative. The effect of such screening is evaluated separately within the overall assessment

6.2.36 Overall, the impact of these limitations is minimal due to their influence on the overall result and/or the inherently conservative approach taken within the assessment, which has followed industry best-practice.

6.3 BASELINE CONDITIONS

Site Description and Context

6.3.1 The assessed 1km area surrounding the Proposed Development is rural containing some dwellings and roads. The following receptors have been identified and modelled:

- Residential dwellings
- The A52 road
- Castle View Road

6.3.2 The main source of irradiance in the area will be the Sun, which is a more intense source of irradiance than solar reflections. Road users are already aware of safety implications when driving in bright sunlight. Dwellings will experience the most noticeable source of irradiance at sunset and sunrise.

Baseline Survey Information

6.3.3 No field work/site surveys were undertaken as part of this assessment.

6.3.4 The necessary technical specification of the Proposed Development was defined within the plans.

6.3.5 Identification of relevant roads and residential infrastructure was based on mapping and aerial imagery.

6.4 ASSESSMENT OF LIKELY SIGNIFICANT EFFECTS

Effects During Construction

6.4.1 Glint and glare effects can occur from any solar panels that are installed at the Application Site. The modelling has evaluated the effects based on the proposed axis tracker i.e. the 'operational' case.

6.4.2 In addition, effects during construction may be sensitive to variable factors such as where panels are stored and in what orientation at the site prior to operation of the site.

6.4.3 In general terms, as not all panels will be installed, the overall level of effect construction phase will be less than or comparable to the level of effect during the operational phase.

Effects During Operation

Road Users

6.4.4 The worst-case magnitude of effect upon road users on Castle View Road under baseline conditions is classified as 'Low' due to effects occurring outside a road user's main field of view. The receptor sensitivity is 'Medium'. The resulting significance of impact, in accordance with Table 6.3, is 'Minor Adverse' in the worst case which is not significant.

6.4.5 The magnitude of effect upon a stretch of the A52 (approximately 550 metres in length) is 'Medium' under baseline conditions. This is because reflections could be visible and within a road user's main field of view. The receptor sensitivity is 'Medium'. The resulting significance of impact, in accordance with Table 6.3, is 'Moderate Adverse' in the worst case which is significant and results in a recommendation for mitigation.

6.4.6 If screening is provided that obstructs the panels from any road users' view on the A52, the remaining magnitude of effect will be 'Negligible' and the overall significance of impact will be Negligible.

Dwellings

6.4.7 The magnitude of effect upon two dwellings to the west of the Proposed Development and fifteen dwellings to the east of the Proposed Development is classified as **'**Medium' under baseline conditions due to effects being possible for more than three months per year but less than sixty minutes per day. The receptor sensitivity is 'Low' due to a dwelling receptor being of local significance. The resulting significance of impact, in accordance with Table 6.3, is 'Moderate Adverse' in the worst case which is significant and results in a recommendation for mitigation.

6.4.8 If screening is provided that significantly obstructs the reflecting panels from an observer's view on the ground floor of the dwellings, the remaining magnitude of effect will be 'Low' and the overall significance of impact will be 'Minor Adverse' which is not significant.

6.5 MITIGATION AND ENHANCEMENT

Mitigation by Design

6.5.1 The mitigation requirements identified within the technical assessment have been incorporated into the landscape plans.

6.5.2 Remaining significant impacts are not predicted following implementation of these mitigation measures (see Appendix 6.1).

Table 6.5: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By Condition
1	Roads	X		
2	Dwellings	X		

Additional Mitigation

6.5.3 No additional mitigation measures have been proposed.

6.6 CUMULATIVE AND IN COMBINATION EFFECTS

6.6.1 No cumulative effects are predicted because existing solar developments that are located such that they would cause simultaneous significant effects do not appear to be present. Furthermore, significant effects from the Proposed Development will be mitigated such that the remaining level of effect is small, further minimising any risk of cumulative effects.

6.7 SUMMARY

Introduction

6.7.1 This Chapter describes the baseline conditions, assessment approach, and the potential glint and glare effects from the Proposed Development upon surrounding road users and dwellings.

Baseline Conditions

6.7.2 The assessed 1 kilometer area surrounding the Proposed Development is rural with some dwellings and roads. The following have been identified and modelled in detail:

- Residential dwellings
- The A52 road
- Castle View Road

Likely Significant Effects

6.7.3 Significant effects under baseline conditions are predicted for a 550 meter stretch of the A52 road, two dwellings to the west and fifteen dwellings to the east of the Proposed Development.

6.7.4 The mitigation requirements identified within the technical assessment have been incorporated into the landscape plans.

6.7.5 Remaining significant impacts are not predicted following implementation of these mitigation measures (see Appendix 6.1).

Mitigation

6.7.6 Landscaping screening is proposed and has been designed to mitigate the potential impacts that are possible under baseline conditions.

Conclusions

6.7.7 The Proposed Development is predicted to have a 'Moderate Adverse' effect upon surrounding roads and dwellings under baseline conditions. The proposed mitigation measures are such that this will reduce to permanent 'Negligible' effect for roads and permanent 'Minor Adverse' for dwellings, which are not significant.

Table 6.6: Summary of Effects, Mitigation and Residual Effects

Receptor/ Receiving Environment	Description of Effect	Nature of Effect *	Sensitivity Value **	Magnitude of Effect **	Geographical Importance ***	Significance of Effects ****	Mitigation/ Enhancement Measures	Residual Effects ****
Construction								
A52 road	Glint and Glare – Distraction (safety hazard)	Temporary / Direct	Medium	Medium	Regional	Moderate Adverse in the absence of mitigation	Screening that obscures the reflecting panels from view of the affected stretch of road	Negligible
Castle View Road	Glint and Glare – Nuisance (amenity)	Temporary / Direct	Medium	Low	Local	Minor Adverse	Not required	Minor Adverse
Dwellings	Glint and Glare – Nuisance (amenity)	Temporary / Direct	Low	Medium	Local	Minor Adverse	Screening that obstructs the nearest reflecting panels from view (from the ground floor)	Minor Adverse
Operation								
A52 road	Glint and Glare – Distraction (safety hazard)	Permanent / Direct	Medium	Medium	Regional	Moderate Adverse in the absence of mitigation	Screening that obscures the reflecting panels from view of the affected stretch of road	Negligible
Castle View Road	Glint and Glare – Nuisance (amenity)	Permanent / Direct	Medium	Low	Local	Minor Adverse	Not required	Minor Adverse
Dwellings	Glint and Glare – Nuisance (amenity)	Permanent / Direct	Low	Medium	Local	Minor Adverse	Screening that obstructs the nearest reflecting panels from view	Minor Adverse

Receptor/ Receiving Environment	Description of Effect	Nature of Effect *	Sensitivity Value **	Magnitude of Effect **	Geographical Importance ***	Significance of Effects ****	Mitigation/ Enhancement Measures	Residual Effects ****
							(from the ground floor)	
Cumulative and In-combination								
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable