PAGERPOWER
Urban & Renewables

Solar Photovoltaic Glint and Glare Study

Enviromena Project Management UK Ltd

Land north of Grimethorpe

January 2026

PLANNING SOLUTIONS FOR:

- Solar
- Telecoms
- Railways
- Defence
- Buildings
- Wind
- Airports
- Radar
- Mitigation

www.pagerpower.com

ADMINISTRATION PAGE

Job Reference:	11868C
Author:	Waqar Qureshi
Email:	waqar@pagerpower.com

Reviewed By:	Abdul Wadud and Michael Sutton (11868A); Philip Charhill (11868B); Jacob Cunningham (11868C)
Email:	abdul@pagerpower.com; michael@pagerpower.com; phillip@pagerpower.com; jacob@pagerpower.com

Issue	Date	Detail of Changes
11868A	24th January 2023	Initial issue (undertaken by Andrea Mariano)
11868A v2	17th May 2023	Updated layout (undertaken by Andrea Mariano)
11868A v3	19th October 2023	Updated layout (undertaken by Andrea Mariano)
11868B	12th December 2023	Remodelling for latest layout (undertaken by Waqar Qureshi)
11868C	30th September 2024	Updated site layout plan and consideration of PROWs/Bridleways (undertaken by Waqar Qureshi)
11868C v2	4th November 2024	Updated site layout plan (undertaken by Waqar Qureshi)
11868C v3	13th December 2024	Updated site layout plan and landscape strategy plan (undertaken by Waqar Qureshi)
11868C v4	12th January 2026	Updated site layout plan (undertaken by Waqar Qureshi)

Stour Valley Business Centre, Brundon Lane, Sudbury, CO10 7GB

T:*+44 (0)1787 319001* E:*info@pagerpower.com* W: *www.pagerpower.com*

EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a proposed solar photovoltaic (PV) development located east of Cudworth, South Yorkshire, England. The assessment pertains to the potential impact upon road safety, residential amenity, and aviation activity associated with YAA Nostell Helicopter Port, Walton Wood Airfield, Askern Airfield, Birds Edge Airstrip and Wentworth Private Airstrip. Public rights of way (PROWs) and bridleways have been considered at a high-level.

Conclusions

Mitigation is recommended for two dwellings due to the duration of effects, and the lack of sufficient mitigating factors. Further information is provided in Section 6.

There are no impacts requiring mitigation on surrounding road users, aviation activity, and PROWs/bridleways.

Guidance and Studies

Guidelines exist in the UK (produced by the Civil Aviation Authority) and in the USA (produced by the Federal Aviation Administration) with respect to solar developments and aviation activity. There is no existing planning guidance for the assessment of solar reflections from solar panels towards roads and nearby dwellings. Pager Power has however produced guidance for glint and glare and solar photovoltaic developments, which was published in early 2017, with the fourth edition published in 2022[1]. The guidance document sets out the methodology for assessing roads, dwellings, and aviation activity with respect to solar reflections from solar panels.

Pager Power's approach is to undertake geometric reflection calculations and, where a solar reflection is predicted, consider the screening (existing and/or proposed) between the receptor and the reflecting solar panels. The scenario in which a solar reflection can occur for all receptors is then identified and discussed, and a comparison is made against the available solar panel reflection studies to determine the overall impact.

The available studies have measured the intensity of reflections from solar panels with respect to other naturally occurring and manmade surfaces. The results show that the reflections produced are of intensity similar to or less than those produced from still water and significantly less than reflections from glass and steel[2].

[1]Pager Power Glint and Glare Guidance, Fourth Edition, September 2022.

[2]Source: SunPower, 2009, SunPower Solar Module Glare and Reflectance (appendix to Solargen Energy, 2010).

Assessment Results

Roads

Technical modelling is not recommended for local roads, where traffic densities are likely to be relatively low. Any solar reflections from the Proposed Development that are experienced by a road user along a local road would be considered low impact in the worst case in accordance with the guidance presented in Appendix D.

No impacts are predicted on the assessed road section, because solar reflections are not geometrically possible, or there is significant screening in the form of existing vegetation, buildings, and/or terrain such that reflections would not be visible in practice.

Dwellings

No significant impacts are predicted on the dwellings within the assessment area subject to the implementation of the landscape strategy plan[3]. Where solar reflections are geometrically possible:

- There is significant existing and/or proposed screening such that reflections are not expected to be visible in practice; or
- the duration of effects received in practice is predicted to be less than 60 minutes on any given day and less than 3 months of the year; or
- there are significant factors that reduce the level of impact including:
    - A significant separation distance between observer and visible reflecting panels;
    - The position of the Sun beyond the reflecting panels – effects that coincide with direct sunlight appear less prominent than those that do not.

Further mitigation is not recommended.

Aviation

Considering the size of the proposed development, its location and distance relative to the identified airfields, the following is applicable:

- YAA Nostell Helicopter Port is a heliport located approximately 7.7km north of the proposed development. Helicopters can approach a heliport from any direction; however, it is predicted that, if solar reflections are possible, the impact of the proposed development upon these airfields' aviation operations will not be significant due to the low glare intensity (low impact for temporary after-image).
- Other airfields such as Walton Wood Airfield, Askern Airfield, Birds Edge Airstrip and Wentworth Private Airstrip are located at a greater distance (further than 10km from the proposed development). It is predicted that, if solar reflections are possible, the impact of the proposed development upon these airfields' aviation operations will not be significant due to the low glare intensity (low impact for temporary after-image).

[3] 11371-FPCR-ZZ-XX-DR-L-0001-0002-P14-Landscape Strategy Plan.pdf

Therefore, no significant impact is predicted for the aviation operation associated with the nearby airfields and no full modelling is recommended.

Public Rights of Way/Bridleways

In Pager Power's experience, significant impacts to pedestrians/equestrians using the surrounding public rights of way/bridleways are not possible due to glint and glare effects from PV developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance. This is because:

- The typical density of pedestrians/horse riders located at these points is low in a rural environment;
- Any resultant effects are less serious than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious. Safety concerns are considered to a greater extent for horse riders and the possible event of being thrown by a scared animal, however the risk of this occurring due to glare from solar panels is considered to be small[4];
- Glint and glare effects towards an observer are transient, and time and location sensitive whereby a pedestrian/horse rider could move beyond the solar reflection zone with ease with little impact upon safety or amenity;
- Any observable solar reflection towards an observer/horse rider would be of similar intensity to those experienced whilst navigating the natural and built environment on a regular basis (e.g. bodies of water), and less intense than reflections from glass and other common outdoor surfaces.

Overall, no significant impact on observers/equestrians using the surrounding public rights of way/bridleways is predicted and therefore mitigation is not required.

[4] This is supported by the 'Advice on Solar Farms' document published by the British Horse Society in April 2024, which states: *"They [standard photovoltaic panels] are designed to absorb rather than reflect light for efficiency (reflected light is wasted energy) and although the amount of reflection varies with the component materials and the angle, the incidence of glare or dazzle is very low compared with glass and will not be uniform throughout a period of sunlight, assuming that the panel is static. Any reflection is unlikely to be a direct problem to horses, riders or carriage-drivers because of the angles and distances involved."*

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 63 countries internationally.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems.

Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

1 INTRODUCTION

1.1 Overview

Pager Power has been retained to assess the possible effects of glint and glare from a proposed solar photovoltaic (PV) development located east of Cudworth, South Yorkshire, England. The assessment pertains to the potential impact upon road safety, residential amenity, and aviation activity associated with YAA Nostell Helicopter Port, Walton Wood Airfield, Askern Airfield, Birds Edge Airstrip and Wentworth Private Airstrip. Public rights of way (PROWs) and bridleways have been considered at a high-level.

This report contains the following:

- Solar development details;
- Explanation of glint and glare;
- Overview of relevant studies and guidance;
- Overview of Sun movement;
- Assessment methodology;
- Identification of receptors;
- Glint and glare assessment for identified receptors;
- High-level overview of aviation concerns;
- High-level overview of PROWs and bridleways;
- Results discussion.

Following this, a summary of findings and overall conclusions and recommendations from the desk-based analysis is presented.

1.2 Pager Power's Experience

Pager Power has undertaken over 1,400 Glint and Glare assessments in the UK and internationally. The studies have included assessment of civil and military aerodromes, railway infrastructure and other ground-based receptors including roads and dwellings.

1.3 Glint and Glare Definition

The definition of glint and glare is as follows:

- Glint – a momentary flash of bright light typically received by moving receptors or from moving reflectors.
- Glare – a continuous source of bright light typically received by static receptors or from large reflective surfaces.

These definitions are aligned with those presented within the National Policy Statement for Renewable Energy Infrastructure (EN-3)[5] and with those used by the Federal Aviation Administration in the USA. The term 'solar reflection' is used in this report to refer to both reflection types.

[5] Published by the Department for Energy Security and Net Zero in November 2023 and last updated on 17 January 2024

2 SOLAR DEVELOPMENT LOCATION AND DETAILS

2.1 Solar PV Areas

Figure 1 on the following page shows the latest proposed solar panel layout[6]. The blue horizontal rectangles denote the solar panel locations.

Figure 2 shows the modelled solar panel layout[7]. The modelling and analysis in this report were undertaken based on this layout.

The modelled layout contains solar panels that are no longer present in the latest layout, therefore this report represents a more conservative and worse-case scenario than now proposed.

[6] Source: P007033-11-PlanningLayout-RevM.pdf (cropped)

[7] Source: P.Grimethorpe_11_PlanningLayout.RevA.pdf (cropped)

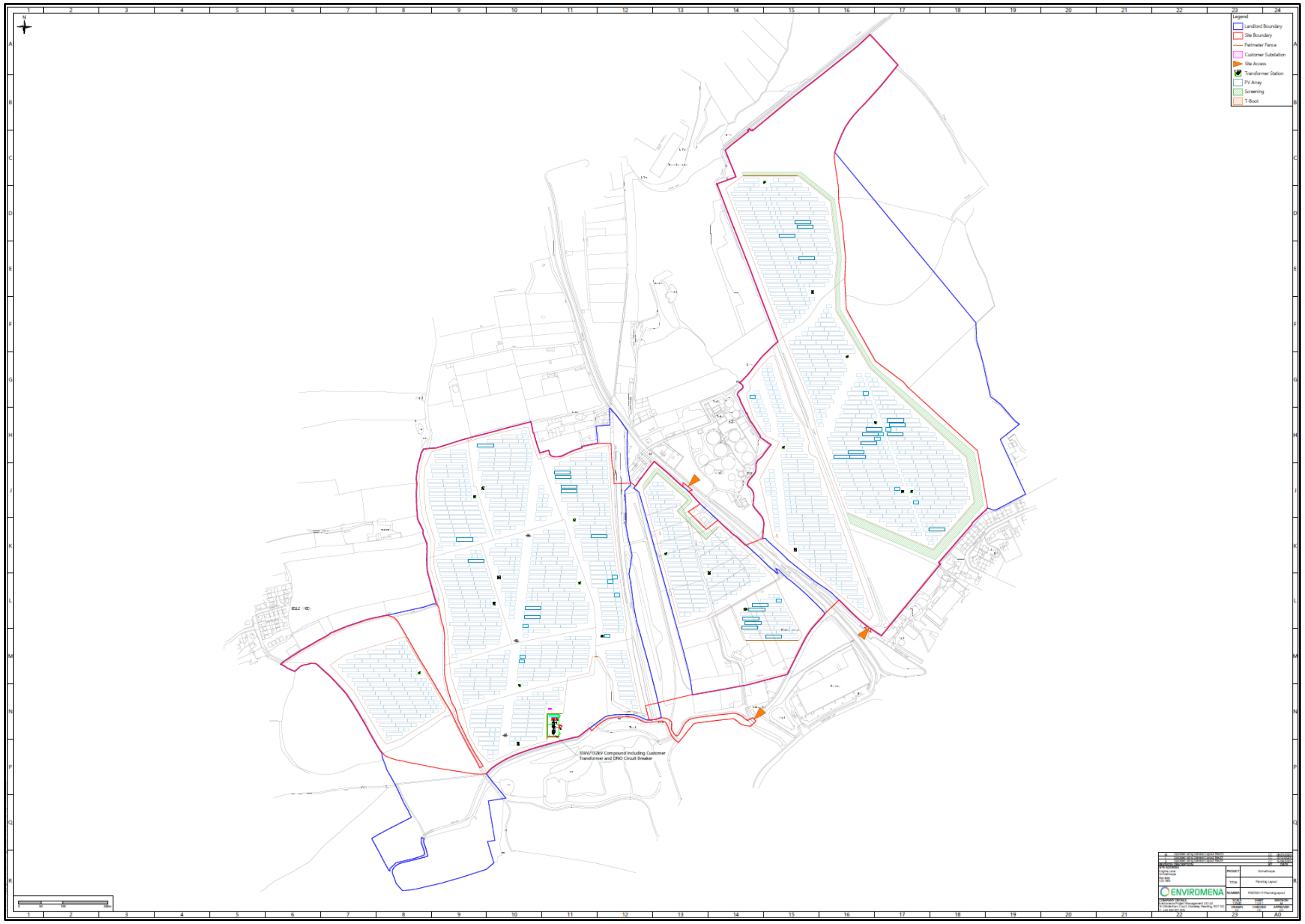


Figure 1 – *Proposed solar panel layout*

Figure 2 – *Modelled solar panel layout*

2.2 Photovoltaic Panel Mounting Arrangements and Orientation

The solar panel details as assessed within this report are as follows:

- Assessed panel height: 1.545m[8] above ground level (agl);
- Tilt: 15 degrees above the horizontal;
- Azimuth: 180 degrees (south facing).

2.3 Reflector Areas

A resolution of 20m has been chosen for this assessment. This means that a geometric calculation is undertaken for each identified receptor from a point every 20m from within the defined areas. This resolution is sufficiently high to maximise the accuracy of the results; increasing the resolution further would not significantly change the modelling output. The number of modelled reflector points is determined by the size of the reflector areas and the assessment resolution. The bounding coordinates for the proposed solar development have been extrapolated from the site plans. The data can be provided on request.

Figure 3 – *Reflector Areas*

[8] This is the centre point of the panel calculated considering the max height (2.490m) and the min height (0.600m): ((2.490-0.600)/2)+0.600.

3 GLINT AND GLARE ASSESSMENT METHODOLOGY

3.1 Overview

The following sub-sections provide a general overview with respect to the guidance studies and methodology which informs this report. Pager Power has also produced its own Glint and Glare Guidance which draws on assessment experience, consultation and industry expertise.

3.2 Guidance and Studies

Appendix A present a review of relevant guidance and independent studies with regard to glint and glare issues from solar panels. The overall conclusions from the available studies are as follows:

- Specular reflections of the Sun from solar panels are possible;
- The measured intensity of a reflection from solar panels can vary from 2% to 30% depending on the angle of incidence;
- Published guidance shows that the intensity of solar reflections from solar panels are equal to or less than those from water. It also shows that reflections from solar panels are significantly less intense than many other reflective surfaces, which are common in an outdoor environment.

3.3 Background

Details of the Sun's movements and solar reflections are presented in Appendix C.

3.4 Methodology

The glint and glare assessment methodology has been derived from the information provided to Pager Power through consultation with stakeholders and by reviewing the available guidance, studies and Pager Power's practical experience. The methodology for this glint and glare assessment is as follows:

- Identify receptors in the area surrounding the proposed development;
- Consider direct solar reflections from the proposed development towards the identified receptors by undertaking geometric calculations;
- Consider the visibility of the reflectors from the receptor's location. If the reflectors are not visible from the receptor then no reflection can occur;
- Based on the results of the geometric calculations, determine whether a reflection can occur, and if so, at what time it will occur;
- Consider both the solar reflection from the proposed development and the location of the direct sunlight with respect to the receptor's position;
- Consider the solar reflection with respect to the published studies and guidance;
- Determine whether a significant detrimental impact is expected in line with Appendix D.

Within the Pager Power model, the reflector area is defined, as well as the relevant receptor locations. The result is a chart that states whether a reflection can occur, the duration and the panels that can produce the solar reflection towards the receptor.

3.5 Assessment Methodology and Limitations

Further technical details regarding the methodology of the geometric calculations and limitations are presented in Appendix E and Appendix F.

4 IDENTIFICATION OF RECEPTORS

4.1 Overview

There is no formal guidance with regard to the maximum distance at which glint and glare should be assessed. From a technical perspective, there is no maximum distance for potential reflections. The significance of a reflection, however, decreases with distance because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances.

The above parameters and extensive experience over a significant number of glint and glare assessments undertaken show that consideration of receptors within 1km of solar PV module areas is appropriate for glint and glare effects on roads and dwellings. Therefore, the study area has been designed accordingly as a 1km boundary from solar PV module areas. The panels are fixed south facing and solar reflections at ground level towards the north at this latitude are highly unlikely. Therefore, the area to the north of the northern-most solar panels has been excluded.

Potential receptors are identified based on mapping and aerial photography of the region. The initial judgement is made based on a high-level consideration of aerial photography and mapping i.e. receptors are excluded if it is clear from the outset that no visibility would be possible. A more detailed assessment is made if the modelling reveals a reflection would be geometrically possible.

Terrain elevation heights have been interpolated based on Ordnance Survey of Great Britain (OSGB) 50m DTM data. Receptor details can be found in Appendix G.

4.2 Road Receptors

4.2.1 Overview

Road types can generally be categorised as:

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

Technical modelling is not recommended for local roads, where traffic densities are likely to be relatively low. Any solar reflections from the Proposed Development that are experienced by a road user along a local road would be considered low impact in the worst case in accordance with the guidance presented in Appendix D.

The analysis has considered any major national, national, and regional roads that:

- are within the one-kilometre study area; and
- have a potential view of the panels.

4.2.2 Identification

The assessed road receptor points along approximately 3km of the A628 (receptors 1-31) are shown in Figure 4 below. A height of 1.5 metres above ground level has been taken as typical eye level for a road user. The distance between road receptors is approximately 100m.

Other roads are located within the study area (indicated by the yellow text in Figure 4) have not been taken forwards for the full assessment since visibility of the proposed development is extremely unlikely due to existing screening such as vegetation, residential areas and terrain.

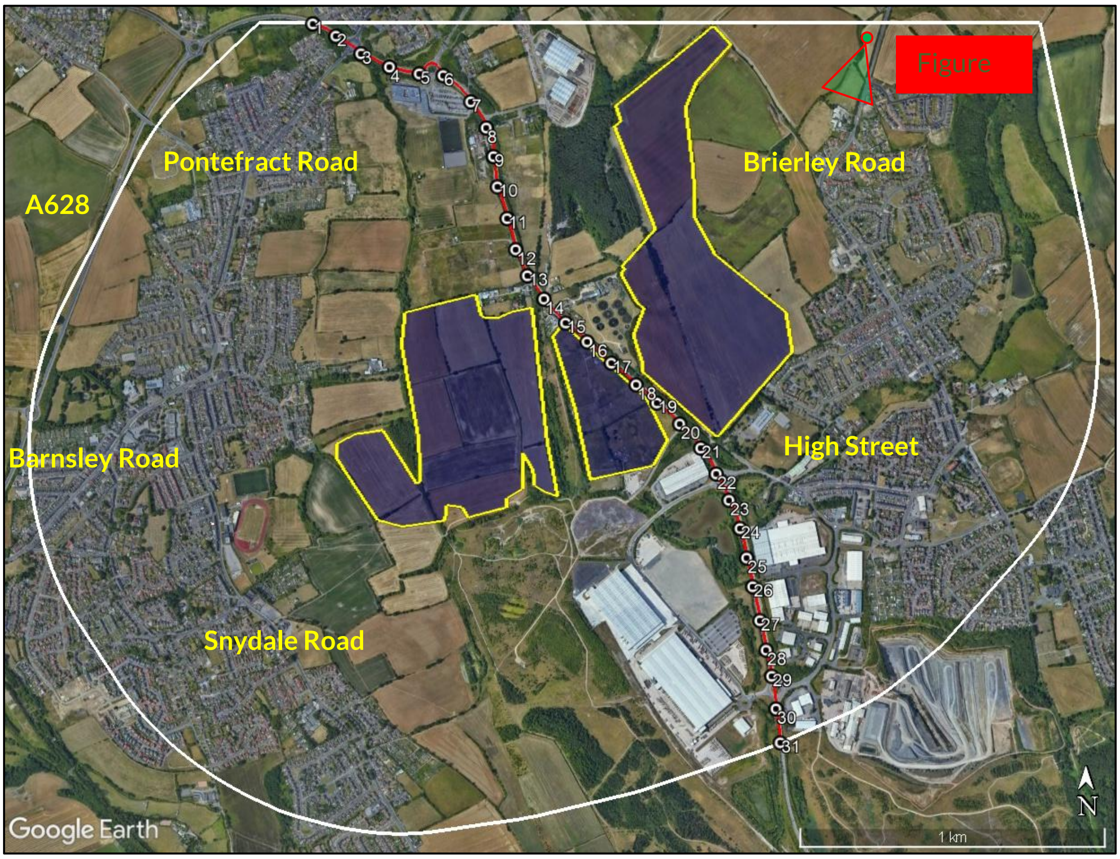


Figure 4 – *Assessed road receptors and other nearby roads*

Figure 5 – *Level of screening on Brierley Road*

4.3 Dwelling Receptors

4.3.1 Overview

The analysis has considered dwellings that:

- are within the one-kilometre study area; and
- have a potential view of the panels.

In residential areas with multiple layers of dwellings, only the outer dwellings have been considered for assessment. This is because they will mostly obscure views of the solar panels to the dwellings behind them, which will therefore not be impacted by the Proposed Development because line of sight will be removed, or they will experience comparable effects to the closest assessed dwelling.

In some cases, one physical structure is split into multiple separate addresses. In such cases, the results for the assessed location will be applicable to all associated addresses. The sampling resolution is sufficiently high to capture the level of effect for all potentially affected dwellings. A height of 1.8 metres above ground level has been taken as typical eye-level for an observer on the ground floor of the dwelling since this is typically the most occupied floor of a dwelling throughout the day[9].

4.3.2 Identification

In total, 286 dwellings were identified for assessment, as shown in Figure 6 on the following page. These receptors are shown in more detail in Figure 7 to Figure 226 on the following pages.

[9] This fixed height for the dwelling receptors is for modelling purposes. Changes to the modelling height by a few metres is not expected to significantly change the modelling results. Views above ground floor are considered in the results discussion where necessary.

Figure 6 – *Overview of dwelling receptors – aerial image*

Figure 7 *Assessed dwelling receptors 1 to 19 – aerial image*

Figure 8 *Assessed dwelling receptors 20 to 42 – aerial image*

Figure 9 *Assessed dwelling receptors 43 to 53 – aerial image*

Figure 10 *Assessed dwelling receptors 54 to 71 – aerial image*

Figure 11 *Assessed dwelling receptors 72 to 92 – aerial image*

Figure 12 *Assessed dwelling receptors 93 to 104 – aerial image*

PAGERPOWER
Urban & Renewables

Figure 13 *Assessed dwelling receptors 105 to 113 – aerial image*

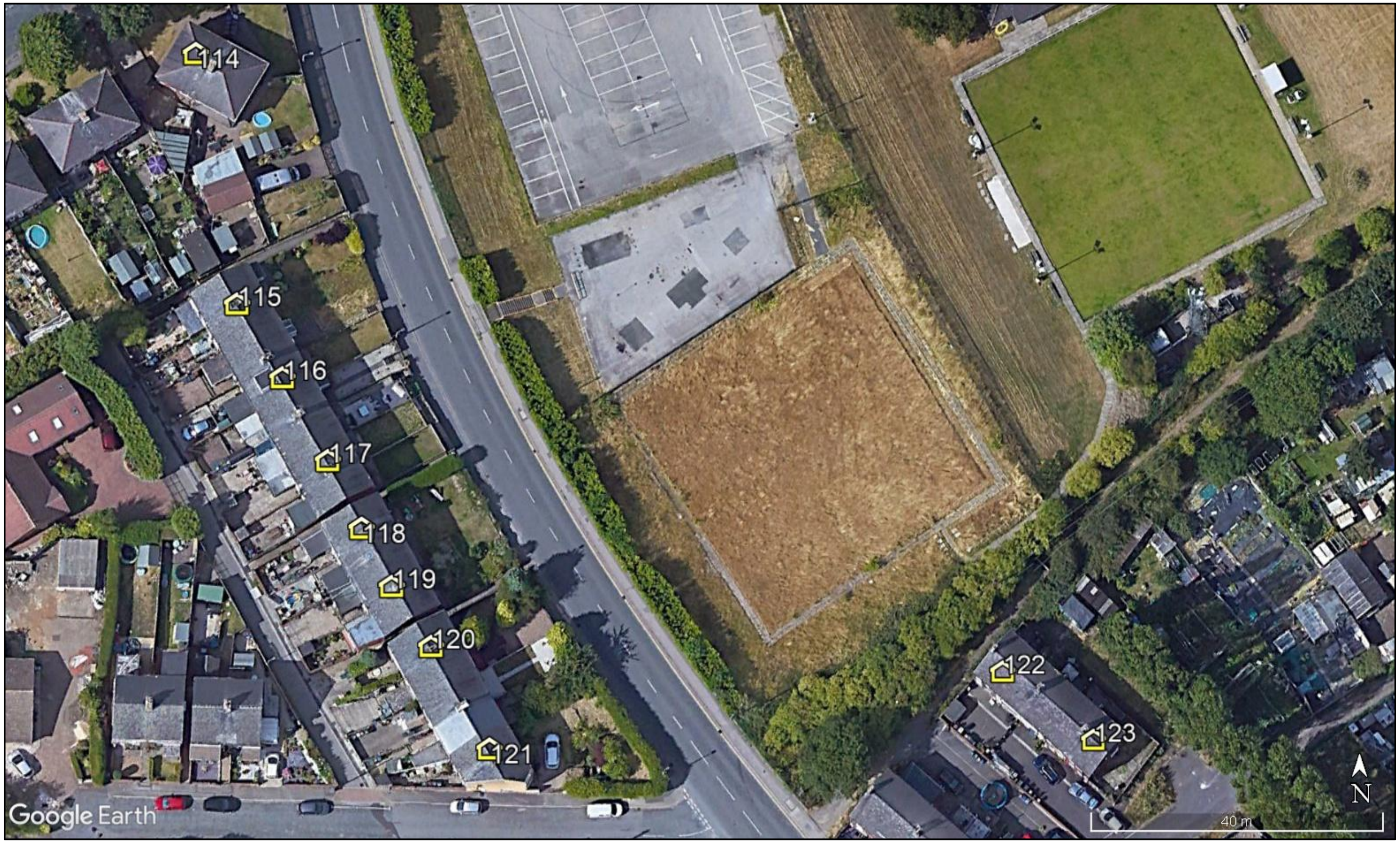


Figure 14 *Assessed dwelling receptors 114 to 123 – aerial image*

Figure 15 *Assessed dwelling receptors 124 to 147 – aerial image*

Figure 16 *Assessed dwelling receptors 148 to 159 – aerial image*

Figure 17 *Assessed dwelling receptors 160 to 165 – aerial image*

Figure 18 *Assessed dwelling receptors 166 to 178 – aerial image*

Figure 19 *Assessed dwelling receptors 179 to 181 – aerial image*

Figure 20 *Assessed dwelling receptors 182 to 189 – aerial image*

Figure 21 *Assessed dwelling receptors 190 to 201 – aerial image*

Figure 22 *Assessed dwelling receptors 201 to 220 – aerial image*

Figure 23 *Assessed dwelling receptors 221 to 228 – aerial image*

Figure 24 *Assessed dwelling receptors 229 to 244 – aerial image*

Figure 25 *Assessed dwelling receptors 245 to 261 – aerial image*

Figure 26 *Assessed dwelling receptors 262 to 276 – aerial image*

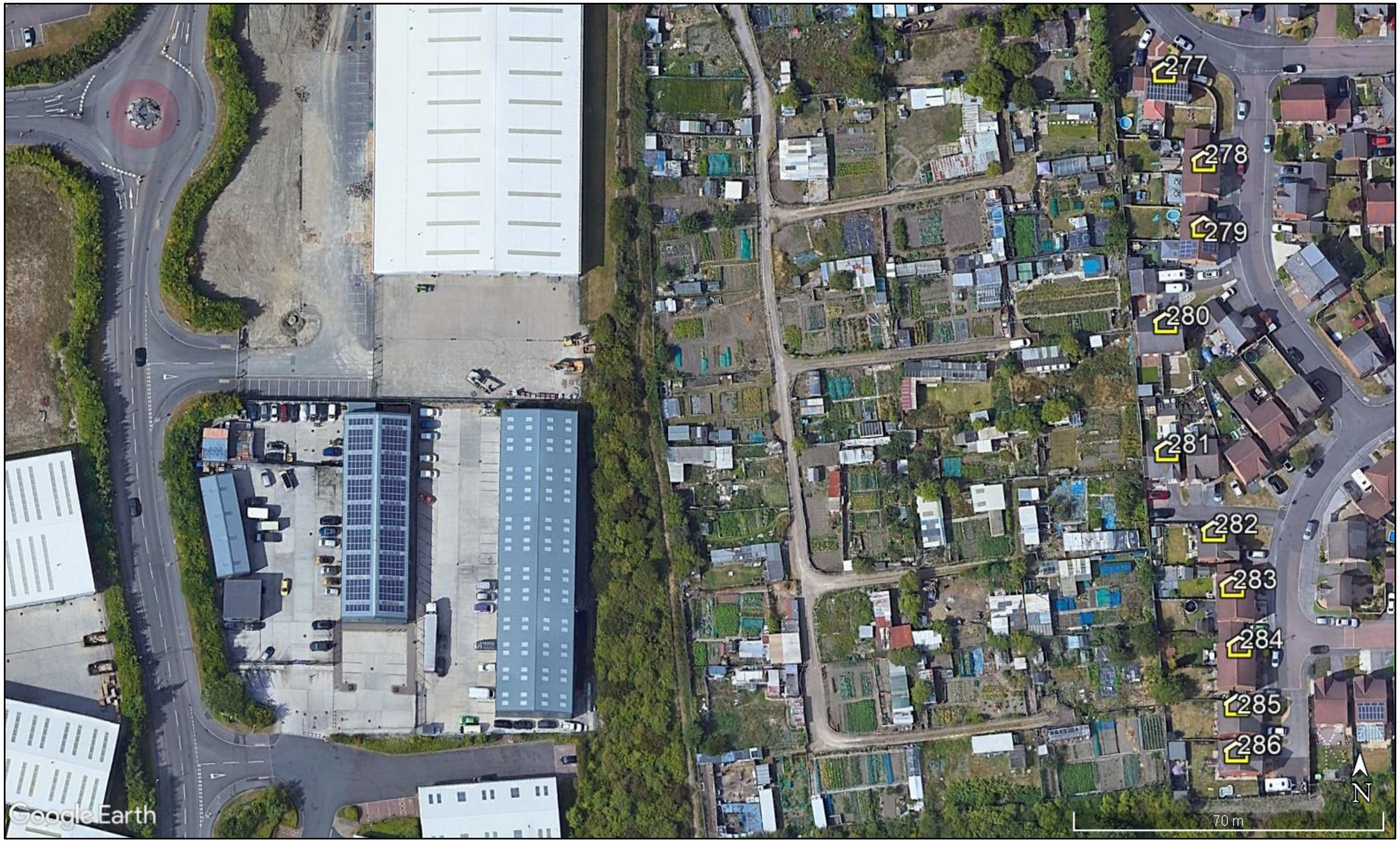


Figure 27 *Assessed dwelling receptors 277 to 286 – aerial image*

5 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

5.1 Overview

The following sub-sections present the modelling results as well as the significance of any predicted impact in the context of existing screening, and the relevant criteria set out in the next subsection. The criteria are determined by the assessment process for each receptor, which are set out in Appendix D.

When determining the visibility of the reflecting panels for an observer, a conservative review of the available imagery is undertaken, whereby it is assumed views of the panels are possible if it cannot be reliably determined that existing screening will remove effects.

The modelling output showing the precise predicted times and the reflecting panel areas can be provided on request.

5.2 Roads

5.2.1 Impact Significance Methodology

The key considerations for road users along major national, national, and regional roads are:

- Whether a reflection is predicted to be experienced in practice; and
- The location of the reflecting panel relative to a road user's direction of travel.

Where the reflecting panels are predicted to be significantly obstructed from view, no impact is predicted, and mitigation is not required.

Where solar reflections are not experienced as a sustained source of glare, originate from outside of a road user's primary horizontal field of view (50 degrees either side of the direction of travel), or the closest reflecting panel is over 1km from the road user, the impact significance is low, and mitigation is not recommended.

Where sustained solar reflections are predicted to be experienced from inside of a road user's primary field of view, expert assessment of the following factors is required to determine the impact significance and mitigation requirement:

- Whether the solar reflection originates from directly in front of a road user – a solar reflection that is directly in front of a road user is more hazardous than a solar reflection to one side;
- Whether visibility is likely for elevated drivers (applicable to dual carriageways and motorways only) – there is typically a higher density of elevated drivers (such as HGVs) along dual carriageways and motorways compared to other types of road;
- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare;
- The position of the Sun – effects that coincide with direct sunlight appear less prominent than those that do not.

If following consideration of the relevant factors, the solar reflections do not remain significant, the impact significance is low, and mitigation is not recommended.

If following consideration of the relevant factors, the solar reflections remain significant, then the impact significance is moderate, and mitigation is recommended.

Where solar reflections originate from directly in front of a road user and there are no mitigating factors, the impact significance is high, and mitigation is required.

5.2.2 Geometric Modelling Results

The modelling results[10] for road receptors are presented in Table 1 on the following page.

[10] Only considering reflections from solar panels within 1km of the receptor. Reflections outside of 1km are not considered to be significant.

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
1 – 3	Solar reflections are not geometrically possible	N/A	N/A	None	No
4 – 7	Solar reflections predicted to originate from **inside** of a road user's primary horizontal field of view 05:30-06:30 in March-May and August-September	Existing vegetation, buildings, and/or terrain screening Views of reflecting panels are not expected to be possible in practice	N/A	None	No
8 – 14	Solar reflections predicted to originate from **outside** of a road user's primary horizontal field of view 05:00-06:00 in March-September	Existing vegetation, buildings, and/or terrain screening Views of reflecting panels are not expected to be possible in practice	N/A	None	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
15 – 20	Solar reflections predicted to originate from **inside** of a road user's primary horizontal field of view 05:00-06:15 and 18:00-19:15 in March-September	Existing vegetation, buildings, and/or terrain screening Views of reflecting panels are not expected to be possible in practice	N/A	None	No
21 - 27	Solar reflections predicted to originate from **outside** of a road user's primary horizontal field of view 18:00-19:15 in March-September	Existing vegetation, buildings, and/or terrain screening Views of reflecting panels are not expected to be possible in practice	N/A	None	No
28 – 31	Solar reflections are not geometrically possible	N/A	N/A	None	No

Table 1 *Geometric modelling results, assessment of impact significance, and mitigation recommendation/requirement – road receptors*

5.2.3 Screening Review

Figure 28 *Screening for road section 4-7 (white polygons) and reflecting points (yellow icons)*

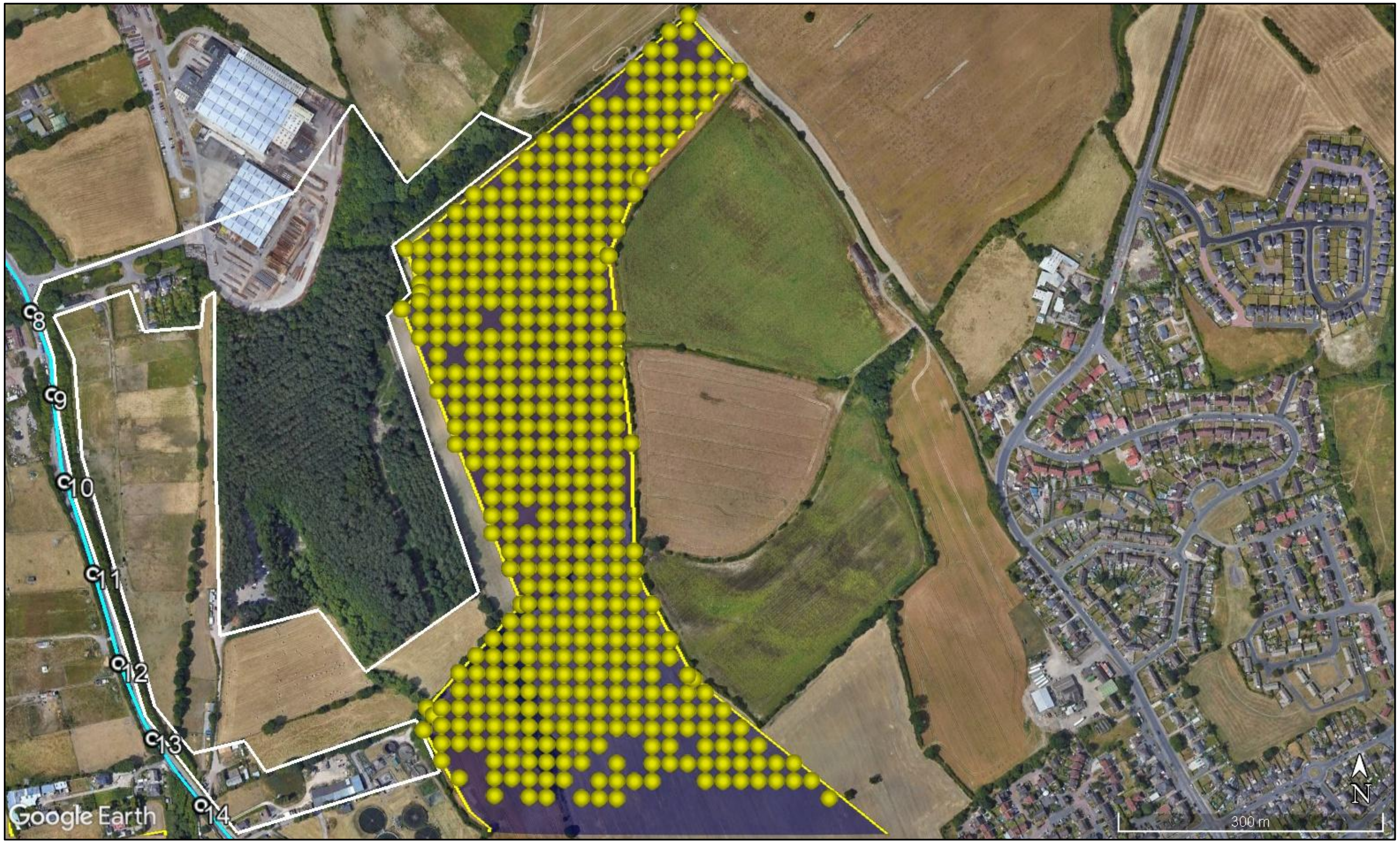


Figure 29 *Screening for road section 8-14 (white polygons) and reflecting points (yellow icons)*

Figure 30 *View south-east bound from road receptor 15 (white polygon representative of the extent of screening for road section 15-20)*

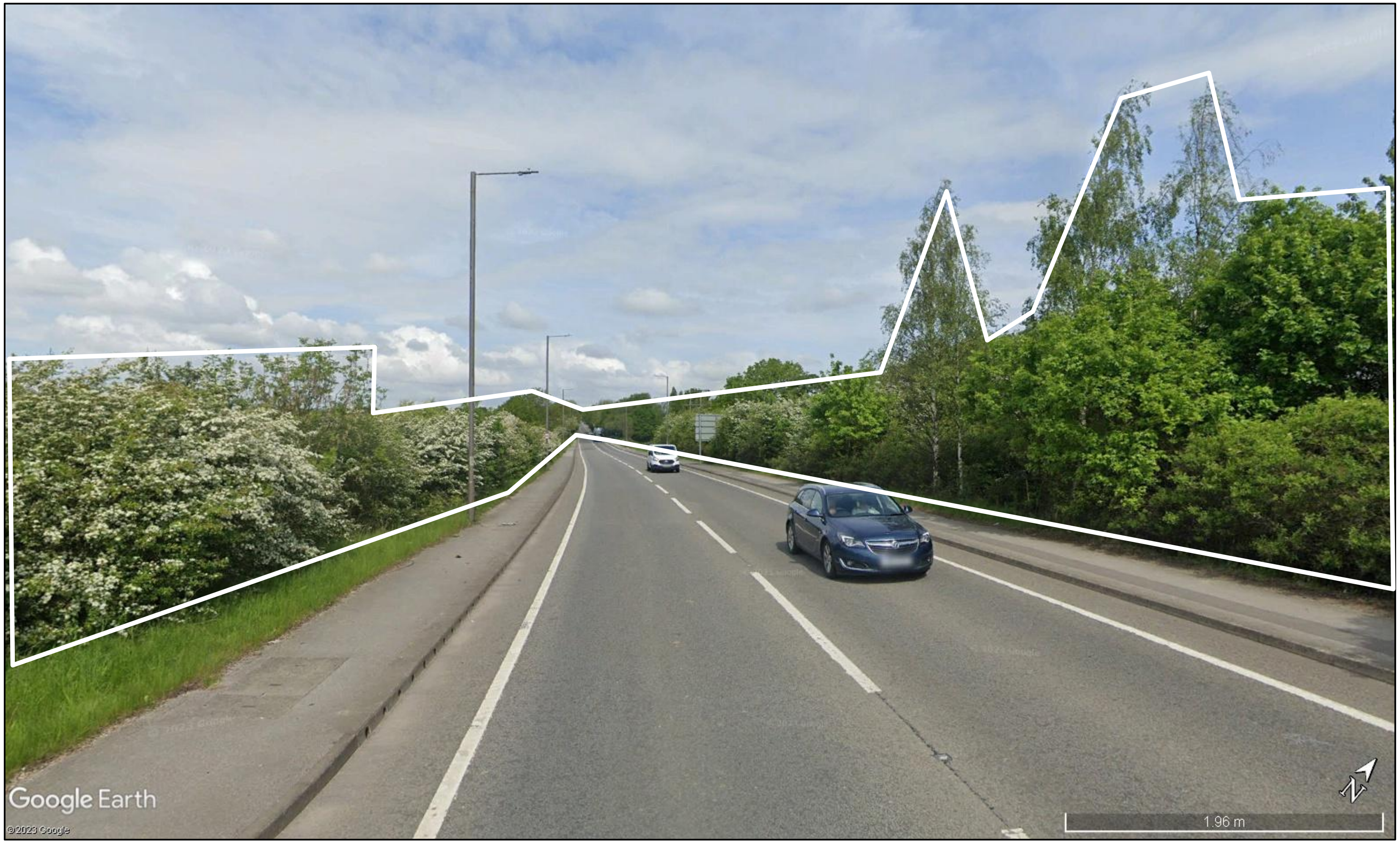


Figure 31 *View north-west bound from road receptor 20 (white polygon representative of the extent of screening for road section 15-20)*

Figure 32 *View towards reflecting panels from road receptor 21 (representative of the extent of screening for road section 21-27)*

5.2.4 Conclusions

No impacts are predicted on the assessed road section, because solar reflections are not geometrically possible, or there is significant screening in the form of existing vegetation, buildings, and/or terrain such that reflections would not be visible in practice.

5.3 Dwellings

5.3.1 Impact Significance Methodology

The key considerations for residential dwellings are:

- Whether a reflection is predicted to be experienced in practice;
- The duration of the predicted effects, relative to thresholds of:
    - 3 months per year;
    - 60 minutes on any given day.

Where solar reflections are not geometrically possible or the reflecting panels are predicted to be significantly obstructed from view, no impact is predicted, and mitigation is not required.

Where solar reflections are experienced for less than three months per year and less than 60 minutes on any given day, or the closest reflecting panel is over 1km from the dwelling, the impact significance is low, and mitigation is not recommended.

Where reflections are predicted to be experienced for more than three months per year **and/or** for more than 60 minutes on any given day, expert assessment of the following mitigating factors is required to determine the impact significance and mitigation requirement:

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

If following consideration of the relevant factors, the solar reflections do not remain significant, the impact significance is low, and mitigation is not recommended. If following consideration of the relevant factors, the solar reflections remain significant, then the impact significance is moderate, and mitigation is recommended.

If effects last for more than three months per year and for more than 60 minutes on any given day, and there are no mitigating factors, the impact significance is high, and mitigation is required.

5.3.2 Geometric Modelling Results

The modelling results[11] for dwelling locations are presented in Table 2 on the following pages.

[11] Only considering reflections from solar panels within 1km of the receptor. Reflections outside of 1km are not considered to be significant.

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
1 – 13	Solar reflections are not geometrically possible	N/A	N/A	None	No
14 – 33	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 05:00-06:15 in March-April and August-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No
34 – 58	Solar reflections are not geometrically possible	N/A	N/A	None	No
59 – 69	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 05:30-06:30 in March-April and August-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
70 – 122	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 05:00-06:30 in March-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No
123 – 125	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 05:00-06:00 in May-August	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No
126	Solar reflections are not geometrically possible	N/A	N/A	None	No
127	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 05:00-06:00 in June	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
128 – 175	Solar reflections are not geometrically possible	N/A	N/A	None	No
176	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 05:00-06:00 in April and September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No
177	Solar reflections are not geometrically possible	N/A	N/A	None	No
178	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 05:30-06:30 in March-April and August-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
179 – 184	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 05:00-06:30 in March-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No
185 – 189	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 05:00-06:30 and 18:00-19:00 in March-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
190 – 223	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 18:00-19:00 in March-September	Some existing vegetation screening Views of the reflecting panels may be possible	Closest visible reflecting panels are at least 400m away from the observer Reflections possible within maximum 2 hours of sunset when the Sun is low in the sky beyond the reflecting panels	Low	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
224 – 229	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 18:00-19:00 in March-September	Some existing vegetation screening Views of the reflecting panels are not predicted from the ground floor Views of some of the reflecting panels are expected to be possible from upper floors	Closest visible reflecting panels are at least 200m away from the observer Reflections possible within maximum 2 hours of sunset when the Sun is low in the sky beyond the reflecting panels	Low	No
230 – 231	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 18:00-19:00 in March-September	Minimal screening Views of some of the reflecting panels are expected to be possible	N/A	Low/none (subject to implementation of landscape strategy plan – see Section 5.3.4)	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
232 – 238	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 18:00-19:00 in March-September	Some existing vegetation and terrain screening Views of some of the reflecting panels are expected to be possible	Closest visible reflecting panels are at least 300m away from the observer Reflections possible within maximum 2 hours of sunset when the Sun is low in the sky beyond the reflecting panels	Low	No
239 – 277	Solar reflections predicted for **less** than 60 minutes on any given day and for **more** than 3 months of the year 18:00-19:00 in March-September	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No

Receptor	Geometric modelling results from panel areas within 1km (without consideration of screening) All times in GMT	Identified screening and predicted visibility (desk-based review)	Relevant Factors	Predicted Impact Classification	Further Mitigation Recommended/Required?
278 – 281	Solar reflections predicted for **less** than 60 minutes on any given day and for **less** than 3 months of the year 18:00-19:00 in May-July	Existing vegetation, building, and/or terrain screening Views of the reflecting panels are not predicted	N/A	None	No
282 – 286	Solar reflections are not geometrically possible	N/A	N/A	None	No

Table 2 *Geometric modelling results, assessment of impact significance, and mitigation recommendation/requirement – dwelling receptors*

5.3.3 Screening Review

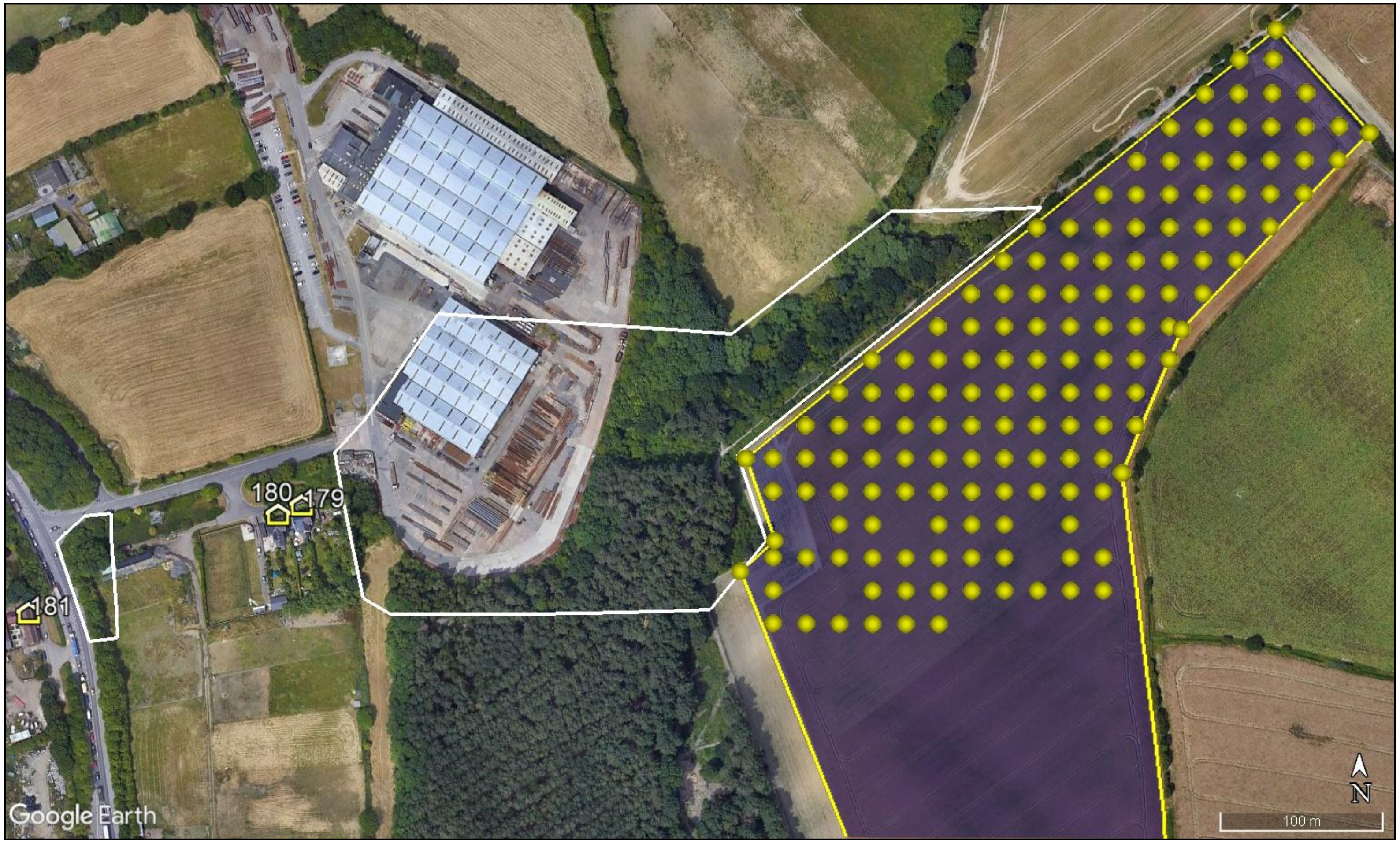


Figure 33 *Reflecting points (yellow icons) and significant screening (white polygons) for dwellings 179 – 181*

Figure 34 *Reflecting points (yellow icons) and significant screening (white polygon) for dwellings 182 – 184*

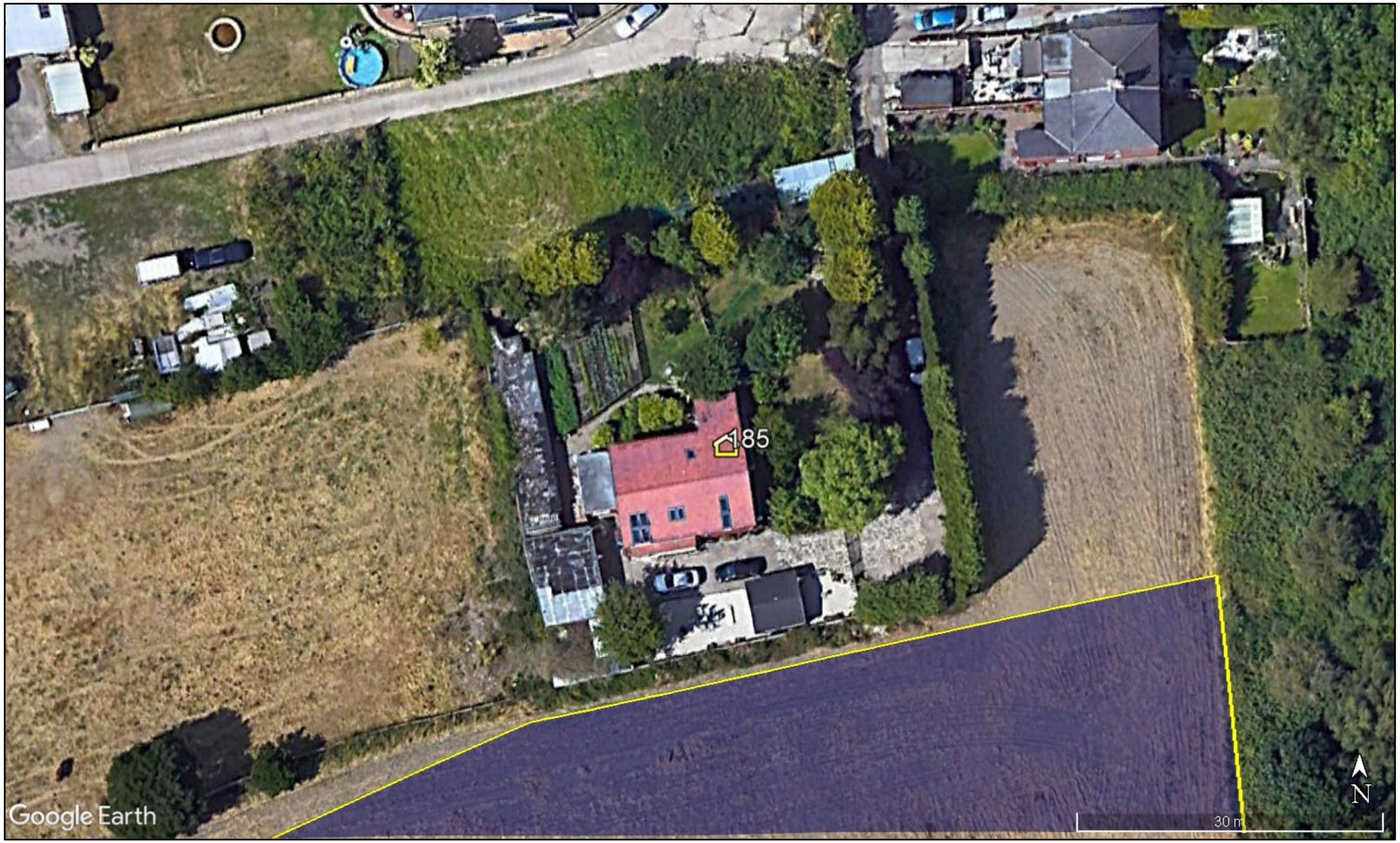


Figure 35 *Significant screening (white polygon) around dwelling 185*

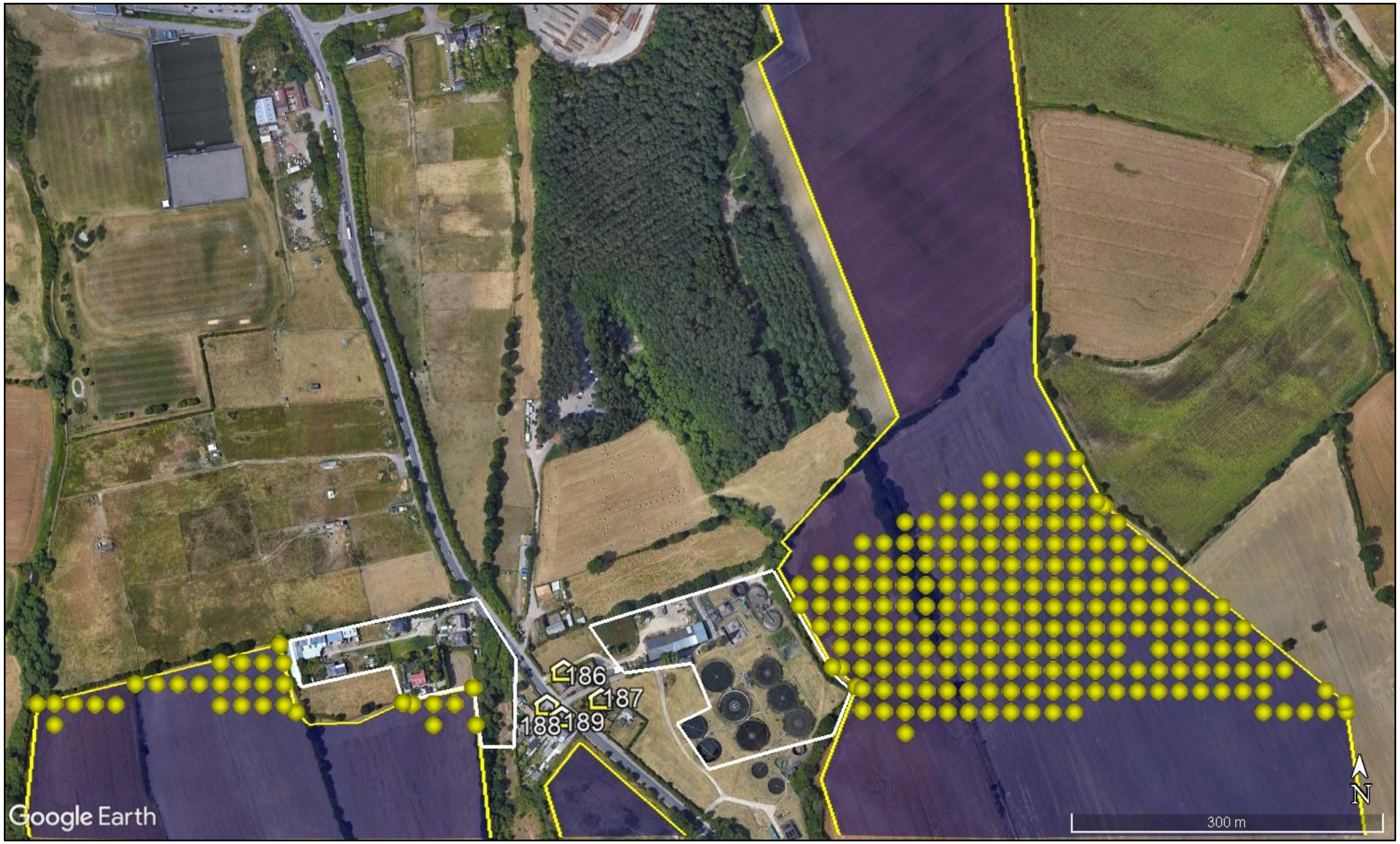


Figure 36 *Reflecting points (yellow icons) and significant screening (white polygon) for dwellings 186 – 189*

5.3.4 High-Level Mitigation Overview

The critical screening locations for dwellings 230 and 231 are shown in Figure 37 below. The yellow area represents the relevant reflecting panels that should be obscured from view.

Figure 37 *Potential screening location for dwellings 230-231 (red line)*

Figure 38 on the following page shows an extract of the landscape strategy plan[12]. A new 10-25m wide belt of native planting to create field boundary is proposed. Standard trees will be included within this area to provide screening while planting establishes. It is assumed that the height of planting will be managed so that relevant reflecting areas are obscured from view from at least the ground floor of these dwellings, so that the impact would be reduced to low/none.

5.3.5 Conclusions

No significant impacts are predicted on the dwellings within the assessment area subject to the implementation of the landscape strategy plan[12]. Where solar reflections are geometrically possible:

- There is significant existing and/or proposed screening such that reflections are not expected to be visible in practice; or
- the duration of effects received in practice is predicted to be less than 60 minutes on any given day and less than 3 months of the year; or
- there are significant factors that reduce the level of impact including:
    - A significant separation distance between observer and visible reflecting panels;
    - The position of the Sun beyond the reflecting panels – effects that coincide with direct sunlight appear less prominent than those that do not.

Further mitigation is not recommended.

[12] 11371-FPCR-ZZ-XX-DR-L-0001-0002-P14-Landscape Strategy Plan.pdf

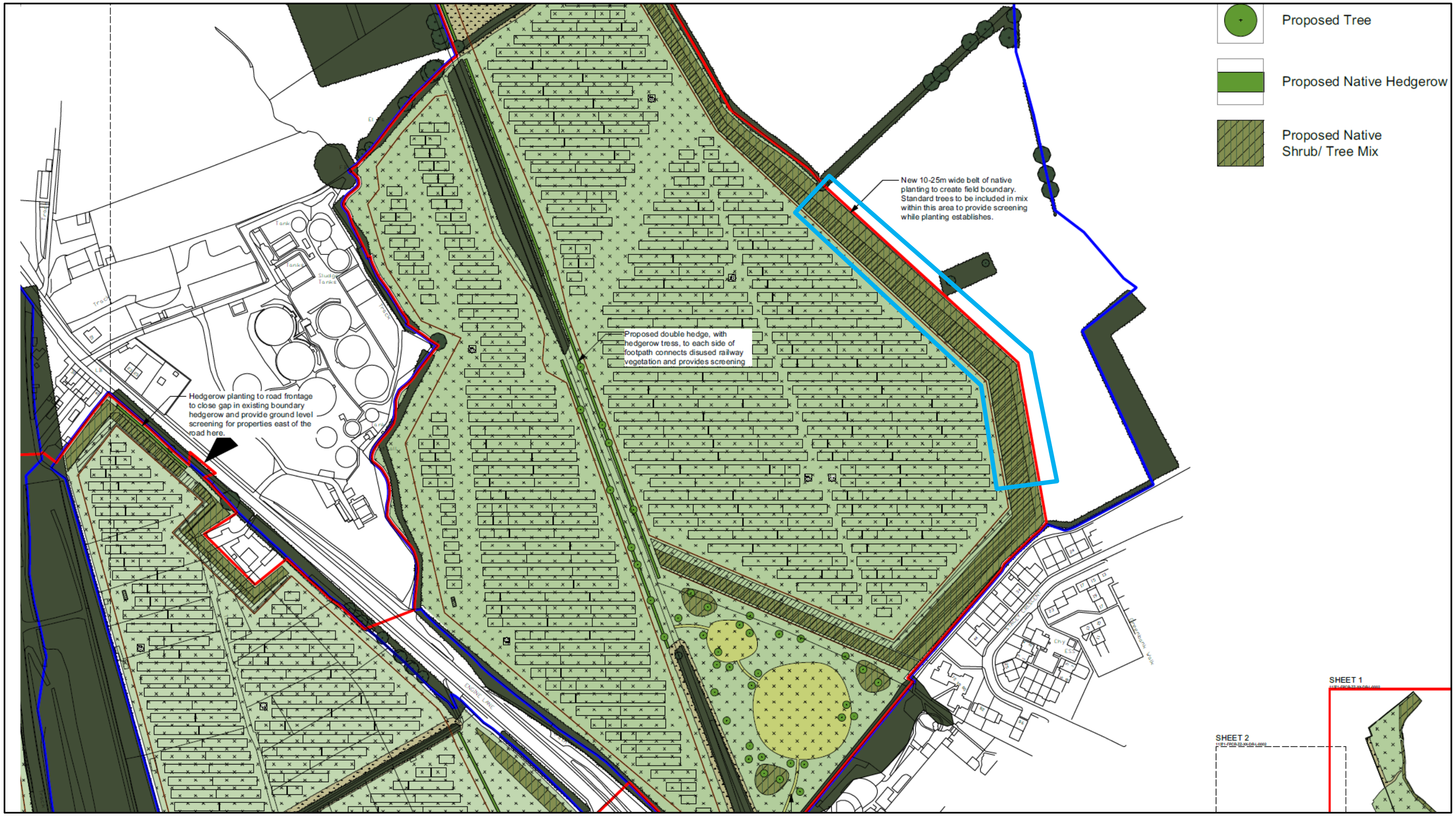


Figure 38 *Extract of Landscape Strategy Plan (blue polygon identifies the relevant screening for dwellings 230-231)*

6 HIGH-LEVEL AVIATION CONSIDERATIONS

6.1 Overview

There is no formal buffer distance within which aviation effects must be modelled. However, in practice, concerns are most often raised for developments within 10km of a licensed airport. Requests for modelling at ranges of 10-20km are far less common. Assessment of aviation effects for developments over 20km from a licensed airfield is a very unusual requirement. A high-level aviation assessment has been undertaken considering the nearest aerodromes to the proposed development (close to the 10km modelling area): YAA Nostell Helicopter Port. Other airfields exist within 10km to 20km from the proposed development (see Figure 39 below).

6.2 Airfield Details and High-Level Conclusions

Considering the size of the proposed development, its location and distance relative to the identified airfields, the following is applicable:

- YAA Nostell Helicopter Port is a heliport located approximately 7.7km north of the proposed development. Helicopters can approach a heliport from any direction; however, it is predicted that, if solar reflections are possible, the impact of the proposed development upon these airfields' aviation operations will not be significant due to the low glare intensity (low impact for temporary after-image).
- Other airfields such as Walton Wood Airfield, Askern Airfield, Birds Edge Airstrip and Wentworth Private Airstrip are located at a greater distance (further than 10km from the proposed development). It is predicted that, if solar reflections are possible, the impact of the proposed development upon these airfields' aviation operations will not be significant due to the low glare intensity (low impact for temporary after-image).

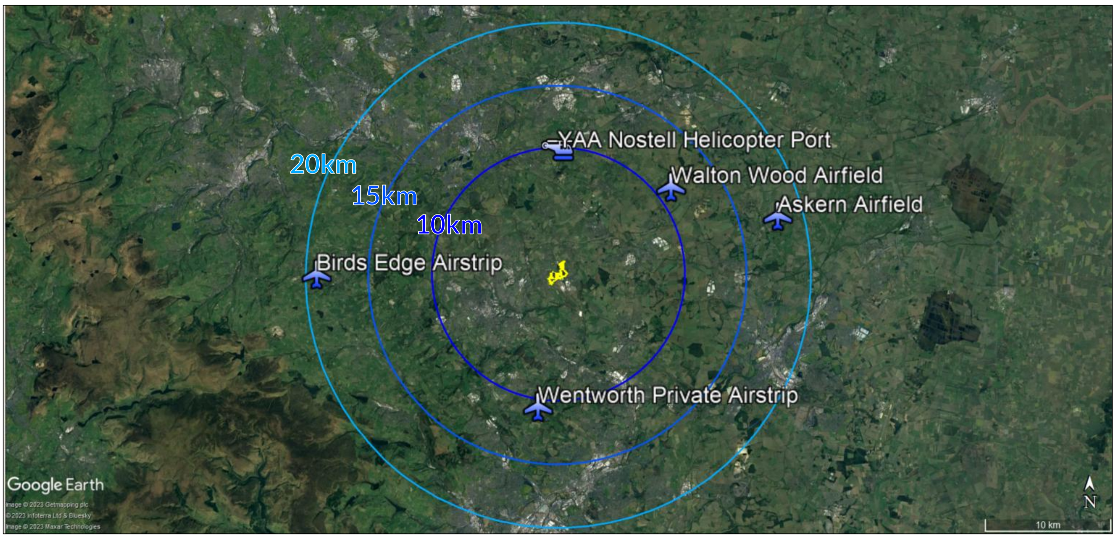


Figure 39 – *Identified Airfields relative to the proposed development*

7 HIGH-LEVEL ASSESSMENT OF PUBLIC RIGHTS OF WAY

7.1 Overview

The following section presents a high-level overview of glint and glare concerns for public rights of way (PROWs) and bridleways.

7.2 Assessment

Figure 40 below shows the location of the nearest PROWs and bridleways (blue and green lines) to the proposed development (pink polygons), and the location of the 1km assessment area (red polygon) for ground-based receptors.

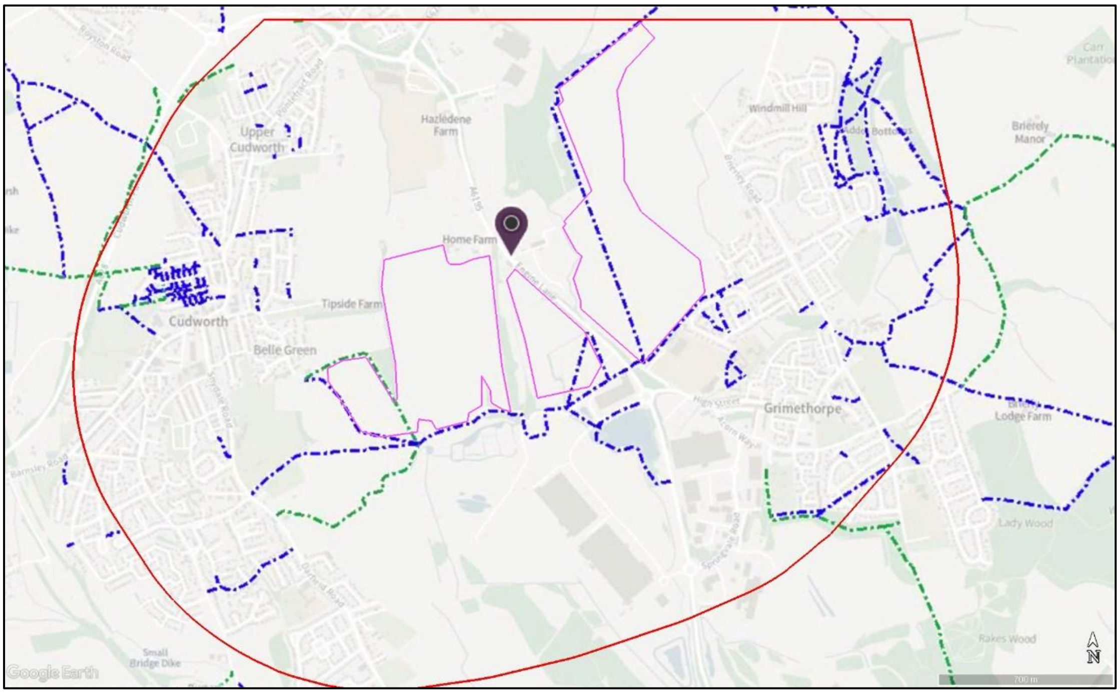


Figure 40 *PROWs and bridleways within 1km of the proposed development*

In Pager Power's experience, significant impacts to pedestrians/equestrians using the surrounding public rights of way/bridleways are not possible due to glint and glare effects from PV developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance. This is because:

- The typical density of pedestrians/horse riders located at these points is low in a rural environment;
- Any resultant effects are less serious than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious. Safety concerns are considered to a greater extent for horse riders and the

possible event of being thrown by a scared animal, however the risk of this occurring due to glare from solar panels is considered to be small[13];

- Glint and glare effects towards an observer are transient, and time and location sensitive whereby a pedestrian/horse rider could move beyond the solar reflection zone with ease with little impact upon safety or amenity;
- Any observable solar reflection towards an observer/horse rider would be of similar intensity to those experienced whilst navigating the natural and built environment on a regular basis (e.g. bodies of water), and less intense than reflections from glass and other common outdoor surfaces.

7.3 Conclusions

Overall, no significant impact on observers/equestrians using the surrounding public rights of way/bridleways is predicted.

[13] This is supported by the 'Advice on Solar Farms' document published by the British Horse Society in April 2024, which states: *"They [standard photovoltaic panels] are designed to absorb rather than reflect light for efficiency (reflected light is wasted energy) and although the amount of reflection varies with the component materials and the angle, the incidence of glare or dazzle is very low compared with glass and will not be uniform throughout a period of sunlight, assuming that the panel is static. Any reflection is unlikely to be a direct problem to horses, riders or carriage-drivers because of the angles and distances involved."*

8 CONCLUSIONS

8.1 Roads

Technical modelling is not recommended for local roads, where traffic densities are likely to be relatively low. Any solar reflections from the Proposed Development that are experienced by a road user along a local road would be considered low impact in the worst case in accordance with the guidance presented in Appendix D.

No impacts are predicted on the assessed road section, because solar reflections are not geometrically possible, or there is significant screening in the form of existing vegetation, buildings, and/or terrain such that reflections would not be visible in practice.

8.2 Dwellings

No significant impacts are predicted on the dwellings within the assessment area subject to the implementation of the landscape strategy plan[14]. Where solar reflections are geometrically possible:

- There is significant existing and/or proposed screening such that reflections are not expected to be visible in practice; or
- the duration of effects received in practice is predicted to be less than 60 minutes on any given day and less than 3 months of the year; or
- there are significant factors that reduce the level of impact including:
    - A significant separation distance between observer and visible reflecting panels;
    - The position of the Sun beyond the reflecting panels – effects that coincide with direct sunlight appear less prominent than those that do not.

Further mitigation is not recommended.

8.3 Aviation (High-Level)

Considering the size of the proposed development, its location and distance relative to the identified airfields, the following is applicable:

- YAA Nostell Helicopter Port is a heliport located approximately 7.7km north of the proposed development. Helicopters can approach a heliport from any direction; however, it is predicted that, if solar reflections are possible, the impact of the proposed development upon these airfields' aviation operations will not be significant due to the low glare intensity (low impact for temporary after-image).
- Other airfields such as Walton Wood Airfield, Askern Airfield, Birds Edge Airstrip and Wentworth Private Airstrip are located at a greater distance (further than 10km from the proposed development). It is predicted that, if solar reflections are possible, the impact of

[14] 11371-FPCR-ZZ-XX-DR-L-0001-0002-P14-Landscape Strategy Plan.pdf

the proposed development upon these airfields' aviation operations will not be significant due to the low glare intensity (low impact for temporary after-image).

Therefore, no significant impact is predicted for the aviation operation associated with the nearby airfields and no full modelling is recommended.

8.4 Public Rights of Way/Bridleways (High-Level)

In Pager Power's experience, significant impacts to pedestrians/equestrians using the surrounding public rights of way/bridleways are not possible due to glint and glare effects from PV developments. The reasoning is due to the sensitivity of the receptors (in terms of amenity and safety) being concluded to be of low significance. This is because:

- The typical density of pedestrians/horse riders located at these points is low in a rural environment;
- Any resultant effects are less serious than, for example, solar reflections experienced towards a road network whereby the resultant impacts of a solar reflection can be much more serious. Safety concerns are considered to a greater extent for horse riders and the possible event of being thrown by a scared animal, however the risk of this occurring due to glare from solar panels is considered to be small[15];
- Glint and glare effects towards an observer are transient, and time and location sensitive whereby a pedestrian/horse rider could move beyond the solar reflection zone with ease with little impact upon safety or amenity;
- Any observable solar reflection towards an observer/horse rider would be of similar intensity to those experienced whilst navigating the natural and built environment on a regular basis (e.g. bodies of water), and less intense than reflections from glass and other common outdoor surfaces.

Overall, no significant impact on observers/equestrians using the surrounding public rights of way/bridleways is predicted and therefore mitigation is not required.

8.5 Overall

Mitigation is recommended for two dwellings due to the duration of effects, and the lack of sufficient mitigating factors. Further information is provided in Section 6.

There are no impacts requiring mitigation on surrounding road users, aviation activity, and PROWs/bridleways.

---

[15] This is supported by the 'Advice on Solar Farms' document published by the British Horse Society in April 2024, which states: *"They [standard photovoltaic panels] are designed to absorb rather than reflect light for efficiency (reflected light is wasted energy) and although the amount of reflection varies with the component materials and the angle, the incidence of glare or dazzle is very low compared with glass and will not be uniform throughout a period of sunlight, assuming that the panel is static. Any reflection is unlikely to be a direct problem to horses, riders or carriage-drivers because of the angles and distances involved."*

APPENDIX A – OVERVIEW OF GLINT AND GLARE GUIDANCE

Overview

This section presents details regarding the relevant guidance and studies with respect to the considerations and effects of solar reflections from solar panels, known as 'Glint and Glare'.

This is not a comprehensive review of the data sources, rather it is intended to give an overview of the important parameters and considerations that have informed this assessment.

UK Planning Policy

Renewable and Low Carbon Energy

The National Planning Policy Framework under the planning practice guidance for Renewable and Low Carbon Energy[16] (specifically regarding the consideration of solar farms, paragraph 013) states:

'What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms?

The deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively.

Particular factors a local planning authority will need to consider include:

…

- the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on **neighbouring uses and aircraft safety**;
- the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun;

…

The approach to assessing cumulative landscape and visual impact of large scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero.'

[16] Renewable and low carbon energy, Ministry of Housing, Communities & Local Government, last updated: 14 August 2023, accessed on: 17/05/2024

National Policy Statement for Renewable Energy Infrastructure

The National Policy Statement for Renewable Energy Infrastructure (EN-3)[17] sets out the primary policy for decisions by the Secretary of State for nationally significant renewable energy infrastructure. Sections 2.10.102-106 state:

'2.10.102 Solar panels are specifically designed to absorb, not reflect, irradiation.[18] However, solar panels may reflect the sun's rays at certain angles, causing glint and glare. Glint is defined as a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel. Glare is a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel. The effect occurs when the solar panel is stationed between or at an angle of the sun and the receptor.

2.10.103 Applicants should map receptors to qualitatively identify potential glint and glare issues and determine if a glint and glare assessment is necessary as part of the application.

2.10.104 When a quantitative glint and glare assessment is necessary, applicants are expected to consider the geometric possibility of glint and glare affecting nearby receptors and provide an assessment of potential impact and impairment based on the angle and duration of incidence and the intensity of the reflection.

2.10.105 The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and design. This may need to account for 'tracking' panels if they are proposed as these may cause differential diurnal and/or seasonal impacts.

2.10.106 When a glint and glare assessment is undertaken, the potential for solar PV panels, frames and supports to have a combined reflective quality may need to be assessed, although the glint and glare of the frames and supports is likely to be significantly less than the panels.'

The EN-3 does not state which receptors should be considered as part of a quantitative glint and glare assessment. Based on Pager Power's extensive project experience, typical receptors include residential dwellings, road users, aviation infrastructure, and railway infrastructure.

Sections 2.10.134-136 state:

'2.10.134 Applicants should consider using, and in some cases the Secretary of State may require, solar panels to comprise of (or be covered with) anti-glare/anti-reflective coating with a specified angle of maximum reflection attenuation for the lifetime of the permission.

2.10.135 Applicants may consider using screening between potentially affected receptors and the reflecting panels to mitigate the effects.

2.10.136 Applicants may consider adjusting the azimuth alignment of or changing the elevation tilt angle of a solar panel, within the economically viable range, to alter the angle of incidence. In practice

---

[17] National Policy Statement for Renewable Energy Infrastructure (EN-3), Department for Energy Security & Net Zero, date: January 2024, accessed on: 17/09/2024.

[18] *'Most commercially available solar panels are designed with anti-reflective glass or are produced with anti-reflective coating and have a reflective capacity that is generally equal to or less hazardous than other objects typically found in the outdoor environment, such as bodies of water or glass buildings.'*

this is unlikely to remove the potential impact altogether but in marginal cases may contribute to a mitigation strategy.'

The mitigation strategies listed within the EN-3 are relevant strategies that are frequently utilised to eliminate or reduce glint and glare effects towards surrounding observers. The most common form of mitigation is the implementation of screening along the site boundary.

Sections 2.10.158-159 state:

2.10.158 Solar PV panels are designed to absorb, not reflect, irradiation. However, the Secretary of State should assess the potential impact of glint and glare on nearby homes, motorists, public rights of way, and aviation infrastructure (including aircraft departure and arrival flight paths).

2.10.159 Whilst there is some evidence that glint and glare from solar farms can be experienced by pilots and air traffic controllers in certain conditions, there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety. Therefore, unless a significant impairment can be demonstrated, the Secretary of State is unlikely to give any more than limited weight to claims of aviation interference because of glint and glare from solar farms.

The EN-3 goes some way in acknowledging that the issue is more complex than presented in the early draft issues; though, this is still unlikely to be welcomed by aviation stakeholders, who will still request a glint and glare assessment on the basis that glare may lead to a potentially significant impact upon aviation safety.

Finally, the EN-3 relates solely to nationally significant renewable energy infrastructure and therefore does not apply to all planning applications for solar farms.

Assessment Process – Ground-Based Receptors

No process for determining and contextualising the effects of glint and glare has been determined when assessing the impact of solar reflections upon surrounding roads and dwellings. Therefore, the Pager Power approach is to determine whether a reflection from the proposed solar development is geometrically possible and then to compare the results against the relevant guidance/studies to determine whether the reflection is significant.

The Pager Power approach has been informed by the policy presented above, current studies (presented in Appendix B) and stakeholder consultation. Further information can be found in Pager Power's Glint and Glare Guidance document[19] which was produced due to the absence of existing guidance and a specific standardised assessment methodology.

[19] Solar Photovoltaic Development Glint and Glare Guidance, Fourth Edition, March 2022. Pager Power.

Aviation Assessment Guidance

The UK Civil Aviation Authority (CAA) issued interim guidance relating to Solar Photovoltaic Systems (SPV) on 17 December 2010 and was subject to a CAA information alert 2010/53. The formal policy was cancelled on September 7th, 2012[20] however the advice is still applicable[21] until a formal policy is developed. The relevant aviation guidance from the CAA is presented in the section below.

CAA Interim Guidance

This interim guidance makes the following recommendations (p.2-3):

'8. It is recommended that, as part of a planning application, the SPV developer provide safety assurance documentation (including risk assessment) regarding the full potential impact of the SPV installation on aviation interests.

9. Guidance on safeguarding procedures at CAA licensed aerodromes is published within CAP 738 Safeguarding of Aerodromes and advice for unlicensed aerodromes is contained within CAP 793 Safe Operating Practices at Unlicensed Aerodromes.

10. Where proposed developments in the vicinity of aerodromes require an application for planning permission the relevant LPA normally consults aerodrome operators or NATS when aeronautical interests might be affected. This consultation procedure is a statutory obligation in the case of certain major airports, and may include military establishments and certain air traffic surveillance technical sites. These arrangements are explained in Department for Transport Circular 1/2003 and for Scotland, Scottish Government Circular 2/2003.

11. In the event of SPV developments proposed under the Electricity Act, the relevant government department should routinely consult with the CAA. There is therefore no requirement for the CAA to be separately consulted for such proposed SPV installations or developments.

12. If an installation of SPV systems is planned on-aerodrome (i.e. within its licensed boundary) then it is recommended that data on the reflectivity of the solar panel material should be included in any assessment before installation approval can be granted. Although approval for installation is the responsibility of the ALH[22], as part of a condition of a CAA Aerodrome Licence, the ALH is required to obtain prior consent from CAA Aerodrome Standards Department before any work is begun or approval to the developer or LPA is granted, in accordance with the procedures set out in CAP 791 Procedures for Changes to Aerodrome Infrastructure.

13. During the installation and associated construction of SPV systems there may also be a need to liaise with nearby aerodromes if cranes are to be used; CAA notification and permission is not required.

[20] Archived at Pager Power
[21] Reference email from the CAA dated 19/05/2014.
[22] Aerodrome Licence Holder.

14. The CAA aims to replace this informal guidance with formal policy in due course and reserves the right to cancel, amend or alter the guidance provided in this document at its discretion upon receipt of new information.

15. Further guidance may be obtained from CAA's Aerodrome Standards Department via aerodromes@caa.co.uk.'

FAA Guidance

The most comprehensive guidelines available for the assessment of solar developments near aerodromes has been produced by the United States Federal Aviation Administration (FAA). The first guidelines were produced initially in November 2010 and updated in 2013. A final policy was released in 2021, which superseded the interim guidance.

The 2010 document is entitled '*Technical Guidance for Evaluating Selected Solar Technologies on Airports'*[23], the 2013 update is entitled '*Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports'*[24], and the 2021 final policy is entitled '*Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports'*[25].

Key excerpts from the final policy are presented below:

Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT cab.

The policy in this document updates and replaces the previous policy by encouraging airport sponsors to conduct an ocular analysis of potential impacts to ATCT cabs prior to submittal of a Notice of Proposed Construction or Alteration Form 7460-1 (hereinafter Form 7460-1). Airport sponsors are no longer required to submit the results of an ocular analysis to FAA. Instead, to demonstrate compliance with 14 CFR 77.5(c), FAA will rely on the submittal of Form 7460-1 in which the sponsor confirms that it has analyzed the potential for glint and glare and determined there is no potential for ocular impact to the airport's ATCT cab. This process will enable FAA to evaluate the solar energy system project, with assurance that the system will not impact the ATCT cab.

FAA encourages airport sponsors of federally-obligated towered airports to conduct a sufficient analysis to support their assertion that a proposed solar energy system will not result in ocular impacts. There are several tools available on the open market to airport sponsors that can analyze potential glint and glare to an ATCT cab. For proposed systems that will clearly not impact ATCT cabs (e.g., on-airport solar energy

[23] Archived at Pager Power

[24] Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports, Department of Transportation, Federal Aviation Administration (FAA), date: 10/2013, accessed on: 08/12/2021.

[25] Federal Aviation Administration Policy: Review of Solar Energy System Projects on Federally-Obligated Airports, Federal Aviation Administration, date: May 2021, accessed on: 08/12/2021.

systems that are blocked from the ATCT cab's view by another structure), the use of such tools may not be necessary to support the assertion that a proposed solar energy system will not result in ocular impacts.

The excerpt above states where a solar PV development is to be located on a federally obligated aerodrome with an ATC Tower, it will require a glint and glare assessment to accompany its application. It states that pilots on approach are no longer a specific assessment requirement due to effects from solar energy systems being similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. Ultimately it comes down to the specific aerodrome to ensure it is adequately safeguarded, and it is on this basis that glint and glare assessments are routinely still requested.

The policy also states that several different tools and methodologies can be used to assess the impacts of glint and glare, which was previously required to be undertaken by the Solar Glare Hazard Analysis Tool (SGHAT) using the Sandia National Laboratories methodology.

In 2018, the FAA released the latest version (Version 1.1) of the '*Technical Guidance for Evaluating Selected Solar Technologies on Airports*'[26]. Whilst the 2021 final policy also supersedes this guidance, many of the points are still relevant because aerodromes are still safeguarding against glint and glare irrespective of the FAA guidance. The key points are presented below for reference:

- *Reflectivity refers to light that is reflected off surfaces. The potential effects of reflectivity are glint (a momentary flash of bright light) and glare (a continuous source of bright light). These two effects are referred to hereinafter as "glare," which can cause a brief loss of vision, also known as flash blindness*[27].
- *The amount of light reflected off a solar panel surface depends on the amount of sunlight hitting the surface, its surface reflectivity, geographic location, time of year, cloud cover, and solar panel orientation.*
- *As illustrated on Figure 16*[28]*, flat, smooth surfaces reflect a more concentrated amount of sunlight back to the receiver, which is referred to as specular reflection. The more a surface is polished, the more it shines. Rough or uneven surfaces reflect light in a diffused or scattered manner and, therefore, the light will not be received as bright.*
- *Because the FAA has no specific standards for airport solar facilities and potential glare, the type of glare analysis may vary. Depending on site specifics (e.g., existing land uses, location and size of the project) an acceptable evaluation could involve one or more of the following levels of assessment:*

[26] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 17/09/2024.

[27] Flash Blindness, as described in the FAA guidelines, can be described as a temporary visual interference effect that persists after the source of illumination has ceased. This occurs from many reflective materials in the ambient environment.

[28] First figure in Appendix B.

  - *A qualitative analysis of potential impact in consultation with the Control Tower, pilots and airport officials;*
  - *A demonstration field test with solar panels at the proposed site in coordination with FAA Tower personnel;*
  - *A geometric analysis to determine days and times when an impact is predicted.*
- *The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and system design.*
- ***1. Assessing Baseline Reflectivity Conditions** – Reflection in the form of glare is present in current aviation operations. The existing sources of glare come from glass windows, auto surface parking, rooftops, and water bodies. At airports, existing reflecting surfaces may include hangar roofs, surface parking, and glassy office buildings. To minimize unexpected glare, windows of air traffic control towers and airplane cockpits are coated with anti-reflective glazing. Operators also wear polarized eye wear. Potential glare from solar panels should be viewed in this context. Any airport considering a solar PV project should first review existing sources of glare at the airport and the effectiveness of measures used to mitigate that glare.*
- ***2. Tests in the Field** – Potential glare from solar panels can easily be viewed at the airport through a field test. A few airports have coordinated these tests with FAA Air Traffic Controllers to assess the significance of glare impacts. To conduct such a test, a sponsor can take a solar panel out to proposed location of the solar project, and tilt the panel in different directions to evaluate the potential for glare onto the air traffic control tower. For the two known cases where a field test was conducted, tower personnel determined the glare was not significant. If there is a significant glare impact, the project can be modified by ensuring panels are not directed in that direction.*
- ***3. Geometric Analysis** – Geometric studies are the most technical approach for reflectivity issues. They are conducted when glare is difficult to assess through other methods. Studies of glare can employ geometry and the known path of the sun to predict when sunlight will reflect off of a fixed surface (like a solar panel) and contact a fixed receptor (e.g., control tower). At any given site, the sun moves across the sky every day and its path in the sky changes throughout year. This in turn alters the destination of the resultant reflections since the angle of reflection for the solar panels will be the same as the angle at which the sun hits the panels. The larger the reflective surface, the greater the likelihood of glare impacts.*
- *Facilities placed in remote locations, like the desert, will be far from receptors and therefore potential impacts are limited to passing aircraft. Because the intensity of the light reflected from the solar panel decreases with increasing distance, an appropriate question is how far you need to be from a solar reflected surface to avoid flash blindness. It is known that this distance is directly proportional to the size of the array in question[29] but still requires further research to definitively answer.*

[29] Ho, Clifford, Cheryl Ghanbari, and Richard Diver. 2009. Hazard Analysis of Glint and Glare From Concentrating Solar Power Plants. SolarPACES 2009, Berlin Germany. Sandia National Laboratories.

- ***Experiences of Existing Airport Solar Projects*** *– Solar installations are presently operating at a number of airports, including megawatt-sized solar facilities covering multiple acres. Air traffic control towers have expressed concern about glint and glare from a small number of solar installations. These were often instances when solar installations were sited between the tower and airfield, or for installations with inadequate or no reflectivity analysis. Adequate reflectivity analysis and alternative siting addressed initial issues at those installations.*

Air Navigation Order (ANO) 2016

In some instances, an aviation stakeholder can refer to the ANO 2016[30] with regard to safeguarding. Key points from the document are presented below.

Lights liable to endanger

224. (1) A person must not exhibit in the United Kingdom any light which—

(a) by reason of its glare is liable to endanger aircraft taking off from or landing at an aerodrome; or

(b) by reason of its liability to be mistaken for an aeronautical ground light is liable to endanger aircraft.

(2) If any light which appears to the CAA to be a light described in paragraph (1) is exhibited, the CAA may direct the person who is the occupier of the place where the light is exhibited or who has charge of the light, to take such steps within a reasonable time as are specified in the direction—

(a) to extinguish or screen the light; and

(b) to prevent in the future the exhibition of any other light which may similarly endanger aircraft.

(3) The direction may be served either personally or by post, or by affixing it in some conspicuous place near to the light to which it relates.

(4) In the case of a light which is or may be visible from any waters within the area of a general lighthouse authority, the power of the CAA under this article must not be exercised except with the consent of that authority.

Lights which dazzle or distract

225. A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft.'

The document states that no 'light', 'dazzle' or 'glare' should be produced which will create a detrimental impact upon aircraft safety.

Endangering safety of an aircraft

240. A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft.

[30] The Air Navigation Order 2016. [online] Available at: https://www.legislation.gov.uk/uksi/2016/765/contents/made [Accessed 4 February 2022].

Endangering safety of any person or property

241. A person must not recklessly or negligently cause or permit an aircraft to endanger any person or property.

Civil Aviation Authority consolidation of UK Regulation 139/2014

The Civil Aviation Authority (CAA) published a consolidating document[31] of UK regulations, (Implementing Rules, Acceptable Means of Compliance and Guidance Material), in 2023. A summary of material relevant to aerodrome safeguarding is presented below:

(a) The aerodrome operator should have procedures to monitor the changes in the obstacle environment, marking and lighting, and in human activities or land use on the aerodrome and the areas around the aerodrome, as defined in coordination with the CAA. The scope, limits, tasks and responsibilities for the monitoring should be defined in coordination with the relevant air traffic services providers, and with the CAA and other relevant authorities.

(b) The limits of the aerodrome surroundings that should be monitored by the aerodrome operator are defined in coordination with the CAA and should include the areas that can be visually monitored during the inspections of the manoeuvring area.

(c) The aerodrome operator should have procedures to mitigate the risks associated with changes on the aerodrome and its surroundings identified with the monitoring procedures. The scope, limits, tasks, and responsibilities for the mitigation of risks associated to obstacles or hazards outside the perimeter fence of the aerodrome should be defined in coordination with the relevant air traffic services providers, and with the CAA and other relevant authorities.

(d) The risks caused by human activities and land use which should be assessed and mitigated should include:

1. obstacles and the possibility of induced turbulence;
2. the use of hazardous, confusing, and misleading lights;
3. the dazzling caused by large and highly reflective surfaces;
4. sources of non-visible radiation, or the presence of moving, or fixed objects which may interfere with, or adversely affect, the performance of aeronautical communications, navigation and surveillance systems;
5. and non-aeronautical ground light near an aerodrome which may endanger the safety of aircraft and which should be extinguished, screened, or otherwise modified so as to eliminate the source of danger.

[31] https://regulatorylibrary.caa.co.uk/139-2014-pdf/PDF.pdf

PAGERPOWER
Urban & Renewables

APPENDIX B – OVERVIEW OF GLINT AND GLARE STUDIES

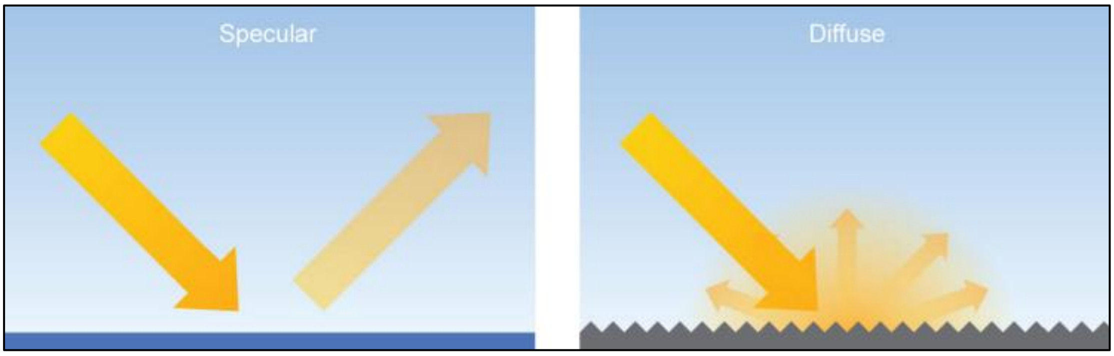
Overview

Studies have been undertaken assessing the type and intensity of solar reflections from various surfaces including solar panels and glass. An overview of these studies is presented below.

The guidelines presented are related to aviation safety. The results are applicable for the purpose of this analysis.

Reflection Type from Solar Panels

Based on the surface conditions reflections from light can be specular and diffuse. A specular reflection has a reflection characteristic similar to that of a mirror; a diffuse will reflect the incoming light and scatter it in many directions. The figure below, taken from the FAA guidance[32], illustrates the difference between the two types of reflections. Because solar panels are flat and have a smooth surface most of the light reflected is specular, which means that incident light from a specific direction is reradiated in a specific direction.



Specular and diffuse reflections

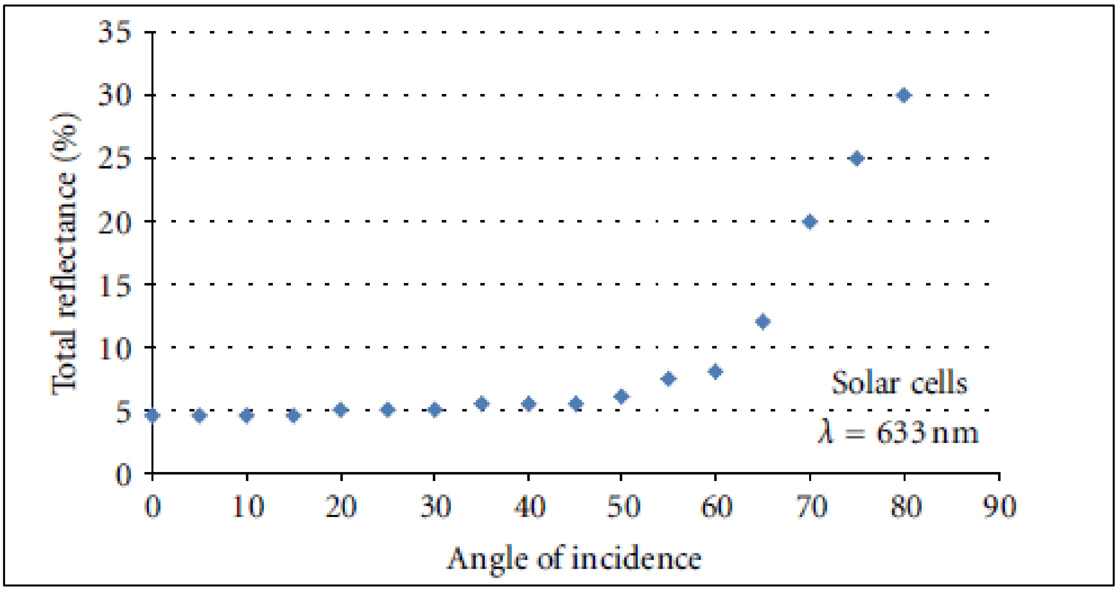
[32] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 17/09/2024.

Solar Reflection Studies

An overview of content from identified solar panel reflectivity studies is presented in the subsections below.

Evan Riley and Scott Olson, "A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems"

Evan Riley and Scott Olson published in 2011 their study titled: A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems[33]". They researched the potential glare that a pilot could experience from a 25 degree fixed tilt PV system located outside of Las Vegas, Nevada. The theoretical glare was estimated using published ocular safety metrics which quantify the potential for a postflash glare after-image. This was then compared to the postflash glare after-image caused by smooth water. The study demonstrated that the reflectance of the solar cell varied with angle of incidence, with maximum values occurring at angles close to 90 degrees. The reflectance values varied from approximately 5% to 30%. This is shown on the figure below.



Total reflectance % when compared to angle of incidence

The conclusions of the research study were:

- The potential for hazardous glare from flat-plate PV systems is similar to that of smooth water;
- Portland white cement concrete (which is a common concrete for runways), snow, and structural glass all have a reflectivity greater than water and flat plate PV modules.

---

[33] Evan Riley and Scott Olson, "A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat-Plate Photovoltaic Systems," ISRN Renewable Energy, vol. 2011, Article ID 651857, 6 pages, 2011. doi:10.5402/2011/651857

FAA Guidance – "Technical Guidance for Evaluating Selected Solar Technologies on Airports"[34]

The 2010 FAA Guidance included a diagram which illustrates the relative reflectance of solar panels compared to other surfaces. The figure shows the relative reflectance of solar panels compared to other surfaces. Surfaces in this figure produce reflections which are specular and diffuse. A specular reflection (those made by most solar panels) has a reflection characteristic similar to that of a mirror. A diffuse reflection will reflect the incoming light and scatter it in many directions. A table of reflectivity values, sourced from the figure within the FAA guidance, is presented below.

Surface	Approximate Percentage of Light Reflected[35]
Snow	80
White Concrete	77
Bare Aluminium	74
Vegetation	50
Bare Soil	30
Wood Shingle	17
Water	5
Solar Panels	5
Black Asphalt	2

Relative reflectivity of various surfaces

Note that the data above does not appear to consider the reflection type (specular or diffuse).

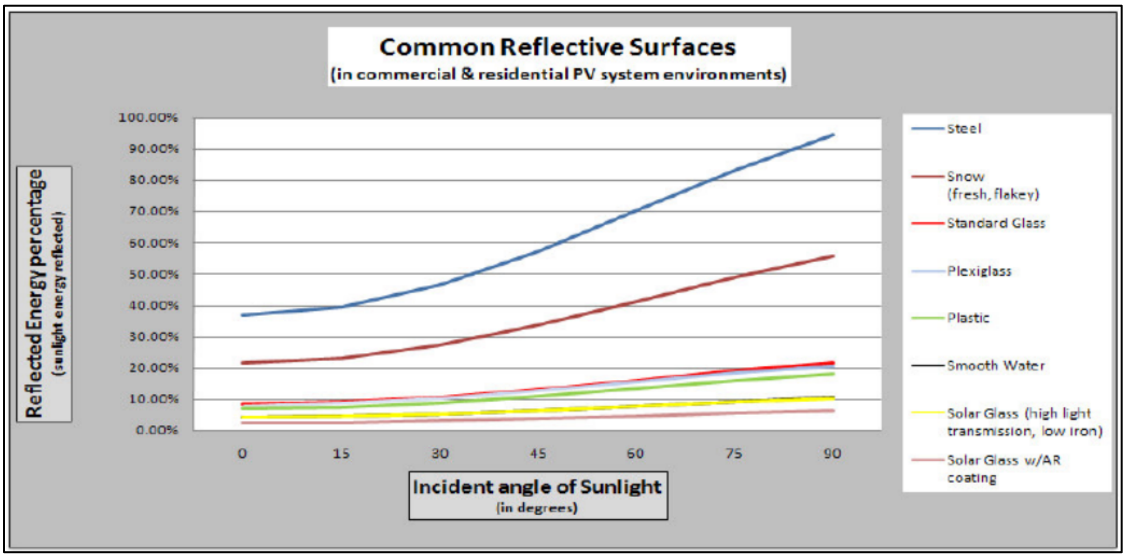
An important comparison in this table is the reflectivity compared to water which will produce a reflection of very similar intensity when compared to that from a solar panel. The study by Riley and Olsen study (2011) also concludes that still water has a very similar reflectivity to solar panels.

[34] Technical Guidance for Evaluating Selected Solar Technologies on Airports, Federal Aviation Administration (FAA), date: 04/2018, accessed on: 17/09/2024.
[35] Extrapolated data, baseline of 1,000 W/m^2 for incoming sunlight.

SunPower Technical Notification (2009)

SunPower published a technical notification[36] to 'increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment'.

The figure presented below shows the relative reflectivity of solar panels compared to other natural and manmade materials including smooth water, standard glass and steel.



Common reflective surfaces

The results, similarly to those from Riley and Olsen study (2011) and the FAA (2010), show that solar panels produce a reflection that is less intense than those of 'standard glass and other common reflective surfaces'.

With respect to aviation and solar reflections observed from the air, SunPower has developed several large installations near airports or on Air Force bases. It is stated that these developments have all passed FAA or Air Force standards with all developments considered "No Hazard to Air Navigation". The note suggests that developers discuss any possible concerns with stakeholders near proposed solar farms.

[36] Source: Technical Support, 2009. SunPower Technical Notification – Solar Module Glare and Reflectance.

APPENDIX C – OVERVIEW OF SUN MOVEMENTS AND RELATIVE REFLECTIONS

The Sun's position in the sky can be accurately described by its azimuth and elevation. Azimuth is a direction relative to true north (horizontal angle i.e. from left to right) and elevation describes the Sun's angle relative to the horizon (vertical angle i.e. up and down).

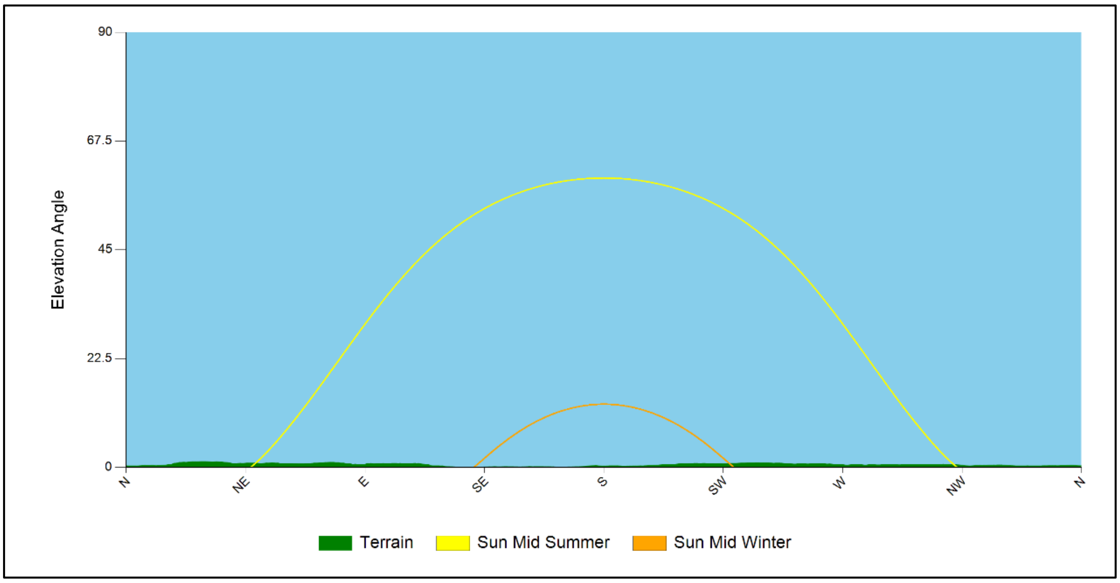
The Sun's position can be accurately calculated for a specific location. The following data being used for the calculation:

- Time.
- Date.
- Latitude.
- Longitude.

The following is true at the location of the solar development:

- The Sun is at its highest around midday and is to the south at this time.
- The Sun rises highest on 21 June (longest day).
- On 21 December, the maximum elevation reached by the Sun is at its lowest (shortest day).

The combination of the Sun's azimuth angle and vertical elevation will affect the direction and angle of the reflection from a reflector. The figure below shows terrain at the horizon as well as the sunrise and sunset curves throughout the year from lon:-1.396707 lat:53.579118.



Terrain elevation at the horizon

APPENDIX D – GLINT AND GLARE IMPACT SIGNIFICANCE

Overview

The significance of glint and glare will vary for different receptors. The following section presents a general overview of the significance criteria with respect to experiencing a solar reflection.

Impact Significance Definition

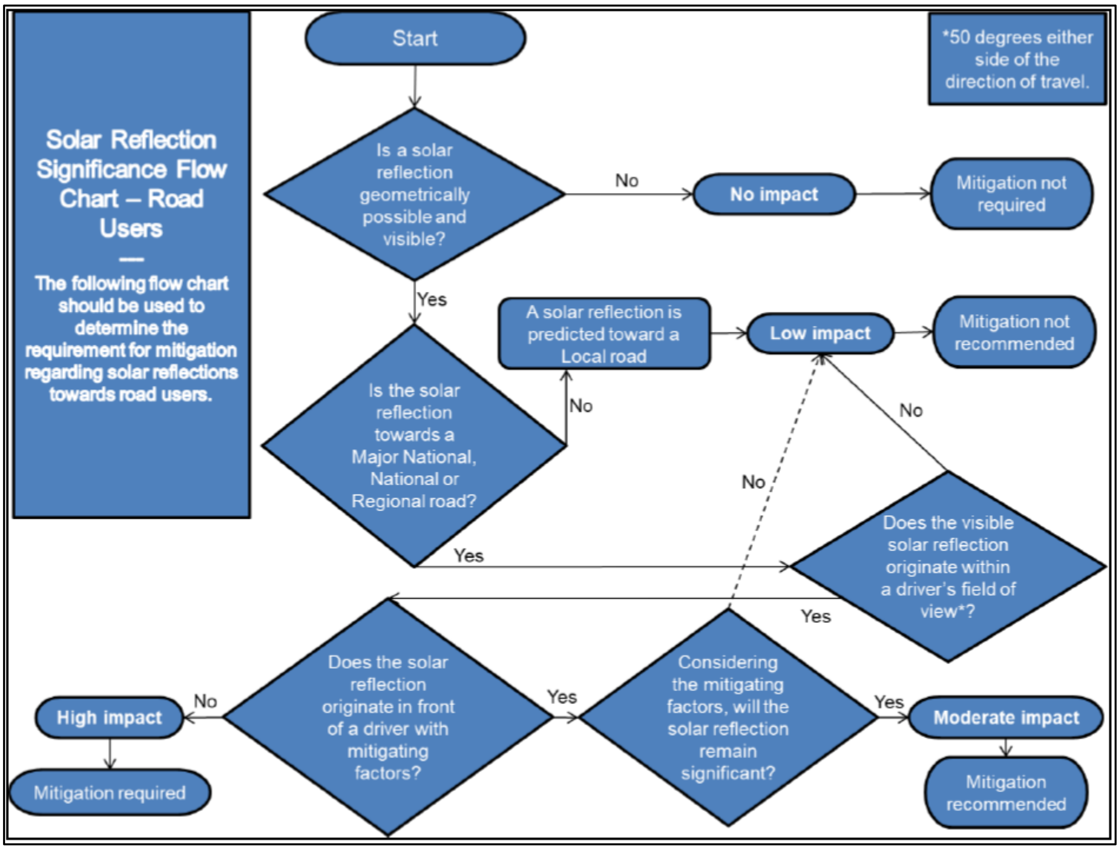
The table below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

Impact Significance	Definition	Mitigation Requirement
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required.
Low	A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g., intervening screening will limit the view of the reflecting solar panels significantly.	No mitigation recommended.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case given individual receptor criteria.	Mitigation recommended.
High	A solar reflection is geometrically possible and visible under worst-case conditions that will produce a significant impact given individual receptor criteria	Mitigation will be required if the proposed development is to proceed.

Impact significance definition

Assessment Process for Road Receptors

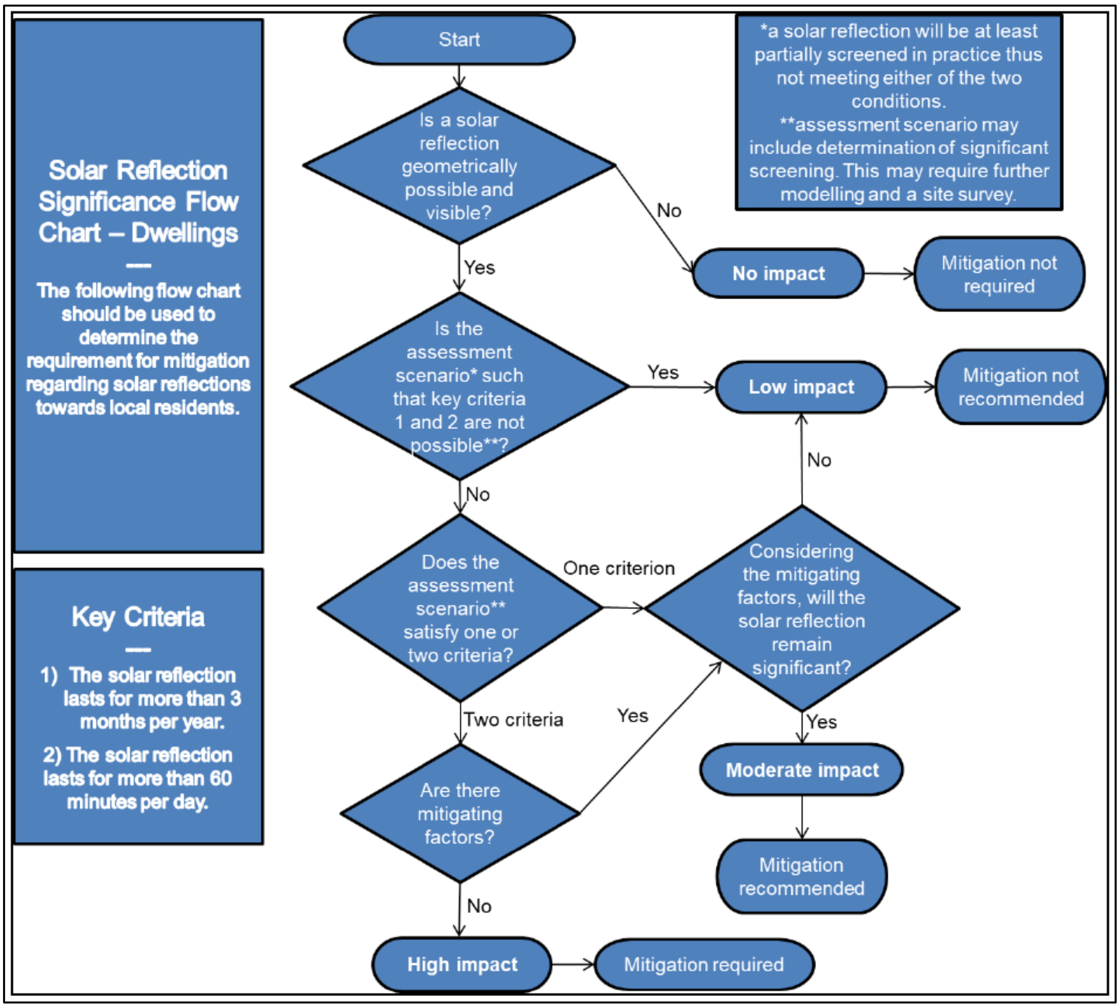
The flow chart presented below has been followed when determining the mitigation requirement for road receptors.



Road receptor mitigation requirement flow chart

Assessment Process for Dwelling Receptors

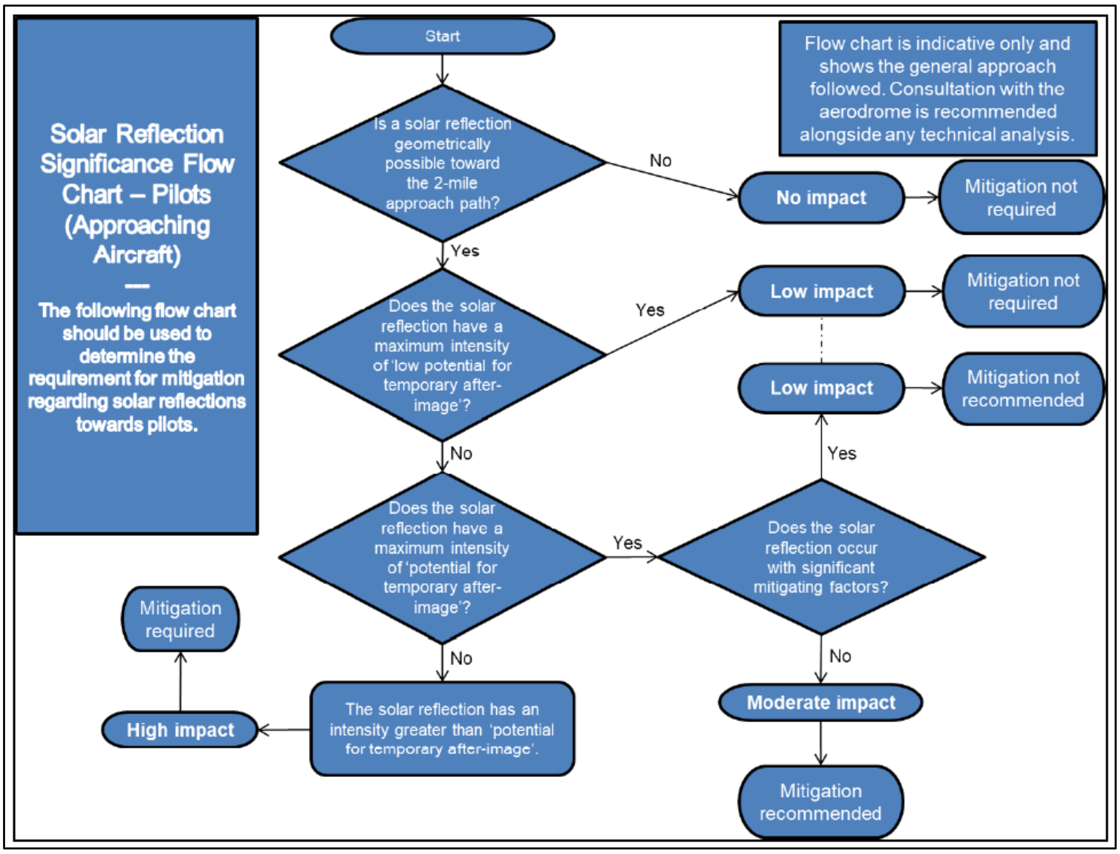
The flow chart presented below has been followed when determining the mitigation requirement for dwelling receptors.



Dwelling receptor mitigation requirement flow chart

Assessment Process – Approaching Aircraft

The flow chart presented below has been followed when determining the mitigation requirement for approaching aircraft.



Approaching aircraft receptor mitigation requirement flow chart

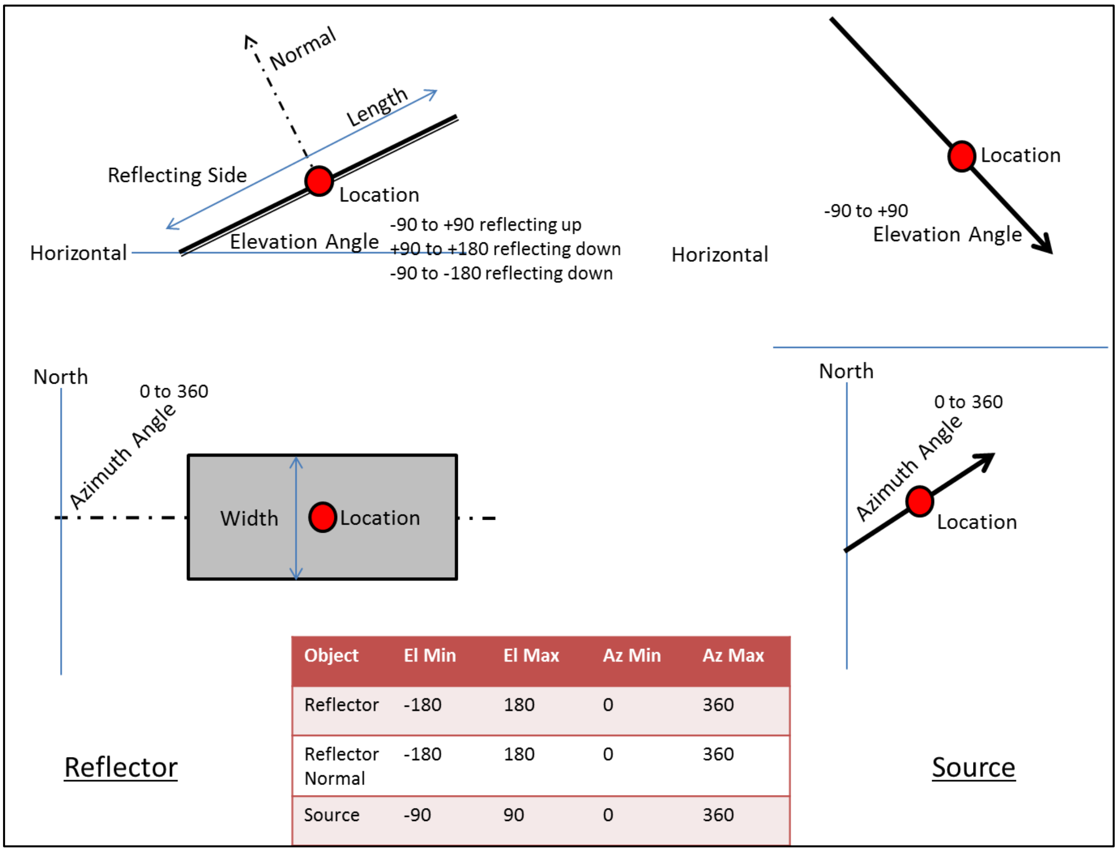
APPENDIX E – REFLECTION CALCULATIONS METHODOLOGY

Pager Power's Reflection Calculations Methodology

The calculations are three dimensional and complex, accounting for:

- The Earth's orbit around the Sun;
- The Earth's rotation;
- The Earth's orientation;
- The reflector's location;
- The reflector's 3D Orientation.

Reflections from a flat reflector are calculated by considering the normal which is an imaginary line that is perpendicular to the reflective surface and originates from it. The diagram below may be used to aid understanding of the reflection calculation process.



Object	El Min	El Max	Az Min	Az Max
Reflector	-180	180	0	360
Reflector Normal	-180	180	0	360
Source	-90	90	0	360

The following process is used to determine the 3D Azimuth and Elevation of a reflection:

- Use the Latitude and Longitude of reflector as the reference for calculation purposes;
- Calculate the Azimuth and Elevation of the normal to the reflector;
- Calculate the 3D angle between the source and the normal;

- If this angle is less than 90 degrees a reflection will occur. If it is greater than 90 degrees no reflection will occur because the source is behind the reflector;
- Calculate the Azimuth and Elevation of the reflection in accordance with the following:
    - The angle between source and normal is equal to angle between normal and reflection;
    - Source, Normal and Reflection are in the same plane.

APPENDIX F – ASSESSMENT LIMITATIONS AND ASSUMPTIONS

Pager Power's Model

The model considers 100% sunlight during daylight hours which is highly conservative.

The model does not account for terrain between the reflecting solar panels and the assessed receptor where a solar reflection is geometrically possible.

The model considers terrain between the reflecting solar panels and the visible horizon (where the sun may be obstructed from view of the panels)[37].

It is assumed that the panel elevation angle assessed represents the elevation angle for all of the panels within each solar panel area defined.

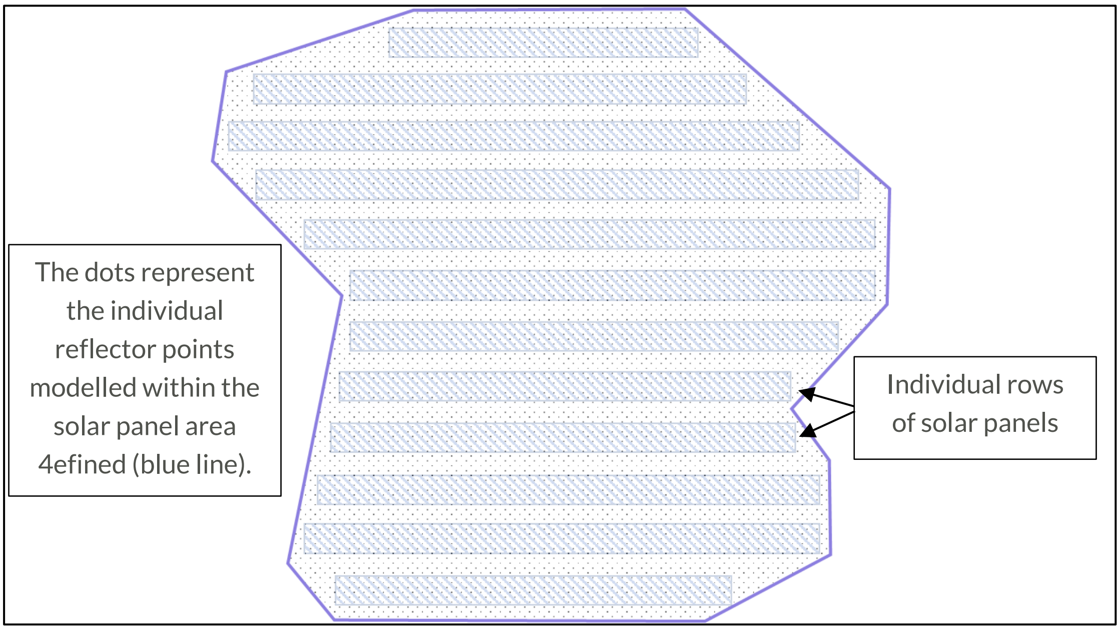
It is assumed that the panel azimuth angle assessed represents the azimuth angle for all of the panels within each solar panel area defined.

Only a reflection from the face of the panel has been considered. The frame or the reverse of the frame of the solar panel has not been considered.

The model assumes that a receptor can view the face of every panel (point, defined in the following paragraph) within the development area whilst in reality this, in the majority of cases, will not occur. Therefore any predicted solar reflection from the face of a solar panel that is not visible to a receptor will not occur in practice.

A finite number of points within each solar panel area defined is chosen based on an assessment resolution so that a comprehensive understanding of the entire development can be formed. This determines whether a solar reflection could ever occur at a chosen receptor. The model does not consider the specific panel rows or the entire face of the solar panel within the development outline, rather a single point is defined every 'x' metres (based on the assessment resolution) with the geometric characteristics of the panel. A panel area is however defined to encapsulate all possible panel locations. See the figure on the following page which illustrates this process.

[37] UK only.



Solar panel area modelling overview

A single reflection point is chosen for the geometric calculations. This suitably determines whether a solar reflection can be experienced at a receptor location and the time of year and duration of the solar reflection. Increased accuracy could be achieved by increasing the number of heights assessed however this would only marginally change the results and is not considered significant.

The available street view imagery, satellite mapping, terrain and any site imagery provided by the developer has been used to assess line of sight from the assessed receptors to the modelled solar panel area, unless stated otherwise. In some cases, this imagery may not be up to date and may not give the full perspective of the installation from the location of the assessed receptor.

Any screening in the form of trees, buildings etc. that may obstruct the Sun from view of the solar panels is not within the modelling unless stated otherwise. The terrain profile at the horizon is considered if stated.

APPENDIX G – RECEPTOR AND REFLECTOR AREA DETAILS

Terrain Height

Terrain Height was calculated from Pager Power's database (established on OSGB Terrain 50m DTM) based on the coordinates of the point of interest.

Road Receptor Data

The table below presents the coordinates for the assessed road receptors.

No.	Longitude (°)	Latitude (°)	No.	Longitude (°)	Latitude (°)
1	-1.40846	53.58902	17	-1.39382	53.57914
2	-1.40732	53.58867	18	-1.39260	53.57850
3	-1.40610	53.58816	19	-1.39157	53.57796
4	-1.40470	53.58777	20	-1.39043	53.57734
5	-1.40324	53.58758	21	-1.38939	53.57663
6	-1.40178	53.58738	22	-1.38862	53.57587
7	-1.40071	53.58677	23	-1.38799	53.57509
8	-1.39995	53.58600	24	-1.38745	53.57426
9	-1.39961	53.58517	25	-1.38712	53.57339
10	-1.39942	53.58429	26	-1.38682	53.57255
11	-1.39894	53.58336	27	-1.38646	53.57155
12	-1.39852	53.58245	28	-1.38615	53.57068
13	-1.39795	53.58169	29	-1.38588	53.56991
14	-1.39713	53.58101	30	-1.38566	53.56895
15	-1.39608	53.58031	31	-1.38549	53.56811
16	-1.39502	53.57976			

Road Receptor Data

Dwelling Receptor Data

The table below presents the coordinates for the assessed dwelling receptors.

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
1	53.588158	-1.407569	144	53.570116	-1.407974
2	53.588051	-1.407777	145	53.570133	-1.407791
3	53.587818	-1.408037	146	53.570157	-1.407606
4	53.587748	-1.408165	147	53.570015	-1.407437
5	53.587654	-1.408295	148	53.569899	-1.407253
6	53.587579	-1.408449	149	53.569763	-1.407124
7	53.587462	-1.408679	150	53.569705	-1.407046
8	53.587325	-1.407507	151	53.569574	-1.406841
9	53.587176	-1.407859	152	53.569352	-1.40636
10	53.587083	-1.407972	153	53.569035	-1.406028
11	53.587009	-1.408068	154	53.568872	-1.405794
12	53.586852	-1.407582	155	53.568713	-1.405559
13	53.586622	-1.407731	156	53.568559	-1.405355
14	53.586486	-1.407635	157	53.568452	-1.404884
15	53.586323	-1.40777	158	53.568186	-1.404554
16	53.586179	-1.407771	159	53.568195	-1.404354
17	53.586056	-1.407783	160	53.567491	-1.404726
18	53.585875	-1.407784	161	53.567317	-1.404514
19	53.585731	-1.407887	162	53.566908	-1.404665
20	53.585605	-1.40786	163	53.566527	-1.404206
21	53.585475	-1.407827	164	53.566358	-1.404012
22	53.585349	-1.407881	165	53.565422	-1.404728
23	53.585247	-1.407878	166	53.588126	-1.404173
24	53.585128	-1.407915	167	53.588201	-1.403889

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
25	53.585017	-1.407912	168	53.588268	-1.403626
26	53.584937	-1.407948	169	53.588349	-1.403345
27	53.584882	-1.407258	170	53.588418	-1.403093
28	53.584825	-1.407996	171	53.588601	-1.402839
29	53.584729	-1.407991	172	53.5888	-1.402926
30	53.584627	-1.40808	173	53.588961	-1.403074
31	53.584476	-1.408077	174	53.588284	-1.401332
32	53.584454	-1.407621	175	53.588111	-1.401204
33	53.58432	-1.408214	176	53.587968	-1.400988
34	53.584321	-1.408693	177	53.58815	-1.399989
35	53.584339	-1.408981	178	53.587547	-1.400771
36	53.584332	-1.409187	179	53.58631	-1.397744
37	53.584326	-1.409383	180	53.586259	-1.397962
38	53.584248	-1.409826	181	53.585729	-1.400204
39	53.584221	-1.41016	182	53.581265	-1.398818
40	53.584177	-1.410536	183	53.581281	-1.397985
41	53.584138	-1.410786	184	53.581158	-1.397933
42	53.584126	-1.411015	185	53.580836	-1.398495
43	53.583252	-1.411226	186	53.580765	-1.396483
44	53.583098	-1.411222	187	53.580518	-1.39595
45	53.582953	-1.411254	188	53.580471	-1.396725
46	53.582682	-1.411734	189	53.580368	-1.396511
47	53.582492	-1.411811	190	53.587066	-1.381143
48	53.58232	-1.41188	191	53.586775	-1.380898
49	53.582144	-1.411946	192	53.586544	-1.380672

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
50	53.581977	-1.411978	193	53.586323	-1.380429
51	53.581823	-1.412099	194	53.586199	-1.382155
52	53.581611	-1.412125	195	53.585914	-1.382316
53	53.58152	-1.409442	196	53.585688	-1.382415
54	53.58134	-1.409341	197	53.585556	-1.382688
55	53.581233	-1.409358	198	53.585562	-1.382932
56	53.58114	-1.409411	199	53.585415	-1.382965
57	53.581046	-1.409382	200	53.585259	-1.38318
58	53.580974	-1.409905	201	53.585154	-1.383438
59	53.580772	-1.409851	202	53.585032	-1.383586
60	53.580683	-1.40945	203	53.584928	-1.383747
61	53.580592	-1.40945	204	53.584861	-1.382703
62	53.580497	-1.409453	205	53.58472	-1.382581
63	53.580408	-1.409476	206	53.58449	-1.383106
64	53.580316	-1.409482	207	53.584338	-1.383128
65	53.58023	-1.409499	208	53.584095	-1.383137
66	53.58014	-1.409506	209	53.584095	-1.383137
67	53.580053	-1.409507	210	53.583903	-1.383027
68	53.579925	-1.409545	211	53.583673	-1.382725
69	53.579655	-1.409676	212	53.583594	-1.382601
70	53.579328	-1.409695	213	53.583512	-1.382464
71	53.579023	-1.409589	214	53.583439	-1.383011
72	53.578376	-1.409423	215	53.58335	-1.382942
73	53.578186	-1.40935	216	53.583277	-1.382786
74	53.578059	-1.408844	217	53.583162	-1.382685

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
75	53.577852	-1.408916	218	53.583072	-1.382597
76	53.57776	-1.408891	219	53.582988	-1.382468
77	53.577659	-1.408882	220	53.582911	-1.382396
78	53.577576	-1.408822	221	53.582786	-1.382271
79	53.57739	-1.408891	222	53.582697	-1.382187
80	53.577105	-1.40887	223	53.582618	-1.382096
81	53.576994	-1.409137	224	53.581468	-1.382113
82	53.576768	-1.409162	225	53.581405	-1.382534
83	53.576726	-1.409307	226	53.581253	-1.382636
84	53.576681	-1.409419	227	53.581206	-1.382756
85	53.576688	-1.409989	228	53.581129	-1.383107
86	53.576635	-1.410537	229	53.581049	-1.383378
87	53.576515	-1.410728	230	53.580812	-1.383819
88	53.576418	-1.410852	231	53.580615	-1.384136
89	53.576349	-1.411027	232	53.580437	-1.383871
90	53.576284	-1.411143	233	53.58035	-1.383799
91	53.576225	-1.411271	234	53.580278	-1.383757
92	53.576124	-1.411551	235	53.580205	-1.383709
93	53.576077	-1.412772	236	53.580125	-1.383603
94	53.575993	-1.413114	237	53.580012	-1.38357
95	53.575767	-1.413721	238	53.579872	-1.383588
96	53.575634	-1.413601	239	53.57953	-1.383182
97	53.575559	-1.413519	240	53.579459	-1.383494
98	53.575415	-1.413399	241	53.579383	-1.383812
99	53.575155	-1.413692	242	53.579248	-1.384265

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
100	53.575051	-1.413619	243	53.579162	-1.384573
101	53.574902	-1.413556	244	53.579062	-1.38491
102	53.574756	-1.41346	245	53.578962	-1.385169
103	53.574574	-1.4134	246	53.578807	-1.385341
104	53.574488	-1.41338	247	53.578711	-1.385549
105	53.574437	-1.413364	248	53.578558	-1.385745
106	53.574394	-1.413352	249	53.578267	-1.386219
107	53.574294	-1.413339	250	53.578211	-1.385927
108	53.574191	-1.413308	251	53.577955	-1.385698
109	53.574069	-1.413275	252	53.577872	-1.385292
110	53.573939	-1.413269	253	53.577785	-1.38498
111	53.573844	-1.413256	254	53.577683	-1.384631
112	53.573636	-1.413224	255	53.577608	-1.384307
113	53.573441	-1.413378	256	53.577507	-1.384007
114	53.573137	-1.41326	257	53.577407	-1.383665
115	53.572845	-1.413177	258	53.577337	-1.383377
116	53.57276	-1.41309	259	53.577095	-1.382964
117	53.572663	-1.413002	260	53.57633	-1.381936
118	53.572585	-1.412936	261	53.576199	-1.382353
119	53.572517	-1.412877	262	53.576067	-1.382767
120	53.572447	-1.4128	263	53.575967	-1.38297
121	53.572326	-1.412686	264	53.575951	-1.383311
122	53.572407	-1.411656	265	53.575628	-1.383514
123	53.572322	-1.411467	266	53.575606	-1.383793
124	53.571549	-1.411834	267	53.575543	-1.384206

No.	Latitude (°)	Longitude (°)	No.	Latitude (°)	Longitude (°)
125	53.571389	-1.411709	268	53.575498	-1.384536
126	53.571335	-1.411231	269	53.575634	-1.38521
127	53.571489	-1.410996	270	53.575294	-1.383886
128	53.571347	-1.410701	271	53.574721	-1.381965
129	53.571255	-1.410539	272	53.574333	-1.380608
130	53.571392	-1.409929	273	53.574157	-1.380655
131	53.571072	-1.410573	274	53.573996	-1.380482
132	53.570966	-1.410466	275	53.573624	-1.379287
133	53.570842	-1.410275	276	53.573446	-1.379284
134	53.570726	-1.410222	277	53.573096	-1.379378
135	53.570582	-1.410159	278	53.572907	-1.379247
136	53.570497	-1.410029	279	53.572769	-1.379254
137	53.570344	-1.409855	280	53.572569	-1.379386
138	53.569978	-1.409811	281	53.572303	-1.379386
139	53.570007	-1.409498	282	53.572138	-1.379231
140	53.570059	-1.408764	283	53.572025	-1.379172
141	53.570015	-1.408434	284	53.571902	-1.379152
142	53.570038	-1.408277	285	53.571782	-1.379162
143	53.570058	-1.40817	286	53.571686	-1.379162

Dwelling Receptor Data

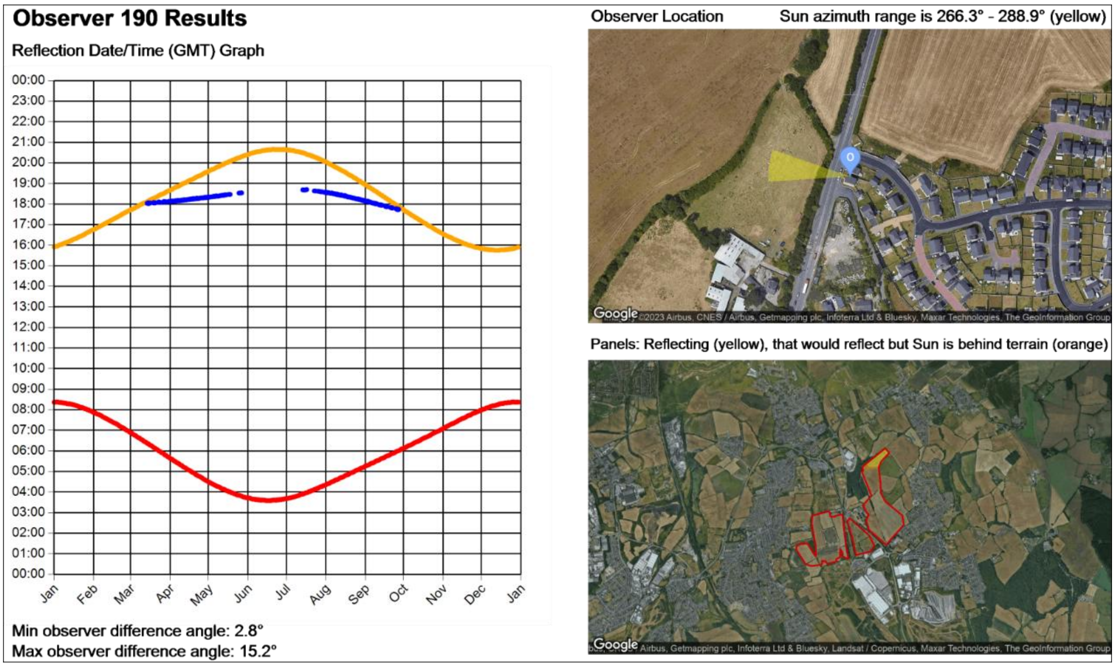
APPENDIX H – MODELLING RESULTS

Overview

The charts for the receptors where an impact is predicted are shown in the following sections. Each chart shows:

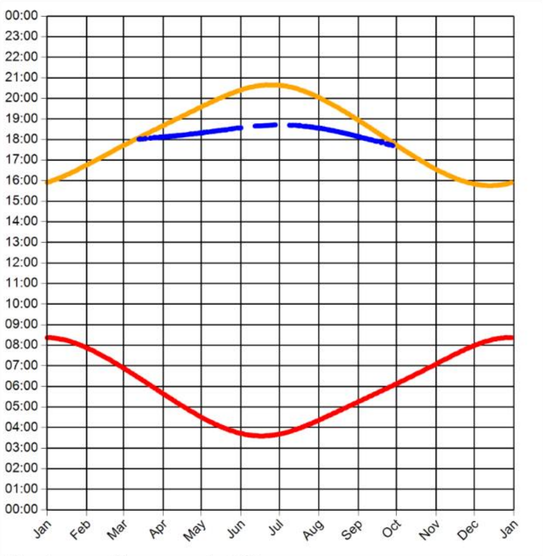
- The receptor (observer) location – top right image. This also shows the azimuth range of the Sun itself at times when reflections are possible. If sunlight is experienced from the same direction as the reflecting panels, the overall impact of the reflection is reduced as discussed within the body of the report;
- The reflection date/time graph – left hand side of the page. The blue line indicates the dates and times at which geometric reflections are possible. This relates to reflections from the yellow areas;
- The sunrise and sunset curves throughout the year (red and yellow lines).

Dwelling Receptors



Observer 191 Results

Reflection Date/Time (GMT) Graph



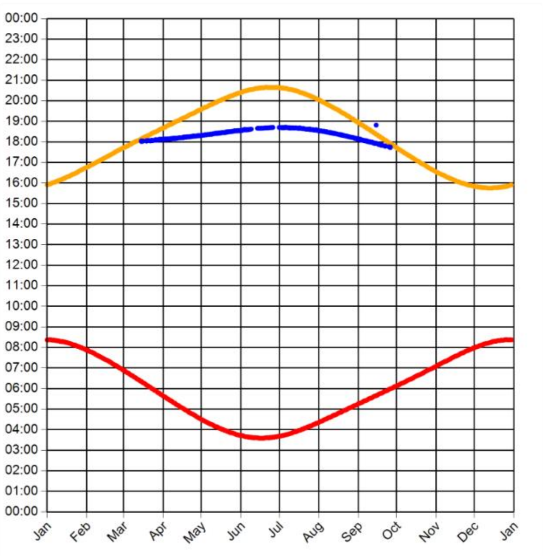
Min observer difference angle: 2.8°
Max observer difference angle: 16.4°

Observer Location   Sun azimuth range is 265.8° - 290.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 192 Results

Reflection Date/Time (GMT) Graph



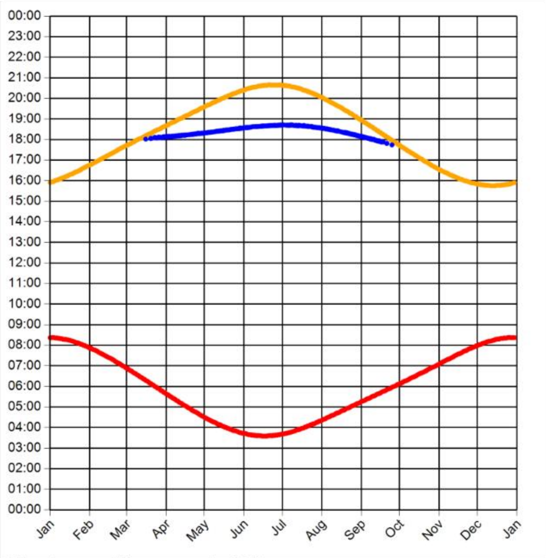
Min observer difference angle: 3°
Max observer difference angle: 16.6°

Observer Location   Sun azimuth range is 266.4° - 290.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 193 Results

Reflection Date/Time (GMT) Graph



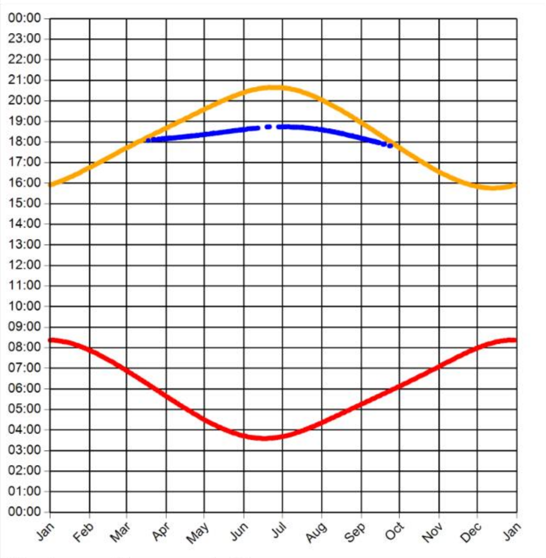
Min observer difference angle: 3.7°
Max observer difference angle: 16.7°

Observer Location   Sun azimuth range is 266.7° - 290.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

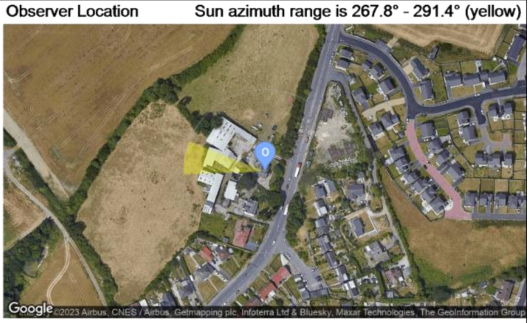
Observer 194 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 3°
Max observer difference angle: 15.5°

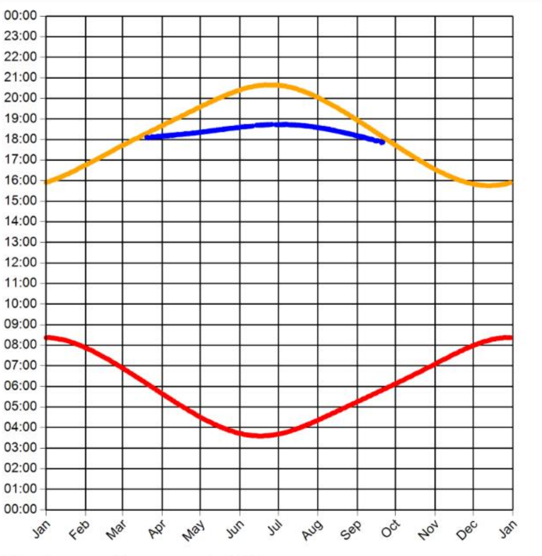
Observer Location   Sun azimuth range is 267.8° - 291.4° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 195 Results

Reflection Date/Time (GMT) Graph



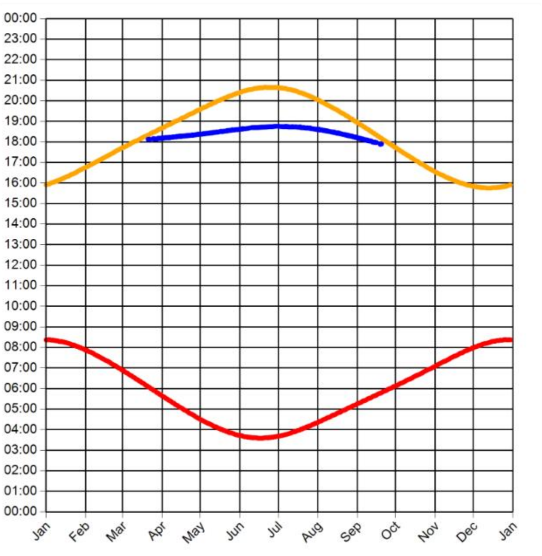
Min observer difference angle: 3.3°
Max observer difference angle: 15.9°

Observer Location | Sun azimuth range is 268.8° - 291.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 196 Results

Reflection Date/Time (GMT) Graph



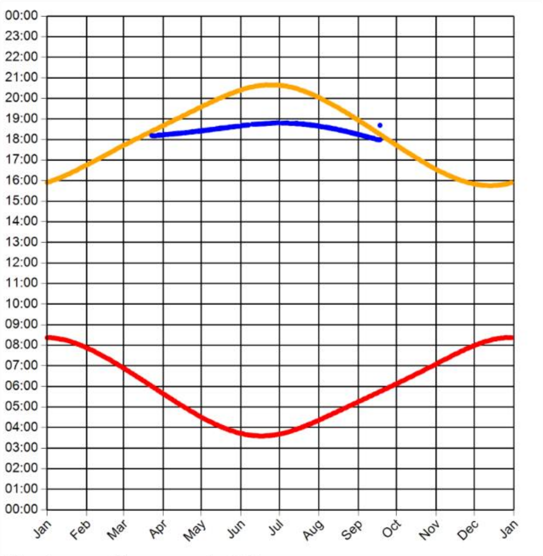
Min observer difference angle: 3.1°
Max observer difference angle: 15.5°

Observer Location | Sun azimuth range is 269.5° - 291.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 197 Results

Reflection Date/Time (GMT) Graph



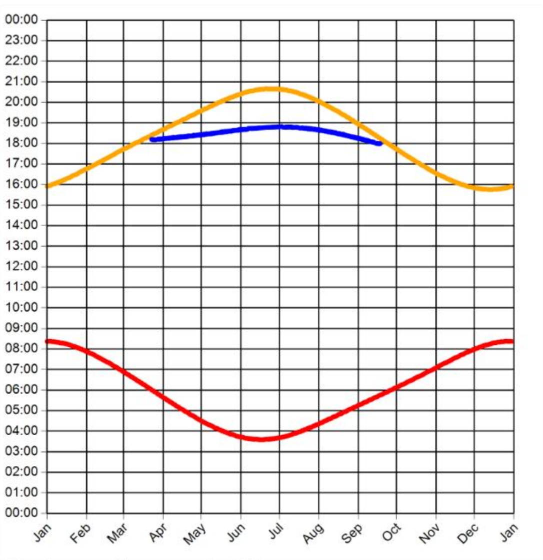
Min observer difference angle: 2.5°
Max observer difference angle: 14.6°

Observer Location — Sun azimuth range is 270.9° - 291.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 198 Results

Reflection Date/Time (GMT) Graph



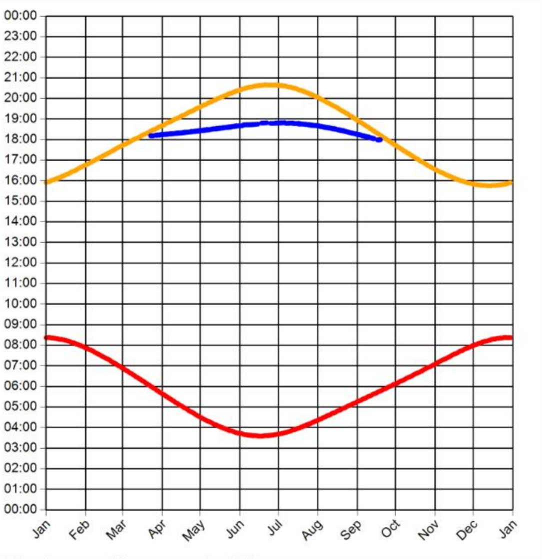
Min observer difference angle: 2.5°
Max observer difference angle: 14.3°

Observer Location — Sun azimuth range is 270.9° - 291.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 199 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 2.1°
Max observer difference angle: 14.3°

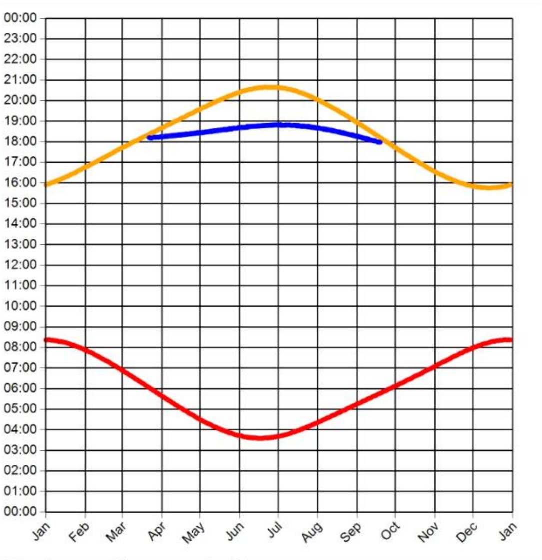
Observer Location

Sun azimuth range is 270.7° - 292.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 200 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 2°
Max observer difference angle: 14.2°

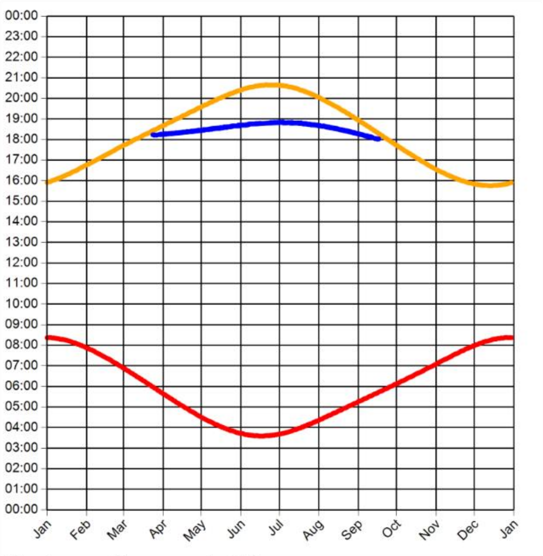
Observer Location

Sun azimuth range is 270.6° - 292.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 201 Results

Reflection Date/Time (GMT) Graph



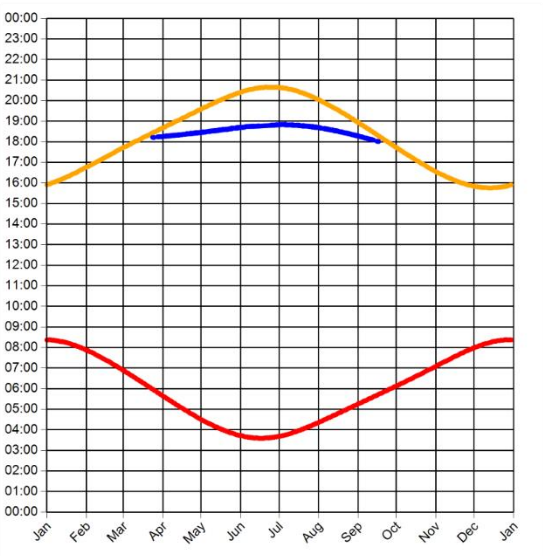
Min observer difference angle: 2.1°
Max observer difference angle: 14°

Observer Location Sun azimuth range is 271.6° - 292.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 202 Results

Reflection Date/Time (GMT) Graph



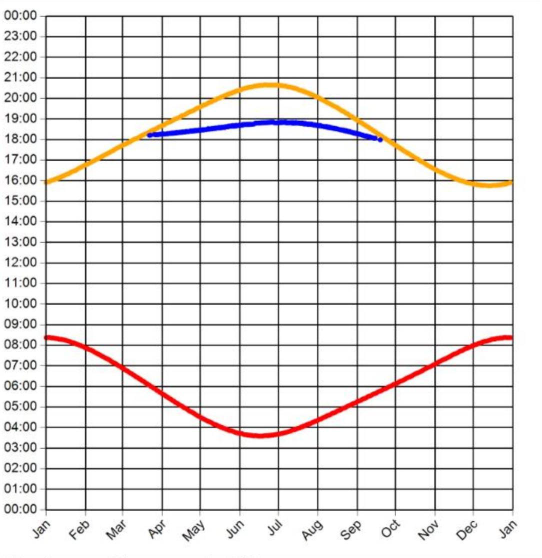
Min observer difference angle: 2.2°
Max observer difference angle: 14.2°

Observer Location Sun azimuth range is 271.4° - 292° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 203 Results

Reflection Date/Time (GMT) Graph



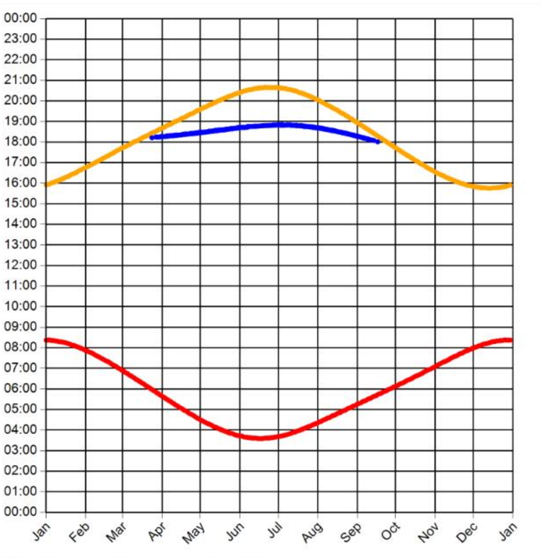
Min observer difference angle: 1.9°
Max observer difference angle: 13.9°

Observer Location Sun azimuth range is 270.7° - 292.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 204 Results

Reflection Date/Time (GMT) Graph



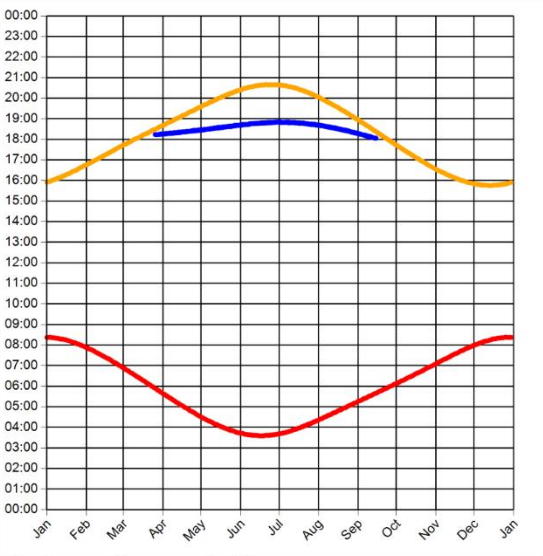
Min observer difference angle: 2.3°
Max observer difference angle: 14°

Observer Location Sun azimuth range is 271.3° - 292.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 205 Results

Reflection Date/Time (GMT) Graph



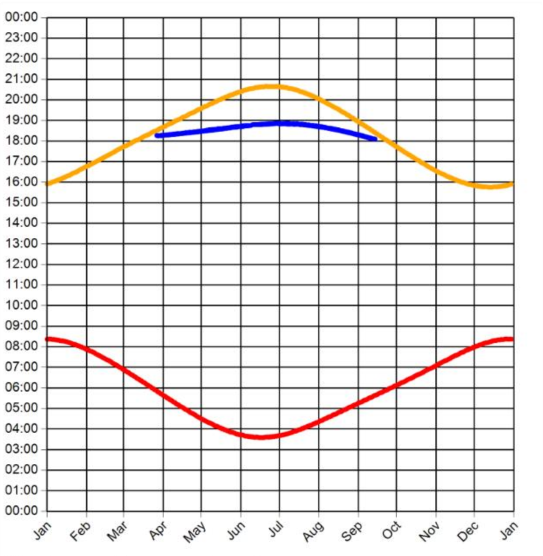
Min observer difference angle: 2.6°
Max observer difference angle: 14.2°

Observer Location Sun azimuth range is 272.1° - 292.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 206 Results

Reflection Date/Time (GMT) Graph



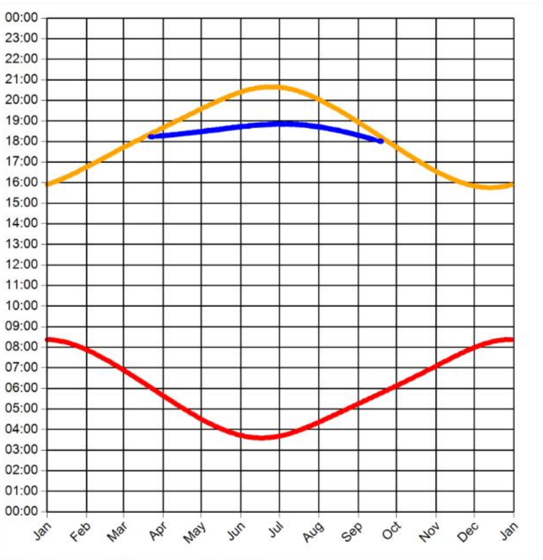
Min observer difference angle: 2.3°
Max observer difference angle: 13.7°

Observer Location Sun azimuth range is 272.9° - 292.4° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 207 Results

Reflection Date/Time (GMT) Graph



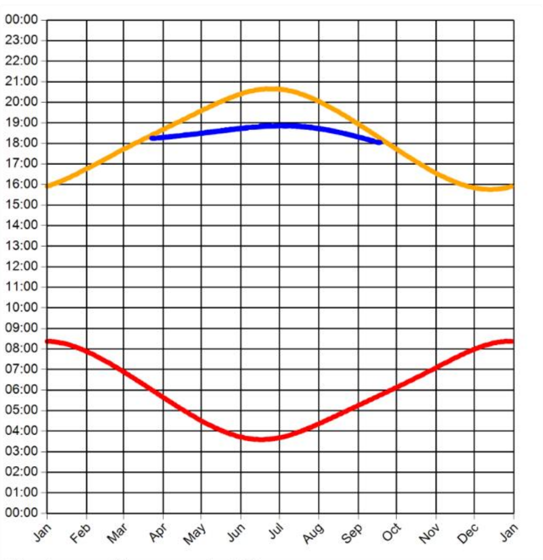
Min observer difference angle: 1.2°
Max observer difference angle: 13.6°

Observer Location Sun azimuth range is 271° - 292.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 208 Results

Reflection Date/Time (GMT) Graph



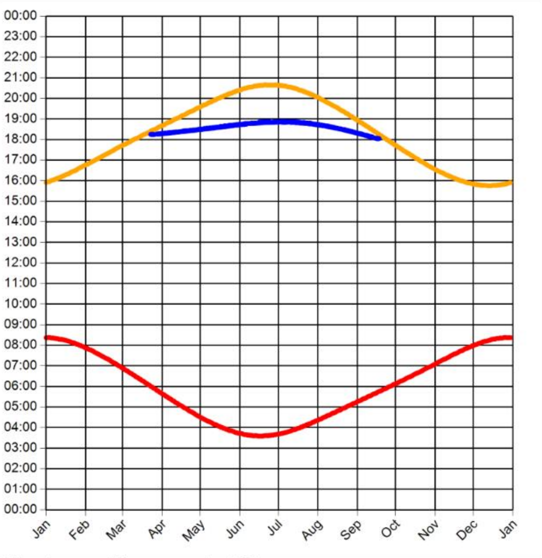
Min observer difference angle: 1.3°
Max observer difference angle: 13.3°

Observer Location Sun azimuth range is 271.6° - 292.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 209 Results

Reflection Date/Time (GMT) Graph



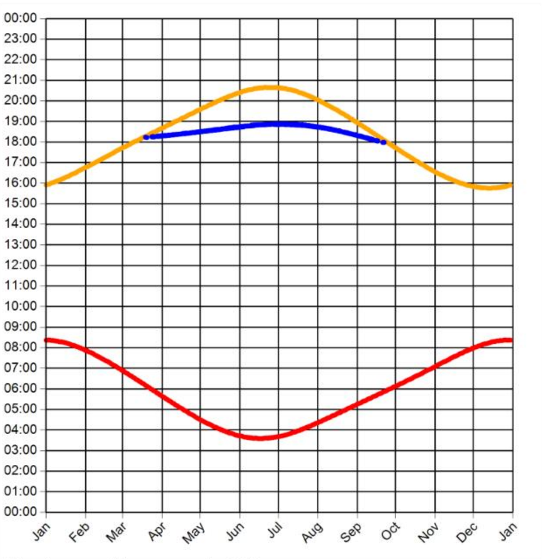
Min observer difference angle: 1.3°
Max observer difference angle: 13.3°

Observer Location Sun azimuth range is 271.6° - 292.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 210 Results

Reflection Date/Time (GMT) Graph



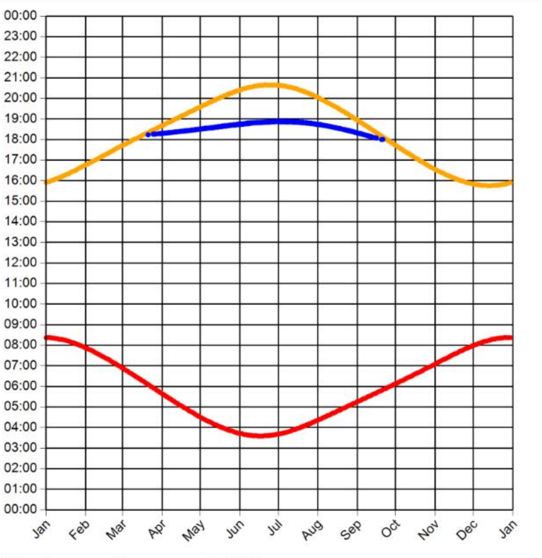
Min observer difference angle: 0.5°
Max observer difference angle: 13.1°

Observer Location Sun azimuth range is 270.1° - 292.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

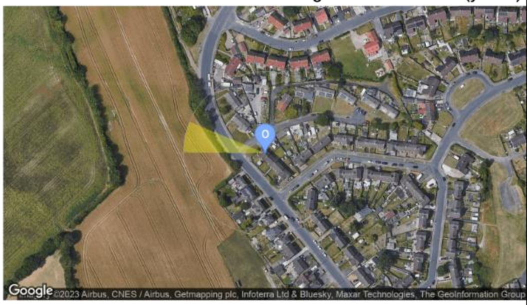
Observer 211 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.6°
Max observer difference angle: 13.1°

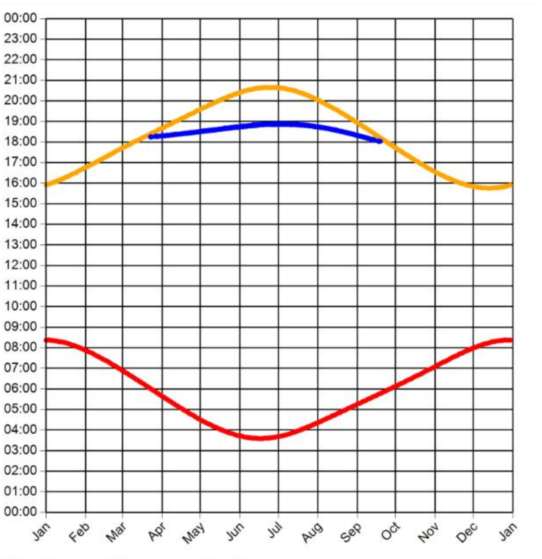
Observer Location Sun azimuth range is 270.6° - 292.8° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

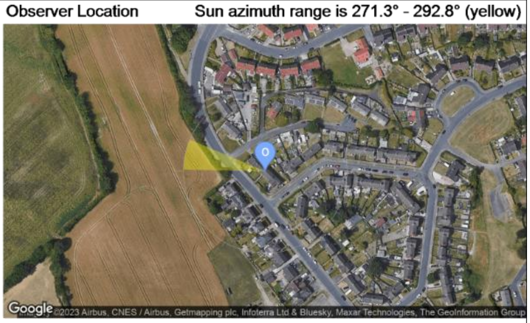
Observer 212 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 1°
Max observer difference angle: 13°

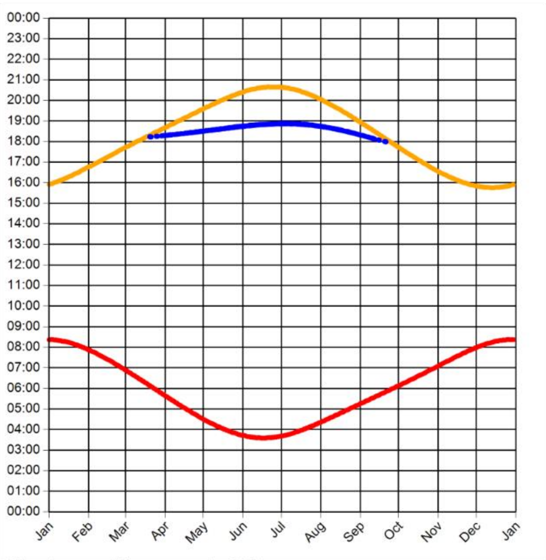
Observer Location Sun azimuth range is 271.3° - 292.8° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 213 Results

Reflection Date/Time (GMT) Graph



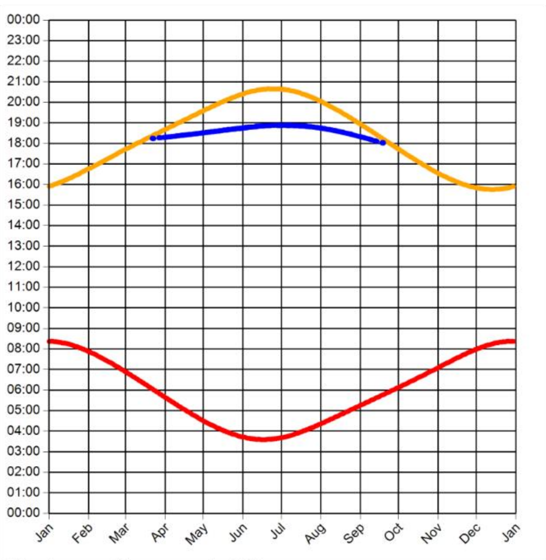
Min observer difference angle: 0.5°
Max observer difference angle: 13.2°

Observer Location Sun azimuth range is 270.2° - 292.7° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

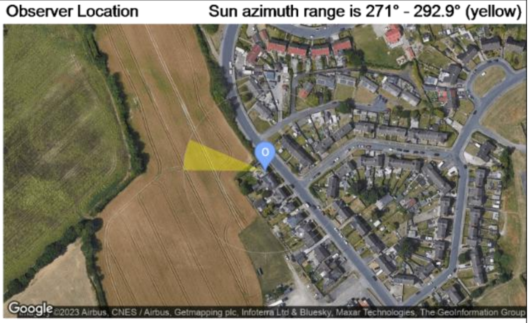
Observer 214 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.8°
Max observer difference angle: 12.8°

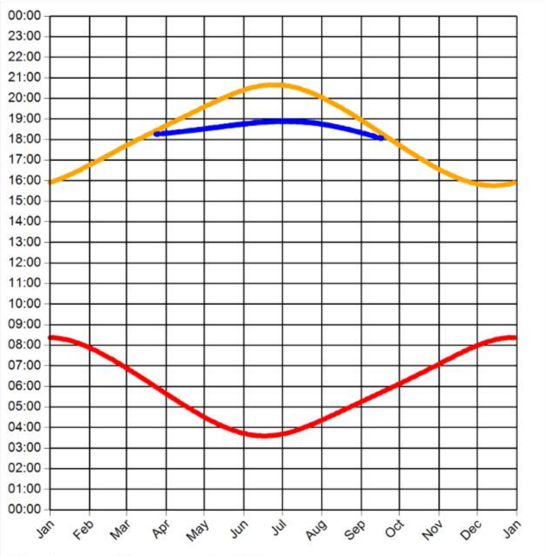
Observer Location Sun azimuth range is 271° - 292.9° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 215 Results

Reflection Date/Time (GMT) Graph



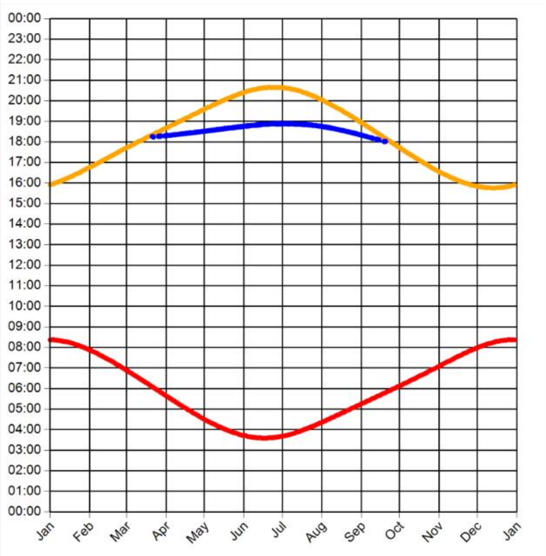
Min observer difference angle: 1.2°
Max observer difference angle: 12.7°

Observer Location — Sun azimuth range is 271.8° - 293° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

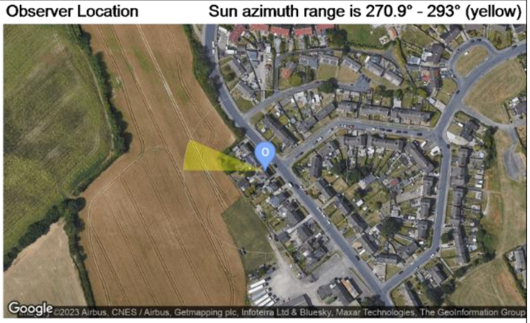
Observer 216 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.4°
Max observer difference angle: 12.7°

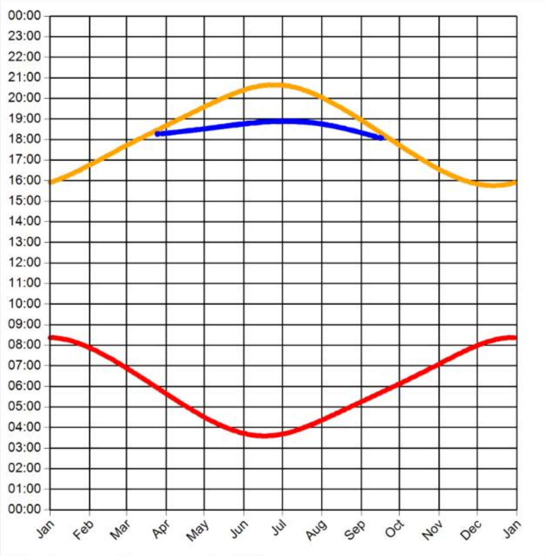
Observer Location — Sun azimuth range is 270.9° - 293° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 217 Results

Reflection Date/Time (GMT) Graph



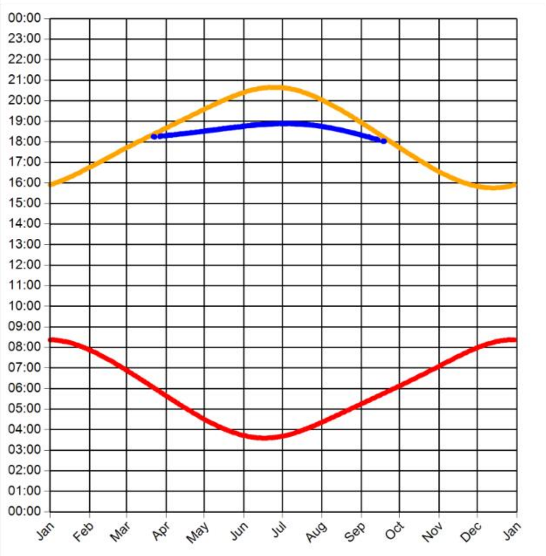
Min observer difference angle: 1.1°
Max observer difference angle: 12.7°

Observer Location Sun azimuth range is 272° - 292.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

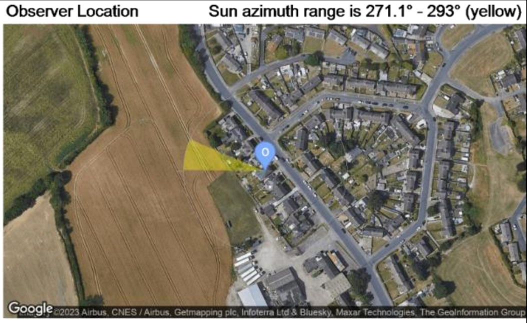
Observer 218 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.7°
Max observer difference angle: 12.7°

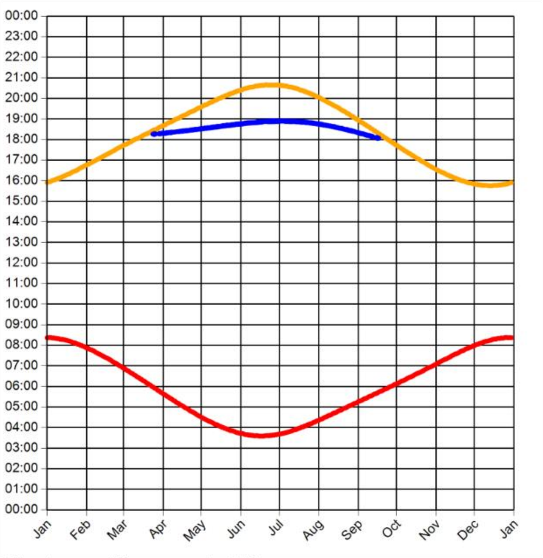
Observer Location Sun azimuth range is 271.1° - 293° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 219 Results

Reflection Date/Time (GMT) Graph



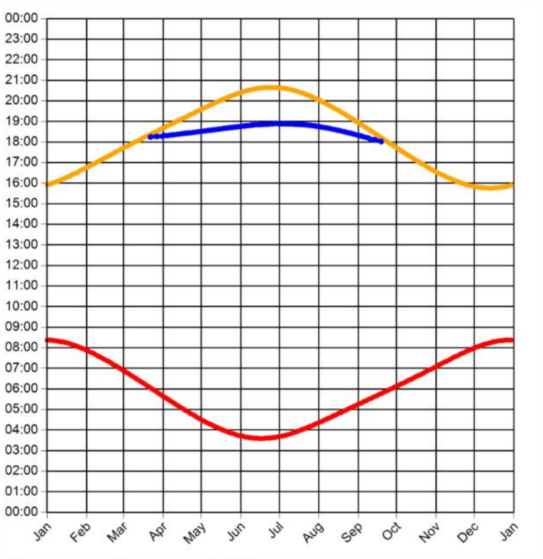
Min observer difference angle: 1.1°
Max observer difference angle: 12.6°

Observer Location Sun azimuth range is 272° - 293.1° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 220 Results

Reflection Date/Time (GMT) Graph



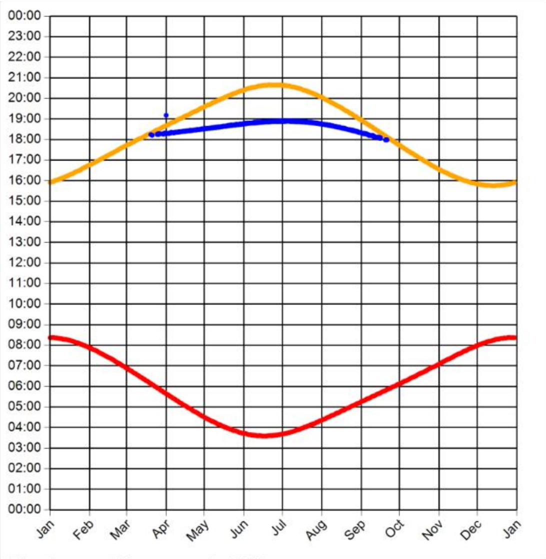
Min observer difference angle: 0.7°
Max observer difference angle: 12.7°

Observer Location Sun azimuth range is 270.9° - 292.9° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 221 Results

Reflection Date/Time (GMT) Graph



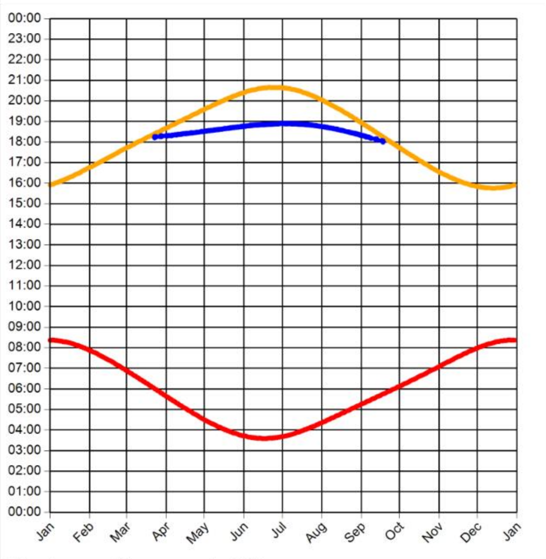
Min observer difference angle: 0.7°
Max observer difference angle: 12.5°

Observer Location Sun azimuth range is 270.3° - 293° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

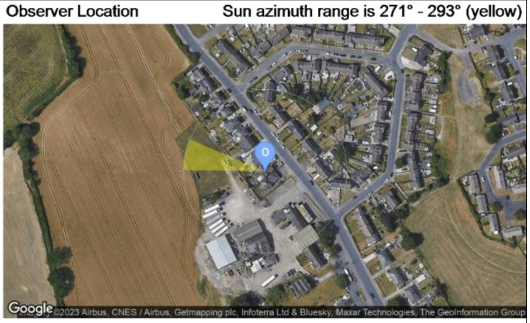
Observer 222 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.8°
Max observer difference angle: 12.6°

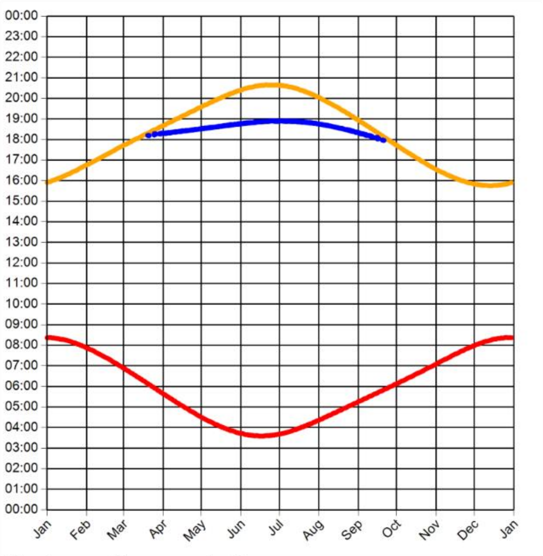
Observer Location Sun azimuth range is 271° - 293° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

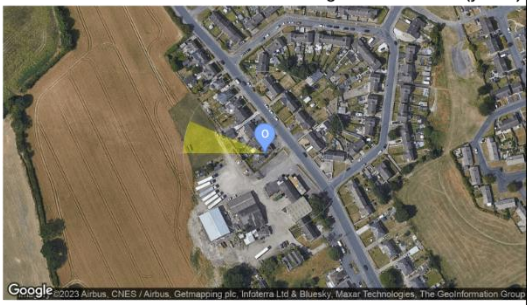
Observer 223 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 1°
Max observer difference angle: 12.4°

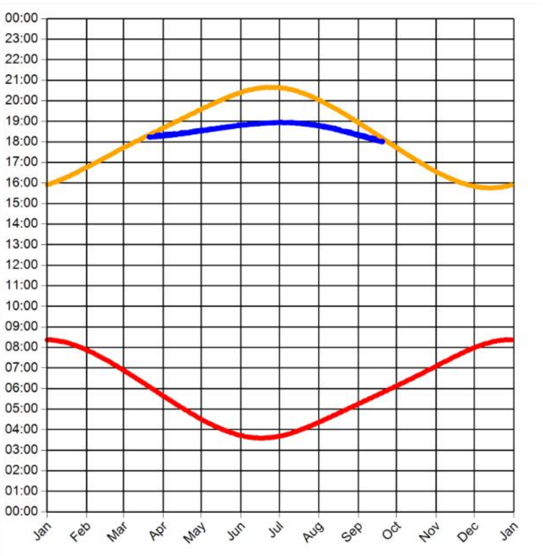
Observer Location Sun azimuth range is 270° - 293.1° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

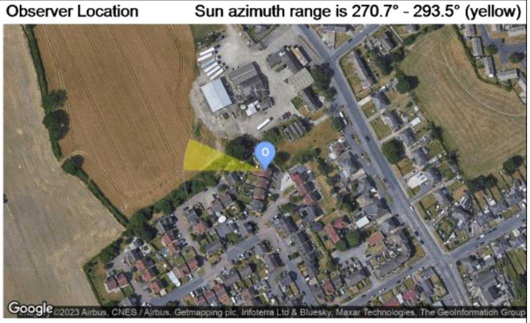
Observer 224 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.7°
Max observer difference angle: 11.5°

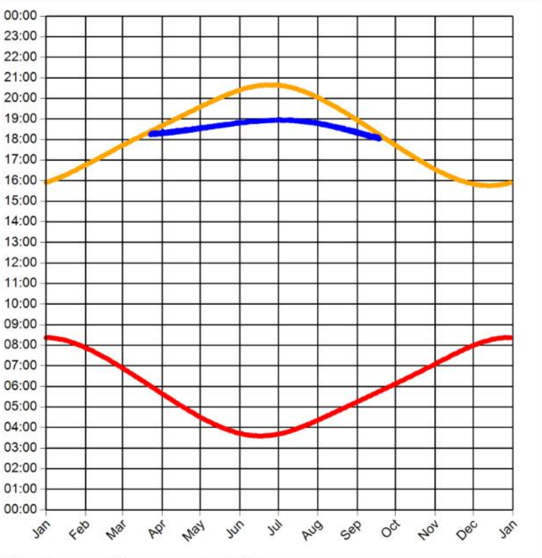
Observer Location Sun azimuth range is 270.7° - 293.5° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

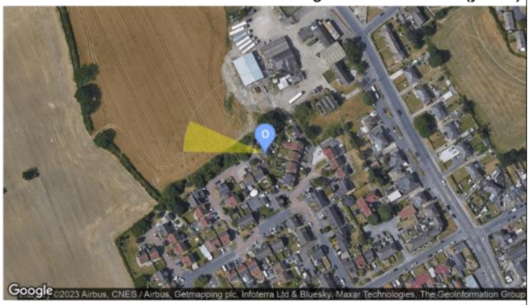
Observer 225 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.2°
Max observer difference angle: 11.5°

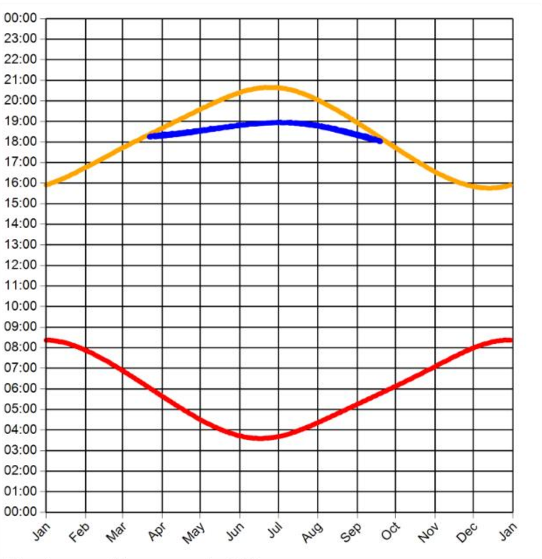
Observer Location — Sun azimuth range is 271.3° - 293.5° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

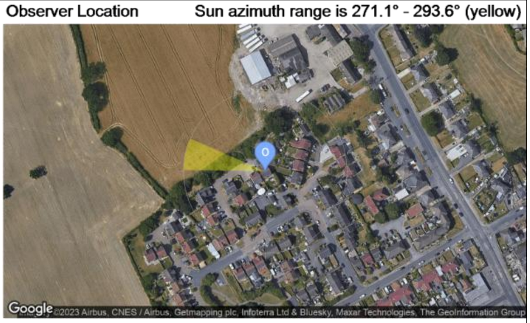
Observer 226 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.3°
Max observer difference angle: 11.5°

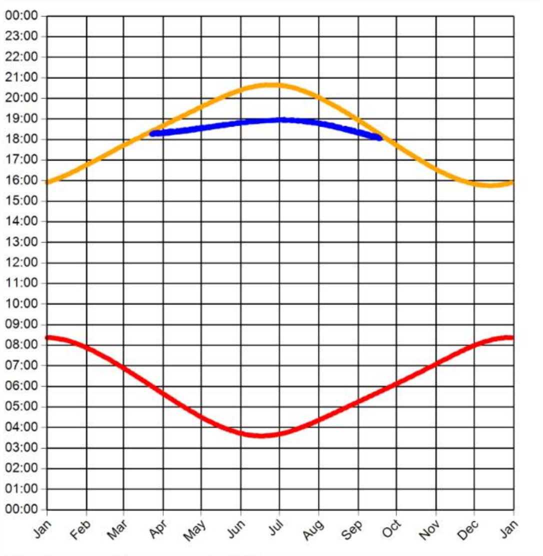
Observer Location — Sun azimuth range is 271.1° - 293.6° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 227 Results

Reflection Date/Time (GMT) Graph



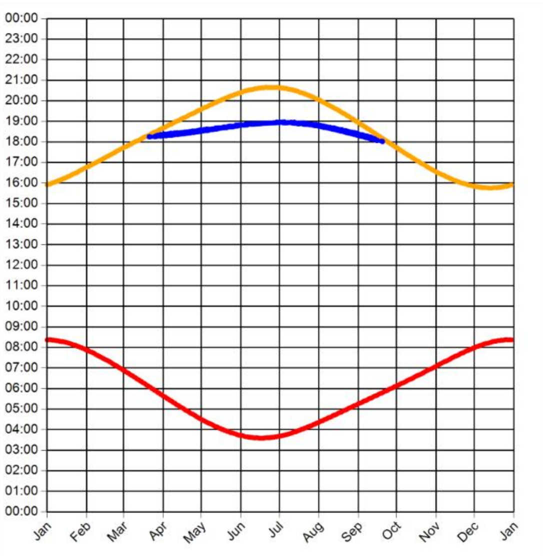
Min observer difference angle: 0.3°
Max observer difference angle: 11.4°

Observer Location Sun azimuth range is 271.6° - 293.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

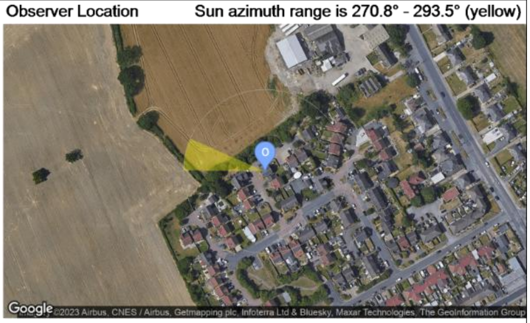
Observer 228 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.4°
Max observer difference angle: 11.6°

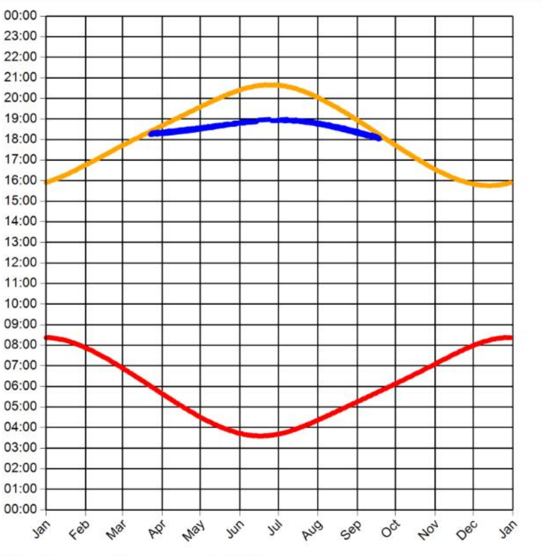
Observer Location Sun azimuth range is 270.8° - 293.5° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 229 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.3°

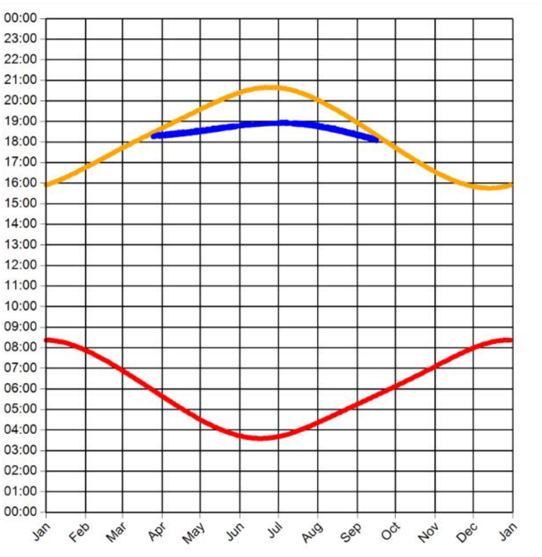
Max observer difference angle: 11.6°

Observer Location — Sun azimuth range is 271.4° - 294° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 230 Results

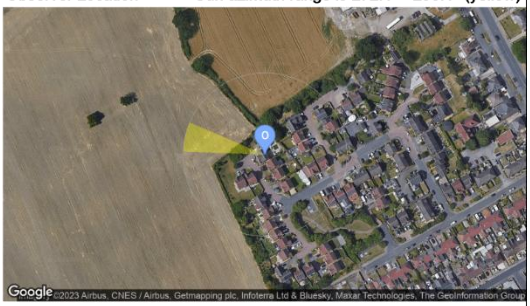
Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.8°

Max observer difference angle: 12°

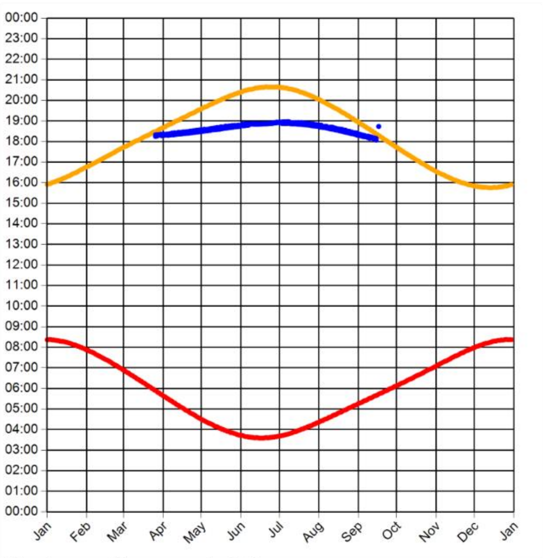
Observer Location — Sun azimuth range is 272.1° - 293.1° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 231 Results

Reflection Date/Time (GMT) Graph



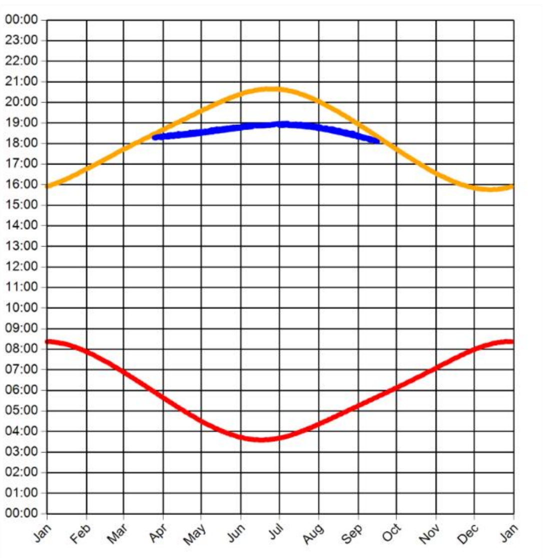
Min observer difference angle: 0.4°
Max observer difference angle: 12.6°

Observer Location — Sun azimuth range is 272.4° - 293.3° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 232 Results

Reflection Date/Time (GMT) Graph



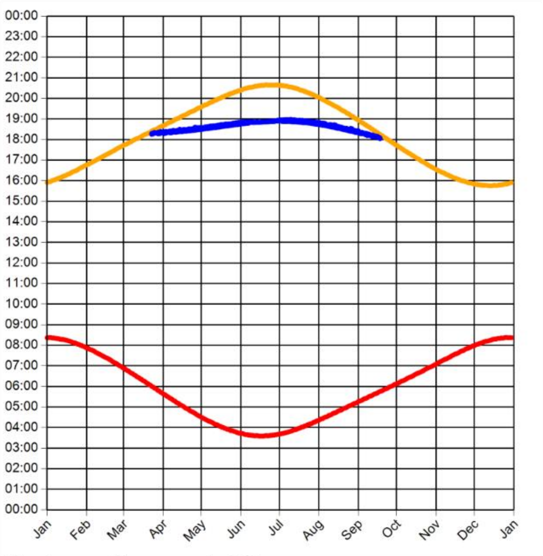
Min observer difference angle: 0.9°
Max observer difference angle: 12.4°

Observer Location — Sun azimuth range is 272.5° - 293.5° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 233 Results

Reflection Date/Time (GMT) Graph



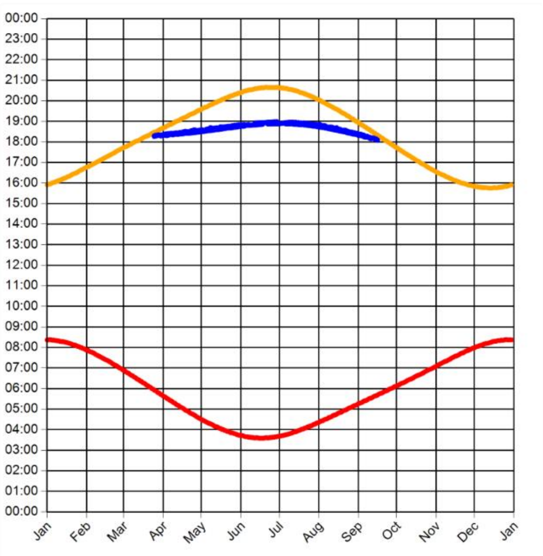
Min observer difference angle: 0.2°
Max observer difference angle: 12.5°

Observer Location Sun azimuth range is 271.5° - 293.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 234 Results

Reflection Date/Time (GMT) Graph



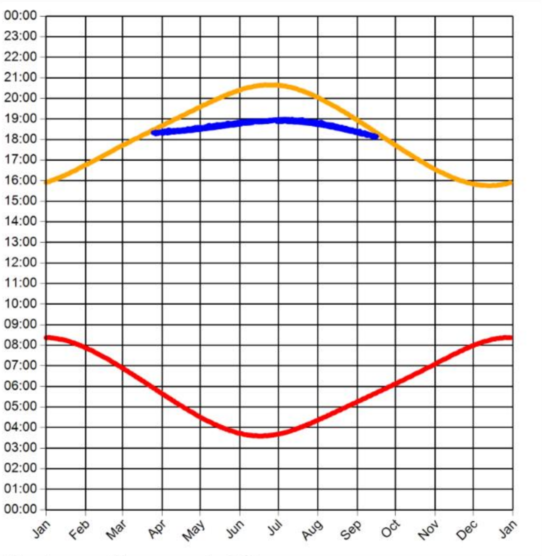
Min observer difference angle: 0.7°
Max observer difference angle: 12.5°

Observer Location Sun azimuth range is 272.3° - 293.8° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 235 Results

Reflection Date/Time (GMT) Graph



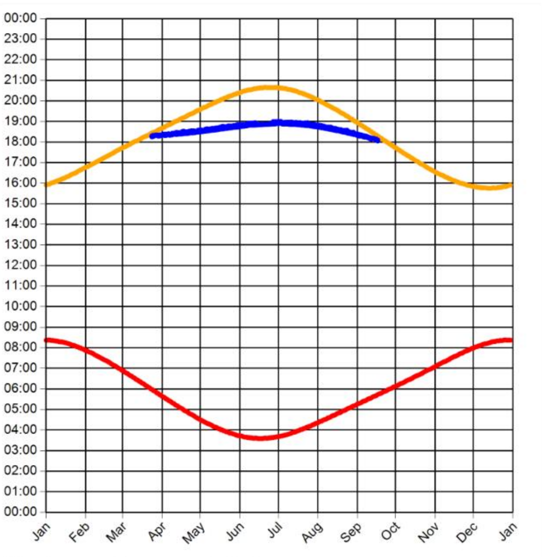
Min observer difference angle: 0.2°
Max observer difference angle: 12.4°

Observer Location | Sun azimuth range is 273° - 293.6° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

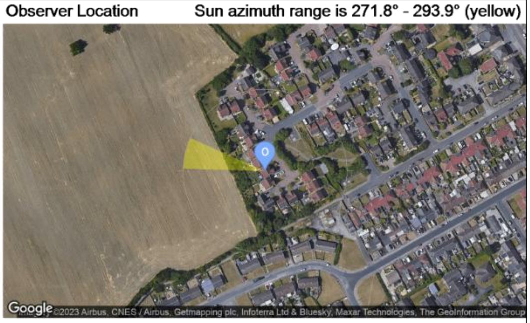
Observer 236 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.3°
Max observer difference angle: 12.6°

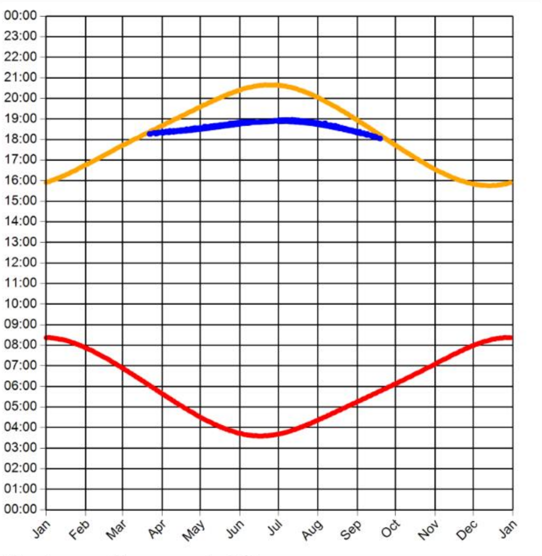
Observer Location | Sun azimuth range is 271.8° - 293.9° (yellow)



Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 237 Results

Reflection Date/Time (GMT) Graph



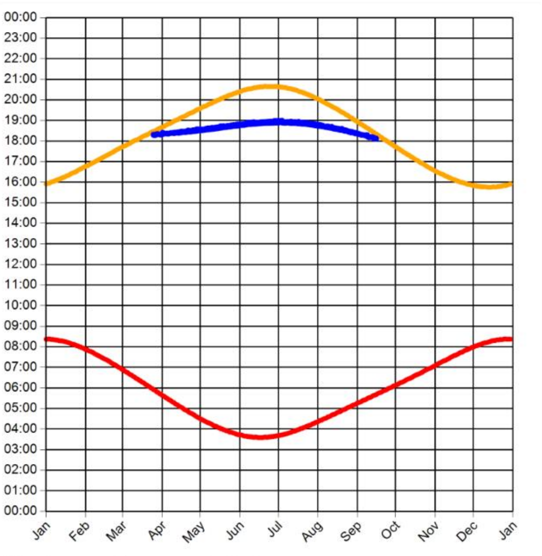
Min observer difference angle: 0.2°
Max observer difference angle: 12.6°

Observer Location Sun azimuth range is 271.3° - 293.2° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

Observer 238 Results

Reflection Date/Time (GMT) Graph



Min observer difference angle: 0.3°
Max observer difference angle: 12.6°

Observer Location Sun azimuth range is 272.4° - 294° (yellow)

Panels: Reflecting (yellow), that would reflect but Sun is behind terrain (orange)

PAGERPOWER
Urban & Renewables

Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com