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Appendix 18-2 – Glint and Glare Assessment

Uisce Éireann
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BALLINA AND LOUGH TALT WATER SUPPLY UPGRADE

macroworks

GLINT AND GLARE ASSESSMENT

Proposed Solar PV Installation

Bonniconlon, Co. Mayo.

Prepared by Macro Works Ltd

May 2026



Executive Summary

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Registered Landscape Architect

1. GLINT AND GLARE ASSESSMENT

1.1 INTRODUCTION

This Glint and Glare Assessment was carried out by Macro Works Ltd to determine the potential for solar reflectance effects upon dwelling and transport route receptors in respect of the proposed solar PV installations on the roof of a proposed Booster Pump Station building at Bonniconlon, Co. Mayo. The proposed building will have a maximum height of 7.67m above the terrain level and will be mounted flush with the south facing roof canopy.

1.1.1 Statement of Authority

Macro Works' relevant experience includes twenty years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments. The Glint and Glare analysis model used in this study for non-aviation receptors was developed by Macro Works in conjunction with the National University of Ireland, (NUI) Maynooth. It has successfully replicated results from the Federal Aviation Administration (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) software and has been utilised to assess the effects of glint and glare for many solar development sites throughout Ireland to date.

1.1.2 Guidance and Best Practice

There is currently no specific guidance or standards for the assessment of photovoltaic glint and glare effects on residential and/or route (road and rail) receptors in Ireland. Guidance has been prepared, however, by the Federal Aviation Administration to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority. This guidance, concerned with hazard assessment, has relevance to the other receptor types mentioned, and coupled with numerous assessments already carried out across the UK, combine to establish a suitable best practice for solar development.

By virtue of their efficiency, the intensity of reflected light from modern PV solar panels is deliberately low and currently equates with that of the reflection from still water. Recent studies generally agree, however, that there still exists the potential for hazard or reflectance upon surrounding receptors. Macro Works' glint and glare analysis methods and determination of effects are based on a combination of available studies and established best practice. This methodology has been successfully implemented on numerous previous solar farm projects that met with the approval of both Planning Authorities and An Coimisiún Pleanála.

1.1.3 Definitions

The study is concerned with the potential reflectance and hazard effects of glint and glare in relation to receptors that include the occupants of surrounding dwellings as well as road and rail users. In its "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[1] the FAA have defined the terms 'Glint' and 'Glare' as meaning;

1 Federal Aviation Administration (FAA) 2018. Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at: https://www.faa.gov/sites/faa.gov/files/airports/environmental/FAA-Airport-Solar-Guide-2018.pdf

Glint – "A momentary flash of bright light"

Glare – "A continuous source of bright light"

Glint and glare are essentially the reflection of sunlight from reflective surfaces. This study uses a multi-step process of elimination to determine which receptors have the potential to experience the effects of glint and glare. It then examines, using a computer-generated geometric model, the times of the year and the times of the day such effects could occur. This is based on the relative angles between the sun, the panels and the receptor throughout the year.

1.1.4 General Nature of Reflectance From Photovoltaic Panels

In terms of reflectance, photovoltaic solar panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Nonetheless, photovoltaic panels have a flat, polished surface, which emits 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface (Figure 1.1 refers). Several studies have shown that photovoltaic panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than the likes of glass, steel, snow and white concrete by comparison (Figure 1.2 refers). Similar levels of reflectance can be found in common situations in rural environments from surfaces such as shed roofs, lines of plastic ground covering used in cropping and wet roads to name but a few (Figure 1.3 - Figure 1.5 refer).

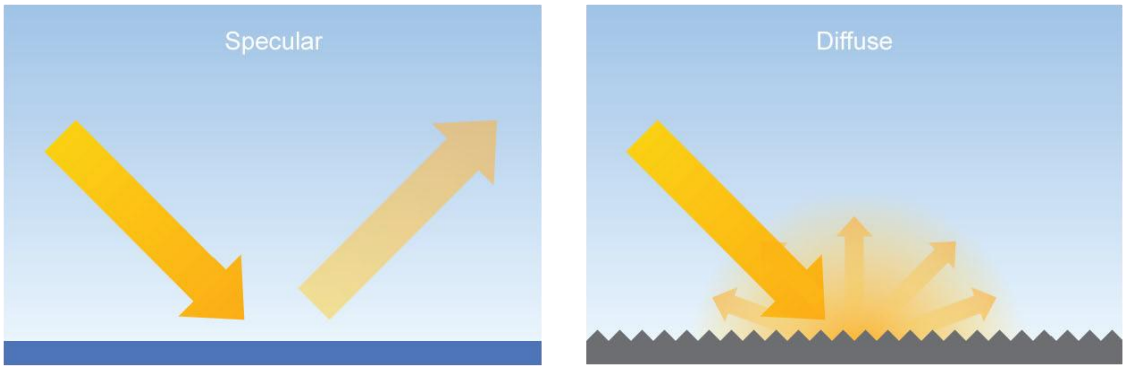


Figure 1.1: Specular vs Diffuse reflection of light from polished and rough surfaces.

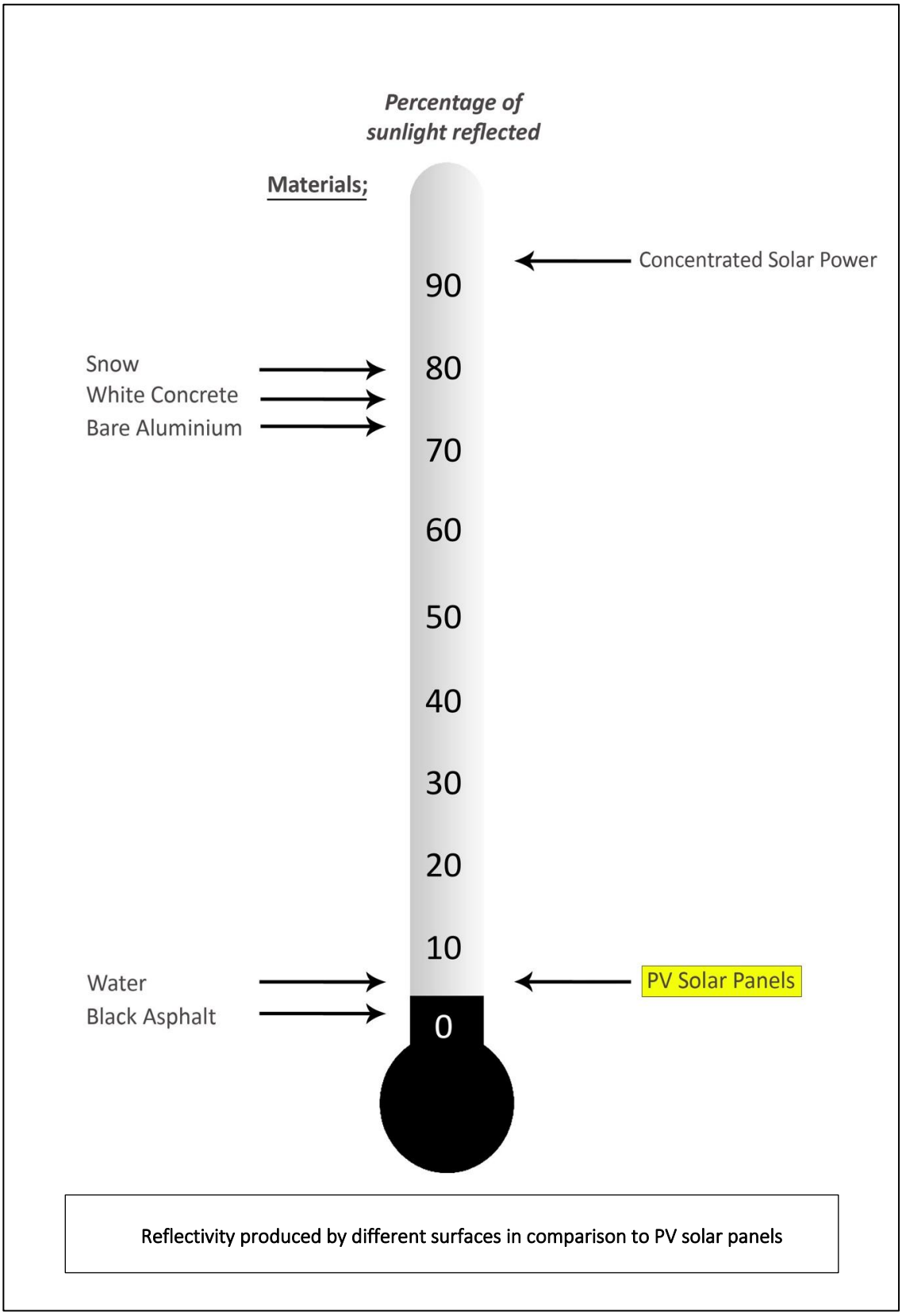


Figure 1.2: Demonstrates that the amount of sunlight (measured in watts per meter -W/m2) reflected from the surface of a solar panel is very similar to that of still water and is far less than that of many surfaces commonly found in the environment, urban or rural.



Figure 1.3: Similar level of reflectance (to photovoltaic panels) emanating from plastic ground covering in an Irish rural scenario.



Figure 1.4: Similar levels of reflectance (to photovoltaic panels) emanating from wet road surfaces.



Figure 1.5: Higher levels of reflectance (to photovoltaic panels) emanating from powder coated corrugated metal roof surfaces in an Irish rural scenario.

1.2 ASSESSMENT OF GROUND-BASED RECEPTORS

1.2.1 Assessment Methodology for Ground-Base Receptors

Macro Works' glint and glare assessment methodology follows a rational sequence of steps to identify receptors that might potentially be affected by glint and glare. These are then further filtered to yield those receptors to those that are likely to actually experience such effects. These steps are set out below;

1. Identify study area within which to assess the potential for glint and glare effects. The potential for substantial reflectance or hazardous impacts are greatest in close proximity to the source of reflectance and the potential for adverse impacts reduces with increased distances therefore to balance these factors a buffer extent of 1km from the site boundary is used by default on all solar developments.

2. Pre-analyse the study area for potential glare effects by populating the study area with a regular grid of receptor points (100m spacing). This analysis (1st analysis) allows us to determine those areas theoretically exposed to glint and glare effects that might warrant further investigation. We call this the "Area of Consideration for Further Analysis". This pre-analysis is based on a 3D model of the development superimposed onto a Digital Terrain Model (DTM) of the study area. Note: This DTM accurately replicates the profile of the terrain but does not account for screening by the vegetation or buildings that are present – in this sense the results are somewhat theoretical but they do offer a representation of a bare-earth, worst-case scenario.

3. Identify relevant receptors (dwellings and transport routes) that fall within the theoretically affected zones of the study area (or the "Area of Consideration for Further Analysis"). Dwelling identification utilises a combination of up to date aerial photography and the Eircode Finder tool which locates and identifies buildings classed as residential. Transport route receptors are defined by regularly spaced points along roads and rail lines (50m spacing). The height of the road Receptor Points are set to 1.7m above ground level. This is broadly equivalent to the eye level a person walking or a driver of a 4x4 / SUV type vehicle. The height of rail Receptor Points are set to 2.8m above ground level to represent the eye level of a train driver.

4. Execute the glint and glare analysis on the DTM-based 3-D model (2nd analysis), in respect of each of the theoretically affected receptors. This identifies the times of the day and months of the year that glint and glare could potentially affect receptors in the absence of screening.

   Note: When the sun is situated within 10 degrees of a reflecting PV panel as viewed from a particular receptor, the sun will be a much greater source of glare than what emanates from the surface of the PV panel therefore any potential glare during these periods is excluded when assessing potential impacts.

5. Perform the same calculations (3rd analysis) using a high-resolution digital surface model (DSM) that accounts for the existing screening inherent on and surrounding the site at the time of capture. This offers a truer reflection of the actual glare that is likely to occur and highlights where landscape mitigation may be required.

   Note: A limitation of DSM data in the context of this assessment type is that it is a snapshot of the screening situation at the time of the data capture. This situation is broadly indicative as hedgerows are a semi-permanent feature of the Irish countryside, however, seasonal variation through growth and/or cutting may result in minor changes to their screening potential. A further limitation is due to the aerial overhead nature of data capture. This can result in the under-reporting of potential visibility beneath the tree or woodland canopy and can understate the visibly porous nature of some thin hedgerows. This can result in minor underestimating of glare periods. However, where the data is deemed to be significantly unreliable for the reasons stated, analysis is supplemented, where possible, with a thorough assessment of aerial photography, Google Street View imagery and on-site verification.

6. Where instances of glint and glare remain, determine whether they are likely to cause a hazard / reflectance. For dwellings, this is achieved by comparing the periods of glare potential with our 'Magnitude of Glint and Glare Effects' table, while transport routes are examined in further detail for potential for hazardous impacts.

7. If hazard / substantial reflectance is likely to occur, mitigation measures are proposed where possible. This might relate to the re-siting of particular panels and / or the provision of additional screening.

8. If necessary, re-run the glint and glare calculations (4th analysis) to verify the effectiveness of the proposed mitigation measures and determine if there are any residual glare impacts.

1.2.2 Magnitude of Impacts for Dwelling Receptors

Although there is currently no regulation or guidance as to acceptable levels of glint and glare effects at receptors in Ireland, it is considered necessary to provide a gauge for determining relative levels of impact across a range of development types. Macro Works has established the following indicative textual categories of effect, which are used herein to determine the relative impact levels (Table 1.1 refers). The percentage figures provided are intended as a relative guide only. The final category of assessment is determined on the basis of professional judgement, and accounts for mitigating factors where relevant and the careful consideration of a range of circumstantial variables that may act to intensify or reduce the effect upon a particular receptor.

Note: The magnitude of glint and glare effects in Table 1.1 relates only to static receptors such as residential dwelling. As road receptors are moving objects and will only ever have the potential to experience momentary reflectance periods, the following impact magnitudes are not considered relevant for road receptors. Instead, road receptors will be assessed on whether periods of reflectance have the potential to generate significant reflectance or hazard effects.

Table 1.1 Magnitude of Glint and Glare Effects

Magnitude of Impact	Description
Very High	Hazard / reflectance effects emanating from highly reflective surfaces (>50% sunlight reflection) for most of the year (>70% / 255 days) and for significant periods of each day (>45 mins).
High	Hazard / reflectance effects emanating from moderately reflective surfaces (>30% sunlight reflection) for the majority of days in a year (>50% / 182 days) and for substantial periods of each day (>30 mins).
Medium	Reflectance effects emanating from moderately/low reflective surfaces (>10% sunlight reflection) for a substantial number of days in a year (>30% / 109 days) and for substantial periods of each day (>20 mins).
Low	Reflectance effects emanating from low reflective surfaces (>5% sunlight reflection) for a modest number of days in a year (>10% / 36 days) and for notable periods of each day (>15 mins).
Very Low	Reflectance effects emanating from low reflective surfaces (>5% sunlight reflection) for a small number of days in a year (≤10% / 36 days) and for short periods of each day (<15 mins).
Negligible	Effects either not geometrically possible or barely measurable.

Important Note

It must be emphasised at this point that all results, whether from FAA endorsed SGHAT software or our own bespoke software, are theoretical by default in that they assume that the sun is always shining and at full intensity. The results do not account for climate and inherent weather patterns that occur across the island of Ireland.

Records from Met Éireann (The Irish Meteorological Service) indicate that "over the year as a whole, most areas get an average of between 3 1/4 and 3 3/4 hours of sunshine each day". It states that "the sunniest months are May and June. During these months, sunshine duration averages between 5 and 6.5 hours per day over most of the country"[2].

While we cannot correlate the historic random periods of sunshine with our predicted periods of glare, we can state with a high level of confidence that the weather, more precisely cloud cover, will account for a substantial reduction in all figures quoted in this report i.e. frequency and duration of glare periods.

In addition, atmospheric conditions such as haze, mist, fog and precipitation will all have the effect of both reducing the visibility of the site overall and reducing the intensity of any glare emanating from the proposed solar development.

1.2.3 Relevant Parameters of the Proposed Development

The photovoltaic panels are to be oriented in a south-facing direction to maximise solar gain and will remain in a fixed position throughout the day and year (i.e. they will not rotate to track the movement of the sun). The proposed panels will be mounted flush to the south facing roof canopy of the proposed pumping station building, which will have a height of between 4.04m and 7.67m above ground level and a pitch of 30 degrees. It is not geometrically possible for glare to occur in the terrain to the north of these south-facing PV panels; hence the 1 km study area does not extend to the north of the proposed PV panels.

The proposed development is located in the rural plains of County Mayo, c. 2km west of Bonniconlon. The study area comprises a gentle rolling agricultural landscape, made up of small to medium sized fields which are bounded by mature hedgerows and treelines. The Srafaungal River is the principal watercourse within the study area, flowing just east of the site boundary. The R294, which runs south of the proposed pumping station, is the main transport route within the study area. The area is also served by a network of local roads. Settlement within the study area is sparse, with dispersed one-off rural dwellings along the regional road representing the predominant settlement pattern. The nearest dwelling to the proposed panels is located c. 125m to the east.

Due to the southerly orientation of the PV panels in the proposed solar development, ground-based receptors (houses and transport routes) situated to the west of the solar array can only be affected by morning reflectance, when the sun is rising in the east. Conversely, receptors situated to the east of the site and can only be affected by evening reflectance, when the sun is setting in the west.

Further, south facing panels in a landscape such as this result in a typical pattern of glare with potential glare impacts upon surrounding receptors occurring during the months February – October. This broadly represents the season where some or all foliage is present on vegetation. The assessment of the screening capacity of the surrounding vegetation in its winter state is therefore not necessary.

2 https://www.met.ie/climate/what-we-measure/sunshine



Figure 1.6: Map of proposed solar development site and the study area.

1.2.4 Assessment of Residential Receptors

1.2.4.1 Identification of Relevant Residential Receptors

Figure 1.7 - Figure 1.8 are output maps of the study area showing the results (areas of potential solar irradiance) of 1st phase reflectance analysis carried out on the proposed solar development. These account for the path of the sun throughout the entire year; the panel positions and parameters; the 3D terrain parameters. This is the starting point for determining which residential receptors have the geometric potential to be affected by glint and glare – in the absence of screening.

Note: The yellow buffer line around the reflectance pattern indicating 'Area of consideration for further analysis' on the output maps represents a precautionary approach of including dwellings at the fringe of potentially affected areas. It accounts for the fact that this 'first-filter' map is based on a sampling grid point density of 100m.

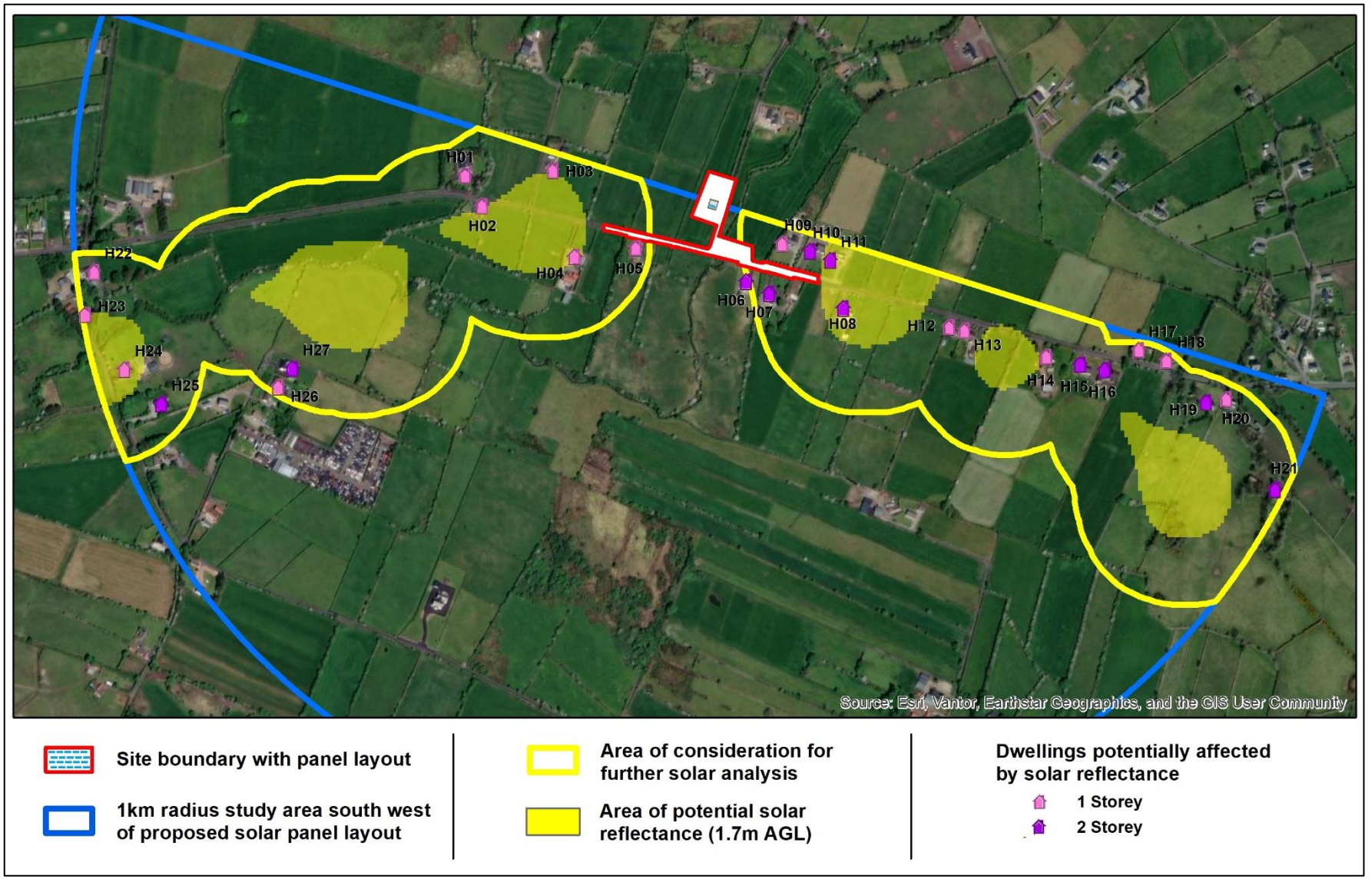


Figure 1.7 Parts of the study area where houses are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on a viewers' eye-level when standing on the ground floor = 1.7m above ground level.

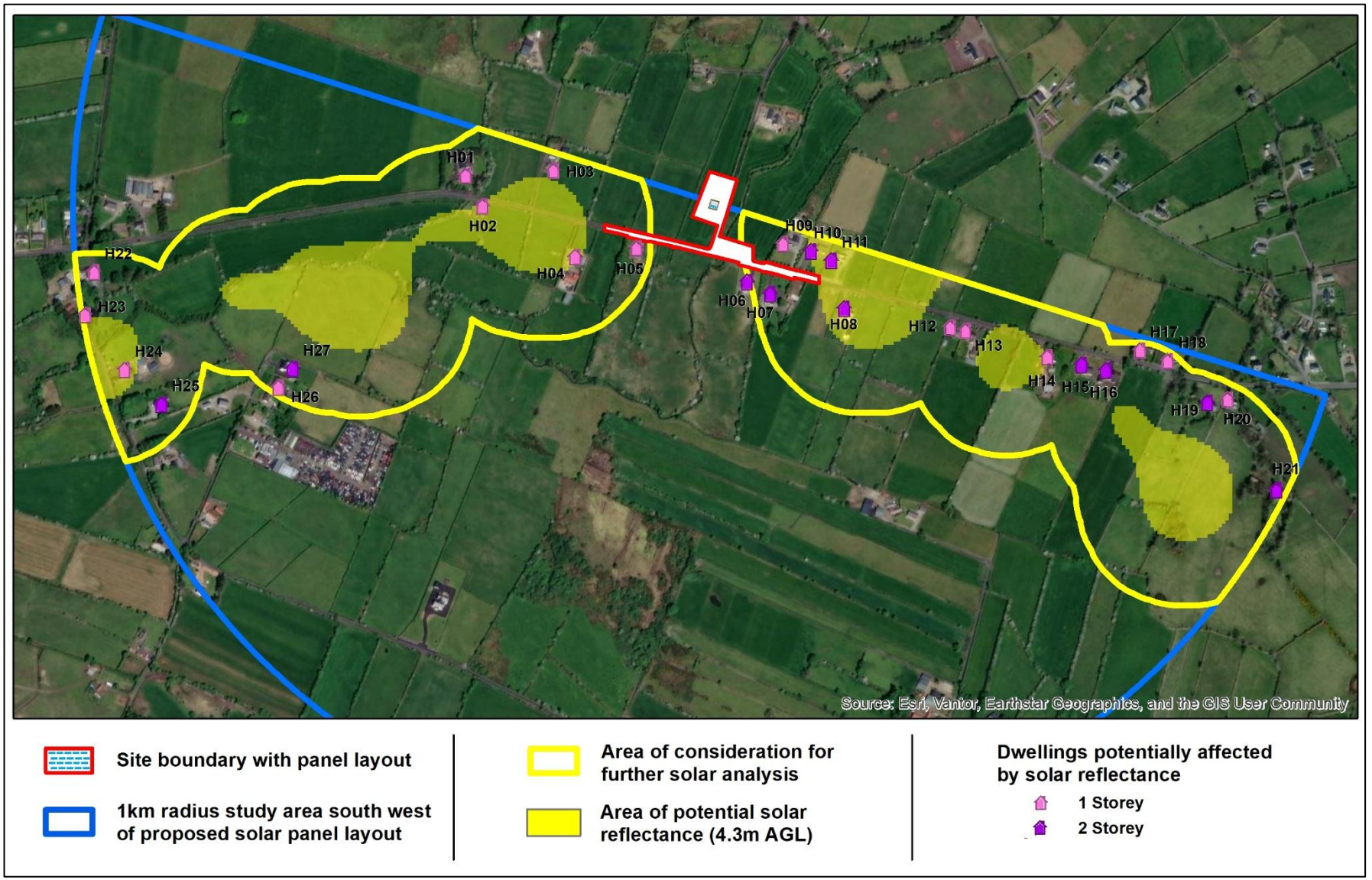


Figure 1.8 Parts of the study area where houses are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on a viewers' eye-level when standing on the first floor = 4.3m above ground level.

1.2.5 Results of Analysis of Residential Receptors

The results of the analysis for the dwellings which occur within the 'Area of Consideration for Further Analysis' are contained in Appendix A and C. These set out the times of day and days of the year that glint and glare effects could theoretically be experienced at residential receptors within the study area. Appendix C includes the entire potential glare periods, however in accordance with the stated methodology, Appendix A excludes periods where the sun is within 10 degrees of the angle of reflectance and it is these figures that form the basis of this assessment.

A summary of the results in Appendix A is included in Table 1.2 below. An assessment of the results will be undertaken in Section 1.2.5.1. This assessment also outlines the potential magnitude of impact that may occur at residential receptors.

Note: The results in the left hand columns of Appendix A are theoretical in that they are derived from a "bare-ground" data model that does not account for screening that might exist in the intervening landscape in the form of buildings and/or vegetation. This helps to establish a worst-case scenario baseline, from which we identify a subset of receptors for more thorough investigation. It is important to note that these figures do not necessarily represent an accurate portrayal of real impacts.

Table 1.2 Summary of Results in Appendix A - Dwellings

Receptor ID	Reflectance theoretically possible based on DTM topographic mapping (for control purposes)	Potential for impact after existing screening is taken into account (DSM)
H01	None	None
H02	Yes Potentially	Yes Potentially
H03	None	None
H04	None	None
H05	None	None
H06	None	None
H07	None	None
H08	None	None
H09	None	None
H10	None	None
H11	None	None
H12	None	None
H13	None	None
H14	None	None
H15	None	None
H16	None	None
H17	None	None
H18	None	None
H19	None	None

H20	None	None
H21	**Yes Potentially**	None
H22	**Yes Potentially**	None
H23	**Yes Potentially**	None
H24	**Yes Potentially**	None
H25	None	None
H26	None	None
H27	None	None

1.2.5.1 Effects on Residential Receptors

A total of 27 dwellings were examined. Computer analysis using terrain-only data (DTM) identified that glint and glare is geometrically possible at five of these. Further analysis, taking account of the existing screening inherent across the study area (using a digital surface model - DSM) and on-site verification of the analysis results, indicates that one dwellings is actually likely to have the potential to be materially affected by glint and glare. This is on the basis of the considerable screening afforded by buildings and hedgerows that occur between the vast majority of receptors and potentially reflecting panels.

Negligible effects

H02 is assessed to have a **Negligible** magnitude of effect, when accounting for existing screening. This is on the basis of the low periods of reflectance that could potentially be experienced at these properties (less than one hour throughout the year).

Note: It is important to note that the reflectance periods identified above are theoretical and represent the worst-case scenario in terms of potential reflectance and assume that the sun is always shining and at full intensity. The results do not account for climate and inherent weather patterns that occur across the island of Ireland (refer to Met Eireann data[3]) . In addition, atmospheric conditions such as haze, mist, fog and precipitation will all have the effect of both reducing the visibility of the site overall and reducing the intensity of any glare emanating from the proposed solar development. Overall, it is not considered that the reflectance periods outlined above will material impact on the enjoyment of any properties considered in this assessment. As landscape professionals with a combined 20+ years of LVIA experience, Macro Works do not consider that the reflectance periods outlined above will materially impact on the enjoyment of this property.

3 https://www.met.ie/climate/what-we-measure/sunshine

1.2.5.2 *Ameliorating Factors*

A key consideration for reflectance effects is the incidence (incoming) angle of the sun's rays when they strike the reflecting surface (solar panels in this instance). The most intense reflective rays occur when the receptor is at 90 degrees to the incidence rays. At decreasing angles the reflectance becomes increasingly diffused across a wider portion of the reflecting surface, thereby diminishing the intensity of the reflected rays. The nature of the reflecting surface also plays a major part in the degree of diffusion / absorption of the incidence rays and modern PV solar panels have become very efficient at absorbing rather than reflecting light. With regard to the proposed development, the potential for reflectance only has the potential to occur when during the early morning hours and later during the evening during the Spring, Summer and Autumn months when the sun is low in the sky – typically at < 30 degree sun incidence angle.

A technical note on solar module glare and reflectance prepared by SunPower Corporation[4] outlines the degree of material reflectivity for a range of sun incident angles. As per the table below (Table 1.3 Material Reflectivity at various sun incident angles (derived from Sunpower Corporation (September 2009), T09014 Solar Module Glare and Reflectance Technical Memo) below) the degree of reflectivity of solar panels below 30 degrees is < 5.03% and is likely to have no material consequence on surrounding receptors. It is also important to reiterate that in terms of reflectance, photovoltaic solar panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Furthermore, as technology has improved, the addition of an antireflective coating on panels has become an option. A June 2023 study by Loughborough University states "currently around 90% of commercial PV modules are supplied with an AR coating applied to the cover glass"[5].

Several studies have shown that even standard photovoltaic panels, without anti-reflective coatings have similar reflectance characteristics to water, which is much lower than the likes of glass, steel and snow by comparison (see Table 1.3). Similar levels of reflectance can be found in common situations in rural environments from surfaces such as shed roofs, lines of plastic ground covering used in cropping and wet roads to name but a few. In the case of modern PV solar panels which include an anti-reflective coating, reflectance levels are even less than that emitted from standard window glass and still water. Indeed, the degree of reflectivity of solar panels below 30 degrees reduces to < 3.12% and is likely to have a negligible effect on surrounding receptors.

It should also be noted that proposed landscape measures will further screen the proposed development from view, thus decreasing reflectance times. It is proposed to plant native trees interspersed with native hedgerow mix around the perimeter of the site, as well as areas of woodland at the northern and southern ends of the site. This will substantively screen the proposed development from view.

Thus, on balance of the reasons outlined above, once anti-reflectance coating is considered, the magnitude of effect at all aforementioned residually effected dwelling receptors will be Negligible.

4 Sunpower Corporation (September 2009), T09014 Solar Module Glare and Reflectance Technical Memo

5 "The performance and durability of Anti-reflection coatings for solar module cover glass – a review" Available at: https://www.sciencedirect.com/science/article/pii/S0038092X23004061

Table 1.3 Material Reflectivity at various sun incident angles (derived from Sunpower Corporation (September 2009), T09014 Solar Module Glare and Reflectance Technical Memo)

Common Reflective Surfaces (In surrounding environments for PV systems)		Sun Incident angle in degrees						
		0	15	30	45	60	75	90
Material Reflectivity (percent of incident light reflected)	Steel	36.73%	39.22%	46.34%	57.11%	70.02%	83.15%	94.40%
	Snow	21.63%	23.09%	27.29%	33.63%	41.23%	48.96%	55.59%
	Standard Glass	8.44%	9.01%	10.65%	13.12%	16.09%	19.10%	21.69%
	Plexiglass	8.00%	8.54%	10.09%	12.44%	15.25%	18.11%	20.56%
	Plastic	6.99%	7.46%	8.82%	10.87%	13.33%	15.83%	17.97%
	Smooth Water	4.07%	4.35%	5.14%	6.33%	7.76%	9.22%	10.47%
	Solar Glass (high light transmission)	3.99%	4.26%	5.03%	6.20%	7.61%	9.03%	10.26%
	Solar Glass w/AR coating	2.47%	2.64%	3.12%	3.84%	4.71%	5.59%	6.35%

Note: Index of refraction values may vary slightly depending on suppliers and reference documentation.

1.2.6 Conclusion - Residential Receptors

Each dwelling within 1km of the proposed development has been fully assessed based on location, height and orientation in relation to the proposed solar development. For the reasons outlined above, it has been determined that glint and glare effects are considered Negligible as the proposed panels are not considered to be highly reflective surfaces, and the frequency/durations involved are not considered excessive to the degree that they will have a material impact on the enjoyment of any property.

It must also be re-emphasised that the reflectance periods provided are theoretical by default and represent a worst-case scenario in that they assume that the sun is always shining and at full intensity. In the Irish context, the reflectance frequency/duration figures provided are likely to be at least double the reality, according to Met Eireann data.

Thus, it is considered that there will be no notable reflectance effects generated from glint and glare towards surrounding dwellings as a result of the proposed solar development.

1.2.7 Assessment of Transport Route Receptors

1.2.7.1 Identification of Relevant Transport Route Receptors

Figure 1.9 is an output map of the study area showing the results (areas of potential solar irradiance) of 1st phase reflectance analysis carried out on the proposed solar development. These account for the path of the sun throughout the entire year; the panel positions and parameters; the 3D terrain parameters. This is the starting point for determining which transport route receptors have the geometric potential to be affected by glint and glare – in the absence of screening.

Note: The yellow buffer line around the reflectance pattern indicating 'Area of consideration for further analysis' on the output map represents a precautionary approach of including transport route sections at the fringe of potentially affected areas. It accounts for the fact that this 'first-filter' map is based on a sampling grid point density of 100m.

Receptor Points have been positioned along all the potentially affected roads (R) and railways (T) within the 'Area of Consideration for Further Analysis'. Transport route Receptor Points are placed automatically in an un-biased fashion at 50m intervals along route lines using Geographic Information Systems (GIS) software. There will be instances where points may be screened by single trees in otherwise open sections of route, or, conversely they may be exposed through a gateway in an otherwise long section of screening hedgerow. Their frequency is designed, however, to reflect the overall screening characteristics of the route sections.

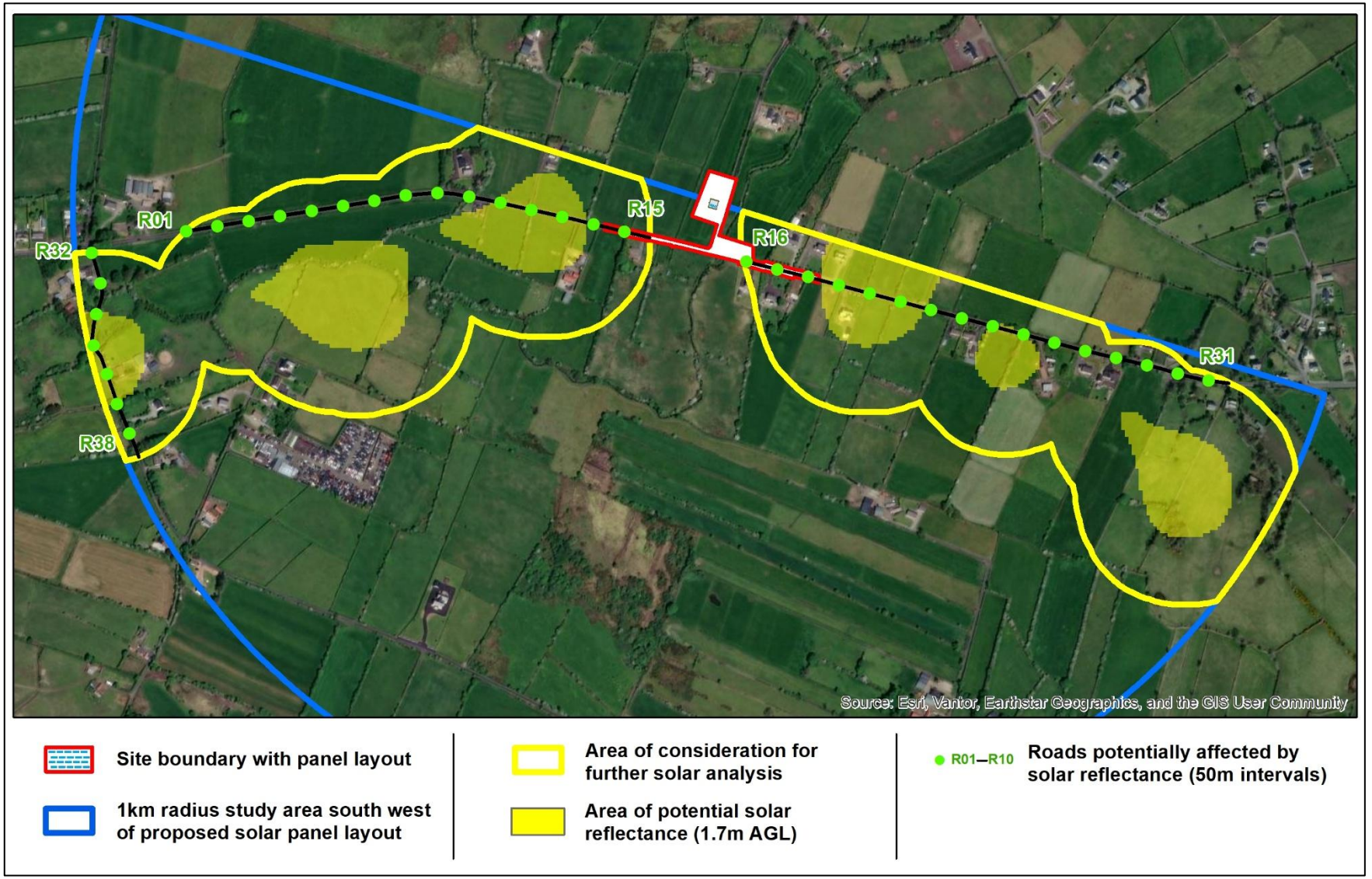


Figure 1.9 Parts of the study area where roads are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on viewer's eye level at 1.7m above ground level for roads

1.2.8 Results of Analysis of Transport Route Receptors

The results of the analysis for the transport routes which occur within the 'Area of Consideration for Further Analysis' is contained in Appendix B and D. These set out the times of day and days of the year that glint and glare effects could theoretically be experienced at transport route receptors within the study area. Appendix D includes the entire potential glare periods, however in accordance with the stated methodology, Appendix B excludes periods where the sun is within 10 degrees of the angle of reflectance, and it is these figures that form the basis of this assessment.

A summary of the results in Appendix B is included in Table 1.4 below. An assessment of the results will be undertaken in Section 1.2.8.1.

Note: The results in the left hand columns of Appendix B are theoretical in that they are derived from a "bare-ground" data model that does not account for screening that might exist in the intervening landscape in the form of buildings and/or vegetation. This helps to establish a worst-case scenario baseline, from which we identify a subset of receptors for more thorough investigation. It is important to note that these figures do not necessarily represent an accurate portrayal of real impacts.

It is important to note that the figures for the maximum minutes per day in Appendix B relate to the time window that a section of route can potentially experience reflectance and are therefore of less consequence than they would be for a static dwelling receptor. Such effects can only be experienced for the period of time it takes to travel along the affected road section, and therefore will be fleeting and in any event significantly less than the maximum periods outlined.

Table 1.4 Summary of Results contained in Appendix B - Transport Receptors: Roads

Receptor ID	Reflectance theoretically possible based on DTM topographic mapping (for control purposes)	Potential for impact after existing screening is taken into account (DSM)
R01	Yes Potentially	Yes Potentially
R02	Yes Potentially	None
R03	Yes Potentially	None
R04	Yes Potentially	None
R05	Yes Potentially	Yes Potentially
R06	Yes Potentially	None
R07	Yes Potentially	Yes Potentially
R08	Yes Potentially	Yes Potentially
R09	Yes Potentially	None
R10	Yes Potentially	None
R11	Yes Potentially	Yes Potentially
R12	Yes Potentially	Yes Potentially
R13	Yes Potentially	None
R14	Yes Potentially	None
R15	Yes Potentially	Yes Potentially

R16	None	None
R17	None	None
R18	None	None
R19	None	None
R20	Yes Potentially	Yes Potentially
R21	None	None
R22	None	None
R23	None	None
R24	None	None
R25	None	None
R26	None	None
R27	None	None
R28	None	None
R29	None	None
R30	None	None
R31	None	None
R32	Yes Potentially	None
R33	Yes Potentially	None
R34	Yes Potentially	None
R35	Yes Potentially	None
R36	Yes Potentially	None
R37	None	None
R38	None	None

1.2.8.1 Effects on Road Receptors

Appendix B examined a total of 38 road Receptor Points. Analysis of terrain-level screening (using a digital terrain model - DTM) identified that glint and glare is theoretically possible at 21 of these road Receptor Points. Further analysis, taking account of the existing screening inherent across the study area (using a digital surface model - DSM) and on-site verification of the analysis results, determined that eight of the road receptor points will actually have the potential to be materially affected by glint and glare. These road receptor points are situated on local and regional roads in the vicinity of the proposed development. The results indicate that the existing screening afforded by buildings and vegetation that occurs between receptors and potentially reflecting panels has a significant bearing on reducing the overall glint and glare likely to be experienced within the study area.

The eight road Receptor Points with the potential to incur glint and glare residual effects in the DSM analysis will be assessed in further detail in the sections below.

R01, R05, R07-08, R11-12, R15, R20

These receptor points represent intermittent stretches along the R294, southwest and southeast of the proposed panels. R15 saw the highest level of potential reflectance at a maximum of two minutes per day over 24 days of the year. It is important to note that reflectance only has the potential to occur for a maximum of 48 minutes per year at R15.

It is important to note that there must be clear sunshine for any glare to occur. It is also important to note that reflectance only has the potential to occur for a brief section of this local road carriageway (< 100m section). Furthermore, glare will not be experienced when travelling west along this section of road as the potential glare will be outside of the field of view, i.e. offset greater than 100 degrees to the direction of travel (Figure 1.10 refers) For these reasons, it is not considered that there will be any significant reflectance or hazard effects generated from glint and glare.

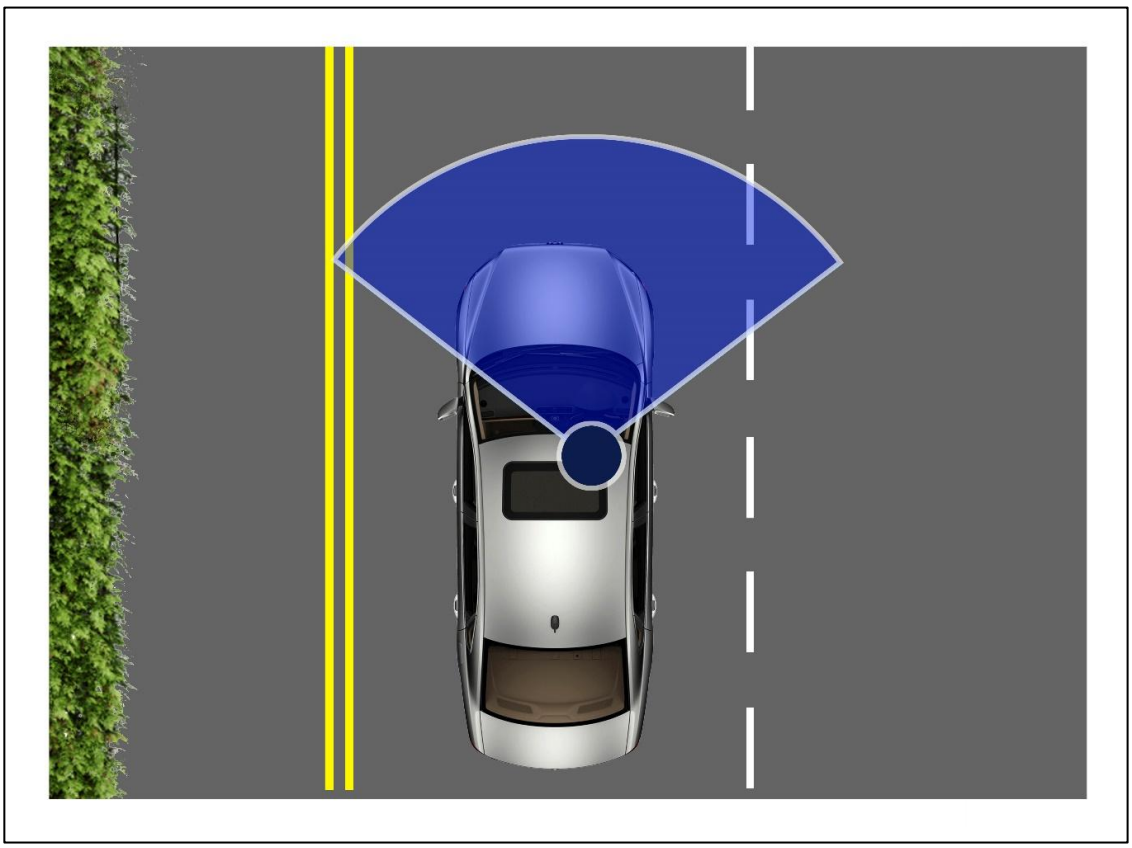


Figure 1.10 Illustration of a 100 degree field of view for driver (blue hatched area) extending 50 degrees to the left and 50 degrees to the right from the direction of travel.

1.2.9 Conclusion - Road Receptors

For the reasons outlined above, it is not considered that the glint and glare emanating from the proposed solar PV panels will generate notable reflectance or hazard effects for road users within the study area.

1.3 ASSESSMENT OF AVIATION RECEPTORS

1.3.1 Identification of Relevant Aviation Receptors

In accordance with current IAA and DAA protocol 10 km and 15 km radius study areas were established for the identification of IAA registered aerodromes and main airports respectively, that might require testing for glint and glare impacts. However, there are no IAA registered aerodromes within the 10 km aviation study area and neither of DAA's Dublin or Cork airports occur within 15 km of the proposed solar development. For these reasons, no further aviation analysis was undertaken.

Furthermore, the Planning and Development (Solar Safeguarding Zone) Regulations 2022 set out 43 Solar Safeguarding Zones (SSZs). A SSZ is an area around an airport, aerodrome or helipad in which there is a potential for glint or glare from solar panels to impact aviation safety. The proposed development is not located within any of the defined SSZs, and therefore, an aviation-based glint and glare analysis was scoped out for further assessment.

1.4 OVERALL CONCLUSION

From the analysis and discussions contained herein, it is considered that there will not be any notable reflectance effects from glint and glare at dwellings within the study area. It is also considered that there will not be any hazardous glint and glare effects upon road receptors resulting from the proposed Bonniconlon Solar Development.

APPENDIX A: RESULTS OF GLINT AND GLARE ASSESSMENT - DWELLING RECEPTORS

The results tables set out the days of the year and the times of the day that glint and glare effects could theoretically be experienced for each residential receptor within the study area. It is important to note that the analysis assumes that the sun will be shining at all times without cloud cover, thus the output periods in the context of the Irish climate could be considered to be significantly exaggerated.

APPENDIX B: RESULTS OF GLINT AND GLARE ASSESSMENT - TRANSPORT RECEPTORS

The results tables set out the days of the year and the times of the day that glint and glare effects could theoretically be experienced for each residential receptor within the study area. It is important to note that the analysis assumes that the sun will be shining at all times without cloud cover, thus the output periods in the context of the Irish climate could be considered to be significantly exaggerated.

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APPENDIX C: GEOMETRIC ASSESSMENT RESULTS – DWELLING RECEPTORS

Note 1: Only those dwellings have been included where an episode of glint and glare has been predicted when taking account of the existing non-landform screening (vegetation and buildings). If a dwelling receptor is not present, it has been determined that glint and glare is unlikely given current levels of screening inherent in the surrounding landscape. See Appendix A for the full list of results for all dwellings in tabular format.

Note 2: Yellow panels are those that have potential to generate reflectance, but not all at once.

Note 3: Unlike for Appendix A, in Appendix C glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

APPENDIX D: GEOMETRIC ASSESSMENT RESULTS – TRANSPORT RECEPTORS

Note 1: Only those transport route receptors have been included where an episode of glint and glare has been recorded when taking account of the existing non-landform screening (vegetation and buildings). If a route receptor is not present, it has been determined that glint and glare is unlikely given current levels of screening inherent in the surrounding landscape. See Appendix B for the full list of results for all transport route receptors in tabular format.

Note 2: Yellow panels are those that have potential to generate reflectance, but not all at once.

Note 3: Unlike for Appendix B, in Appendix D glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H01										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H02		April	3	6	2	8:30 a.m. - 9:00 a.m.	6			Tot days: 7 1.9% days Tot mins: 14 Max mins: 2 Avg mins: 2	Tot days: 7 1.9% days Tot mins: 14 Max mins: 2 Avg mins: 2
		August	1	2	2	8:30 a.m. - 9:00 a.m.	2				
		September	3	6	2	8:30 a.m. - 9:00 a.m.	6				

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H03										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H04										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H05										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H06a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H06b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H07a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H07b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H08a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H08b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H09										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H10a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H10b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H11a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H11b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H12										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H13										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H14										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H15a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H15b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H16a										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H16b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H17										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H18										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H19a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H19b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH Tot Days	PER MONTH Tot Mins	PER MONTH Avg Mins	MORNING Period	MORNING Tot Mins	EVENING Period	EVENING Tot Mins	WITHOUT SCREENING	WITH EXISTING SCREENING
H20										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH Tot Days	PER MONTH Tot Mins	PER MONTH Avg Mins	MORNING Period	MORNING Tot Mins	EVENING Period	EVENING Tot Mins	WITHOUT SCREENING	WITH EXISTING SCREENING
H21a										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH Tot Days	PER MONTH Tot Mins	PER MONTH Avg Mins	MORNING Period	MORNING Tot Mins	EVENING Period	EVENING Tot Mins	WITHOUT SCREENING	WITH EXISTING SCREENING
H21b	2 of 2	May	3	6	2			8:00 p.m. - 8:30 p.m.	6	Tot days: 6	Tot days: 0
		July	3	6	2			8:30 p.m. - 9:00 p.m.	6	1.6% days Tot mins: 12 Max mins: 2 Avg mins: 2	Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H22		April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 5	Tot days: 0
		August	3	6	2	8:30 a.m. - 9:00 a.m.	6			1.4% days	
										Tot mins: 10	Tot mins: 0
										Max mins: 2	
										Avg mins: 2	

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H23		May	2	8	4	8:30 a.m. - 9:00 a.m.	8			Tot days: 5	Tot days: 0
		August	3	6	2	8:30 a.m. - 9:00 a.m.	6			1.4% days	
										Tot mins: 14	Tot mins: 0
										Max mins: 4	
										Avg mins: 2.8	

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H24		June	22	50	2.3	8:30 a.m. - 9:00 a.m.	50			Tot days: 24	Tot days: 0
		July	2	4	2	8:30 a.m. - 9:00 a.m.	4			6.6% days	
										Tot mins: 54	Tot mins: 0
										Max mins: 4	
										Avg mins: 2.25	

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H25a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H25b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H26										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H27a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H27b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R01	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 3
	August	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.1% days	0.8% days
									Tot mins: 8	Tot mins: 6
									Max mins: 2	Max mins: 2
									Avg mins: 2	Avg mins: 2

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R02	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 0
	August	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.1% days	
									Tot mins: 8	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R03	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 0
	August	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.1% days	
									Tot mins: 8	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R04	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 5	Tot days: 0
	August	3	6	2	8:30 a.m. - 9:00 a.m.	6			1.4% days	
									Tot mins: 10	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R05	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 2
	August	2	6	3	8:30 a.m. - 9:00 a.m.	6			1.1% days	0.5% days
									Tot mins: 10	Tot mins: 4
									Max mins: 4	Max mins: 2
									Avg mins: 2.5	Avg mins: 2

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R06	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 0
	September	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.1% days	
									Tot mins: 8	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R07	April	3	6	2	8:30 a.m. - 9:00 a.m.	6			Tot days: 5	Tot days: 5
	September	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.4% days	1.4% days
									Tot mins: 10	Tot mins: 10
									Max mins: 2	Max mins: 2
									Avg mins: 2	Avg mins: 2

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R08	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 4
	September	2	4	2	8:00 a.m. - 8:30 a.m.	4			1.1% days	1.1% days
									Tot mins: 8	Tot mins: 8
									Max mins: 2	Max mins: 2
									Avg mins: 2	Avg mins: 2

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R09	April	3	6	2	8:30 a.m. - 9:00 a.m.	6			Tot days: 5	Tot days: 0
	September	2	4	2	8:00 a.m. - 8:30 a.m.	4			1.4% days	
									Tot mins: 10	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R10	April	3	8	2.7	8:30 a.m. - 9:00 a.m.	8			Tot days: 6	Tot days: 0
	September	3	6	2	8:00 a.m. - 8:30 a.m.	6			1.6% days	
									Tot mins: 14	Tot mins: 0
									Max mins: 4	
									Avg mins: 2.33	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R11	April	3	6	2	8:30 a.m. - 9:00 a.m.	6			Tot days: 6	Tot days: 6
	September	3	10	3.3	8:00 a.m. - 9:00 a.m.	10			1.6% days	1.6% days
									Tot mins: 16	Tot mins: 16
									Max mins: 4	Max mins: 4
									Avg mins: 2.67	Avg mins: 2.67

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R12	April	3	6	2	8:30 a.m. - 9:00 a.m.	6			Tot days: 7	Tot days: 7
	August	4	8	2	8:30 a.m. - 9:00 a.m.	8			1.9% days	1.9% days
									Tot mins: 14	Tot mins: 14
									Max mins: 2	Max mins: 2
									Avg mins: 2	Avg mins: 2

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R13	April	5	12	2.4	8:00 a.m. - 8:30 a.m.	12			Tot days: 10	Tot days: 0
	August	5	10	2	8:30 a.m. - 9:00 a.m.	10			2.7% days	
									Tot mins: 22	Tot mins: 0
									Max mins: 4	
									Avg mins: 2.2	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R14	May	8	22	2.8	8:00 a.m. - 8:30 a.m.	22			Tot days: 16	Tot days: 0
	August	8	16	2	8:30 a.m. - 9:00 a.m.	16			4.4% days	
									Tot mins: 38	Tot mins: 0
									Max mins: 4	
									Avg mins: 2.38	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R15	June	22	44	2	8:30 a.m. - 9:00 a.m.	44			Tot days: 24	Tot days: 24
	July	2	4	2	8:30 a.m. - 9:00 a.m.	4			6.6% days	6.6% days
									Tot mins: 48	Tot mins: 48
									Max mins: 2	Max mins: 2
									Avg mins: 2	Avg mins: 2

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R16 to R19									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R20	May	7	18	2.6			8:00 p.m. - 8:30 p.m.	18	Tot days: 15	Tot days: 6
	July	8	20	2.5			8:30 p.m. - 9:00 p.m.	20	4.1% days Tot mins: 38 Max mins: 4 Avg mins: 2.53	1.6% days Tot mins: 12 Max mins: 2 Avg mins: 2

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R21 to R31									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R32	April	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot days: 4	Tot days: 0
	August	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.1% days	
									Tot mins: 8	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R33	April	1	2	2	8:30 a.m. - 9:00 a.m.	2			Tot days: 4	Tot days: 0
	May	1	2	2	8:30 a.m. - 9:00 a.m.	2			1.1% days	
	August	2	4	2	8:30 a.m. - 9:00 a.m.	4			Tot mins: 8	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R34	May	2	6	3	8:30 a.m. - 9:00 a.m.	6			Tot days: 4	Tot days: 0
	August	2	4	2	8:30 a.m. - 9:00 a.m.	4			1.1% days	
									Tot mins: 10	Tot mins: 0
									Max mins: 4	
									Avg mins: 2.5	

Appendix B - Road Receptor Results

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R35	May	5	10	2	8:30 a.m. - 9:00 a.m.	10			Tot days: 9	Tot days: 0
	July	4	8	2	8:30 a.m. - 9:00 a.m.	8			2.5% days	
									Tot mins: 18	Tot mins: 0
									Max mins: 2	
									Avg mins: 2	

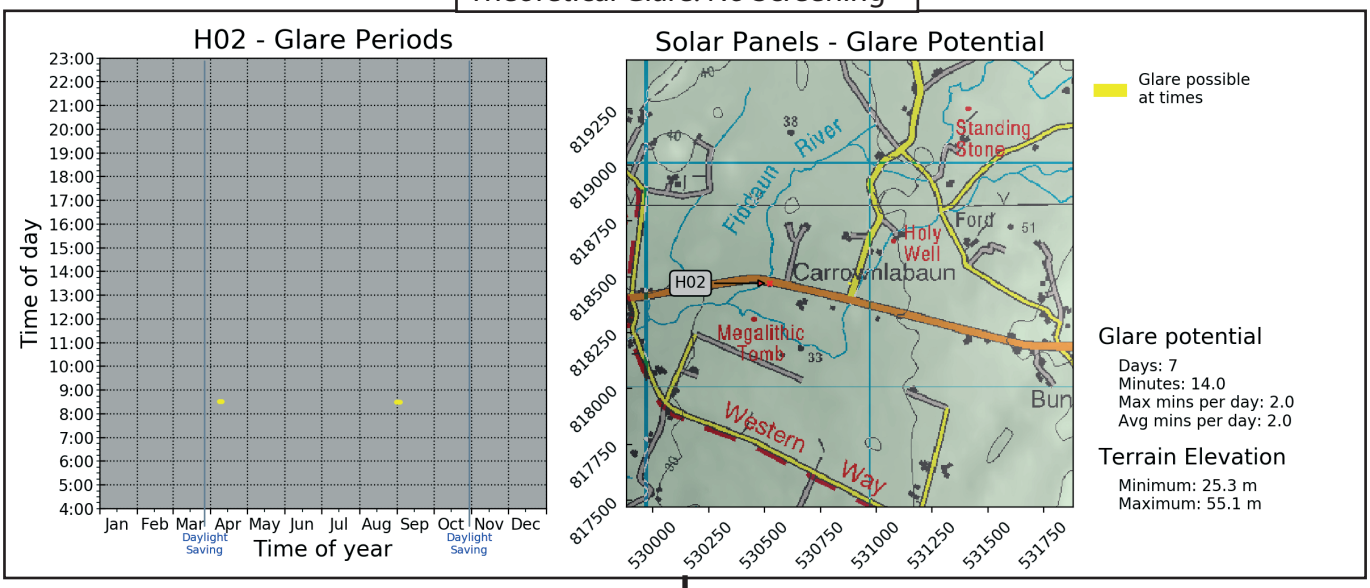
Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R36	June	22	50	2.3	8:30 a.m. - 9:00 a.m.	50			Tot days: 24	Tot days: 0
	July	2	4	2	8:30 a.m. - 9:00 a.m.	4			6.6% days	
									Tot mins: 54	Tot mins: 0
									Max mins: 4	
									Avg mins: 2.25	

Receptor		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R37									Tot days: 0	Tot days: 0
to										
R38									Tot mins: 0	Tot mins: 0

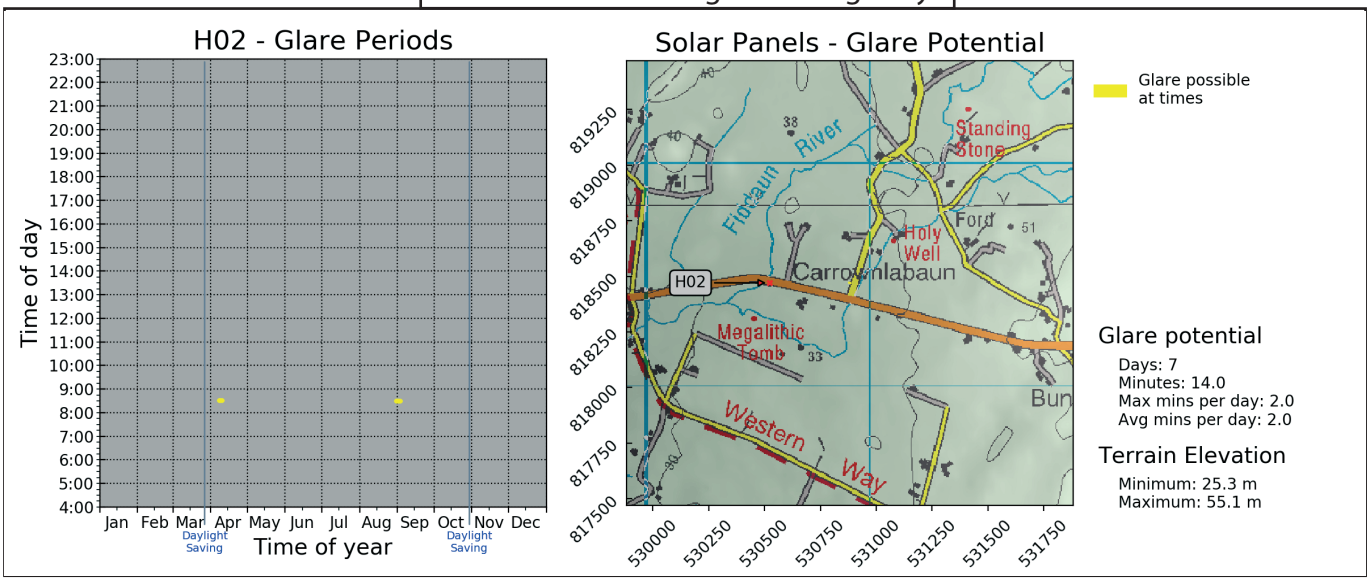
Appendix C - Glare Periods - Dwelling Receptors

Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



Actual Glare: Existing Screening Only

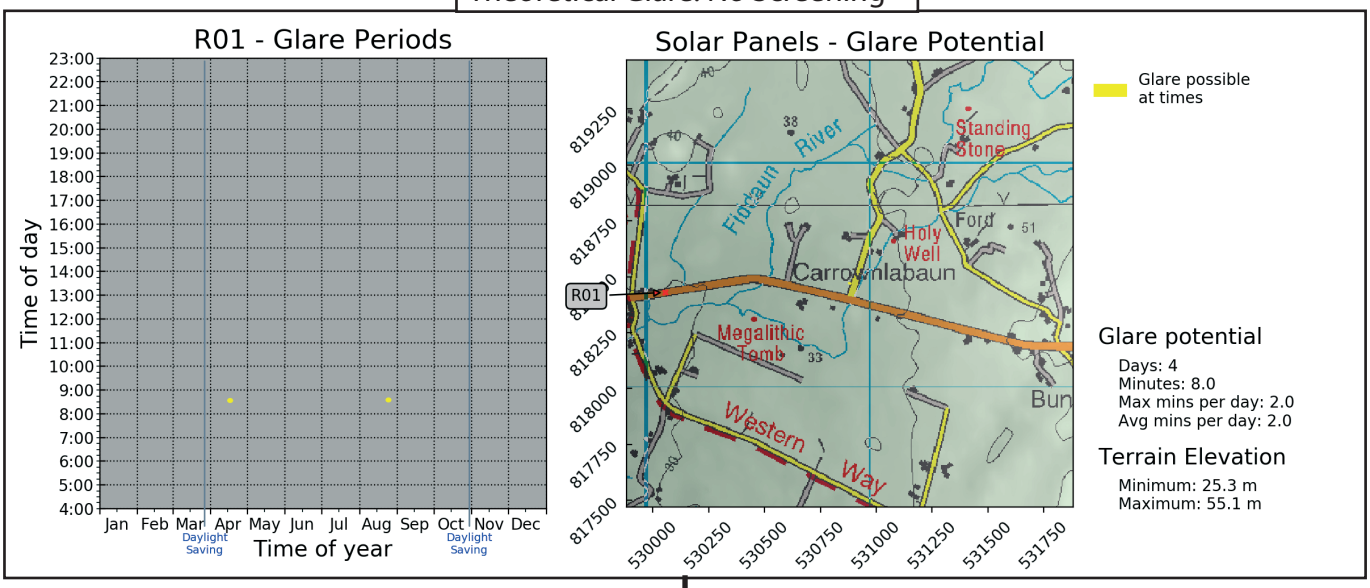


Note: the use of 'a' and 'b' in a receptor name indicates the lower and upper floor respectively of a 2-storey dwelling

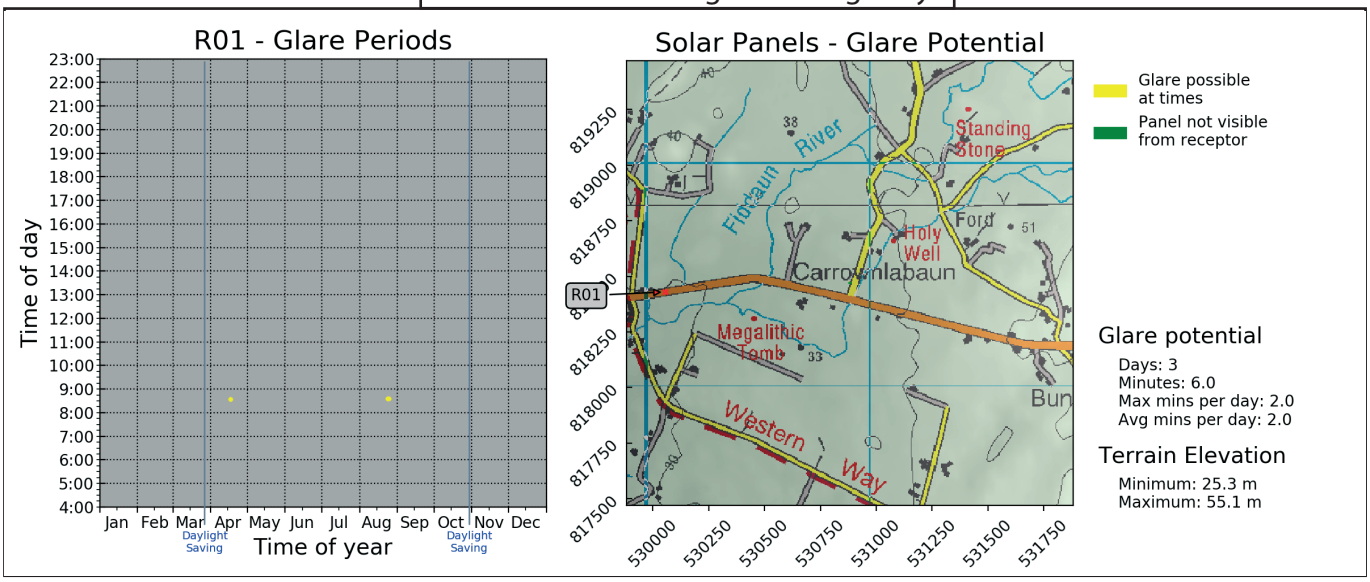
Appendix D - Glare Periods - Road Receptors

Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



Actual Glare: Existing Screening Only

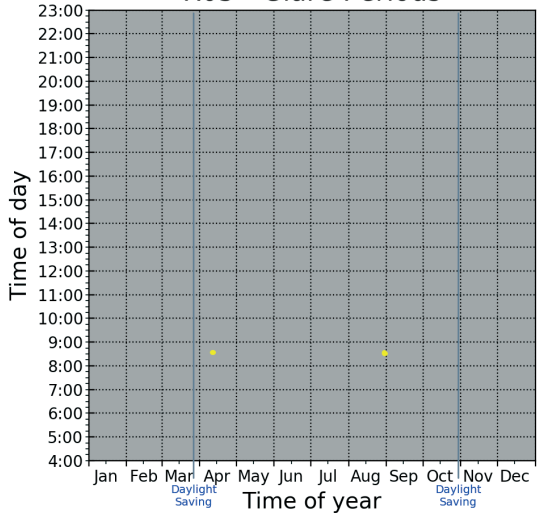


Appendix D - Glare Periods - Road Receptors

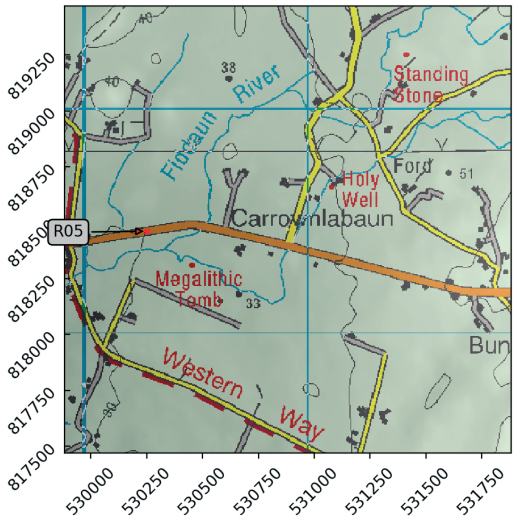
Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening

R05 - Glare Periods



Solar Panels - Glare Potential



Glare possible at times
Sun reflection does not affect receptor

Glare potential

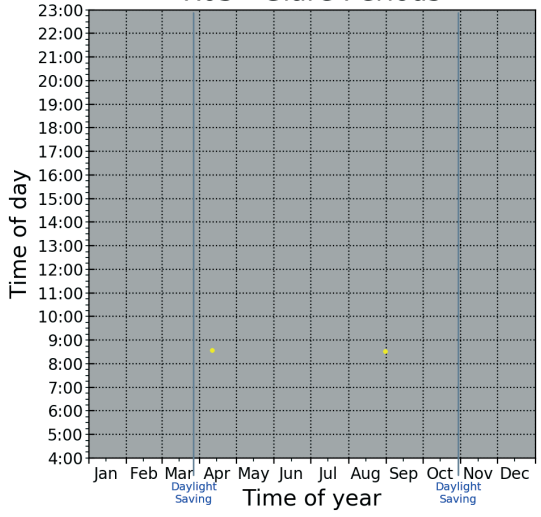
Days: 4
Minutes: 10.0
Max mins per day: 4.0
Avg mins per day: 2.5

Terrain Elevation

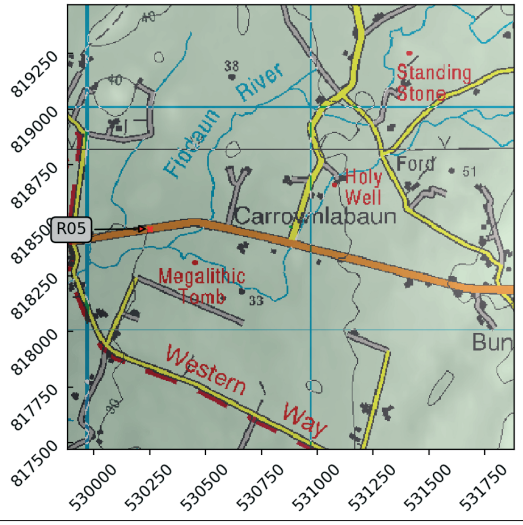
Minimum: 25.3 m
Maximum: 55.1 m

Actual Glare: Existing Screening Only

R05 - Glare Periods



Solar Panels - Glare Potential



Glare possible at times
Panel not visible from receptor

Glare potential

Days: 2
Minutes: 4.0
Max mins per day: 2.0
Avg mins per day: 2.0

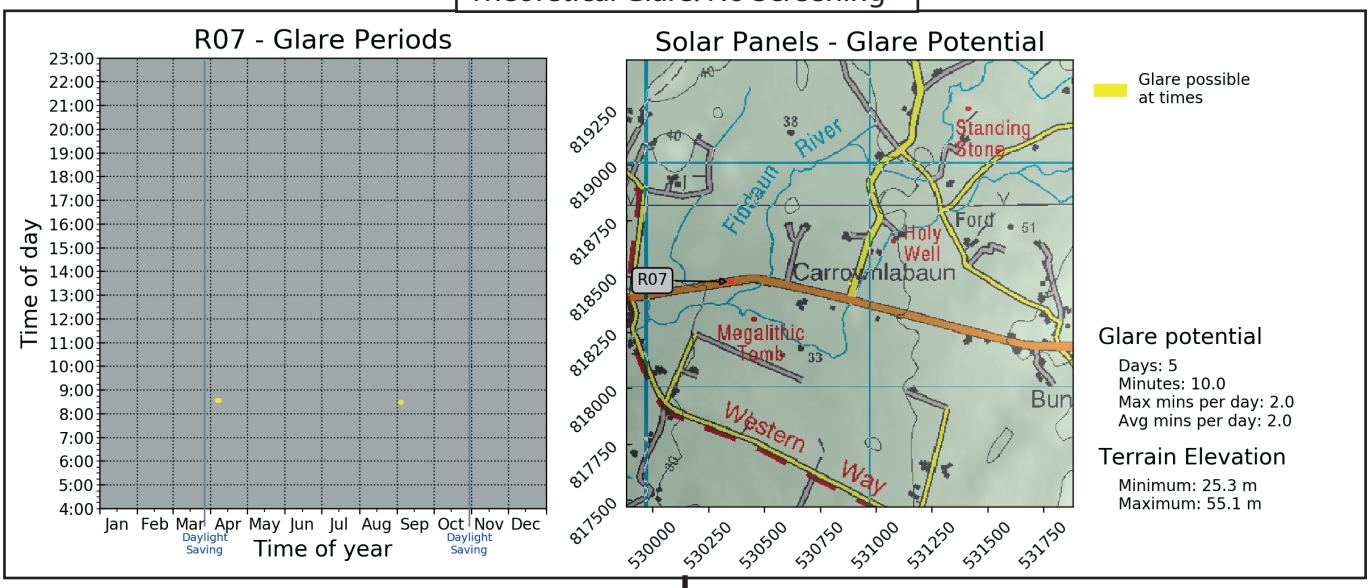
Terrain Elevation

Minimum: 25.3 m
Maximum: 55.1 m

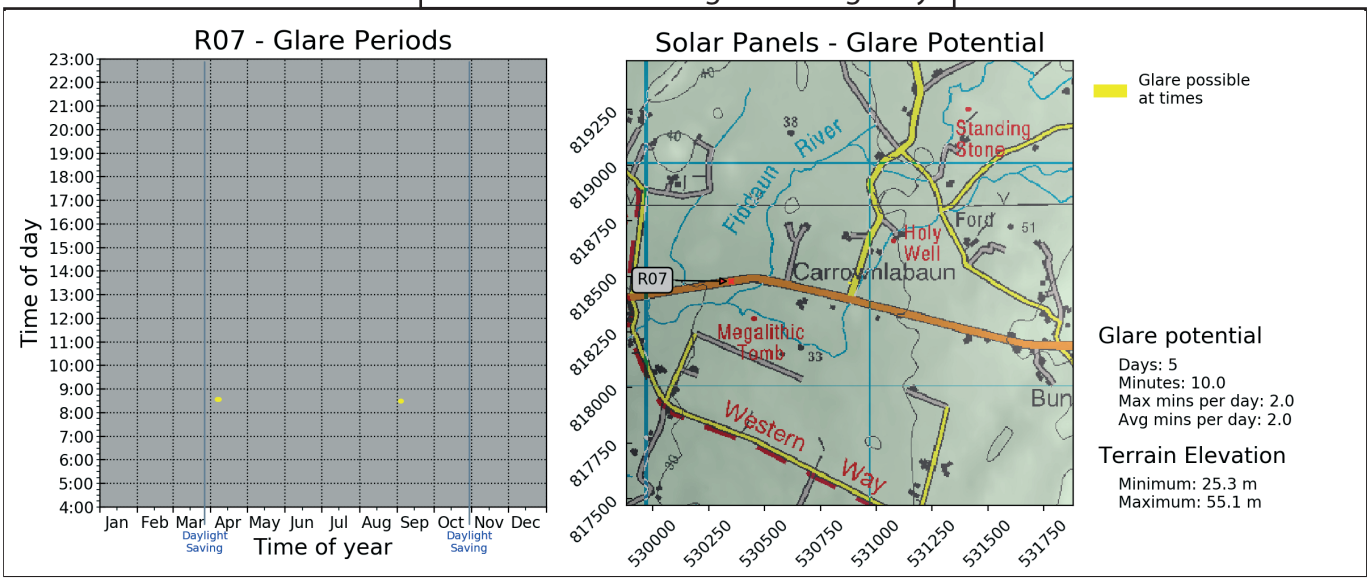
Appendix D - Glare Periods - Road Receptors

Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



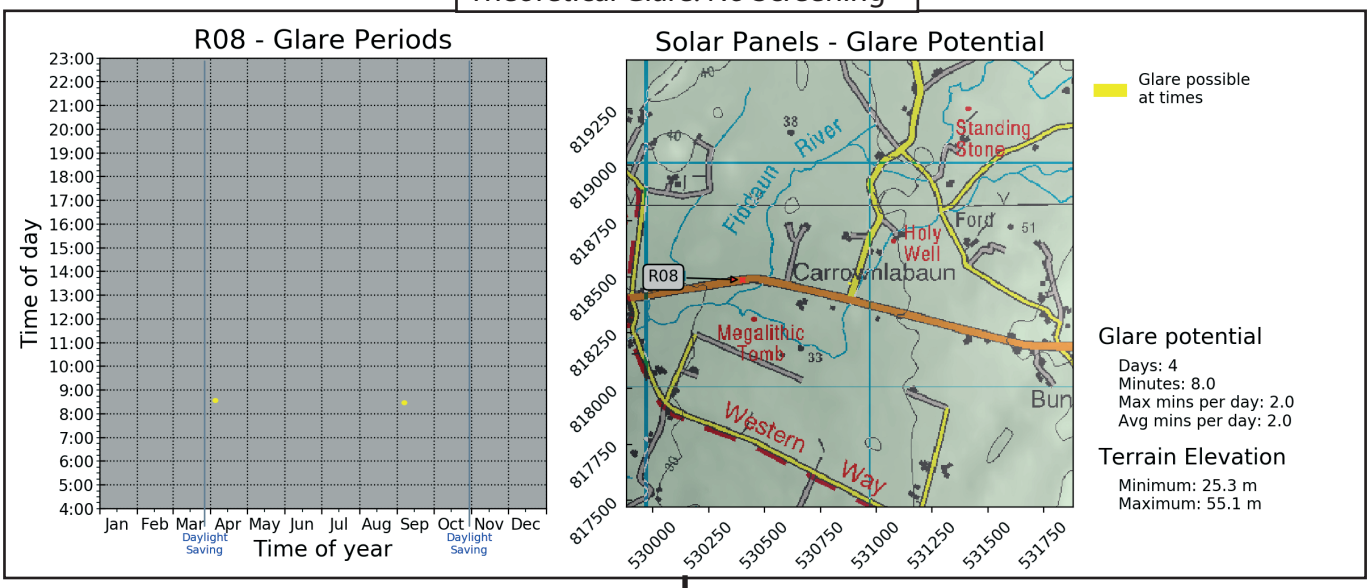
Actual Glare: Existing Screening Only



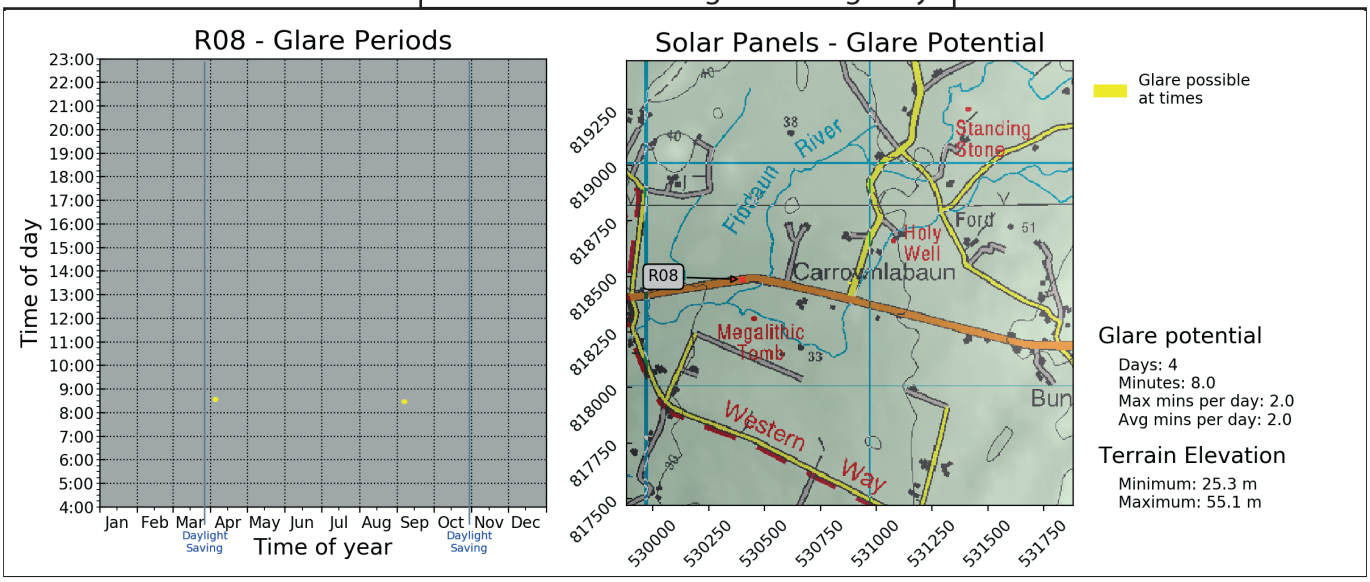
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Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



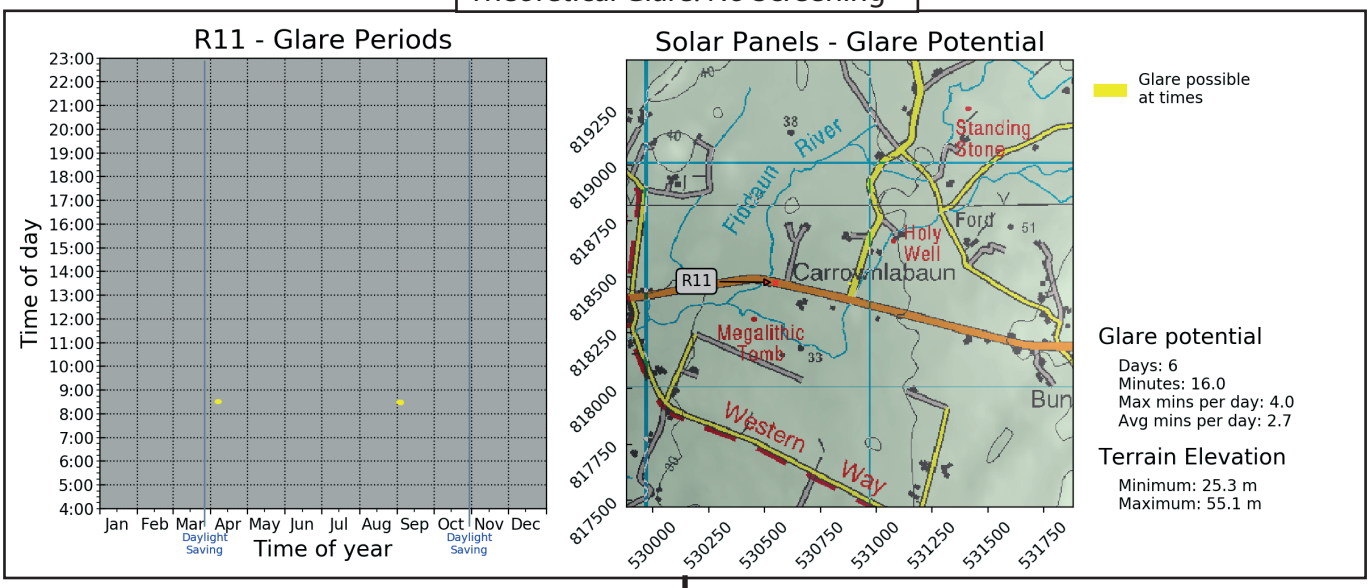
Actual Glare: Existing Screening Only



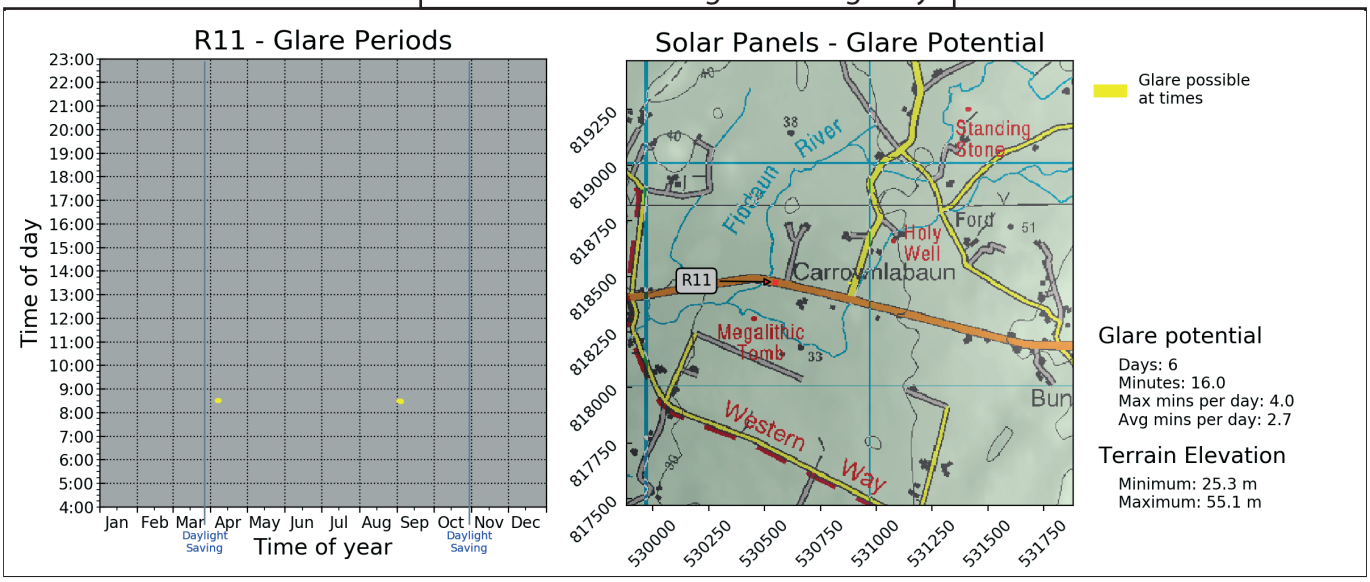
Appendix D - Glare Periods - Road Receptors

Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



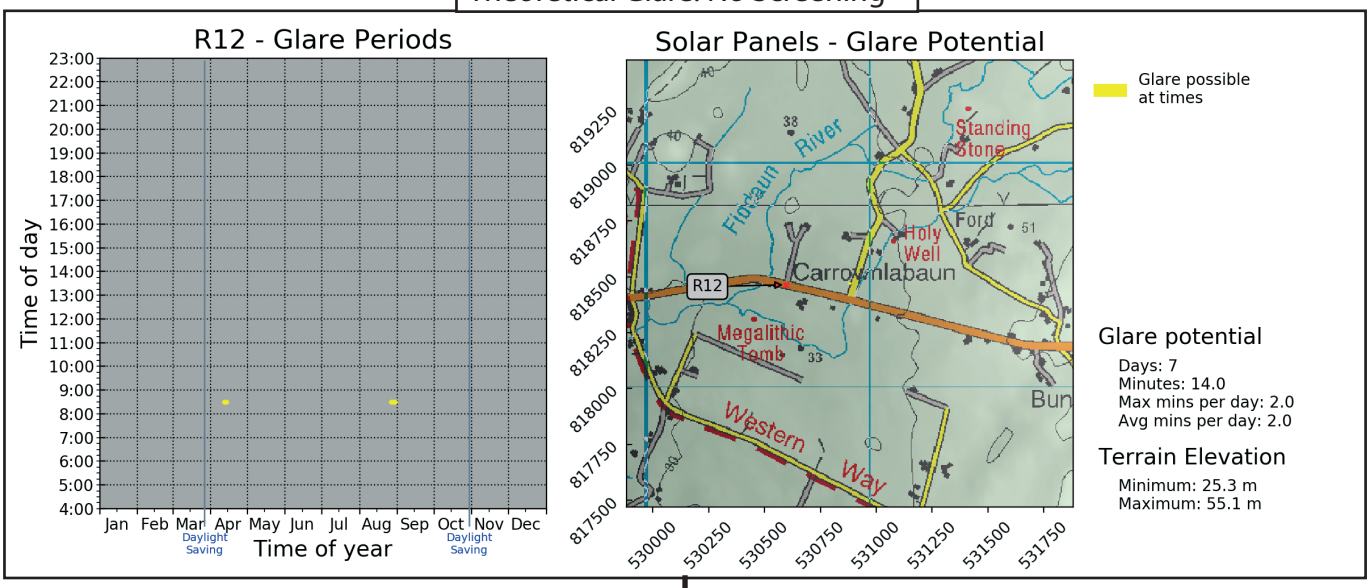
Actual Glare: Existing Screening Only



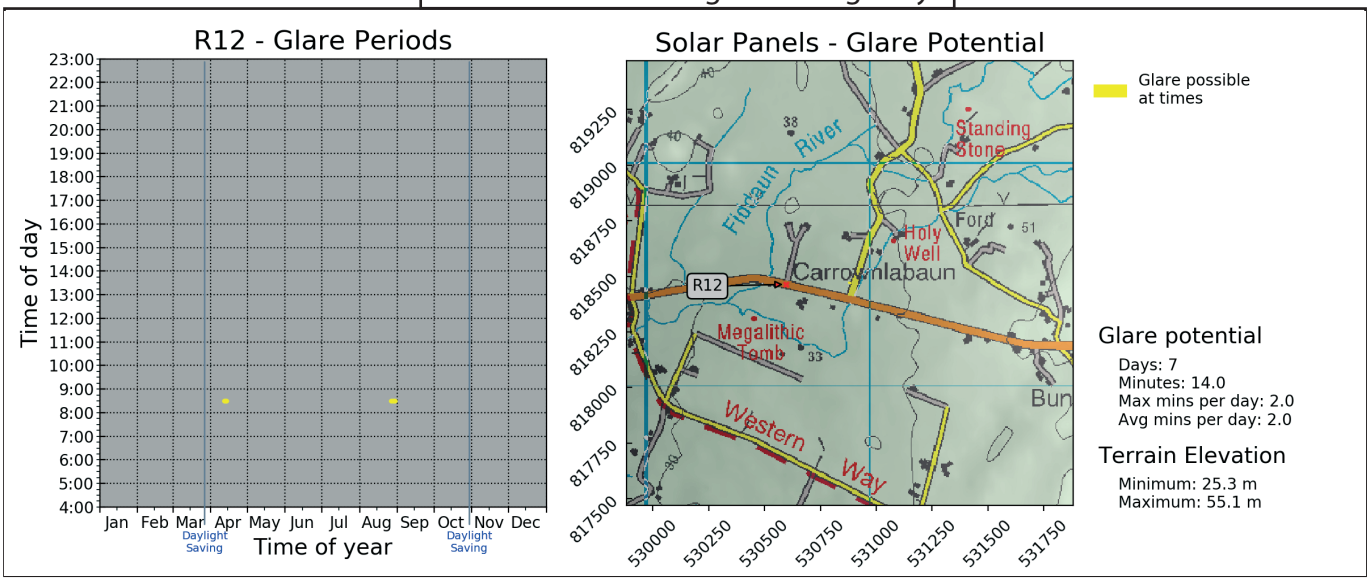
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Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



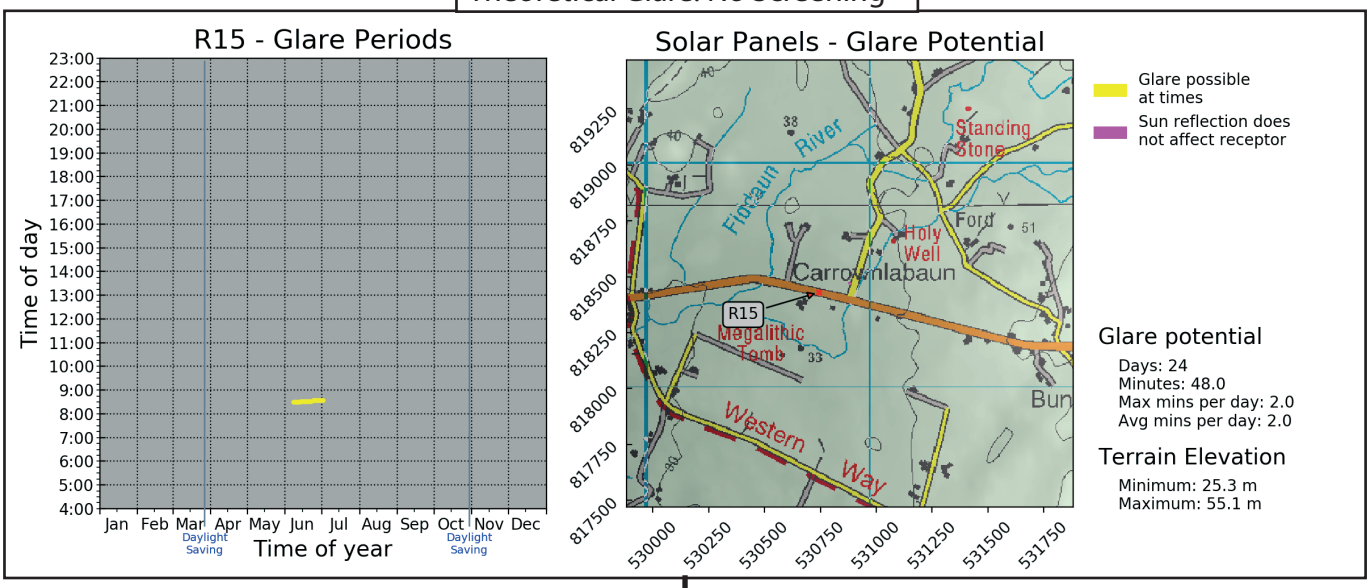
Actual Glare: Existing Screening Only



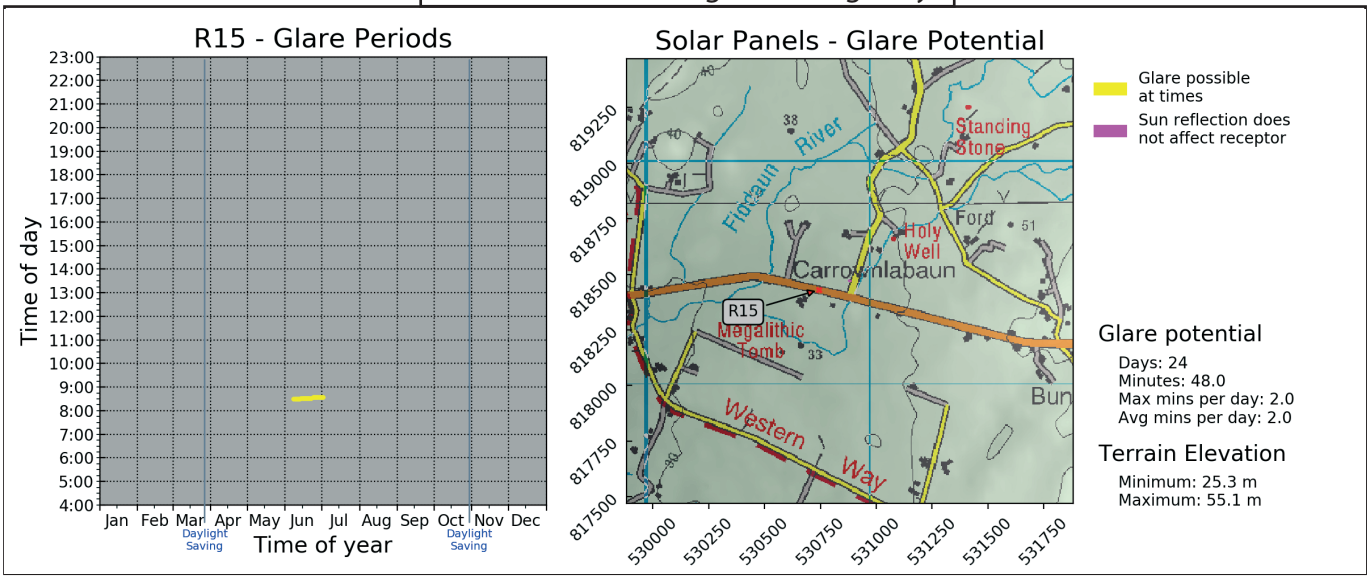
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Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



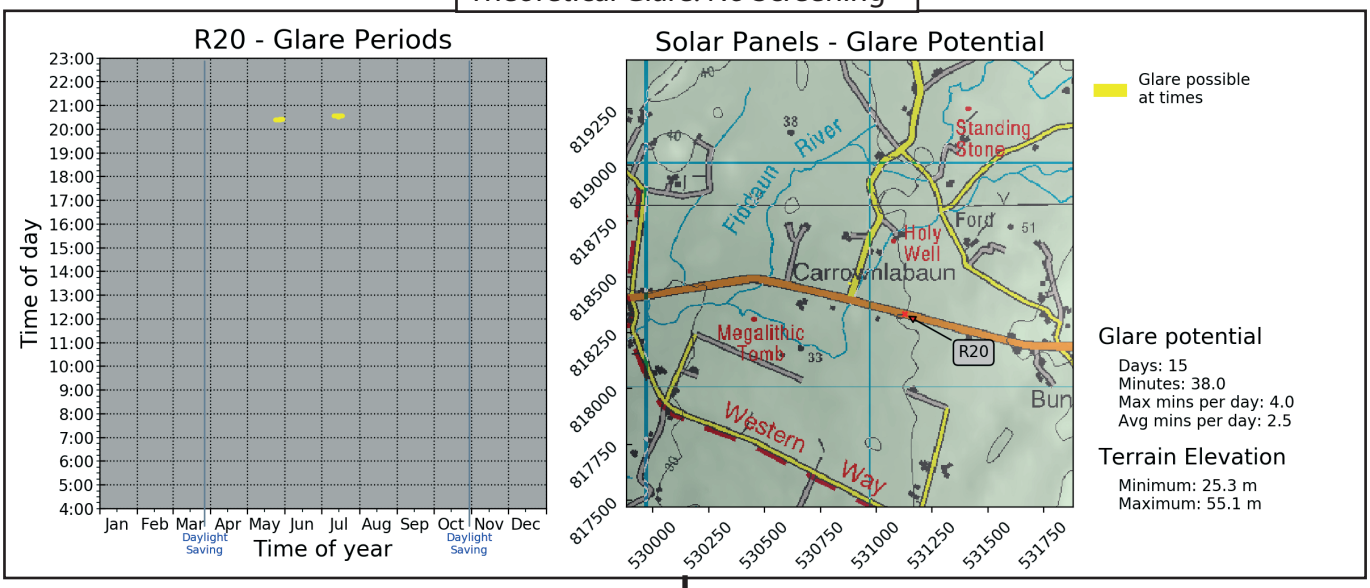
Actual Glare: Existing Screening Only



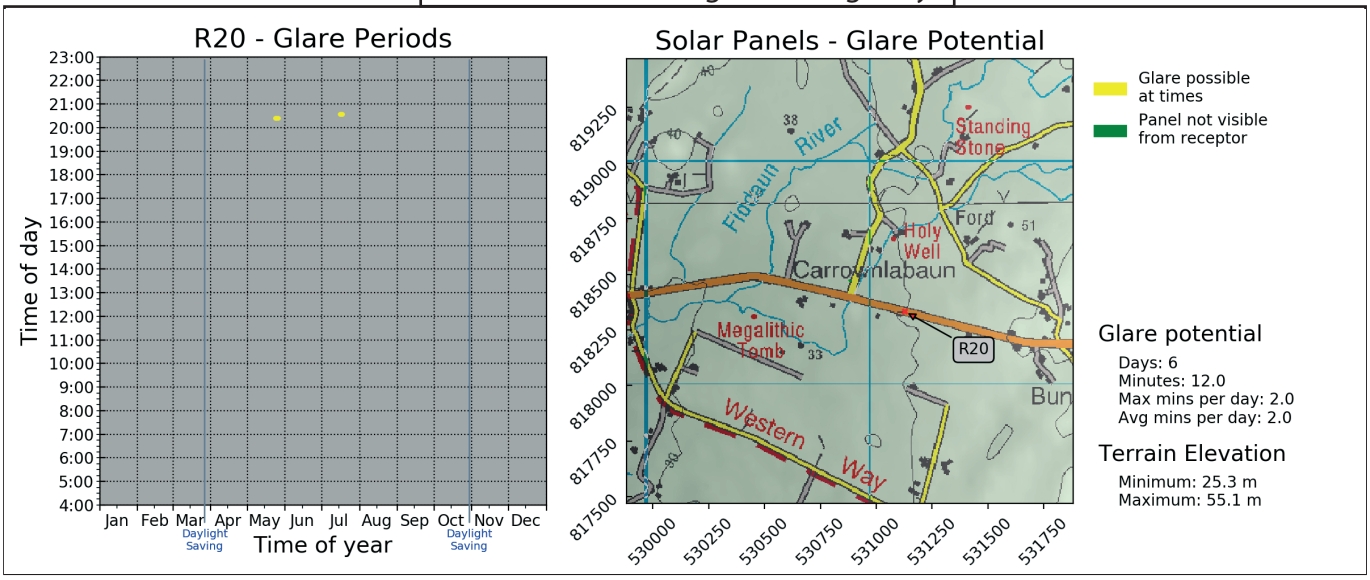
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Only includes receptors with potential for glare after existing screening has been accounted for.
Glare periods where the glaring panels are within 10 degrees of the shining sun have been included.

Theoretical Glare: No Screening



Actual Glare: Existing Screening Only



macroworks

GLINT AND GLARE ASSESSMENT

Proposed Solar PV Installation

Lisglennon, Co. Mayo.

Prepared by Macro Works Ltd

May 2026



1. GLINT AND GLARE ASSESSMENT 3

1.1 Introduction 3

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1.3 Assessment of Aviation Receptors 17

1.4 Overall Conclusion 17

Appendix A: Results of Glint and Glare Assessment - Dwelling Receptors A

Appendix B: Results of Glint and Glare Assessment - Transport Receptors B

Registered Landscape Architect

1. GLINT AND GLARE ASSESSMENT

1.1 INTRODUCTION

This Glint and Glare Assessment was carried out by Macro Works Ltd to determine the potential for solar reflectance effects upon dwelling and transport route receptors in respect of the proposed solar PV installations on the roof of a proposed and an existing reservoir building, as well as ground mounted panels at Lisglennon, Co. Mayo. The proposed reservoir will have a maximum height of 4.2m above the terrain level, with the roof of the existing building sitting 2.8m above the ground. The proposed panels will have a height of approximately 1m and will be tilted at an angle of 35 degrees towards the south.

1.1.1 Statement of Authority

Macro Works' relevant experience includes twenty years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments. The Glint and Glare analysis model used in this study for non-aviation receptors was developed by Macro Works in conjunction with the National University of Ireland, (NUI) Maynooth. It has successfully replicated results from the Federal Aviation Administration (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) software and has been utilised to assess the effects of glint and glare for many solar development sites throughout Ireland to date.

1.1.2 Guidance and Best Practice

There is currently no specific guidance or standards for the assessment of photovoltaic glint and glare effects on residential and/or route (road and rail) receptors in Ireland. Guidance has been prepared, however, by the Federal Aviation Administration to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority. This guidance, concerned with hazard assessment, has relevance to the other receptor types mentioned, and coupled with numerous assessments already carried out across the UK, combine to establish a suitable best practice for solar development.

By virtue of their efficiency, the intensity of reflected light from modern PV solar panels is deliberately low and currently equates with that of the reflection from still water. Recent studies generally agree, however, that there still exists the potential for hazard or reflectance upon surrounding receptors. Macro Works' glint and glare analysis methods and determination of effects are based on a combination of available studies and established best practice. This methodology has been successfully implemented on numerous previous solar farm projects that met with the approval of both Planning Authorities and An Coimisiún Pleanála.

1.1.3 Definitions

The study is concerned with the potential reflectance and hazard effects of glint and glare in relation to receptors that include the occupants of surrounding dwellings as well as road and rail users. In its "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[1] the FAA have defined the terms 'Glint' and 'Glare' as meaning;

1 Federal Aviation Administration (FAA) 2018. Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at: https://www.faa.gov/sites/faa.gov/files/airports/environmental/FAA-Airport-Solar-Guide-2018.pdf

Glint – "A momentary flash of bright light"

Glare – "A continuous source of bright light"

Glint and glare are essentially the reflection of sunlight from reflective surfaces. This study uses a multi-step process of elimination to determine which receptors have the potential to experience the effects of glint and glare. It then examines, using a computer-generated geometric model, the times of the year and the times of the day such effects could occur. This is based on the relative angles between the sun, the panels and the receptor throughout the year.

1.1.4 General Nature of Reflectance from Photovoltaic Panels

In terms of reflectance, photovoltaic solar panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Nonetheless, photovoltaic panels have a flat, polished surface, which emits 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface (Figure 1.1 refers). Several studies have shown that photovoltaic panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than the likes of glass, steel, snow and white concrete by comparison (Figure 1.2 refers). Similar levels of reflectance can be found in common situations in rural environments from surfaces such as shed roofs, lines of plastic ground covering used in cropping and wet roads to name but a few (Figure 1.3 - Figure 1.5 refer).

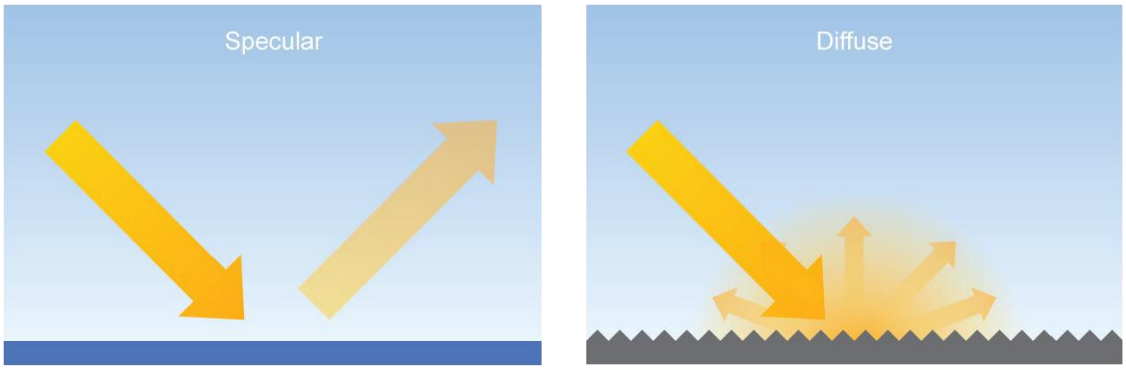


Figure 1.1: Specular vs Diffuse reflection of light from polished and rough surfaces.

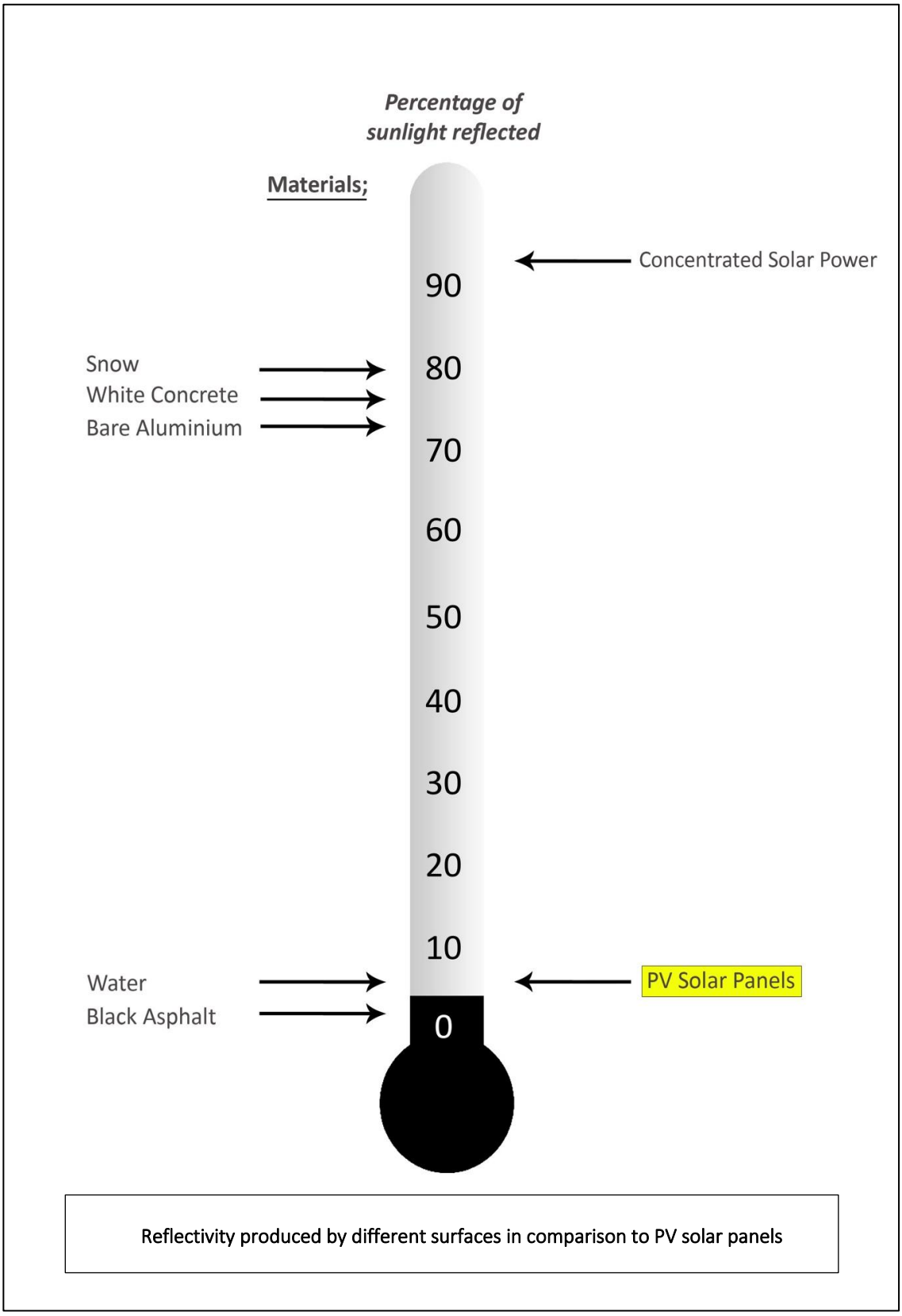


Figure 1.2: Demonstrates that the amount of sunlight (measured in watts per meter -W/m2) reflected from the surface of a solar panel is very similar to that of still water and is far less than that of many surfaces commonly found in the environment, urban or rural.



Figure 1.3: Similar level of reflectance (to photovoltaic panels) emanating from plastic ground covering in an Irish rural scenario.



Figure 1.4: Similar levels of reflectance (to photovoltaic panels) emanating from wet road surfaces.



Figure 1.5: Higher levels of reflectance (to photovoltaic panels) emanating from powder coated corrugated metal roof surfaces in an Irish rural scenario.

1.2 ASSESSMENT OF GROUND-BASED RECEPTORS

1.2.1 Assessment Methodology for Ground-Base Receptors

Macro Works' glint and glare assessment methodology follows a rational sequence of steps to identify receptors that might potentially be affected by glint and glare. These are then further filtered to yield those receptors to those that are likely to actually experience such effects. These steps are set out below;

1. Identify study area within which to assess the potential for glint and glare effects. The potential for substantial reflectance or hazardous impacts are greatest in close proximity to the source of reflectance and the potential for adverse impacts reduces with increased distances therefore to balance these factors a buffer extent of 1km from the site boundary is used by default on all solar developments.

2. Pre-analyse the study area for potential glare effects by populating the study area with a regular grid of receptor points (100m spacing). This analysis (1st analysis) allows us to determine those areas theoretically exposed to glint and glare effects that might warrant further investigation. We call this the "Area of Consideration for Further Analysis". This pre-analysis is based on a 3D model of the development superimposed onto a Digital Terrain Model (DTM) of the study area. Note: This DTM accurately replicates the profile of the terrain but does not account for screening by the vegetation or buildings that are present – in this sense the results are somewhat theoretical but they do offer a representation of a bare-earth, worst-case scenario.

3. Identify relevant receptors (dwellings and transport routes) that fall within the theoretically affected zones of the study area (or the "Area of Consideration for Further Analysis"). Dwelling identification utilises a combination of up to date aerial photography and the Eircode Finder tool which locates and identifies buildings classed as residential. Transport route receptors are defined by regularly spaced points along roads and rail lines (50m spacing). The height of the road Receptor Points are set to 1.7m above ground level. This is broadly equivalent to the eye level a person walking or a driver of a 4x4 / SUV type vehicle. The height of rail Receptor Points are set to 2.8m above ground level to represent the eye level of a train driver.

4. Execute the glint and glare analysis on the DTM-based 3-D model (2nd analysis), in respect of each of the theoretically affected receptors. This identifies the times of the day and months of the year that glint and glare could potentially affect receptors in the absence of screening.

   Note: When the sun is situated within 10 degrees of a reflecting PV panel as viewed from a particular receptor, the sun will be a much greater source of glare than what emanates from the surface of the PV panel therefore any potential glare during these periods is excluded when assessing potential impacts.

5. Perform the same calculations (3rd analysis) using a high-resolution digital surface model (DSM) that accounts for the existing screening inherent on and surrounding the site at the time of capture. This offers a truer reflection of the actual glare that is likely to occur and highlights where landscape mitigation may be required.

   Note: A limitation of DSM data in the context of this assessment type is that it is a snapshot of the screening situation at the time of the data capture. This situation is broadly indicative as hedgerows are a semi-permanent feature of the Irish countryside, however, seasonal variation through growth and/or cutting may result in minor changes to their screening potential. A further limitation is due to the aerial overhead nature of data capture. This can result in the under-reporting of potential visibility beneath the tree or woodland canopy and can understate the visibly porous nature of some thin hedgerows. This can result in minor underestimating of glare periods. However, where the data is deemed to be significantly unreliable for the reasons stated, analysis is supplemented, where possible, with a thorough assessment of aerial photography, Google Street View imagery and on-site verification.

6. Where instances of glint and glare remain, determine whether they are likely to cause a hazard / reflectance. For dwellings, this is achieved by comparing the periods of glare potential with our 'Magnitude of Glint and Glare Effects' table, while transport routes are examined in further detail for potential for hazardous impacts.

7. If hazard / substantial reflectance is likely to occur, mitigation measures are proposed where possible. This might relate to the re-siting of particular panels and / or the provision of additional screening.

8. If necessary, re-run the glint and glare calculations (4th analysis) to verify the effectiveness of the proposed mitigation measures and determine if there are any residual glare impacts.

1.2.2 Magnitude of Impacts for Dwelling Receptors

Although there is currently no regulation or guidance as to acceptable levels of glint and glare effects at receptors in Ireland, it is considered necessary to provide a gauge for determining relative levels of impact across a range of development types. Macro Works has established the following indicative textual categories of effect, which are used herein to determine the relative impact levels (Table 1.1 refers). The percentage figures provided are intended as a relative guide only. The final category of assessment is determined on the basis of professional judgement, and accounts for mitigating factors where relevant and the careful consideration of a range of circumstantial variables that may act to intensify or reduce the effect upon a particular receptor.

Note: The magnitude of glint and glare effects in Table 1.1 relates only to static receptors such as residential dwelling. As road receptors are moving objects and will only ever have the potential to experience momentary reflectance periods, the following impact magnitudes are not considered relevant for road receptors. Instead, road receptors will be assessed on whether periods of reflectance have the potential to generate significant reflectance or hazard effects.

Table 1.1 Magnitude of Glint and Glare Effects

Magnitude of Impact	Description
Very High	Hazard / reflectance effects emanating from highly reflective surfaces (>50% sunlight reflection) for most of the year (>70% / 255 days) and for significant periods of each day (>45 mins).
High	Hazard / reflectance effects emanating from moderately reflective surfaces (>30% sunlight reflection) for the majority of days in a year (>50% / 182 days) and for substantial periods of each day (>30 mins).
Medium	Reflectance effects emanating from moderately/low reflective surfaces (>10% sunlight reflection) for a substantial number of days in a year (>30% / 109 days) and for substantial periods of each day (>20 mins).
Low	Reflectance effects emanating from low reflective surfaces (>5% sunlight reflection) for a modest number of days in a year (>10% / 36 days) and for notable periods of each day (>15 mins).
Very Low	Reflectance effects emanating from low reflective surfaces (>5% sunlight reflection) for a small number of days in a year (≤10% / 36 days) and for short periods of each day (<15 mins).
Negligible	Effects either not geometrically possible or barely measurable.

Important Note

It must be emphasised at this point that all results, whether from FAA endorsed SGHAT software or our own bespoke software, are theoretical by default in that they assume that the sun is always shining and at full intensity. The results do not account for climate and inherent weather patterns that occur across the island of Ireland.

Records from Met Éireann (The Irish Meteorological Service) indicate that "over the year as a whole, most areas get an average of between 3 1/4 and 3 3/4 hours of sunshine each day". It states that "the sunniest months are May and June. During these months, sunshine duration averages between 5 and 6.5 hours per day over most of the country"[2].

While we cannot correlate the historic random periods of sunshine with our predicted periods of glare, we can state with a high level of confidence that the weather, more precisely cloud cover, will account for a substantial reduction in all figures quoted in this report i.e. frequency and duration of glare periods.

In addition, atmospheric conditions such as haze, mist, fog and precipitation will all have the effect of both reducing the visibility of the site overall and reducing the intensity of any glare emanating from the proposed solar development.

1.2.3 Relevant Parameters of the Proposed Development

The photovoltaic panels are to be oriented in a south-facing direction to maximise solar gain and will remain in a fixed position throughout the day and year (i.e. they will not rotate to track the movement of the sun). The proposed panels will be installed on the roof of an existing reservoir building standing c. 2.8m above ground level, as well as on the roof of a proposed reservoir building which will have a height of 4.2m above the level of the terrain. There will also be a ground mounted array. Each of the panels will sit approximately 1m above the ground and will be tilted at a pitch of 35 degrees from horizontal towards the south. It is not geometrically possible for glare to occur in the terrain to the north of these south-facing PV panels; hence the 1 km study area does not extend to the north of the proposed PV panels.

The proposed development is located in the rural plains of County Mayo, c. 2.6km south of Kilalla. The study area comprises a gentle rolling agricultural landscape, made up of small to medium sized fields which are bounded by mature hedgerows and treelines. There are no notable watercourses within the study area. The area is served by a network of local roads. Settlement within the study area is sparse, with dispersed one-off rural dwellings along the local roads representing the predominant settlement pattern. The nearest dwelling to the proposed panels is located c. 200m to the north.

Due to the southerly orientation of the PV panels in the proposed solar development, ground-based receptors (houses and transport routes) situated to the west of the solar array can only be affected by morning reflectance, when the sun is rising in the east. Conversely, receptors situated to the east of the site and can only be affected by evening reflectance, when the sun is setting in the west.

Further, south facing panels in a landscape such as this result in a typical pattern of glare with potential glare impacts upon surrounding receptors occurring during the months February – October. This broadly represents the season where some or all foliage is present on vegetation. The assessment of the screening capacity of the surrounding vegetation in its winter state is therefore not necessary.

2 https://www.met.ie/climate/what-we-measure/sunshine



Figure 1.6: Map of proposed solar development site and the study area.

1.2.4 Assessment of Residential Receptors

1.2.4.1 Identification of Relevant Residential Receptors

Figure 1.7 - Figure 1.8 are output maps of the study area showing the results (areas of potential solar irradiance) of 1st phase reflectance analysis carried out on the proposed solar development. These account for the path of the sun throughout the entire year; the panel positions and parameters; the 3D terrain parameters. This is the starting point for determining which residential receptors have the geometric potential to be affected by glint and glare – in the absence of screening.

Note: The yellow buffer line around the reflectance pattern indicating 'Area of consideration for further analysis' on the output maps represents a precautionary approach of including dwellings at the fringe of potentially affected areas. It accounts for the fact that this 'first-filter' map is based on a sampling grid point density of 100m.

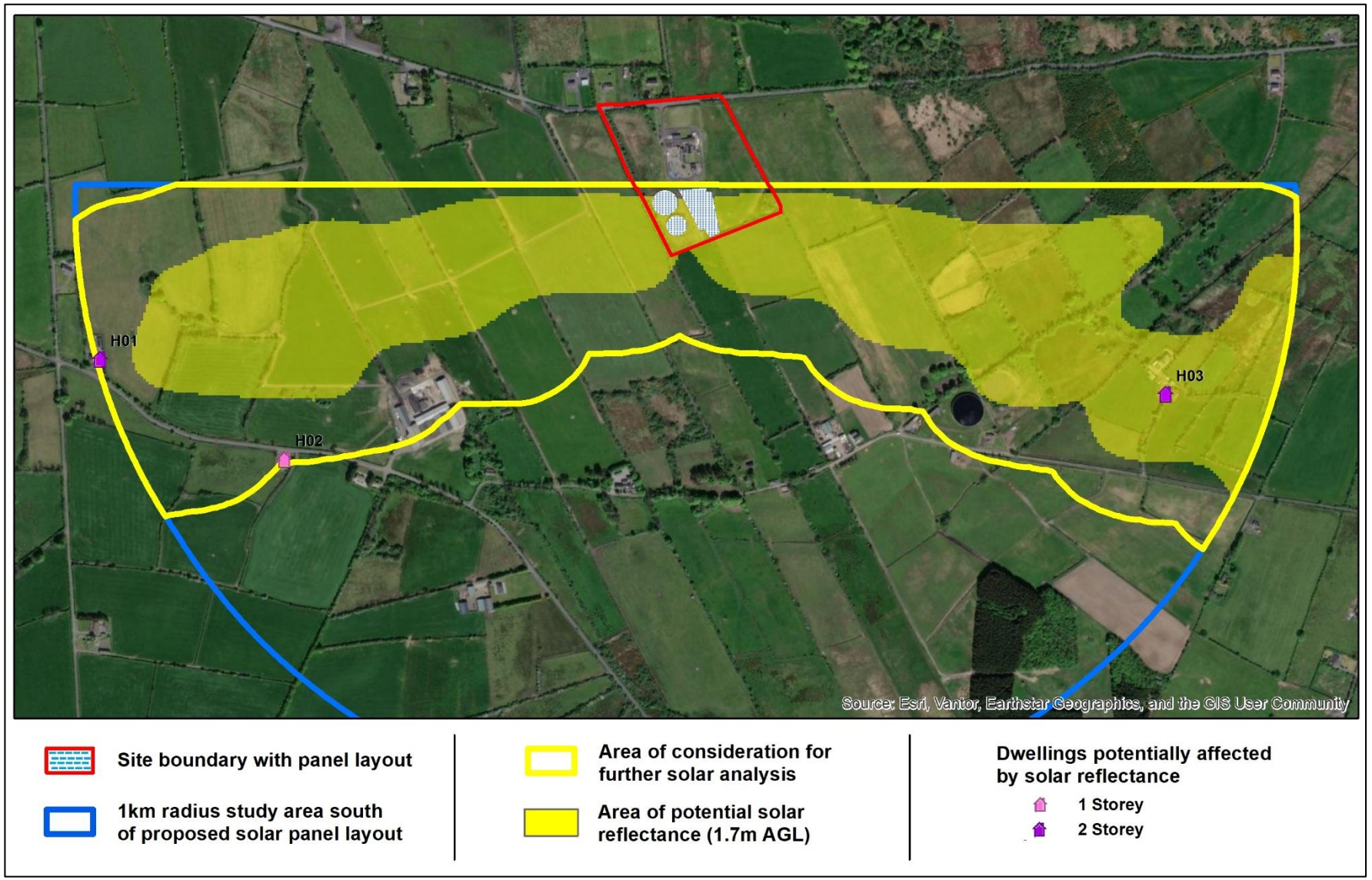


Figure 1.7 Parts of the study area where houses are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on a viewers' eye-level when standing on the ground floor = 1.7m above ground level.

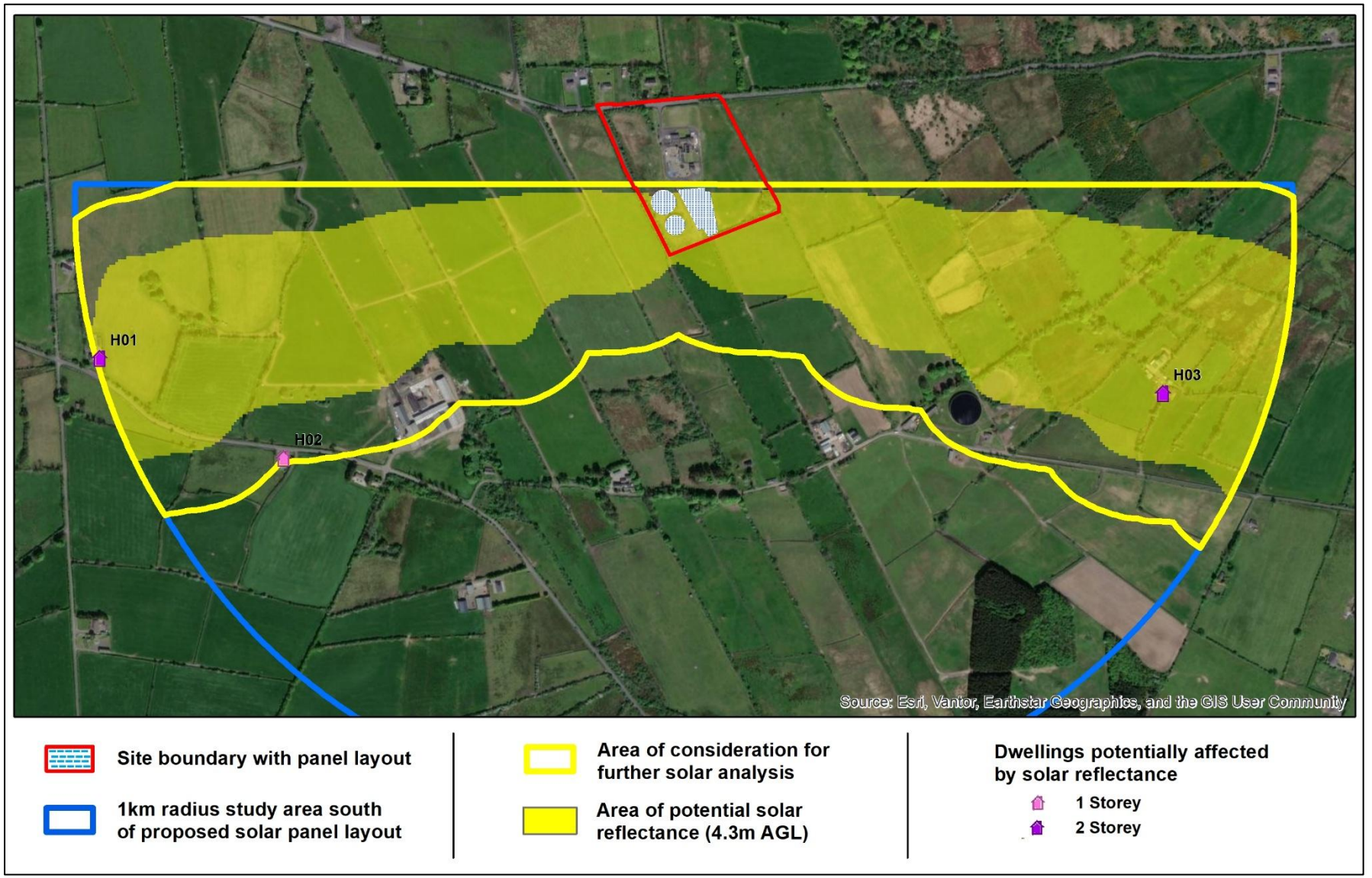


Figure 1.8 Parts of the study area where houses are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on a viewers' eye-level when standing on the first floor = 4.3m above ground level.

1.2.5 Results of Analysis of Residential Receptors

The results of the analysis for the dwellings which occur within the 'Area of Consideration for Further Analysis' are contained in Appendix A. These set out the times of day and days of the year that glint and glare effects could theoretically be experienced at residential receptors within the study area. Appendix A excludes periods where the sun is within 10 degrees of the angle of reflectance and it is these figures that form the basis of this assessment.

A summary of the results in Appendix A is included in Table 1.2 below. An assessment of the results will be undertaken in Section 1.2.5.1. This assessment also outlines the potential magnitude of impact that may occur at residential receptors.

Note: The results in the left hand columns of Appendix A are theoretical in that they are derived from a "bare-ground" data model that does not account for screening that might exist in the intervening landscape in the form of buildings and/or vegetation. This helps to establish a worst-case scenario baseline, from which we identify a subset of receptors for more thorough investigation. It is important to note that these figures do not necessarily represent an accurate portrayal of real impacts.

Table 1.2 Summary of Results in Appendix A - Dwellings

Receptor ID	Reflectance theoretically possible based on DTM topographic mapping (for control purposes)	Potential for impact after existing screening is taken into account (DSM)
H01	Yes Potentially	None
H02	None	None
H03	Yes Potentially	None

1.2.5.1 Effects on Residential Receptors

A total of three residential receptor points were examined. Computer analysis using terrain-only data (DTM) identified that glint and glare is geometrically possible at two of these. Further analysis, taking account of the existing screening inherent across the study area (using a digital surface model - DSM) and on-site verification of the analysis results, indicates that none of these dwelling receptors are actually likely to have the potential to be materially affected by glint and glare. This is on the basis of the considerable screening afforded by buildings and hedgerows that occur between the receptors and potentially reflecting panels. As such, no further assessment was deemed necessary.

1.2.6 Conclusion - Residential Receptors

It has been determined that there will be no glint and glare effects at any of the urban area receptors analysed in this assessment.

1.2.7 Assessment of Transport Route Receptors

1.2.7.1 Identification of Relevant Transport Route Receptors

Figure 1.9 is an output map of the study area showing the results (areas of potential solar irradiance) of 1st phase reflectance analysis carried out on the proposed solar development. These account for the path of the sun throughout the entire year; the panel positions and parameters; the 3D terrain parameters. This is the starting point for determining which transport route receptors have the geometric potential to be affected by glint and glare – in the absence of screening.

Note: The yellow buffer line around the reflectance pattern indicating 'Area of consideration for further analysis' on the output map represents a precautionary approach of including transport route sections at the fringe of potentially affected areas. It accounts for the fact that this 'first-filter' map is based on a sampling grid point density of 100m.

Receptor Points have been positioned along all the potentially affected roads (R) and railways (T) within the 'Area of Consideration for Further Analysis'. Transport route Receptor Points are placed automatically in an un-biased fashion at 50m intervals along route lines using Geographic Information Systems (GIS) software. There will be instances where points may be screened by single trees in otherwise open sections of route, or, conversely they may be exposed through a gateway in an otherwise long section of screening hedgerow. Their frequency is designed, however, to reflect the overall screening characteristics of the route sections.

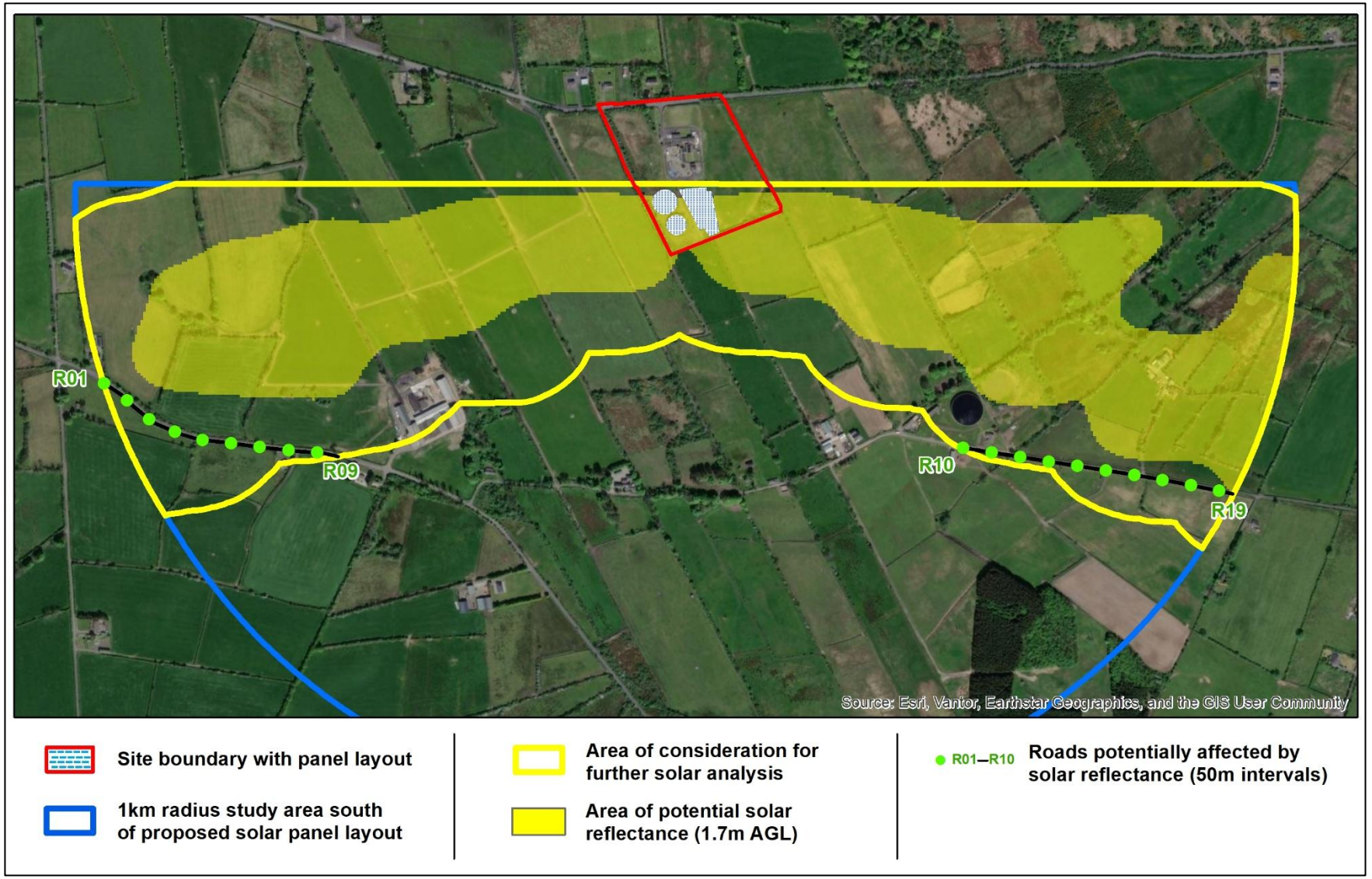


Figure 1.9 Parts of the study area where roads are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on viewer's eye level at 1.7m above ground level for roads

1.2.8 Results of Analysis of Transport Route Receptors

The results of the analysis for the transport routes which occur within the 'Area of Consideration for Further Analysis' is contained in Appendix B. These set out the times of day and days of the year that glint and glare effects could theoretically be experienced at transport route receptors within the study area. Appendix B excludes periods where the sun is within 10 degrees of the angle of reflectance, and it is these figures that form the basis of this assessment.

A summary of the results in Appendix B is included in Table 1.3 below. An assessment of the results will be undertaken in Section 1.2.8.1.

Note: The results in the left hand columns of Appendix B are theoretical in that they are derived from a "bare-ground" data model that does not account for screening that might exist in the intervening landscape in the form of buildings and/or vegetation. This helps to establish a worst-case scenario baseline, from which we identify a subset of receptors for more thorough investigation. It is important to note that these figures do not necessarily represent an accurate portrayal of real impacts.

It is important to note that the figures for the maximum minutes per day in Appendix B relate to the time window that a section of route can potentially experience reflectance and are therefore of less consequence than they would be for a static dwelling receptor. Such effects can only be experienced for the period of time it takes to travel along the affected road section, and therefore will be fleeting and in any event significantly less than the maximum periods outlined.

Table 1.3 Summary of Results contained in Appendix B - Transport Receptors: Roads

Receptor ID	Reflectance theoretically possible based on DTM topographic mapping (for control purposes)	Potential for impact after existing screening is taken into account (DSM)
R01	None	None
R02	None	None
R03	None	None
R04	None	None
R05	None	None
R06	None	None
R07	None	None
R08	None	None
R09	None	None
R10	None	None
R11	None	None
R12	None	None
R13	None	None
R14	None	None
R15	None	None
R16	None	None

R17	None	None
R18	None	None
R19	None	None

1.2.8.1 Effects on Road Receptors

Appendix B examined a total of 19 road Receptor Points. Analysis of terrain-level screening (using a digital terrain model - DTM) identified that glint and glare is theoretically possible at none of these road Receptor Points. Further analysis, taking account of the existing screening inherent across the study area (using a digital surface model - DSM) and on-site verification of the analysis results, determined that none of the road receptor points will actually have the potential to be materially affected by glint and glare. As such, no further assessment was deemed necessary.

1.2.9 Conclusion - Road Receptors

It has been determined that there will be no glint and glare effects at any of the road receptors analysed in this assessment.

1.3 ASSESSMENT OF AVIATION RECEPTORS

1.3.1 Identification of Relevant Aviation Receptors

In accordance with current IAA and DAA protocol 10 km and 15 km radius study areas were established for the identification of IAA registered aerodromes and main airports respectively, that might require testing for glint and glare impacts. However, there are no IAA registered aerodromes within the 10 km aviation study area and neither of DAA's Dublin or Cork airports occur within 15 km of the proposed solar development. For these reasons, no further aviation analysis was undertaken.

Furthermore, the Planning and Development (Solar Safeguarding Zone) Regulations 2022 set out 43 Solar Safeguarding Zones (SSZs). A SSZ is an area around an airport, aerodrome or helipad in which there is a potential for glint or glare from solar panels to impact aviation safety. The proposed development is not located within any of the defined SSZs, and therefore, an aviation-based glint and glare analysis was scoped out for further assessment.

1.4 OVERALL CONCLUSION

From the analysis and discussions contained herein, it is considered that there will be no reflectance effects experienced at any of the dwelling or transport receptors in this assessment as a result of the proposed Lisglennon Solar Development.

APPENDIX A: RESULTS OF GLINT AND GLARE ASSESSMENT - DWELLING RECEPTORS

The results tables set out the days of the year and the times of the day that glint and glare effects could theoretically be experienced for each residential receptor within the study area. It is important to note that the analysis assumes that the sun will be shining at all times without cloud cover, thus the output periods in the context of the Irish climate could be considered to be significantly exaggerated.

APPENDIX B: RESULTS OF GLINT AND GLARE ASSESSMENT - TRANSPORT RECEPTORS

The results tables set out the days of the year and the times of the day that glint and glare effects could theoretically be experienced for each residential receptor within the study area. It is important to note that the analysis assumes that the sun will be shining at all times without cloud cover, thus the output periods in the context of the Irish climate could be considered to be significantly exaggerated.

Appendix A - Dwelling Results

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H01a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H01b	2 of 2	April	8	18	2.3	7:30 a.m. - 8:00 a.m.	18			Tot days: 32 8.8% days Tot mins: 66 Max mins: 4 Avg mins: 2.06	Tot days: 0 Tot mins: 0
		May	8	16	2	7:30 a.m. - 8:00 a.m.	16				
		August	16	32	2	7:30 a.m. - 8:00 a.m.	32				

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H02										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H03a	1 of 2	May	25	78	3.1			7:00 p.m. - 7:30 p.m.	78	Tot days: 68	Tot days: 0
		June	9	18	2			7:00 p.m. - 7:30 p.m.	18	18.6% days	
		July	31	88	2.8			7:00 p.m. - 7:30 p.m.	88	Tot mins: 190	Tot mins: 0
		August	3	6	2			7:00 p.m. - 7:30 p.m.	6	Max mins: 4	
										Avg mins: 2.79	

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H03b	2 of 2	May	25	76	3			7:00 p.m. - 7:30 p.m.	76	Tot days: 70	Tot days: 0
		June	10	20	2			7:00 p.m. - 7:30 p.m.	20	19.2% days	
		July	31	86	2.8			7:00 p.m. - 7:30 p.m.	86	Tot mins: 190	Tot mins: 0
		August	4	8	2			7:00 p.m. - 7:30 p.m.	8	Max mins: 4	
										Avg mins: 2.71	

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix B - Road Receptor Results

Receptor	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
		Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R01									Tot days: 0	Tot days: 0
to										
R19									Tot mins: 0	Tot mins: 0

macroworks

GLINT AND GLARE ASSESSMENT

Proposed Solar PV Installation

Lough Talt, Co. Sligo.

Prepared by Macro Works Ltd

May 2026



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Appendix A: Results of Glint and Glare Assessment - Dwelling Receptors A

Appendix B: Results of Glint and Glare Assessment - Transport Receptors B

Registered Landscape Architect

1. GLINT AND GLARE ASSESSMENT

1.1 INTRODUCTION

This Glint and Glare Assessment was carried out by Macro Works Ltd to determine the potential for solar reflectance effects upon dwelling and transport route receptors in respect of the proposed solar PV installations on the roof of a proposed reservoir building, as well as ground mounted panels at Lough Talt, Co. Sligo. The proposed reservoir will have a maximum height of approximately 4.8m above the terrain level. The proposed panels will have a height of approximately 1m and will be tilted at an angle of 35 degrees towards the south.

1.1.1 Statement of Authority

Macro Works' relevant experience includes twenty years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments. The Glint and Glare analysis model used in this study for non-aviation receptors was developed by Macro Works in conjunction with the National University of Ireland, (NUI) Maynooth. It has successfully replicated results from the Federal Aviation Administration (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) software and has been utilised to assess the effects of glint and glare for many solar development sites throughout Ireland to date.

1.1.2 Guidance and Best Practice

There is currently no specific guidance or standards for the assessment of photovoltaic glint and glare effects on residential and/or route (road and rail) receptors in Ireland. Guidance has been prepared, however, by the Federal Aviation Administration to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority. This guidance, concerned with hazard assessment, has relevance to the other receptor types mentioned, and coupled with numerous assessments already carried out across the UK, combine to establish a suitable best practice for solar development.

By virtue of their efficiency, the intensity of reflected light from modern PV solar panels is deliberately low and currently equates with that of the reflection from still water. Recent studies generally agree, however, that there still exists the potential for hazard or reflectance upon surrounding receptors. Macro Works' glint and glare analysis methods and determination of effects are based on a combination of available studies and established best practice. This methodology has been successfully implemented on numerous previous solar farm projects that met with the approval of both Planning Authorities and An Coimisiún Pleanála.

1.1.3 Definitions

The study is concerned with the potential reflectance and hazard effects of glint and glare in relation to receptors that include the occupants of surrounding dwellings as well as road and rail users. In its "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[1] the FAA have defined the terms 'Glint' and 'Glare' as meaning;

1 Federal Aviation Administration (FAA) 2018. Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at: https://www.faa.gov/sites/faa.gov/files/airports/environmental/FAA-Airport-Solar-Guide-2018.pdf

Glint – "A momentary flash of bright light"

Glare – "A continuous source of bright light"

Glint and glare are essentially the reflection of sunlight from reflective surfaces. This study uses a multi-step process of elimination to determine which receptors have the potential to experience the effects of glint and glare. It then examines, using a computer-generated geometric model, the times of the year and the times of the day such effects could occur. This is based on the relative angles between the sun, the panels and the receptor throughout the year.

1.1.4 General Nature of Reflectance from Photovoltaic Panels

In terms of reflectance, photovoltaic solar panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Nonetheless, photovoltaic panels have a flat, polished surface, which emits 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface (Figure 1.1 refers). Several studies have shown that photovoltaic panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than the likes of glass, steel, snow and white concrete by comparison (Figure 1.2 refers). Similar levels of reflectance can be found in common situations in rural environments from surfaces such as shed roofs, lines of plastic ground covering used in cropping and wet roads to name but a few (Figure 1.3 - Figure 1.5 refer).

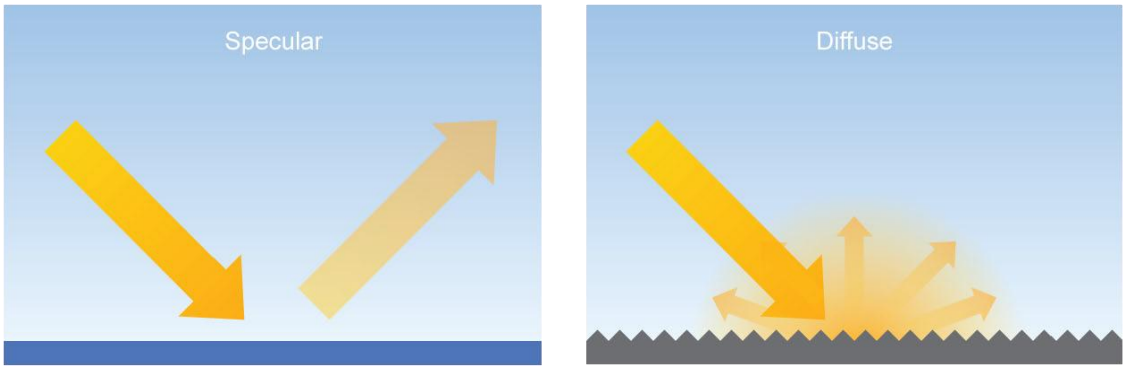


Figure 1.1: Specular vs Diffuse reflection of light from polished and rough surfaces.

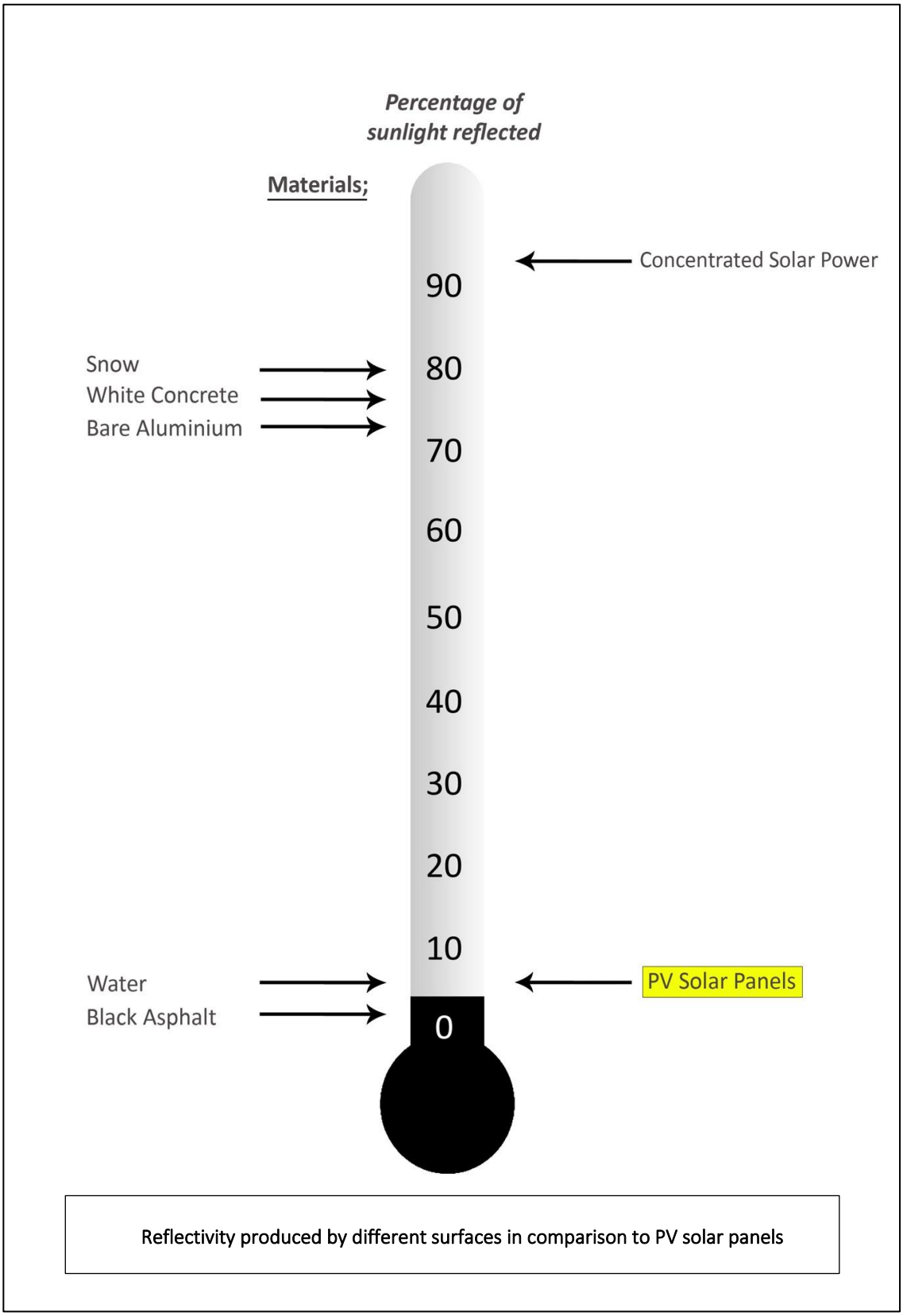


Figure 1.2: Demonstrates that the amount of sunlight (measured in watts per meter -W/m2) reflected from the surface of a solar panel is very similar to that of still water and is far less than that of many surfaces commonly found in the environment, urban or rural.



Figure 1.3: Similar level of reflectance (to photovoltaic panels) emanating from plastic ground covering in an Irish rural scenario.



Figure 1.4: Similar levels of reflectance (to photovoltaic panels) emanating from wet road surfaces.



Figure 1.5: Higher levels of reflectance (to photovoltaic panels) emanating from powder coated corrugated metal roof surfaces in an Irish rural scenario.

1.2 ASSESSMENT OF GROUND-BASED RECEPTORS

1.2.1 Assessment Methodology for Ground-Base Receptors

Macro Works' glint and glare assessment methodology follows a rational sequence of steps to identify receptors that might potentially be affected by glint and glare. These are then further filtered to yield those receptors to those that are likely to actually experience such effects. These steps are set out below;

1. Identify study area within which to assess the potential for glint and glare effects. The potential for substantial reflectance or hazardous impacts are greatest in close proximity to the source of reflectance and the potential for adverse impacts reduces with increased distances therefore to balance these factors a buffer extent of 1km from the site boundary is used by default on all solar developments.

2. Pre-analyse the study area for potential glare effects by populating the study area with a regular grid of receptor points (100m spacing). This analysis (1st analysis) allows us to determine those areas theoretically exposed to glint and glare effects that might warrant further investigation. We call this the "Area of Consideration for Further Analysis". This pre-analysis is based on a 3D model of the development superimposed onto a Digital Terrain Model (DTM) of the study area. Note: This DTM accurately replicates the profile of the terrain but does not account for screening by the vegetation or buildings that are present – in this sense the results are somewhat theoretical but they do offer a representation of a bare-earth, worst-case scenario.

3. Identify relevant receptors (dwellings and transport routes) that fall within the theoretically affected zones of the study area (or the "Area of Consideration for Further Analysis"). Dwelling identification utilises a combination of up to date aerial photography and the Eircode Finder tool which locates and identifies buildings classed as residential. Transport route receptors are defined by regularly spaced points along roads and rail lines (50m spacing). The height of the road Receptor Points are set to 1.7m above ground level. This is broadly equivalent to the eye level a person walking or a driver of a 4x4 / SUV type vehicle. The height of rail Receptor Points are set to 2.8m above ground level to represent the eye level of a train driver.

4. Execute the glint and glare analysis on the DTM-based 3-D model (2nd analysis), in respect of each of the theoretically affected receptors. This identifies the times of the day and months of the year that glint and glare could potentially affect receptors in the absence of screening.

   Note: When the sun is situated within 10 degrees of a reflecting PV panel as viewed from a particular receptor, the sun will be a much greater source of glare than what emanates from the surface of the PV panel therefore any potential glare during these periods is excluded when assessing potential impacts.

5. Perform the same calculations (3rd analysis) using a high-resolution digital surface model (DSM) that accounts for the existing screening inherent on and surrounding the site at the time of capture. This offers a truer reflection of the actual glare that is likely to occur and highlights where landscape mitigation may be required.

   Note: A limitation of DSM data in the context of this assessment type is that it is a snapshot of the screening situation at the time of the data capture. This situation is broadly indicative as hedgerows are a semi-permanent feature of the Irish countryside, however, seasonal variation through growth and/or cutting may result in minor changes to their screening potential. A further limitation is due to the aerial overhead nature of data capture. This can result in the under-reporting of potential visibility beneath the tree or woodland canopy and can understate the visibly porous nature of some thin hedgerows. This can result in minor underestimating of glare periods. However, where the data is deemed to be significantly unreliable for the reasons stated, analysis is supplemented, where possible, with a thorough assessment of aerial photography, Google Street View imagery and on-site verification.

6. Where instances of glint and glare remain, determine whether they are likely to cause a hazard / reflectance. For dwellings, this is achieved by comparing the periods of glare potential with our 'Magnitude of Glint and Glare Effects' table, while transport routes are examined in further detail for potential for hazardous impacts.

7. If hazard / substantial reflectance is likely to occur, mitigation measures are proposed where possible. This might relate to the re-siting of particular panels and / or the provision of additional screening.

8. If necessary, re-run the glint and glare calculations (4th analysis) to verify the effectiveness of the proposed mitigation measures and determine if there are any residual glare impacts.

1.2.2 Magnitude of Impacts for Dwelling Receptors

Although there is currently no regulation or guidance as to acceptable levels of glint and glare effects at receptors in Ireland, it is considered necessary to provide a gauge for determining relative levels of impact across a range of development types. Macro Works has established the following indicative textual categories of effect, which are used herein to determine the relative impact levels (Table 1.1 refers). The percentage figures provided are intended as a relative guide only. The final category of assessment is determined on the basis of professional judgement, and accounts for mitigating factors where relevant and the careful consideration of a range of circumstantial variables that may act to intensify or reduce the effect upon a particular receptor.

Note: The magnitude of glint and glare effects in Table 1.1 relates only to static receptors such as residential dwelling. As road receptors are moving objects and will only ever have the potential to experience momentary reflectance periods, the following impact magnitudes are not considered relevant for road receptors. Instead, road receptors will be assessed on whether periods of reflectance have the potential to generate significant reflectance or hazard effects.

Table 1.1 Magnitude of Glint and Glare Effects

Magnitude of Impact	Description
Very High	Hazard / reflectance effects emanating from highly reflective surfaces (>50% sunlight reflection) for most of the year (>70% / 255 days) and for significant periods of each day (>45 mins).
High	Hazard / reflectance effects emanating from moderately reflective surfaces (>30% sunlight reflection) for the majority of days in a year (>50% / 182 days) and for substantial periods of each day (>30 mins).
Medium	Reflectance effects emanating from moderately/low reflective surfaces (>10% sunlight reflection) for a substantial number of days in a year (>30% / 109 days) and for substantial periods of each day (>20 mins).
Low	Reflectance effects emanating from low reflective surfaces (>5% sunlight reflection) for a modest number of days in a year (>10% / 36 days) and for notable periods of each day (>15 mins).
Very Low	Reflectance effects emanating from low reflective surfaces (>5% sunlight reflection) for a small number of days in a year (≤10% / 36 days) and for short periods of each day (<15 mins).
Negligible	Effects either not geometrically possible or barely measurable.

Important Note

It must be emphasised at this point that all results, whether from FAA endorsed SGHAT software or our own bespoke software, are theoretical by default in that they assume that the sun is always shining and at full intensity. The results do not account for climate and inherent weather patterns that occur across the island of Ireland.

Records from Met Éireann (The Irish Meteorological Service) indicate that "over the year as a whole, most areas get an average of between 3 1/4 and 3 3/4 hours of sunshine each day". It states that "the sunniest months are May and June. During these months, sunshine duration averages between 5 and 6.5 hours per day over most of the country"[2].

While we cannot correlate the historic random periods of sunshine with our predicted periods of glare, we can state with a high level of confidence that the weather, more precisely cloud cover, will account for a substantial reduction in all figures quoted in this report i.e. frequency and duration of glare periods.

In addition, atmospheric conditions such as haze, mist, fog and precipitation will all have the effect of both reducing the visibility of the site overall and reducing the intensity of any glare emanating from the proposed solar development.

1.2.3 Relevant Parameters of the Proposed Development

The photovoltaic panels are to be oriented in a south-facing direction to maximise solar gain and will remain in a fixed position throughout the day and year (i.e. they will not rotate to track the movement of the sun). The proposed panels will be installed on the roof of a proposed reservoir building which will have a height of 4.8m above the level of the terrain. There will also be a ground mounted array. Each of the panels will sit approximately 1m above the ground and will be tilted at a pitch of 35 degrees from horizontal towards the south. It is not geometrically possible for glare to occur in the terrain to the north of these south-facing PV panels; hence the 1 km study area does not extend to the north of the proposed PV panels.

The proposed development is located in the rural plains of County Sligo, c. 250m south of the shore of Lough Talt. The study area comprises a mix of peatland and woodland with areas of agricultural farmland. The site is located at the bottom of the Inagh river valley, with the landform rising noticeably in the northern and southern peripheries of the study area. The River Inagh, which flows c. 20m south of the site boundary, is the principal watercourse within the study area. The R294 is the main transport route within the study area. Settlement within the study area is sparse, with dispersed one-off rural dwellings along the regional road representing the predominant settlement pattern. The nearest dwelling to the proposed panels is located c. 130m to the southwest.

Due to the southerly orientation of the PV panels in the proposed solar development, ground-based receptors (houses and transport routes) situated to the west of the solar array can only be affected by morning reflectance, when the sun is rising in the east. Conversely, receptors situated to the east of the site and can only be affected by evening reflectance, when the sun is setting in the west.

Further, south facing panels in a landscape such as this result in a typical pattern of glare with potential glare impacts upon surrounding receptors occurring during the months February – October. This broadly represents the season where some or all foliage is present on vegetation. The assessment of the screening capacity of the surrounding vegetation in its winter state is therefore not necessary.

2 https://www.met.ie/climate/what-we-measure/sunshine

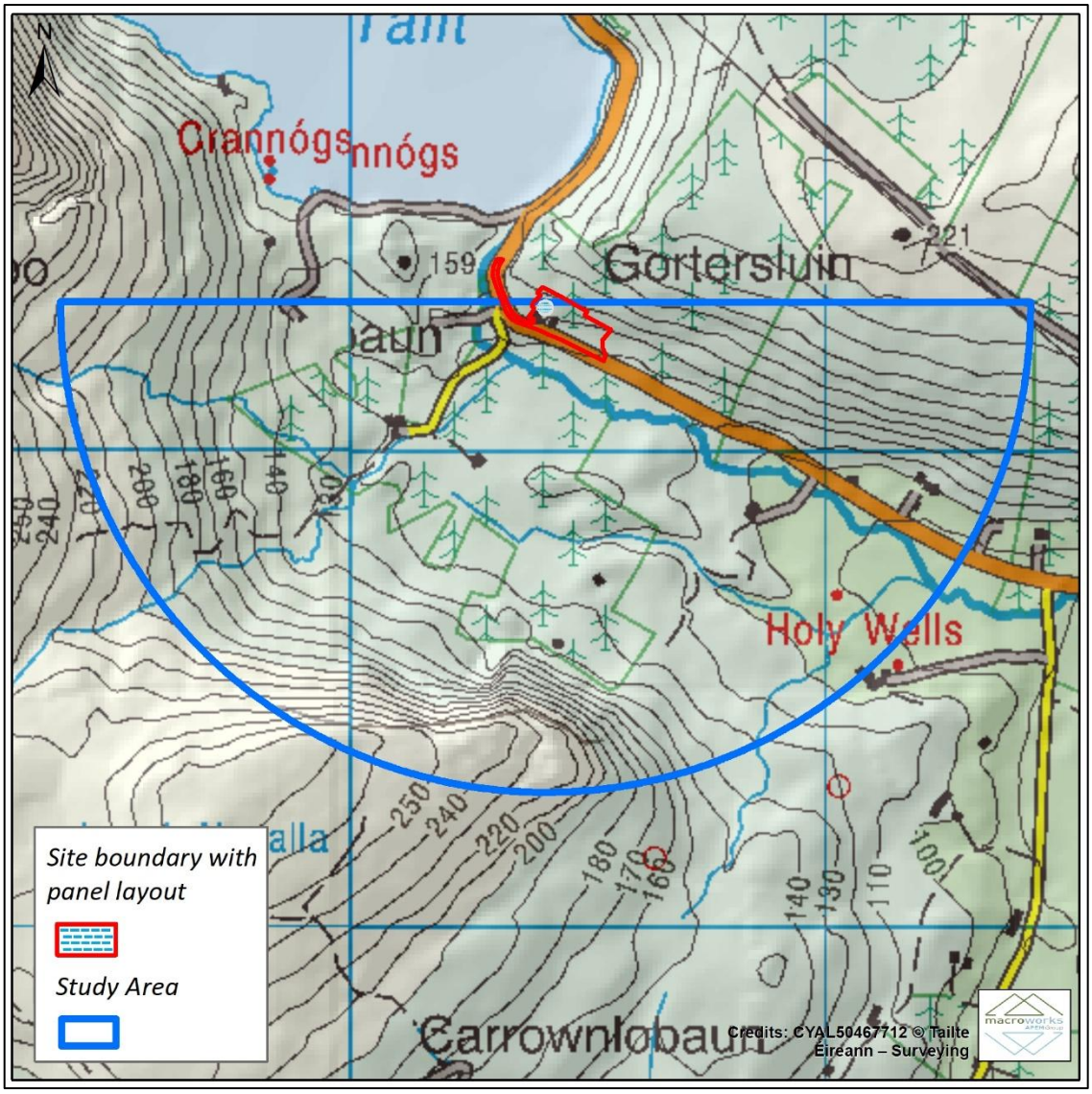


Figure 1.6: Map of proposed solar development site and the study area.

1.2.4 Assessment of Residential Receptors

1.2.4.1 Identification of Relevant Residential Receptors

Figure 1.7 - Figure 1.8 are output maps of the study area showing the results (areas of potential solar irradiance) of 1st phase reflectance analysis carried out on the proposed solar development. These account for the path of the sun throughout the entire year; the panel positions and parameters; the 3D terrain parameters. This is the starting point for determining which residential receptors have the geometric potential to be affected by glint and glare – in the absence of screening.

Note: The yellow buffer line around the reflectance pattern indicating 'Area of consideration for further analysis' on the output maps represents a precautionary approach of including dwellings at the fringe of potentially affected areas. It accounts for the fact that this 'first-filter' map is based on a sampling grid point density of 100m.

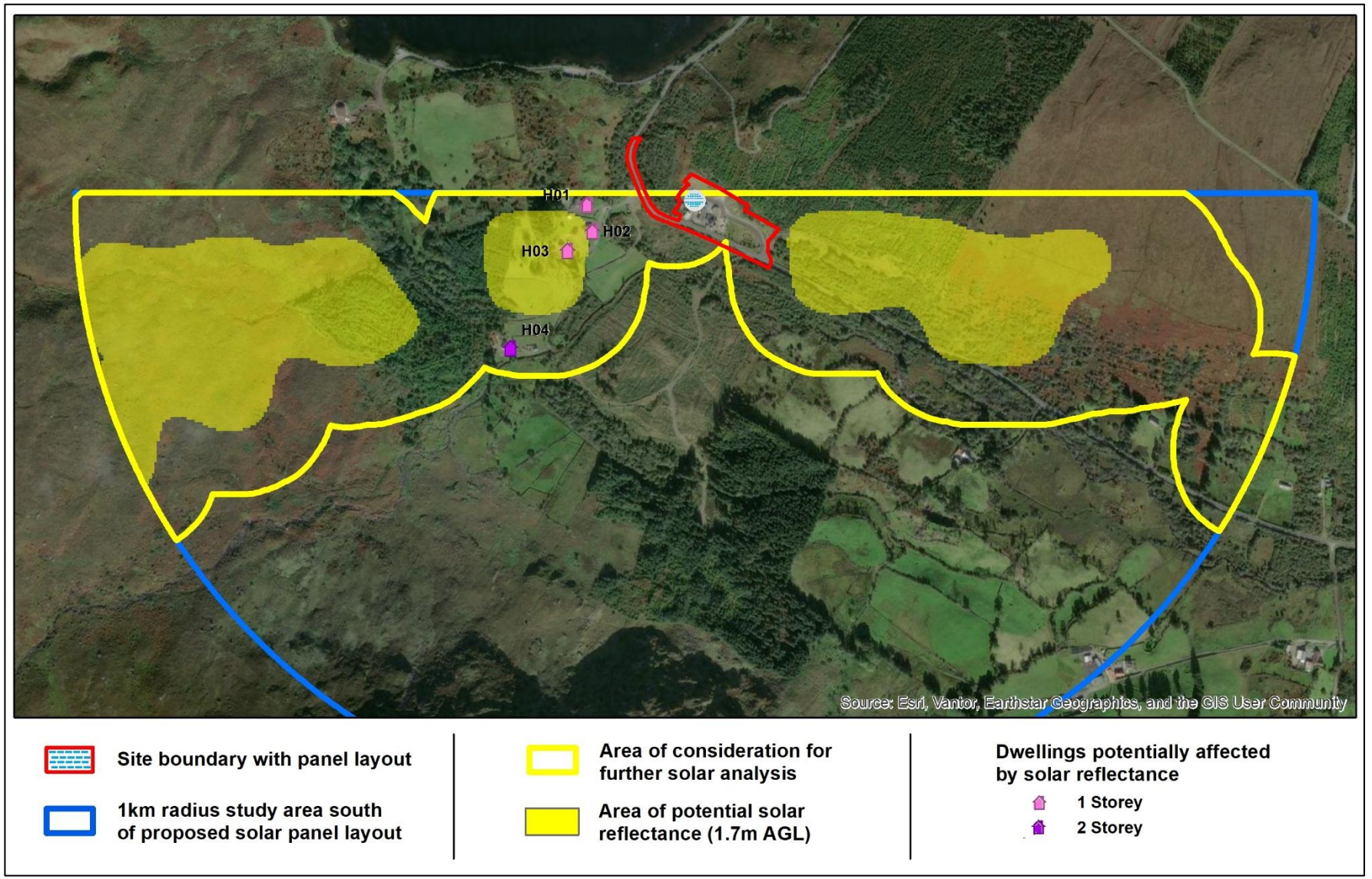


Figure 1.7 Parts of the study area where houses are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on a viewers' eye-level when standing on the ground floor = 1.7m above ground level.

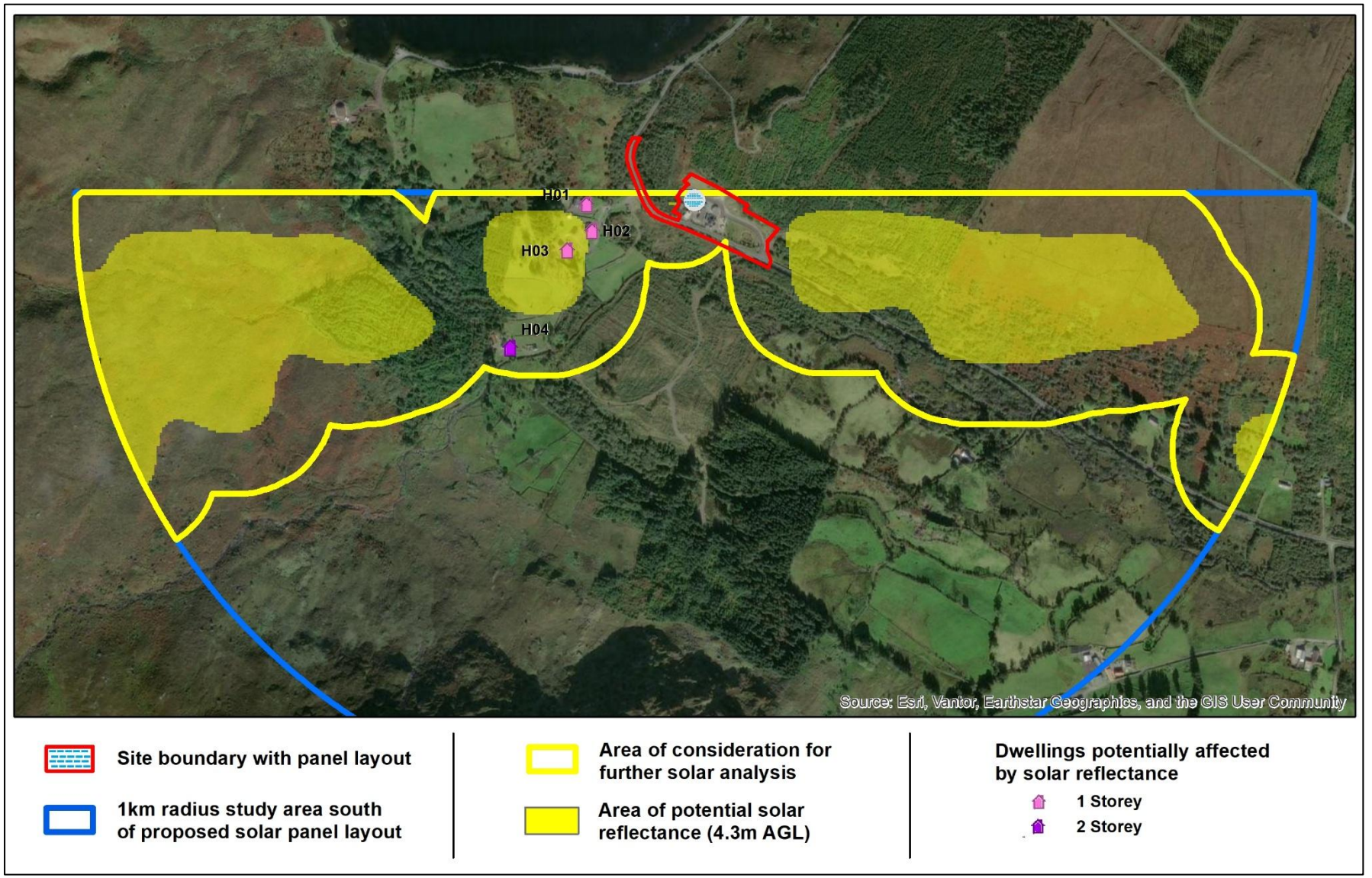


Figure 1.8 Parts of the study area where houses are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on a viewers' eye-level when standing on the first floor = 4.3m above ground level.

1.2.5 Results of Analysis of Residential Receptors

The results of the analysis for the dwellings which occur within the 'Area of Consideration for Further Analysis' are contained in Appendix A. These set out the times of day and days of the year that glint and glare effects could theoretically be experienced at residential receptors within the study area. Appendix A excludes periods where the sun is within 10 degrees of the angle of reflectance and it is these figures that form the basis of this assessment.

A summary of the results in Appendix A is included in Table 1.2 below. An assessment of the results will be undertaken in Section 1.2.5.1. This assessment also outlines the potential magnitude of impact that may occur at residential receptors.

Note: The results in the left hand columns of Appendix A are theoretical in that they are derived from a "bare-ground" data model that does not account for screening that might exist in the intervening landscape in the form of buildings and/or vegetation. This helps to establish a worst-case scenario baseline, from which we identify a subset of receptors for more thorough investigation. It is important to note that these figures do not necessarily represent an accurate portrayal of real impacts.

Table 1.2 Summary of Results in Appendix A - Dwellings

Receptor ID	Reflectance theoretically possible based on DTM topographic mapping (for control purposes)	Potential for impact after existing screening is taken into account (DSM)
H01	None	None
H02	Yes Potentially	None
H03	Yes Potentially	None
H04	None	None

1.2.5.1 Effects on Residential Receptors

A total of four residential receptor points were examined. Computer analysis using terrain-only data (DTM) identified that glint and glare is geometrically possible at two of these. Further analysis, taking account of the existing screening inherent across the study area (using a digital surface model - DSM) and on-site verification of the analysis results, indicates that none of these dwelling receptors are actually likely to have the potential to be materially affected by glint and glare. This is on the basis of the considerable screening afforded by buildings and hedgerows that occur between the receptors and potentially reflecting panels. As such, no further assessment was deemed necessary.

1.2.6 Conclusion - Residential Receptors

It has been determined that there will be no glint and glare effects at any of the urban area receptors analysed in this assessment.

1.2.7 Assessment of Transport Route Receptors

1.2.7.1 Identification of Relevant Transport Route Receptors

Figure 1.9 is an output map of the study area showing the results (areas of potential solar irradiance) of 1st phase reflectance analysis carried out on the proposed solar development. These account for the path of the sun throughout the entire year; the panel positions and parameters; the 3D terrain parameters. This is the starting point for determining which transport route receptors have the geometric potential to be affected by glint and glare – in the absence of screening.

Note: The yellow buffer line around the reflectance pattern indicating 'Area of consideration for further analysis' on the output map represents a precautionary approach of including transport route sections at the fringe of potentially affected areas. It accounts for the fact that this 'first-filter' map is based on a sampling grid point density of 100m.

Receptor Points have been positioned along all the potentially affected roads (R) and railways (T) within the 'Area of Consideration for Further Analysis'. Transport route Receptor Points are placed automatically in an un-biased fashion at 50m intervals along route lines using Geographic Information Systems (GIS) software. There will be instances where points may be screened by single trees in otherwise open sections of route, or, conversely they may be exposed through a gateway in an otherwise long section of screening hedgerow. Their frequency is designed, however, to reflect the overall screening characteristics of the route sections.

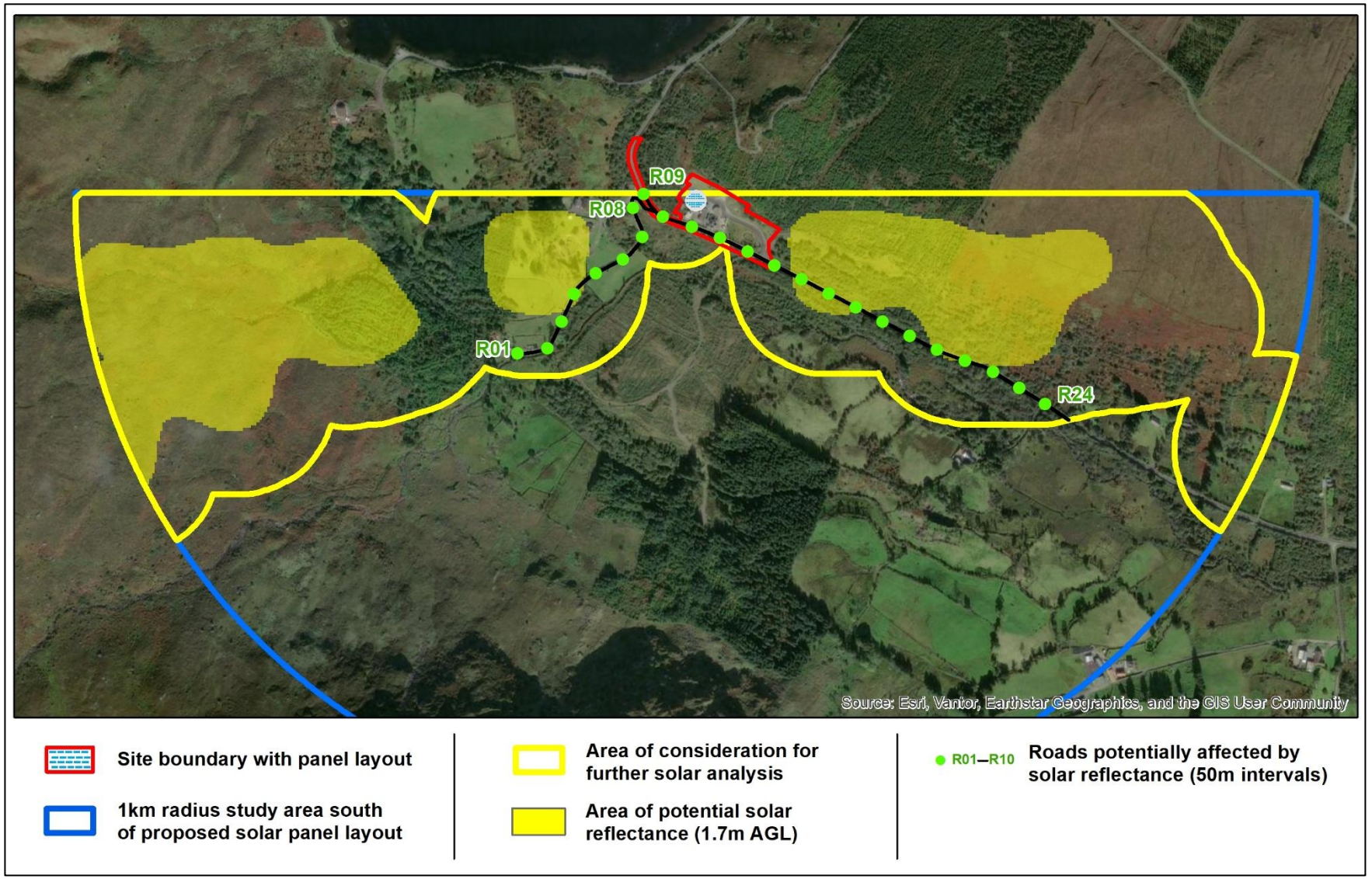


Figure 1.9 Parts of the study area where roads are potentially affected by glint and glare. The results are based on 3D terrain data that does not account for screening by vegetation or man-made structures and are based on viewer's eye level at 1.7m above ground level for roads

1.2.8 Results of Analysis of Transport Route Receptors

The results of the analysis for the transport routes which occur within the 'Area of Consideration for Further Analysis' is contained in Appendix B. These set out the times of day and days of the year that glint and glare effects could theoretically be experienced at transport route receptors within the study area. Appendix B excludes periods where the sun is within 10 degrees of the angle of reflectance, and it is these figures that form the basis of this assessment.

A summary of the results in Appendix B is included in Table 1.3 below. An assessment of the results will be undertaken in Section 1.2.8.1.

Note: The results in the left hand columns of Appendix B are theoretical in that they are derived from a "bare-ground" data model that does not account for screening that might exist in the intervening landscape in the form of buildings and/or vegetation. This helps to establish a worst-case scenario baseline, from which we identify a subset of receptors for more thorough investigation. It is important to note that these figures do not necessarily represent an accurate portrayal of real impacts.

It is important to note that the figures for the maximum minutes per day in Appendix B relate to the time window that a section of route can potentially experience reflectance and are therefore of less consequence than they would be for a static dwelling receptor. Such effects can only be experienced for the period of time it takes to travel along the affected road section, and therefore will be fleeting and in any event significantly less than the maximum periods outlined.

Table 1.3 Summary of Results contained in Appendix B - Transport Receptors: Roads

Receptor ID	Reflectance theoretically possible based on DTM topographic mapping (for control purposes)	Potential for impact after existing screening is taken into account (DSM)
R01	None	None
R02	None	None
R03	None	None
R04	None	None
R05	None	None
R06	None	None
R07	None	None
R08	None	None
R09	None	None
R10	None	None
R11	None	None
R12	None	None
R13	None	None
R14	None	None
R15	None	None
R16	None	None

R17	None	None
R18	None	None
R19	None	None
R20	None	None
R21	None	None
R22	None	None
R23	None	None
R24	None	None

1.2.8.1 Effects on Road Receptors

Appendix B examined a total of 24 road Receptor Points. Analysis of terrain-level screening (using a digital terrain model - DTM) identified that glint and glare is theoretically possible at none of these road Receptor Points. Further analysis, taking account of the existing screening inherent across the study area (using a digital surface model - DSM) and on-site verification of the analysis results, determined that none of the road receptor points will actually have the potential to be materially affected by glint and glare. As such, no further assessment was deemed necessary.

1.2.9 Conclusion - Road Receptors

It has been determined that there will be no glint and glare effects at any of the road receptors analysed in this assessment.

1.3 ASSESSMENT OF AVIATION RECEPTORS

1.3.1 Identification of Relevant Aviation Receptors

In accordance with current IAA and DAA protocol 10 km and 15 km radius study areas were established for the identification of IAA registered aerodromes and main airports respectively, that might require testing for glint and glare impacts. However, there are no IAA registered aerodromes within the 10 km aviation study area and neither of DAA's Dublin or Cork airports occur within 15 km of the proposed solar development. For these reasons, no further aviation analysis was undertaken.

Furthermore, the Planning and Development (Solar Safeguarding Zone) Regulations 2022 set out 43 Solar Safeguarding Zones (SSZs). A SSZ is an area around an airport, aerodrome or helipad in which there is a potential for glint or glare from solar panels to impact aviation safety. The proposed development is not located within any of the defined SSZs, and therefore, an aviation-based glint and glare analysis was scoped out for further assessment.

1.4 OVERALL CONCLUSION

From the analysis and discussions contained herein, it is considered that there will be no reflectance effects experienced at any of the dwelling or transport receptors in this assessment as a result of the proposed Lough Talt Solar Development.

APPENDIX A: RESULTS OF GLINT AND GLARE ASSESSMENT - DWELLING RECEPTORS

The results tables set out the days of the year and the times of the day that glint and glare effects could theoretically be experienced for each residential receptor within the study area. It is important to note that the analysis assumes that the sun will be shining at all times without cloud cover, thus the output periods in the context of the Irish climate could be considered to be significantly exaggerated.

APPENDIX B: RESULTS OF GLINT AND GLARE ASSESSMENT - TRANSPORT RECEPTORS

The results tables set out the days of the year and the times of the day that glint and glare effects could theoretically be experienced for each residential receptor within the study area. It is important to note that the analysis assumes that the sun will be shining at all times without cloud cover, thus the output periods in the context of the Irish climate could be considered to be significantly exaggerated.

Appendix A - Dwelling Results

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H01										Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H02		May	3	6	2	7:00 a.m. - 7:30 a.m.	6			Tot days: 5 1.4% days Tot mins: 10 Max mins: 2 Avg mins: 2	Tot days: 0 Tot mins: 0
		July	2	4	2	7:00 a.m. - 7:30 a.m.	4				

House Nos.			PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Level	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H03		May	7	14	2	7:00 a.m. - 7:30 a.m.	14			Tot days: 49 13.4% days Tot mins: 98 Max mins: 2 Avg mins: 2	Tot days: 0 Tot mins: 0
		June	27	54	2	7:00 a.m. - 8:00 a.m.	54				
		July	15	30	2	7:30 a.m. - 8:00 a.m.	30				

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix A - Dwelling Results

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H04a	1 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

House Nos.	Level	Month	PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
			Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
H04b	2 of 2									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0

Note: dwellings identified with an 'a' and 'b' are two-storey dwellings. 'a' relates to the ground floor, and 'b' relates to the 1st floor.

Appendix B - Road Receptor Results

Receptors		PER MONTH			MORNING		EVENING		WITHOUT SCREENING	WITH EXISTING SCREENING
	Month	Tot Days	Tot Mins	Avg Mins	Period	Tot Mins	Period	Tot Mins		
R01 to R24									Tot days: 0 Tot mins: 0	Tot days: 0 Tot mins: 0