Chapter 15
Glint and Glare

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15 Glint and Glare

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15 Glint and Glare

15.1 Executive Summary

15.1.1 This chapter presents an assessment of the potential glint and glare (G&G) impacts from the Proposed Development, focusing on the operational phase. The assessment evaluates the exposure of relevant receptors, including roads and fixed receptors (residential dwellings and commercial properties), to G&G based on the geometry of the solar arrays, receptors, and surrounding obstacles that are input to the modelling software. The study takes into account factors such as weather conditions, sunlight angles, and visibility of the solar panels to determine where and when G&G may occur. There are a number of significant conservatisms in the model, including an assumption that the sun shines 365 days per year, and the model being limited in its consideration of obstacles (e.g. hills, trees, buildings etc.) between the solar panels and receptors.

15.1.2 The assessment identified three primary routes - A70, B743, and U731 (rural road) - as well as fixed receptors (largely residential dwellings) that could theoretically be impacted by G&G. The study also confirms that there are no aviation receptors within the study area, with the closest being Strathaven Airfield, more than 15 km away.

15.1.3 The Proposed Development Landscape Strategy Plan (**Figure 5.26**) has been considered as embedded (design) mitigation and includes proposals for planting native scrub and trees, which will reduce G&G impacts. Aspects of the Landscape Strategy Plan have been developed specifically to mitigate potential G&G effects, and this is included as committed mitigation by design.

15.1.4 No potential for significant cumulative impacts, from other existing or proposed developments together with the Proposed Development, has been identified.

15.1.5 Overall, taking into account the embedded mitigation measures, including planting as set out in the Landscape Strategy Plan (**Figure 5.26**) , the risk of G&G from the Proposed Development will be minimal, and any effects will be not significant in EIA terms, posing no significant risks to health or safety.

15.2 Introduction

15.2.1 This chapter considers the potential G&G effects arising from the solar component of the Proposed Development.

15.2.2 The assessment is based on the proposed design and information provided by the Applicant, with a focus on the southern development area. Full details can be found in **Chapter 3** and shown in **Figure 3.1** and **Figure 3.2**. The solar, battery energy storage systems (BESS), and substation will be located within the Netherwood landholding, approximately 1.4 km north of Muirkirk in East Ayrshire at its closest point (shown in **Figure 3.2**). The solar photovoltaic (PV) part of the Proposed Development is designed to have an output capacity of approximately 60 MW and is divided into six distinct areas.

Solar PV Array Details

15.2.3 The Proposed Development has considered fixed PV modules with a tilt angle of 20° and south orientation. **Table 15.1** shows the module specifications for the Proposed Development, summarising the parameters used within the assessment.

Table 15.1 - Solar PV Design Details

Parameter	Details
Mounting details	Fixed tilt (no tracking)
Module tilt	20°
Module orientation	180° (south)

Definitions

15.2.4 Glint, glare and dazzle are often used interchangeably but are defined in this chapter as described in **Table 15.2** below.

Table 15.2 - Terms Definitions

Name	Description
Glint	Glint is a momentary flash of bright light.
Glare	Glare is a more continuous source of bright light.
Dazzle	This is an effect caused by intense glint and glare, which can cause distraction, and if strong enough reduce the ability of the receptor (pilot or driver, or otherwise) to distinguish details and objects.
Specular Reflections	Specular reflections are direct reflections of the sun's light off smooth surfaces, such as glass, steel, and calm water.
Diffuse Reflections	Diffuse reflections are scattered reflections of light produced from rougher surfaces such as concrete, tarmac, and vegetation.

15.2.5 It is noted that different organisations and agencies apply slightly different definitions to these terms, and some refer to the terms glint and glare interchangeably. In this assessment, in line with the ForgeSolar modelling software, the term 'glare' is used as an umbrella term to cover glint and glare effects.

15.2.6 **Image 15.1** illustrates the difference between specular reflection, produced as a direct reflection of the sun on to a smooth surface, and diffused reflection, which is a scattered reflection of light.

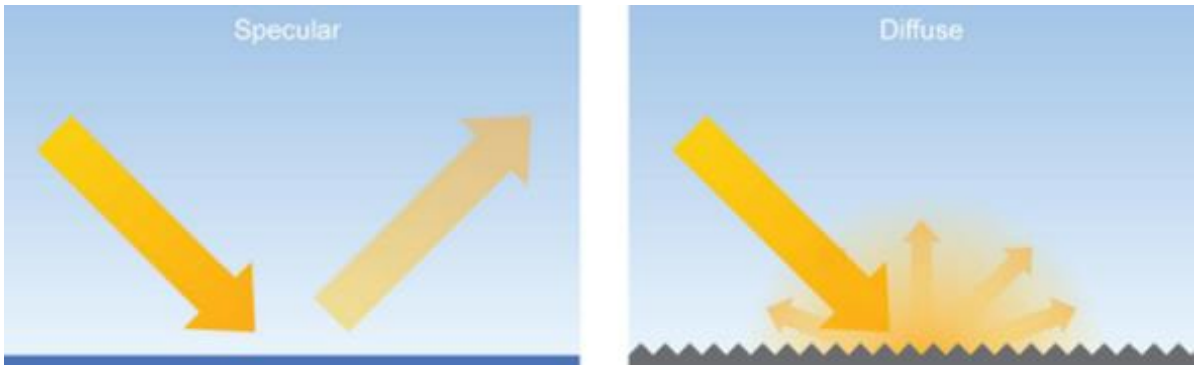

Image 15.1: Types of Reflection: Specular (left) and Diffused (right).

Source: **(Federal Aviation Administrator, 2018)**

15.2.7 The perceived intensity of glare will vary depending on the ambient light levels (influenced by the time of the day as well as weather patterns), orientation and inclination of the panels, and the distance to the receptor.

15.2.8 The ForgeSolar software output defines glare under a traffic light system, as 'green glare', 'yellow glare' and 'red glare'. This is explained in **Table** 15.3 below.

Table 15.3 - Magnitude of Glare

Category	Description
Green glare	'Green glare' is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Yellow glare	'Yellow glare' is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Red glare	'Red glare' has potential to cause retinal burn (permanent eye damage). Retinal burn is typically not possible for PV glare since the reflected light is not focused on a concentrated point.

15.2.9 Temporary after-image is the phenomenon whereby an image remains momentarily visible on the retina after looking away from a bright light source.

The Reflectivity of Solar Panels

15.2.10 Solar PV panels are designed to absorb sunlight and convert it into electricity; they are not designed to reflect light, although there may still be a small unavoidable reflective component present. The glass which forms the surface layer of solar panels is specifically designed with a low iron content to aid the absorption of daylight and thus has a much lower level of reflectivity than the glass typically seen in conventional windows.

15.2.11 For example, with a 75° angle of incidence, less than 9% of the total incident visible light is reflected, while normal glass reflects approximately 19% of light. If the panels have an anti-reflective coating applied, reflectivity drops to about 5%. Thus, reflectance levels from a given solar site will be much lower than the reflectance generated by standard glass and other common reflective surfaces in the surrounding environment, although reflectance characteristics will also vary with the incidence angle, which changes as the sun moves across the sky.

15.2.12 Solar panels have a comparable reflectivity to calm water and are considerably less reflective that other natural materials such as snow. Any glare that may occur would be less intense than that seen when flying over a reservoir on a calm day or a snow-covered landscape on a bright day. As can be seen from **Image 15.2**, the reflectivity of light incident on solar glass is considerably less than light reflections from many other materials found in the built and natural environment, and approximately half that of standard glass.

15.2.13 As distance from the glint and glare source increases, the intensity of the event drops appreciably. This is due to a combination of factors including the diffraction of light after it reflects off the panel, atmospheric weather conditions such as the presence of particulates, haze, or low cloud, and the diminishing subtended viewing angle.

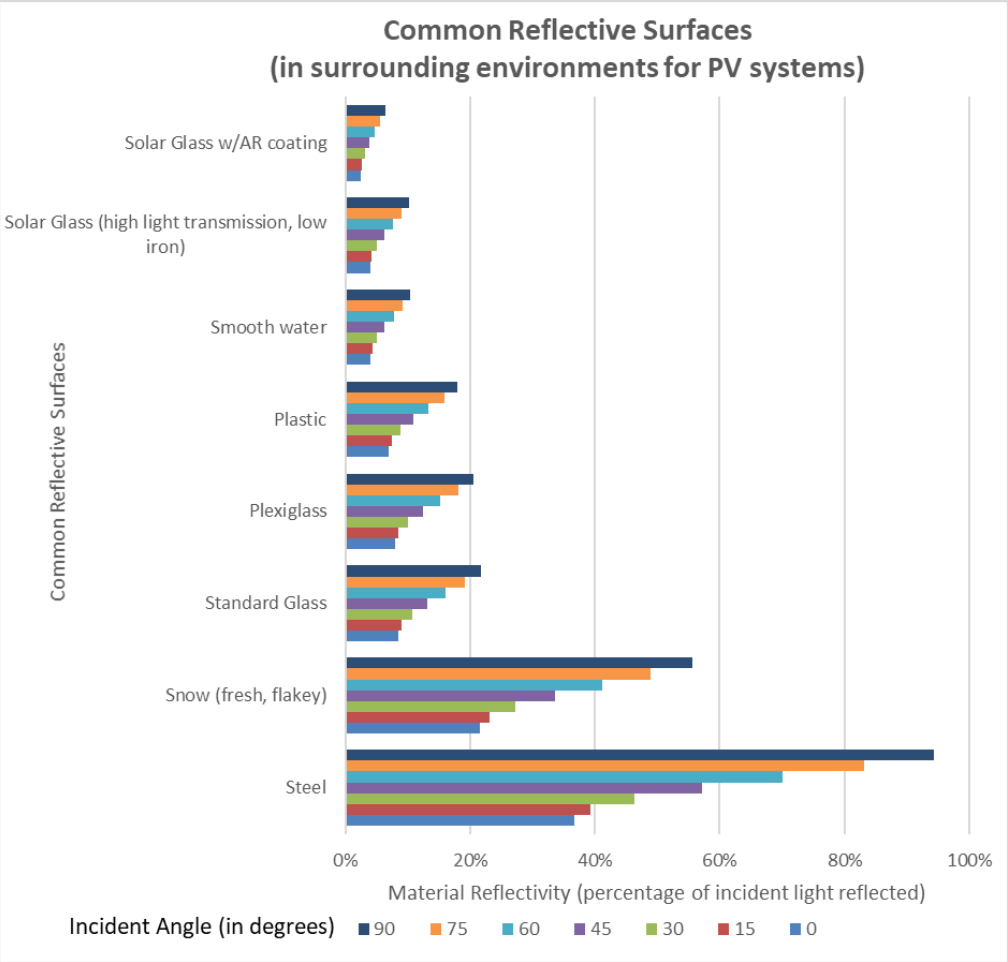

Image 15.2 - Reflectivity of Common Materials at Varying Angles of Incidence (Based on data from Sunpower Corporation, 2009)

Occurrence of Glint and Glare

15.2.14 Glint and glare can only occur when direct sunlight can reach the solar panels. Diffused lighting, caused by weather conditions such as cloud, fog, and mist, cannot result in glint due to the low energy intensity of the light incident on the panels.

15.3 Legislation, Policy and Guidelines

15.3.1 Specific policy, legislation and guidance relating to assessing glint and glare effects from solar parks have been considered as part of this assessment and are summarised below.

National Policy and Guidance

15.3.2 National Planning Framework 4 (NPF4) requires G&G studies to be considered, stating that solar arrays should be supported if the planning authority is satisfied G&G does not result in adverse impacts. However, there is no explicit guidance on the proximity of receptors to the development that should be considered for the assessment within NPF4 either.

15.3.3 The National Planning Policy Guidance (NPPG) (planning policy for England but still serving as a useful reference) notes that large scale solar farms "*could have a damaging effect on the landscape…particularly in undulating landscapes*" and that the "*visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively*" (Paragraph 007: ID 5-007-20140306 & Paragraph 013: ID 5-013-20150327). There is no explicit guidance on the proximity of receptors to the development that should be considered for assessment.

15.3.4 The British Research Establishment (BRE) states that "*the sensitivities associated glint and glare, and the landscape/visual impact and the potential impact on aircraft safety, should be a consideration. In some instances, it may be necessary to seek a glint and glare assessment as part of a planning application*." It does not define a proximity to the development that receptors should be considered.

15.3.5 Both the NPPG and BRE guidance highlight the additional importance of a G&G study if solar tracking systems are used, whereby solar PV modules rotate to follow the sun's path to maximise power generation. These can cause "*additional impacts*" such as "*differential diurnal and/or seasonal*" variations of G&G. The Proposed Development utilises a fixed mounting structure, rather than a tracking system, therefore these specific notes relating to solar tracking systems are not applicable.

15.3.6 Regarding air-based receptors, the UK Civil Aviation Authority (CAA) states "*consideration of glint and glare should be made over a wider area*" and indicates a range of up to 2 km from an Aerodrome Reference Point (ARP) as an area of most concern. CAA also developed an interim guidance document published in 2010 and then retracted this in 2012. As a result, no formal copy exists.

Local Planning Policy

15.3.7 The Planning Statement associated with this Section 36 application sets out a detailed assessment of the Proposed Development against planning policy This chapter considers the aspects of National Planning Framework 4 (NPF4), Planning Advice Notes, the East Ayrshire Local Development Plan 2 (LDP2) adopted in April 2024, and other guidance relevant to the G&G assessment. The LDP2 does not contain any policy that specifically refers to assessment of G&G for solar PV developments, although Policy RE1: Renewable Energy notes that, "*proposals for the generation, storage and utilisation of renewable energy, including proposals for the co-location of these technologies… are encouraged and will be supported… where they are acceptable when assessed against all relevant criteria set out in the Renewable Energy Assessment Criteria table…*" The criteria table referred to includes "*impacts on communities and individual dwellings*", and "*impacts on aviation and defence interests*" but does not specifically mention G&G.

15.4 Assessment Methodology and Significance Criteria

15.4.1 The study uses the following methodology to assess the impacts of G&G arising from the Proposed Development.

Glint and Glare Analysis

15.4.2 A geometric analysis is conducted to study where and when glint and glare events may occur. This examines receptors present at ground level, such as dwellings, roads, national waymarked trails, and railway lines. Receptors are identified using available mapping, aerial photography, and street level imagery.

15.4.3 The G&G analysis is completed in several stages using various methods, software models and tools to progressively assess the potential for effects, while building an understanding of the local environmental conditions, either existing or proposed, that impact the potential for glare in the local area.

Study Area

15.4.4 The study area, as shown on **Figure 15.1**, is determined as a 1 km radius from the solar component of the Proposed Development for all ground-based receptors (buildings and roads); and 5 km for aviation receptors (noting that, as given in **paragraph 15.3.6**, the CAA indicates that aviation receptors within 2 km would be "*of most concern*", but a wider initial study area is considered for completeness).

Assessment of Effects

15.4.5 The detailed geometric analysis uses a software model to make a prediction on the dates, times and durations of G&G effects at fixed positions over the course of a year. The software used is the GlareGauge tool that was originally developed in the United States by the Sandia National Laboratory and since improved upon and licensed to ForgeSolar. The times reported as to when

G&G may occur are reported in Coordinated Universal Time (UTC) and therefore any relevant daylight savings should be considered when observing the results.

15.4.6 The computer model predicts whether glare effects are possible at a 1-minute temporal resolution over the course of a full year. The model accounts for the maximum panel height, the area taken up by the panels and a fixed observer height.

15.4.7 Any glare that is predicted is classified as either 'green glare' or 'yellow glare' or 'red glare', as described previously in **Table** 15.3. Yellow or red glare impacting receptors such as residential dwellings, roads, railways and aviation receptors may be considered 'significant' in EIA terms, subject to professional judgement on the sensitivity of the receptor and extent, duration and timing of predicted G&G impacts. Effects arising from green glare would generally not be considered 'significant' in EIA terms.

15.4.8 It is important to understand certain limitations within the model. The model calculates results based on the geometric relationship between the observation point at a fixed height, the reflective plane (panels) at a fixed height, and the position of the sun at each time interval as it progresses across the sky. It therefore takes no account of any screening features. It does not account for surface features such as buildings or trees or intervening topography. The software also assumes it is sunny, at the maximum intensity possible, 365 days per year. Since the computer model indicates when glare 'can' happen, not when it 'will' happen, it considerably overstates the realistic glare duration, which is why further interpretation is essential.

15.4.9 The following steps were followed to assess the impacts of G&G arising from the Proposed Development:

- **Identify receptors required for assessment:** In this case, the main focus is on the A70, B743, rural roads and buildings and residential dwellings within 1 km from the solar component of the Proposed Development. No aviation receptors were identified as requiring assessment, due to their distance from the Proposed Development.
- **Input receptors and solar PV array details:** Details such as location and area of coverage were entered into the ForgeSolar modelling tool, and simulations were run.
- **Assess the results:** The simulation results were analysed to assess the duration, intensity, and potential impact of G&G on all identified receptors. While the model has inherent limitations (e.g., the model does not consider objects such as trees, buildings and intervening topography), existing screening measures—such as trees and hedgerows—were manually incorporated into the simulation. These were identified via Google Earth Pro and available OS mapping. This allowed for a more realistic representation of the anticipated conditions, although intervening topography between panels and receptors is still not considered in the model.

15.5 Receptor Identification

15.5.1 The following section highlights the receptors considered for the assessment.

Ground-based Receptors

15.5.2 These are divided into: fixed receptors; and roads and trainlines.

- There are a small number of dwellings within the 1 km study area. In some cases, the identified location is considered to be representative of several discrete receptors in close proximity.
- There are a small number of roads within the 1 km study area of the Proposed Development. Not all of these roads needed to be assessed as some are outside of the area within which effects could theoretically be received. Studies have therefore focused on the B743, that the U731 rural road which crosses the site, and for completeness the A70 which lies beyond the 1 km study area but in proximity to the site. There are no operative trainlines within the 1 km study area or near to the site.

15.5.3 A list of residential receptors within the 1 km study area, and the three public road receptors noted above, were selected to be included for G&G modelling based on their proximity and position around the Proposed Development.

15.5.4 **Figure 15.2** illustrates the study area, including the PV arrays, roads and residential receptors.

15.5.5 Note that the BESS and substation areas have been excluded from the simulation, as G&G effects would occur only from the PV panels.

Air-based Receptors

15.5.6 There are no aviation receptors within 5 km of the Proposed Development, with the closest being Strathaven Airfield, located more than 15 km north.

15.6 ForgeSolar Software

15.6.1 This section details the results of the assumptions and limitations of the software.

Modelling Assumptions

15.6.2 In order to model the panels in the software accurately, the arrays have been separated into six discrete areas to prevent the over-prediction of glint and glare effects. This helps to avoid a limitation in the software whereby convex shapes are assumed to contain panels. The modelled panel array area was therefore divided into the constituent parts, as shown on **Figure 15.2**.

15.6.3 There are a total of three sets of modelling assumptions required for the simulation, detailed in **Table 15.4**, **Table 15.5** and **Table 15.6** below.

Table 15.4 - Site configuration parameters

Parameter	Details
Subtended angle of the sun	9.3mrad (0.5°). This is the default setting given by the software.
Direct Normal Irradiance (DNI)	DNI scales with the position of the sun and has a peak value of 1,000 W/m².
Ocular transmission coefficient	This is the radiation absorbed in the eye before reaching the retina. Value of 0.5 (default figure recommended by the software).
Pupil diameter	This is the diameter of the pupil when daylight is present. Value of 2 mm (default figure recommended by the software).
Eye focal length	This is the projected image size on the retina from a given glare source for a given subtended angle. Value of 1.7 cm This is the default figure recommended by the software.
Time interval	Value of 1 to represent 1 minute

Table 15.5 - Receptors Parameters

Parameter	Details
Route receptors	Three routes: A70, B743, and U731 Greenock Water rural road
Azimuthal viewing angle	The default setting assumes the pilot (if applicable) can see 50° to the left and right during their approach. In addition, the software considers the road has two directions.
Residential Receptors - Observation points (OPs)	Nine OPs (some which represent more than one residential property at the same approximate location)
Obstructions	Range of trees and buildings scattered around site.

Table 15.6 - PV Array Parameters

Parameter	Details
PV material category	Category 1. Defined as smooth glass with anti-reflective coating.
Slope error value	A value of 'varies' to imply that this depends on the PV material selected. In this case, material Category 1 was selected.
Reflective value	A value of 'varies' to imply that this depends on the PV material selected. In this case, material Category 1 was selected.

Modelling Limitations

15.6.4 It is important to understand certain limitations within the model.

- The geometry of the entire system is not considered, such as gaps between panels and heights of the mounting structures and individual panels. Therefore, a module height above ground of 3 m assumes this is the only elevation at which sunlight reflects from the module (i.e. the lower and higher portions of the array are not considered).
- The shape of surrounding obstacles and obstructions (such as trees, electricity poles and fences) are not fully considered. For example, a tree is considered as uniform in its circumference from its tip to the ground as opposed to thinner at the bottom from the trunk and widest in the middle. This can lead to an obstacle's ability to shield a receptor from G&G being both under and overestimated. Further, the precise height of shading obstacles is not known, and estimates are therefore made.
- The model does not consider daily variations in weather conditions (e.g. cloud cover) and instead uses a typical clear day as a default. The software also assumes it is sunny, at the maximum intensity possible, 365 days per year. Since the computer model indicates when glare 'can' happen, not when it 'will' happen, it considerably overstates the realistic glare duration, which is why further interpretation is essential. This also overestimates the impacts of G&G.
- As noted in **paragraph 15.4.8** above, the model does not automatically consider obstacles (either man-made or natural) between the solar panels and the receptors, such as trees, hills, buildings etc. Obstructions can and have been manually added to the model, however only ten obstructions can be modelled. As a result, many existing obstructions such as hills, trees and hedgerows and other buildings may not be present in the model. G&G is therefore overestimated in this instance.

15.7 Assessment of Potential Effects

15.7.1 This section details the results of the G&G simulation, along with implications for the Proposed Development, and limitations of the study. Note that further details can be found in the G&G simulation report within **Appendix 15.1**, noting the model assumptions listed in **paragraph 15.6.4** above.

15.7.2 Additionally, while the Landscape Strategy Plan (**Figure 5.26**) has been considered in the discussion of potential effects (as embedded mitigation), it was not incorporated into the simulation.

15.7.3 The potential impacts have been assessed for relevance during the construction, operation, and decommissioning phases of the Proposed Development. Based on the nature of the project and surrounding receptors, the construction and decommissioning phases have been scoped out, as detailed below:

Construction

15.7.4 Assessment of construction phase effects has been scoped out due to the factors noted below.

- Temporary nature of activities: The construction phase will involve the use of temporary materials and equipment, which are not highly reflective or positioned in a manner that would result in glint or glare impacts.
- Lack of fixed reflective surfaces: Solar panels, the primary source of potential G&G impacts, are not operational during this phase.
- Low risk to receptors: Temporary equipment or construction activities are unlikely to create significant visual impacts on receptors, such as nearby roads or residences. Any reflections would be momentary, minor, and mitigated through standard construction practices.

Decommissioning

15.7.5 Assessment of decommissioning phase effects has been scoped out due to the factors noted below.

- Removal of reflective surfaces: The primary reflective surfaces, i.e., the solar panels, will be removed during this phase, eliminating the potential for G&G impacts.
- Temporary and managed activities: Similar to construction, decommissioning activities are temporary and involve equipment that is unlikely to generate significant glint or glare effects.

Operation

15.7.6 Therefore, only the operational phase has been considered in this assessment. Furthermore, all mitigation measures presented in this section apply solely to the operational phase.

Summary of Identified Receptors:

15.7.7 **Table 15.7** highlights the total duration and magnitude of G&G theoretically experienced by all identified receptors across the day and year, based on the ForgeSolar simulation outputs (**Appendix 15.1**) and noting the model assumptions listed in **paragraph 15.6.4**..

Table 15.7 - Duration and diurnal/seasonal patterns of G&G.

Receptor	Receptor Reference in ForgeSolar Simulation (Appendix 15.1)	G&G Hazard Summary	PV Area	Cumulative Time and Daily G&G Duration
A70	A70	Green	PV Arrays: 1, 3, 4 and 5	Periods between Apr to Aug, between 18:00 to 19:00, up to 30 min per day.
B743	B743	Mostly Green	PV Arrays: 3, 4, 5 and 6	Periods between Apr to Sep, between 18:00 to 19:00 up to 40 min per day.
U731	Route 3	Yellow	PV Arrays: 1, 2, 3, 5 and 6	Periods all year round between 05:00 to 20:00 up to 200 min per day.
Netherwood (two properties)*	OP21	Mostly Green	PV Arrays: 1, 2 and 3	Periods between Apr to Aug between 05:00 to 06:30 up to 30 min per day.

Receptor	Receptor Reference in ForgeSolar Simulation (Appendix 15.1)	G&G Hazard Summary	PV Area	Cumulative Time and Daily G&G Duration
Burnfoot Farm (two properties)*	OP25	Yellow	PV Arrays: 1, 2 and 3	Periods between Mar to Sep between 05:30 to 07:00 and 18:00 to 19:30 up to 35 min per day.
Linburn*	OP27	No G&G Predicted	N/A	N/A
Bibblon Lodge*	OP30	Mostly Green	PV Arrays: 1, 2, 3 and 5	Periods between Apr to Aug between 05:00 to 06:30 up to 25 min per day.
Greenockdyke	OP31	Green	PV Arrays: 1, 2, 3 and 5	Periods between May to Aug between 05:00 to 06:30 up to 25 min per day.
Middlefield (two properties)*	OP32	Yellow	PV Arrays: 3, 5 and 6	Periods between Mar to Sep between 05:00 to 07:00 and 18:00 to 19:00 up to 25 min per day.
Forkings (two properties)	OP33	No G&G Predicted	N/A	N/A
Laigh Hall	OP35	Yellow	PV Array 2	Periods between Apr to Sep between 18:00 to 19:30 up to 20 min per day.
Blackside Farm	OP37	No G&G Predicted	N/A	N/A

**Property with financial involvement in the Proposed Development*

Routes

15.7.8 The G&G assessment evaluates three routes: A70, B743, and U731.

U731 Greenock Water

15.7.9 Road U731 is the most affected, as it runs between PV Array 1 and PV Array 2 and is adjacent to the northern side of the other arrays, as shown on **Figure 15.2**. Additionally, there is limited existing screening obstructing views of the solar PV panels (see **Image 15.3**). However, this road is not heavily used, as it is located in a very rural area and primarily serves a few houses or farms along the way.

Image 15.3 - Road U731 in between PV Array 1 (left) and PV Array 2 (right)

15.7.10 Road U731 is most affected by PV Array 1 and PV Array 5. **Image 15.4** below illustrates the affected short sections of road U731 and the corresponding PV array areas generating G&G. These figures focus on PV Array 1 and PV Array 5, while additional details can be found in **Appendix 15.1**.

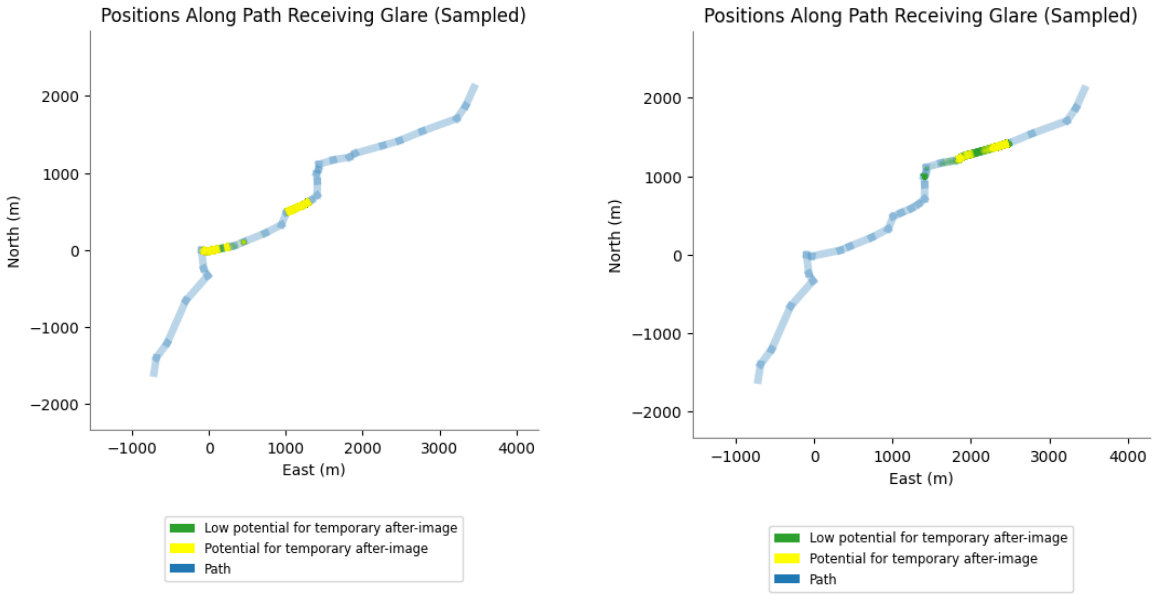

Image 15.4 - Positions along road U731 receiving G&G from PV Array 1 (left) and PV Array 5 (right).

15.7.11 The Proposed Development's Landscape Strategy Plan (**Figure 5.26**) includes native vegetation as screening measure in the south side of PV Area 1 and west side of PV Area 2. As a result, the potential impact on road U731 is significantly reduced.

15.7.12 It is noted that this road has low traffic usage. While the impact is classified as yellow magnitude - comparable to reflections from windows - the number of affected users is predicted to be minimal. In addition, it is important to note the very conservative modelling assumptions as stated in **paragraph 15.6.4**, including the assumption that there is no cloud cover at any time. Taking account of the road usage, highly conservative model assumptions, and the anticipated effect of screening from landscape planting as set out in the Landscape Strategy Plan, the effect is assessed as **not significant**.

B743

15.7.13 Based on the model results, a short stretch of the B743 is predicted to be affected by glare from the PV arrays . The G&G magnitude is predominantly green, indicating a lower intensity than reflections from windows and posing minimal risk to road users. However, the modelled glare from PV Array 5 is classified as yellow over a short stretch of the B743 north of Greenside. In total, the B743 may theoretically experience glare for periods between April to September, between 18:00 and 19:00, for up to 40 minutes per day. This occurs during summer evenings when the setting sun's angle causes reflections from the west-facing panels towards the east, where the road is located. PV Array 5 has the most impact on the B743, with **Image 15.5** illustrating which segments of the road are affected by specific sections of PV Array 5.

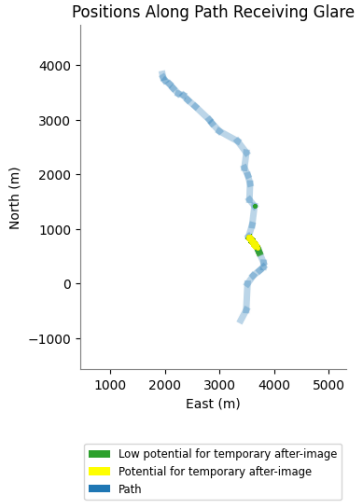

Image 15.5 - Positions along B743 receiving glare

15.7.14 However, as noted in the modelling assumptions (paragraph 15.6.4), the model does not take account of intervening topography, which in this case is likely to provide screening given there is a hill immediately west/north-west of the road. Additionally, the BESS, located in the south-east corner of PV Array 5, will provide substantial screening, noting that the height of BESS modules could be up to 9 m (refer to **Chapter 3**). As a result of this screening and the fact the model significantly over-estimates the amount of time the sun will be shining in this location, the actual occurrence of yellow magnitude glare is expected to be much lower than predicted, and the G&G effect on the B743 is assessed as **not significant**.

A70

15.7.15 Short sections of the A70 road are shown to be theoretically affected by a green magnitude of glare only, which poses minimal risks to road users. This is modelled to occur between April and August, from 18:00 to 19:00, for a maximum of 30 minutes per day from PV Arrays 1, 3, 4, and 5. However, in real-world conditions, the effects are likely to be greatly reduced due to additional obstructions (intervening topography, vegetation and built environment) not accounted for in the simulation, which is limited by the software, and the inherently conservative model assumptions as noted above. The G&G effect on the A70 is therefore assessed as **not significant**.

Fixed Receptors

15.7.16 The remaining ground-based receptors potentially affected by G&G from the Proposed Development primarily consist of residential dwellings and a few farm buildings. A total of nine fixed receptors have been identified in the G&G assessment (some representing more than one individual property at approximately the same location), with only six of them potentially exposed to G&G.

15.7.17 The fixed receptors most affected by glare, based on modelling results, are Burnfoot Farm (two properties), Middlefield (two properties), and Laigh Hall (all shown on **Figure 15.2**). The properties at Burnfoot Farm and Middlefield are all financially involved in the Proposed Development; Laigh Hall is not.

Burnfoot

15.7.18 The Burnfoot Farm receptor represents two dwellings located to the west of PV Array 2 and south of PV Array 1. Both properties are financially involved in the Proposed Development with PV Array 2 being partly located on land owned by Burnfoot Farm. In the absence of mitigation, these arrays are predicted to generate glare of yellow magnitude at the Burnfoot Farm receptor. However, not all obstructions, such as the trees separating this receptor from PV Array 1, could be incorporated into the simulation (see **Image 15.6**), also noting the fact the model significantly over-estimates the amount of time the sun will be shining in this location. As a result, the actual glare impact from PV Array 1 is likely to be minimal.

Image 15.6 - Actual screening between PV Array 1 (field on the left) and OP5.

15.7.19 The glare from PV Array 2 impacting Burnfoot Farm is theoretically predicted to occur in the morning, for periods between 05:30 and 07:30, for up to 35 minutes per day from March to September. This effect is caused by the rising sun in the east reflecting westward on PV Array 2. **Image 15.7** below illustrates Burnfoot Farm, PV Array 1, PV Array 2, and the modelled obstructions (shown in orange). Note that this is the worst-case scenario and assumes the sun is shining 365 days per year, which is clearly a highly conservative assumption.

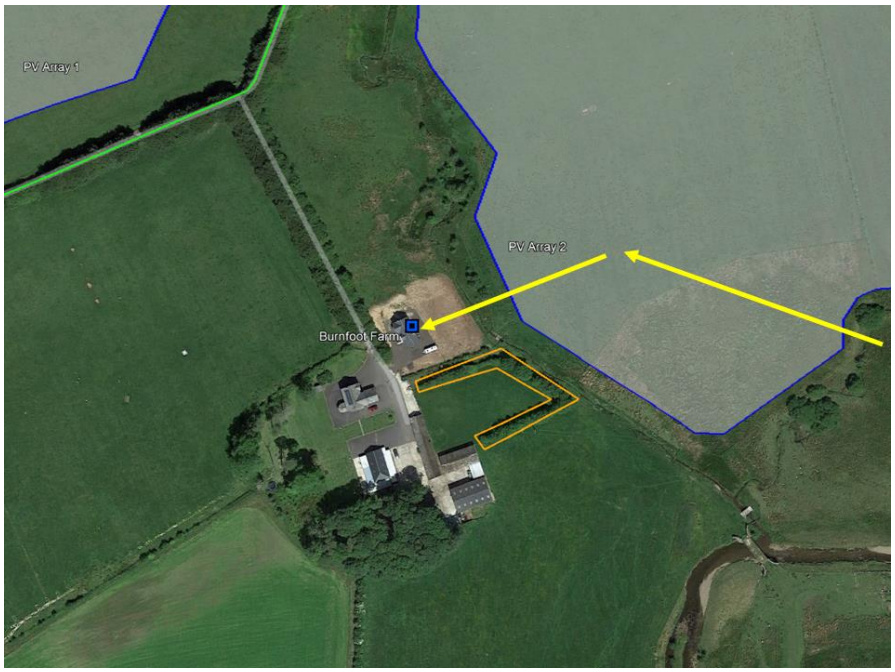

Image 15.7: Burnfoot Farm and the modelled obstruction (orange). Yellow arrows to indicate how the sun reflects westwards in the morning.

15.7.20 Furthermore, the Landscape Strategy Plan (**Figure 5.26**) shows that the west side of PV Area 2 will be screened with native vegetation, significantly reducing the potential glare impact on the residential properties at Burnfoot Farm. Therefore, the effect is assessed as **minimal to negligible** and **not significant**.

15.7.21 The Middlefield receptor also comprises two properties (Middlefield Farm and Middlefield Cottage), both financially involved in the Proposed Development. This receptor is located between PV Array 3, PV Array 4, and PV Array 5. Based on the model results, it is theoretically predicted to experience a mix of green and yellow magnitude glare from PV Array 3 in the evenings and PV Array 5 in the mornings, for periods up to 25 minutes per day between March and September. However, as noted above, given that the sun will not shine 365 days a year and that the Landscape Strategy Plan (**Figure 5.26**) includes screening around Middlefield, the G&G effect is assessed as **minimal to negligible** and **not significant**.

15.7.22 The Laigh Hall receptor is located south of PV Array 3 and south-east of PV Array 2. Based on the model results, it is theoretically predicted to experience a mix of green and yellow magnitude glare from PV Array 2 in the evenings, for periods up to 20 minutes per day, from April to September. No G&G is predicted to arise from PV Array 3 or any of the other arrays. As noted above, this is a theoretical modelling result which includes an assumption of the sun shining 365 days per year, therefore the actual magnitude of G&G will be less. Additionally, the Landscape Strategy Plan (**Figure 5.26**) includes screening along the south-east edge of PV Array 2, which will mitigate the G&G effect at this receptor. The G&G effect is therefore assessed as **minimal to negligible** and **not significant**.

15.7.23 The other residential receptors within the study area are only affected by green glare (or no predicted G&G in the case of two receptors), and due to the limited duration and lower intensity of the glare, the risk is deemed minimal and **not signifncant**.

15.7.24 The G&G effect on all residential receptors is therefore assessed as **not significant**.

15.8 Mitigation

15.8.1 As discussed in **paragraphs 16.6.3** the G&G simulation model results are likely to be highly conservative due to the assumption of 365 days of sunshine as well as local vegetation, intervening topography, built environment and dwelling orientation, that are not included in the model. Additionally, while G&G may potentially occur at these locations it is possible that it will not be 'experienced' at all locations due to the location or time of day during which it may potentially occur.

15.8.2 No potentially significant G&G effects have been identified when taking account of embedded mitigation, including implementation of the Landscape Strategy Plan (**Figure 5.26**), which proposes planting native scrub and trees to provide screening where potential G&G effects have been identified. The Landscape Strategy Plan includes for installing temporary measures such as shade netting if required while the planting establishes to an appropriate height. Additionally, the long duration BESS, located in the south-east corner of PV Array 5, will contribute to glare reduction.

15.8.3 No additional, specific mitigation beyond implementation of the Landscape Strategy Plan is considered to be required.

15.9 Residual Effects

15.9.1 The residual effect is unchanged from the potential effects, given that the latter take account of embedded mitigaiton (implementation of the Landscape Strategy Plan). Residual effects are therefore considered minimal to negligible and **not significant** at all receptors.

15.10 Cumulative Assessment

15.10.1 According to the Renewable Energy Planning Database (Department for Energy Security & Net Zero, 2025), there is only one solar development project within 10 km of the Proposed Development: Auldhouseburn Farm, located east of Muirkirk, with an installed capacity of 0.2 MWp. This project, currently in the 'Awaiting Construction' stage, is situated to the south of the Proposed Development. This is not considered to represent any potential for cumulative effects with the Proposed

Development, as its reflections will predominantly occur towards the south, away from the Proposed Development.

15.10.2 Given the size and distance of the only identified existing or planned solar development from the Proposed Development, cumulative impacts from glint and glare can be disregarded. The scale and separation of this site from the Proposed Development is such that their combined influence is not expected to affect the sensitive receptors identified for this assessment.

15.11 Summary

15.11.1 This chapter presents an assessment of the potential G&G impacts from the Proposed Development, focusing on the operational phase. The modelling includes all relevant receptors within the study area, including roads and fixed receptors, and evaluates their exposure to G&G based on the geometry of the solar arrays and surrounding obstacles.

15.11.2 For G&G to occur, there must be viable weather conditions, the correct geometrical alignment for glint (i.e. reflected light must physically reach the receptor, based on the relative position of the sun and the panels), and visibility of the panels (i.e. no intervening landforms or surface features such as buildings, trees, or hedgerows).

15.11.3 The assessment used the GlareGauge software (by ForgeSolar) to identify the impacts on the identified receptors by both magnitude and duration of G&G across the year, highlighting the likely diurnal and seasonal impacts. However, the tool has some limitations, as discussed in the assessment, such as not taking account of intervening topography or other obstructions such as trees and buildings unless manually input (with a limit of ten obstructions that can be manually input). Additionally, since G&G only occurs under sunny conditions, the software does not account for weather variations, leading to potential overestimations of glare occurrence.

15.11.4 'Green' glare indicates a low potential for after-image formation and poses minimal risk to health and safety. 'Yellow' glare, while indicating some potential for after-image formation, has an impact comparable to common reflective materials such as glass, windows, or metallic surfaces.

Receptors and Potential Effects

15.11.5 The assessment identifies three primary routes, A70, B743 and U731, as well as fixed receptors (residential properties) potentially impacted by G&G.

15.11.6 The Landscape Strategy Plan (**Figure 5.26**) has been considered in the discussion of embedded mitigation measures. It proposes planting native scrub and trees, some elements of which have been included specifically to reduce G&G impacts. This includes hedgerow planting and temporary shade netting if required, to provide immediate screening while the hedgerows become fully established.

15.11.7 The U731 Greenock Water local road theoretically experiences 'yellow' magnitude glare from PV Arrays 1 and 5, but this is unlikely to affect many users due to the road's low traffic volume. Additionally, the Proposed Development Landscape Strategy Plan includes landscape planting which will provide screening and will significantly reduce G&G affecting Road U731. The B743 predominantly experiences 'green' glare (posing minimal risk), but some short sections of the road are predicted to theoretically experience 'yellow' glare during summer evenings. This does not take account of intervening topography or the proposed long-duration BESS (up to 9m height) which will provide screening and will substantially reduce any actual G&G effects on the B743. Additionally, the Landscape Strategy Plan includes for vegetation screening will further mitigate any effect. Road A70 is theoretically impacted by 'green glare', which has a minimal effect, and is likely an overestimate of effects in real-world conditions, given intervening topography and additional obstructions not included in the model, and the model's assumption of the sun shining 365 days of the year.

15.11.8 Fixed receptors, including residential dwellings, experience mixed glare intensities, but the overall impact is minimal effectively mitigated through screening measures as included in the Landscape Strategy Plan.

15.11.9 There are no aviation receptors in the study area, with the closest being Strathaven Airfield, located more than 15 km north of the Proposed Development.

15.11.10 No potential for significant cumulative impacts, from other existing or proposed developments together with the Proposed Development, has been identified.

15.11.11 The overall risk of glint and glare from the Proposed Development is minimal when taking account of the embedded mitigation provided by the Landscape Strategy Plan. With the committed screening in place, the potential and residual G&G effects will be minimal and not significant in EIA terms, posing no significant risks to health or safety.

Table 15.8 – Summary Table

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
During Construction & Decommissioning					
Based on the nature of the project and surrounding receptors, the construction and decommissioning phases have been scoped out.					
During Operation					
Effect on all road receptors	Minimal to negligible	Adverse	Embedded mitigation – implementing Landscape Strategy Plan including planting/screening and, where required and appropriate, installation of temporary shade netting while vegetation is established.	Minimal to negligible	Adverse
Effect on fixed (residential) receptors: Netherwood, Burnfoot Farm, Greenockdyke, Bibblon Lodge, Laigh Hall, Middlefield	Minimal to negligible	Adverse	Embedded mitigation – implementing Landscape Strategy Plan including planting/screening and, where required and appropriate, installation of temporary shade netting while vegetation is established.	Minimal to negligible	Adverse
Effect on other fixed (residential) receptors within the study area: Forkings, Linburn, Blackside Farm	None	N/A	N/A	None	N/A
Effect on Aviation Receptors	N/A	N/A	N/A	N/A	N/A
Cumulative Effects					
Given the size and distance of the existing and planned solar developments from the Proposed Development, cumulative impacts on glint and glare can be disregarded.					

15.12 References

Legislation, Policy and Guidance

BRE (2013) Planning guidance for the development of large-scale ground-mounted solar PV systems. Available at https://www.bre.co.uk/filelibrary/pdf/other_pdfs/KN5524_Planning_Guidance_reduced.pdf

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Model

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