HELIOS RENEWABLE ENERGY PROJECT

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Environmental Statement Appendix 2.5 - Solar Photovoltaic Glint and Glare Study

February 2025

PAGERPOWER
Urban & Renewables

Solar Photovoltaic Glint and Glare Study

Enso Green Holdings D Limited

Helios Renewable Energy Project

~~January~~ February 2025

PLANNING SOLUTIONS FOR:

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

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ADMINISTRATION PAGE

Job Reference:	11606G
Author:	[redacted]
Telephone:	[redacted]
Email:	[redacted]@pagerpower.com

Reviewed By:	[redacted]
Email:	[redacted]

Issue	Date	Detail of Changes
1	August 2022	Initial issue
2	June 2023	Second issue – layout revision
3	August 2023	Third issue – layout revision
4	September 2023	Fourth issue – minor amendments
5	September 2023	Fifth issue – minor amendments
6	February 2024	Sixth issue – minor layout changes
7	May 2024	Seventh issue – minor layout changes
8	~~January~~February 2025	Updated aviation receptors

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 commissioned to assess the possible effects of glint and glare from a solar photovoltaic (PV) array electricity generating facility (the 'Proposed Development') on land to the south-west of the village of Camblesforth and to the north of the village of Hirst Courtney in North Yorkshire (the 'Site'). The Site is located within the administrative area of North Yorkshire Council. This assessment pertains to the possible impact upon surrounding aviation activity, residential amenity, road safety, and railway operations and infrastructure.

Overall Conclusions

No significant impacts from the Proposed Development are predicted upon residential amenity, road safety, and train drivers travelling along the assessed section of railway track. Therefore no mitigation is required for these receptors.

Mitigation is recommended for ~~the approach path towards the visual circuits for runways 07/25, 01/19, and 15/33 and the splayed approaches for runways 25, 01, and 33~~operations at Burn Airfield~~ due to a lack of sufficient mitigating factors.~~

~~The results of this report should be made available to the safeguarding teams~~. Potential mitigation for the Proposed Development can include fixing the Single Access Tracker System at a resting angle that would avoid significant effects at the times at which glare is predicted towards the circuit paths at Burn Airfield~~ and Cliffe~~. Any glare that occurs outside the operational hours for Burn Airfield ~~to discuss their position towards the Proposed Development~~will not be mitigated.

Once the detailed design is confirmed modelling can be undertaken to identify the appropriate mitigation solution(s) to be implemented. On the basis that the mitigation solution(s) once implemented would reduce the glare to an acceptable intensity or reduce the glare to times/durations that can be operationally accommodated, the predicted impact will be low at worst and therefore not significant. The identified solution will be presented within a Glint and Glare Mitigation Strategy secured by a Requirement in the draft Development Consent Order.

The assessment results are presented on the following pages.

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. The UK CAA guidance is relatively high-level and does not prescribe a formal methodology. A specific national guidance policy for determining the impact of glint and glare on road safety and residential amenity has also not been produced to date. Therefore, in the absence of this, Pager Power reviewed more general existing planning guidelines and the available studies (discussed below) in the process of defining its own glint and glare assessment guidance and methodology[1].

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

This methodology defines the process for determining the impact upon road safety, residential amenity, and aviation activity.

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. For aviation activity, where appropriate, solar intensity calculations are undertaken in line with the Sandia National Laboratories' FAA methodology[2]. 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[3].

Assessment Results - Aviation Receptors

Burn Airfield

Solar reflections with 'potential for temporary after-image' are predicted towards the circuits ~~07/25,~~for runways 01~~/~~, 19, 25 and ~~15/~~33. Sufficient mitigating factors have not been identified to reduce the level of impact towards a pilot and therefore mitigation is recommended.

~~Solar reflections with 'potential for temporary after-image' are predicted towards the splayed approaches for runways 07, 25, 01, 19, 15, and 33.~~

~~It is judged that 'yellow' glare along the splayed approaches for runways 01, 15 and 19 at Burn Airfield can be operationally accommodated where solar reflections are predicted to occur outside the operational hours of the airfield.~~

~~For the runway 25 splayed approach path, the majority of solar reflections that are geometrically possible will occur outside of the operational hours of the airfield. However, solar reflections originating from the two most northern panel areas are predicted occur during the stated operational hours, without sufficient mitigating factors. Therefore, a moderate impact is predicted and mitigation is recommended to reduce the level of impact.~~

~~For the runway 01 splayed approach path, the majority of solar reflections that are geometrically possible will occur outside of the operational hours of the airfield. However, solar reflections originating from the two most southern panel areas are predicted occur during the stated operational hours, without sufficient mitigating factors. Therefore, a moderate impact is predicted and mitigation is recommended to reduce the level of impact.~~

~~For the runway 33 splayed approach path, solar reflections with 'potential for temporary after-image' are predicted and sufficient mitigating factors have not been identified. Therefore, mitigation is recommended to reduce the level of impact towards a pilot.~~

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[2] Formerly mandatory for on-airfield solar developments in the USA under the FAA's interim policy, superseded in 2021 with a policy that effectively requires individual airports to sign off on their on-airfield development as they see fit.

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

Cliffe Airfield

The results of the analysis have shown that no solar reflections towards pilots approaching runway 10 are geometrically possible. Therefore, no mitigation is required.

Solar reflections with 'potential for temporary after-image' are predicted towards the splayed approaches for runway 28. Overall, it is judged that 'yellow' glare along circuits for runway 28 at Cliffe Airfield can be operationally accommodated due to the identification of mitigating factors.

Assessment Results - Dwelling Receptors

The results of the analysis have shown that reflections from the Proposed Development are geometrically possible towards 104 out of the identified dwelling receptors for more than three months per year and less than 60 minutes per day.

For 98 dwellings, existing and proposed (please see Figures 7.~~8~~20-7.~~10~~22 of the Landscape Strategy ~~of the Preliminary Environmental Information Report)~~Plan). screening in the form of vegetation, terrain and buildings removes the visibility of the reflecting panel areas. Therefore, no impacts from the Proposed Development are predicted and mitigation is not required.

For the remaining six dwellings, there are sufficient mitigating factors. These include:

- A large separation distance between the reflecting panel area and the dwelling. This reduces the proportion of an observer's field of view that is affected by glare.
- The effects coincide with direct sunlight, which is a more significant source of light; therefore the effects appear much less significant.
- The effects cannot be seen from an observer on the ground floor – which has the greatest impact on residential amenity.
- The effects occur outside the 1km assessment area and would therefore be a maximum of low impact, due to the separation distance and intervening terrain/vegetation.

Therefore, mitigation is not recommended for these dwellings.

Assessment Results - Road Receptors

The results of the analysis have shown that solar reflections from the Proposed Development are geometrically possible along approximately all of the assessed sections of road along the A1041, A645, Barlow Road, Common Lane, Hirst Road and Station Road.

Where solar reflections are geometrically possible inside a road user's primary field of view, along a combined 4.1km section of road, existing and proposed vegetation and buildings will remove visibility of any solar reflections. Therefore, no impacts from the Proposed Development are predicted, and mitigation is not required for these sections of road.

Assessment Results - Train Driver Receptors

The analysis has shown that reflections are geometrically possible towards 2.8km of railway track. Reflections are predicted to occur within the train driver's primary field of view (30 degrees either side of the direction of travel) along 200m of railway track; however, screening in the form of heavy existing vegetation is present. Therefore, no impacts from the Proposed Development are predicted and mitigation is not required.

A low impact from the Proposed Development is predicted for the remaining sections of railway track where solar reflections are geometrically possible. The reflections occur outside of the train driver's primary field of view. Therefore, no mitigation is required.

Assessment Results - High-Level Aviation

Considering the size of the Proposed Development and its location relative to Sherburn-in-Elmet Airfield (approximately 9.5km away), the following is applicable:

- In Pager Power's experience and expertise, it can be safely presumed that any predicted solar reflections towards pilots approaching runway thresholds 06, 19 and both runway 10 thresholds, would have intensities no greater than 'low potential for temporary after image', which is acceptable in accordance with the associated guidance and industry best practice.
- Any solar reflections will be outside a pilot's primary field of view (50 degrees either side of the approach bearing) along the approach paths towards runway thresholds 01, 24, and both runway 28 thresholds, which is acceptable in accordance with the associated guidance and industry best practice.

Therefore, no significant impacts, from the Proposed Development, upon aviation activity associated with Sherburn-in-Elmet are predicted, and no further detailed modelling is recommended.

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ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in ~~58~~60 countries within Europe, Africa, America, Asia and Australasia.

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 commissioned to assess the possible effects of glint and glare from a solar photovoltaic (PV) array electricity generating facility (the 'Proposed Development') on land to the south-west of the village of Camblesforth and to the north of the village of Hirst Courtney in North Yorkshire (the 'Site'). The Site is located within the administrative area of North Yorkshire Council. This assessment pertains to the possible impact upon surrounding aviation activity, residential amenity, road safety, and railway operations and infrastructure.

This report contains the following:

- Solar development details.
- Explanation of glint and glare.
- Overview of relevant guidance.
- Overview of relevant studies.
- Overview of Sun movement.
- Assessment methodology.
- Identification of receptors.
- Glint and glare assessment for identified receptors.
- Results discussion.
- Overview of mitigation requirement.
- Overall conclusions.

1.2 Pager Power's Experience

Pager Power has undertaken over 1,~~000~~500 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[4] 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.

The term 'solar reflection' is used in this report to refer to both reflection types i.e. glint and glare.

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[4] These definitions are aligned with those presented within the Draft National Policy Statement for Renewable Energy Infrastructure (EN-3) – published by the Department for Energy Security & Net Zero in March 2023 and the Federal Aviation Administration in the USA.

2 SOLAR DEVELOPMENT LOCATION AND DETAILS

2.1 Proposed Development Parameter Plan

Figure 1 below[5] shows the parameter plan for the Proposed Development. The light blue areas denote the panel areas.

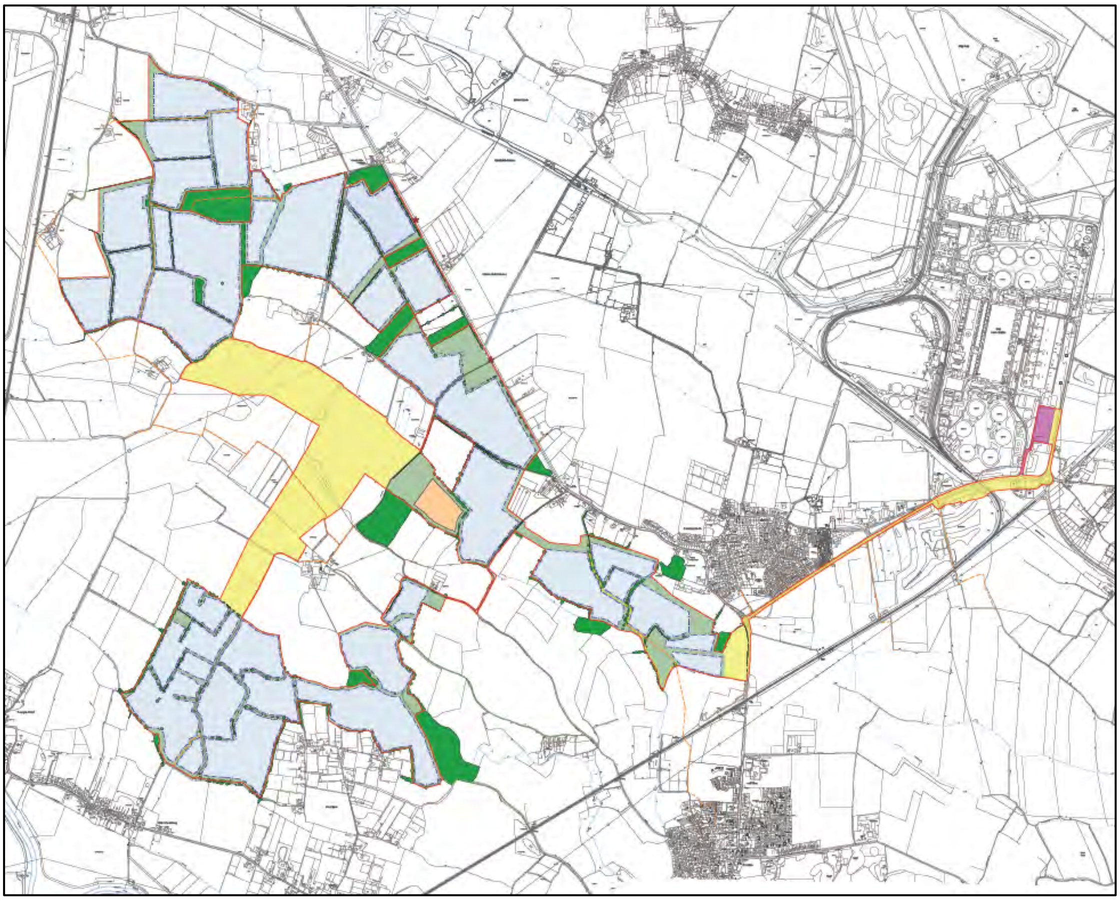
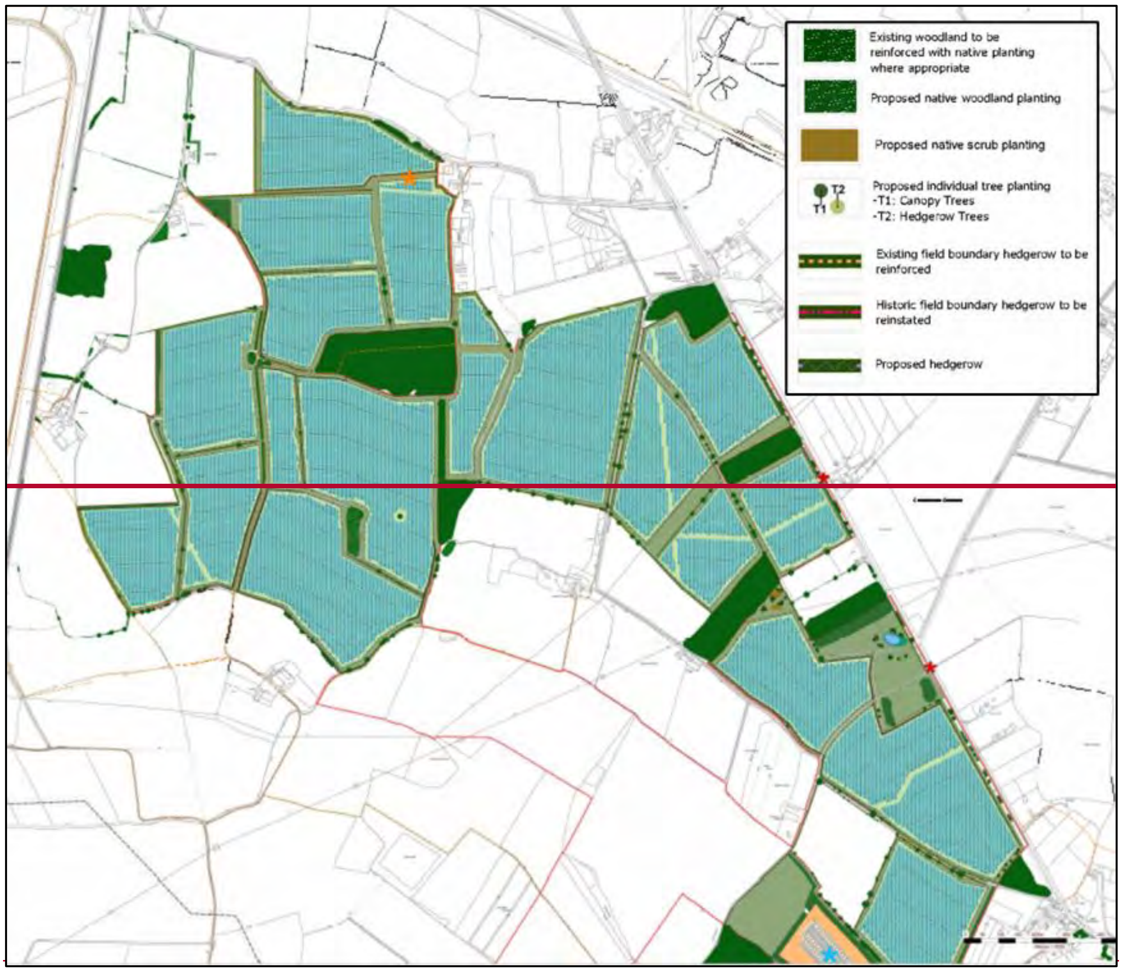


Figure 1 *Parameter plan*

[5] Source: DX-01-P02 Rev11 Parameter Plan

2.2 Landscape Strategy

Figures 2-4 on the following pages show the landscape strategy for the Proposed Development.


Existing woodland to be reinforced with native planting where appropriate
Proposed native woodland planting
Proposed native scrub planting
Proposed individual tree planting
-T1: Canopy Trees
-T2: Hedgerow Trees
T1
T2
Existing field boundary hedgerow to be reinforced
Historic field boundary hedgerow to be reinstated
Proposed hedgerow

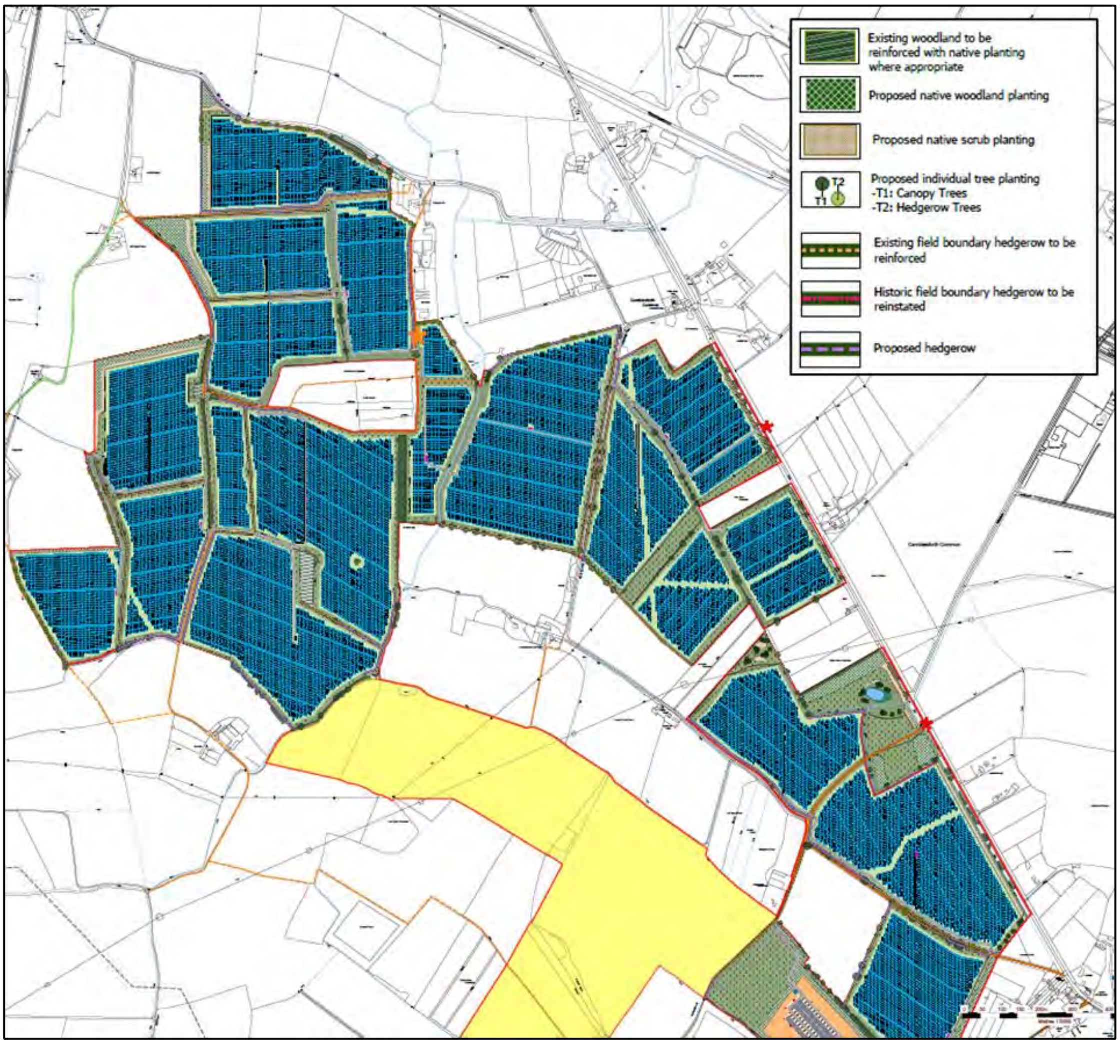
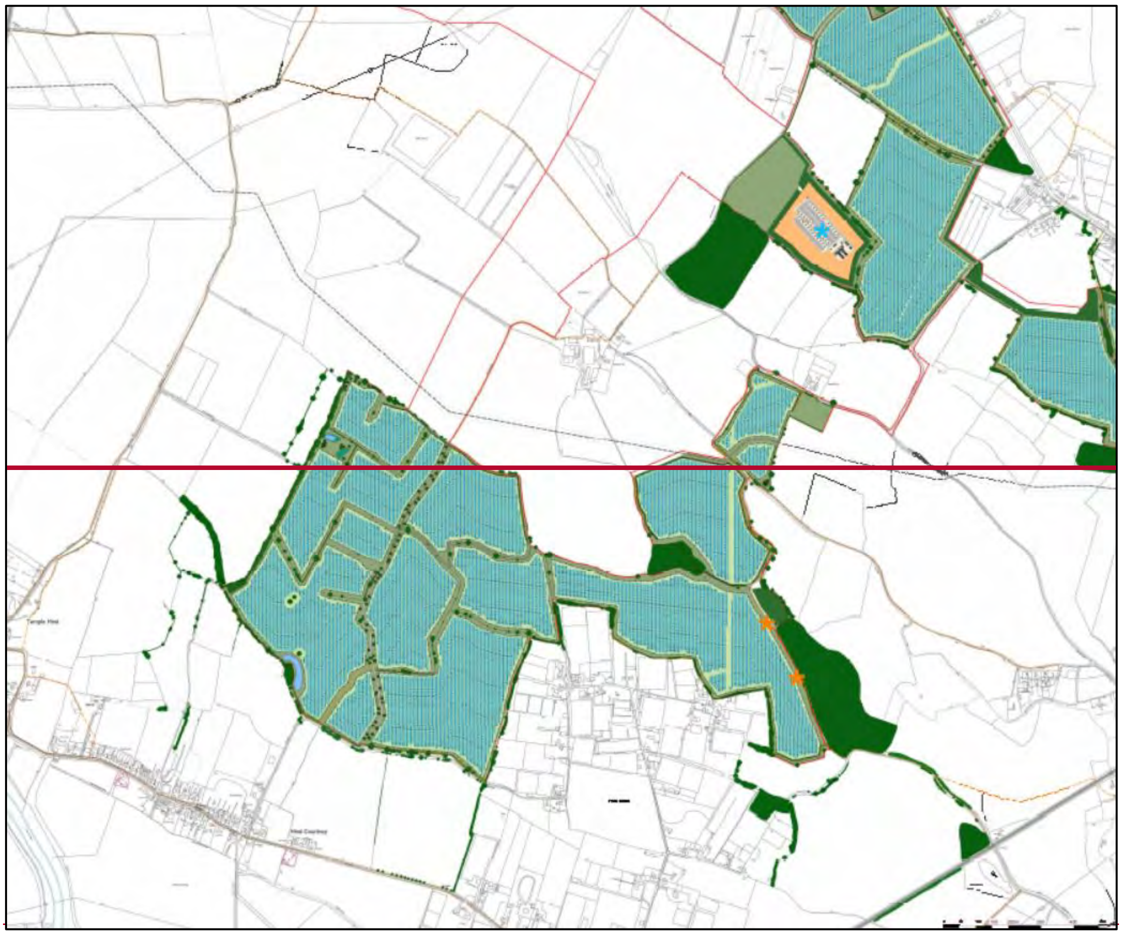


Figure 2~~2~~ *Landscape strategy (Figure 7.~~8 of the PEIR~~20 EN010140/APP/6.2.7.20)*



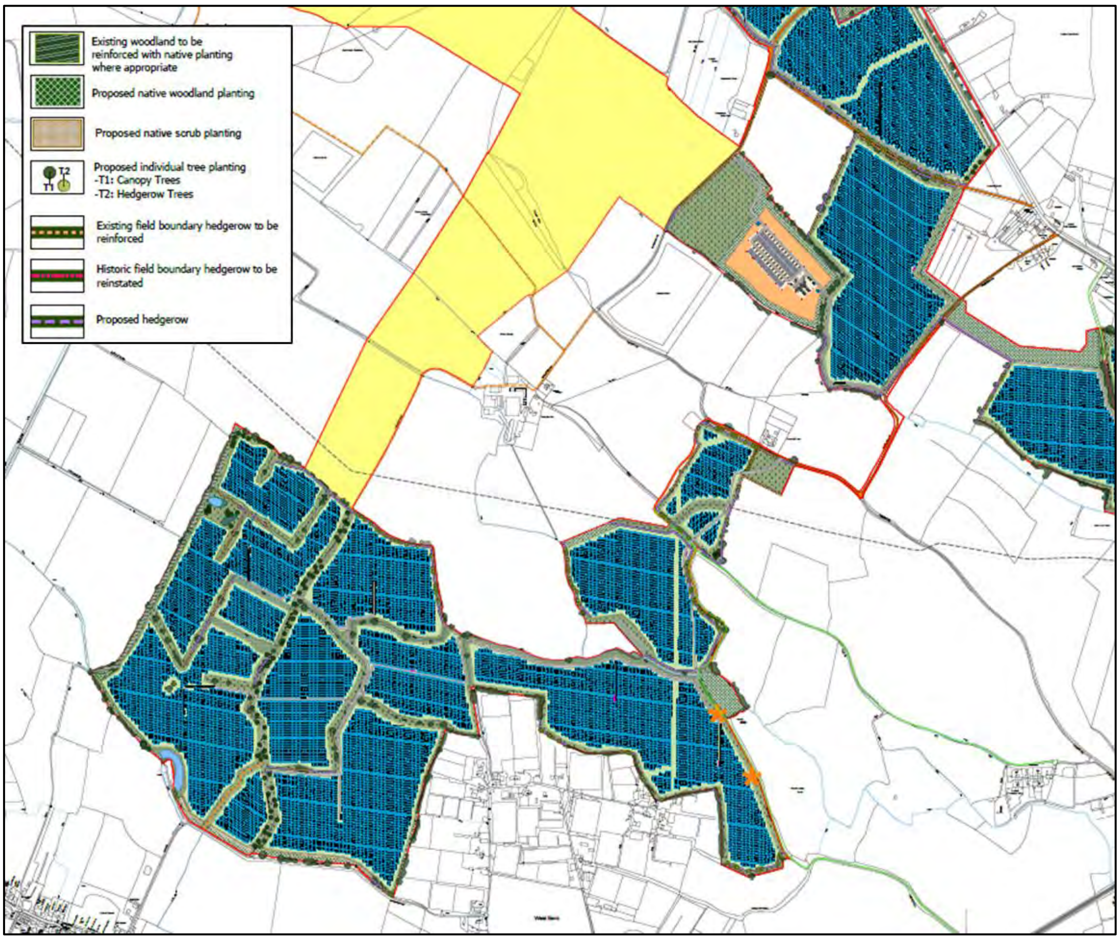
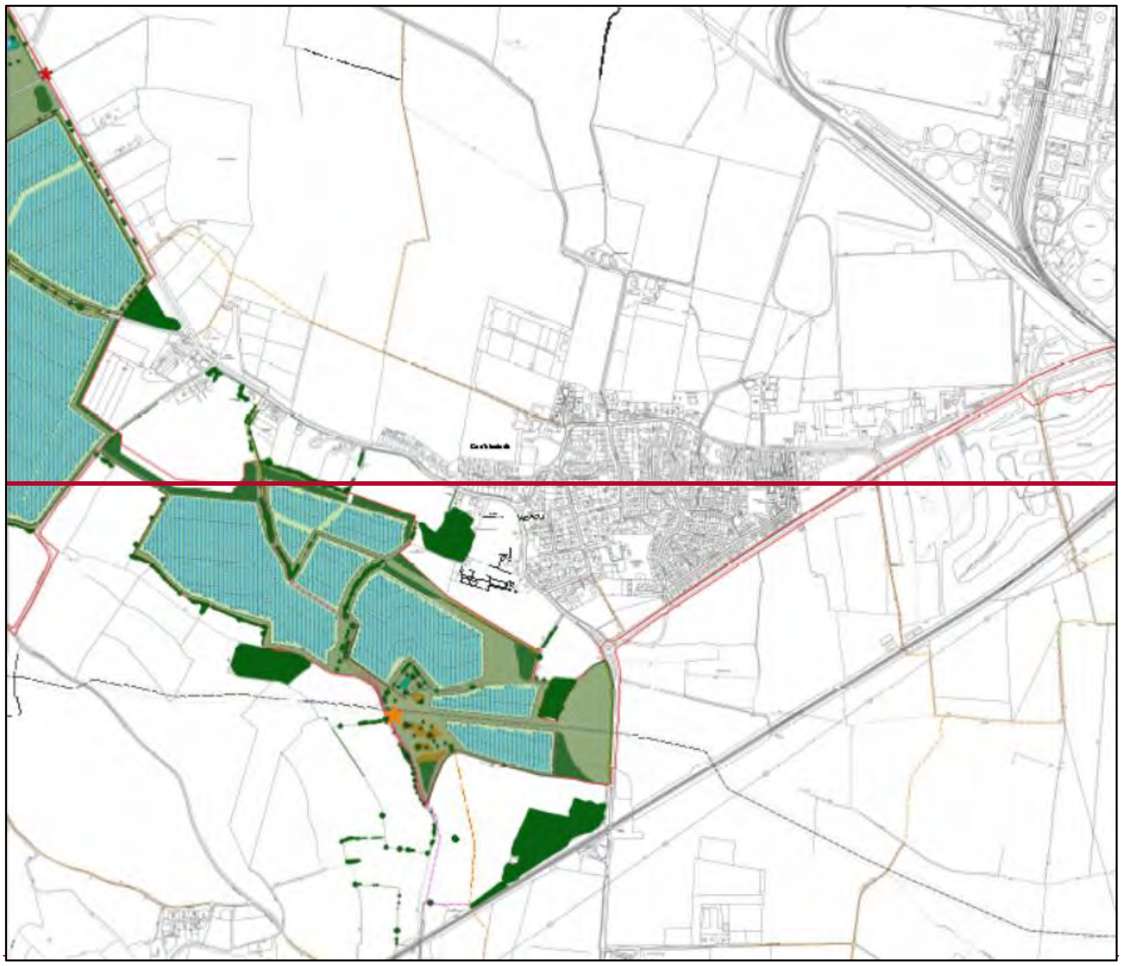


Figure ~~3~~3 *Landscape strategy (Figure 7.~~9 of the PEIR~~21 EN010140/APP/6.2.7.21)*



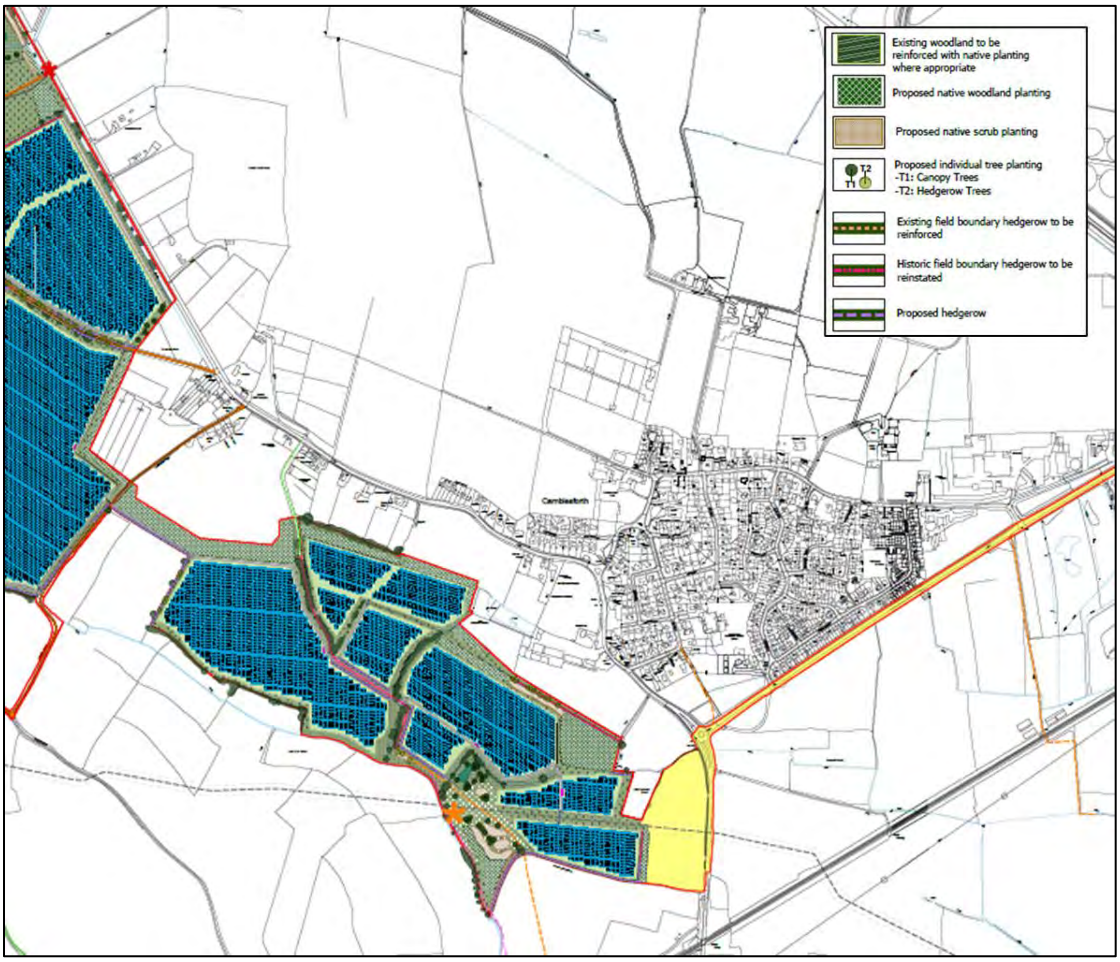


Figure 44 *Landscape strategy (Figure 7.~~10 of the PEIR~~22 EN010140/APP/6.2.7.22)*

2.3 Proposed Development Location – Aerial Image

Figure 5 below shows the Proposed Development's solar PV panel areas overlaid onto aerial imagery (blue outlines). The IDs for the panel areas used in this report are also shown.

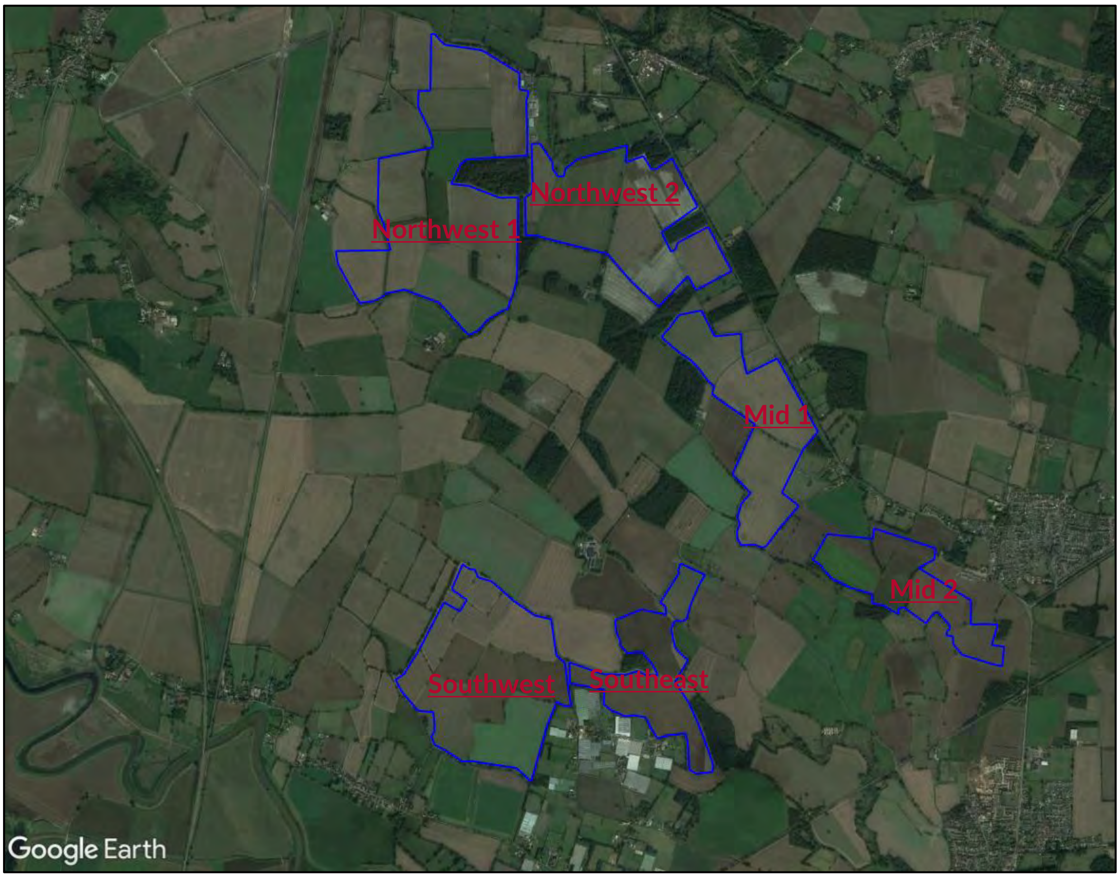


Figure 5 *Proposed Development location – aerial image*

2.4 Solar Panel Technical Information

The technical information used for the modelling ~~are~~is presented in Table 1~~Table 1~~[6] below.

Solar Panel Technical Information	
Assessed centre-height (m)	2 agl (above ground level)
Tracking	Horizontal Single Axis tracks Sun East to West
Tilt of tracking axis (°)	0
Orientation of tracking axis (°)	180
Offset angle of module (°)	0

[6] Based on information received from Enso Green Holdings D Ltd.

Solar Panel Technical Information	
Tracker Range of Motion (°)	±60
Resting angle (°)	0
Surface material	Smooth glass without an anti-reflective coating (ARC)

Table 1 *Solar panel technical information*

2.4.1 Solar Panel Backtracking

Shading considerations dictate the panel tilt. This is affected by:

- The elevation angle of the Sun;
- The vertical tilt of the panels; and
- The spacing between the panel rows.

This means that early in the morning and late in the evening, the panels will not be directed exactly towards the Sun, as the loss from shading of the panels (caused by facing the sun directly when the Sun is low in the horizon), would be greater than the loss from lowering the panels to a less direct angle in order to avoid the shading Figure 36 below illustrates this.

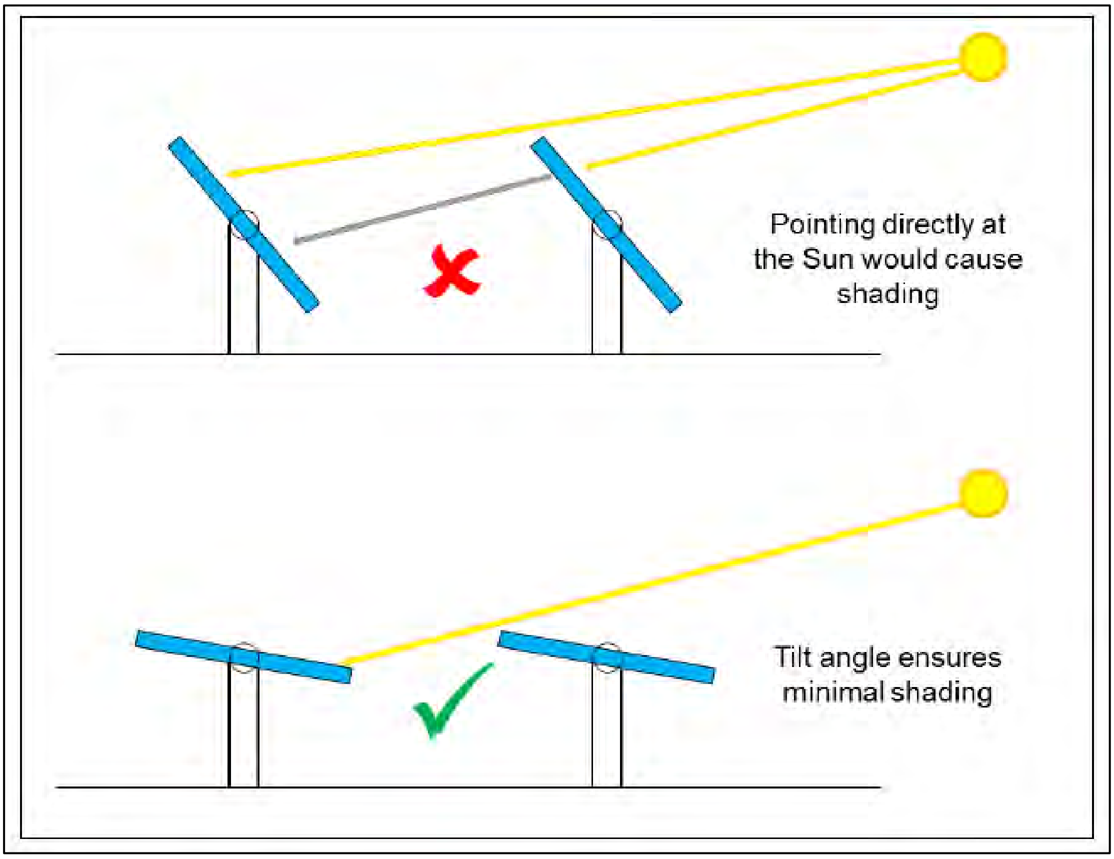


Figure 6 *Shading considerations*

Later in the day, the panels can be directed towards the Sun without any shading issues. This is illustrated in Figure ~~4 on the following page~~7 below.

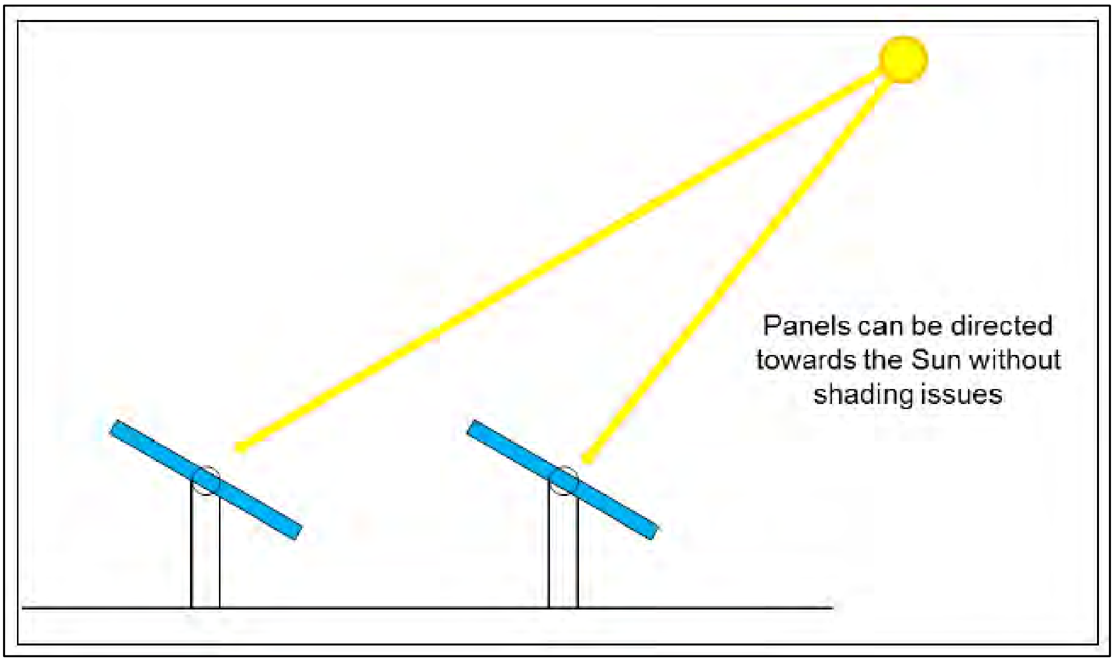


Figure 7 *Panel alignment at high solar angles*

Note that in reality, the lines from the Sun to each panel would be effectively parallel due to the large separation distance. The two previous figures are for illustrative purposes only.

The solar panels backtrack (where the panel angle gradually declines to prevent shading) by reverting to 0 degrees (flat) once the maximum elevation angle of the panels (60 degrees) becomes ineffective due to the low height of the Sun above the horizon and to avoid shading.

3 AIRFIELD DETAILS

3.1 Overview

The following subsections present details concerning the two identified airfields; Burn Airfield and Cliffe Airfield.

3.2 Airfield Information

3.2.1 Burn Airfield

Burn Airfield is an unlicensed aerodrome operated by Burn Gliding Club Ltd, primarily used for gliding operations.

Burn Gliding Club confirmed[7] the operational hours of the airfield to be between 10am and 30 minutes after sunset, three days a week (Thursday, Saturday and Sunday).

3.2.2 Cliffe Airfield

Cliffe Airfield is an unlicensed aerodrome. It is not known who the aerodrome is owned or operated by. Contact details for the operator cannot be located.

3.3 Runway Details

3.3.1 Burn Airfield

Burn Airfield has three runways:

- 01/19 runway dimensions 1,100 x 46 m (asphalt);
- 07/25 runway dimensions 1,300 x 46 m (asphalt);
- 15/33 runway dimensions 950 x 46 m (asphalt).

The aerodrome chart for Burn Airfield is shown in Figure 8[8] on the following page.

3.3.2 Cliffe Airfield

Cliffe Airfield has one runway:

- 10/28 runway dimensions 600 x 15 m (grass).

An aerial image of the runway is shown in Figure 9 on page ~~24~~26.

3.4 Air Traffic Control Tower

It is understood that neither Burn Airfield, nor Cliffe Airfield have an Air Traffic Control (ATC) Tower present.

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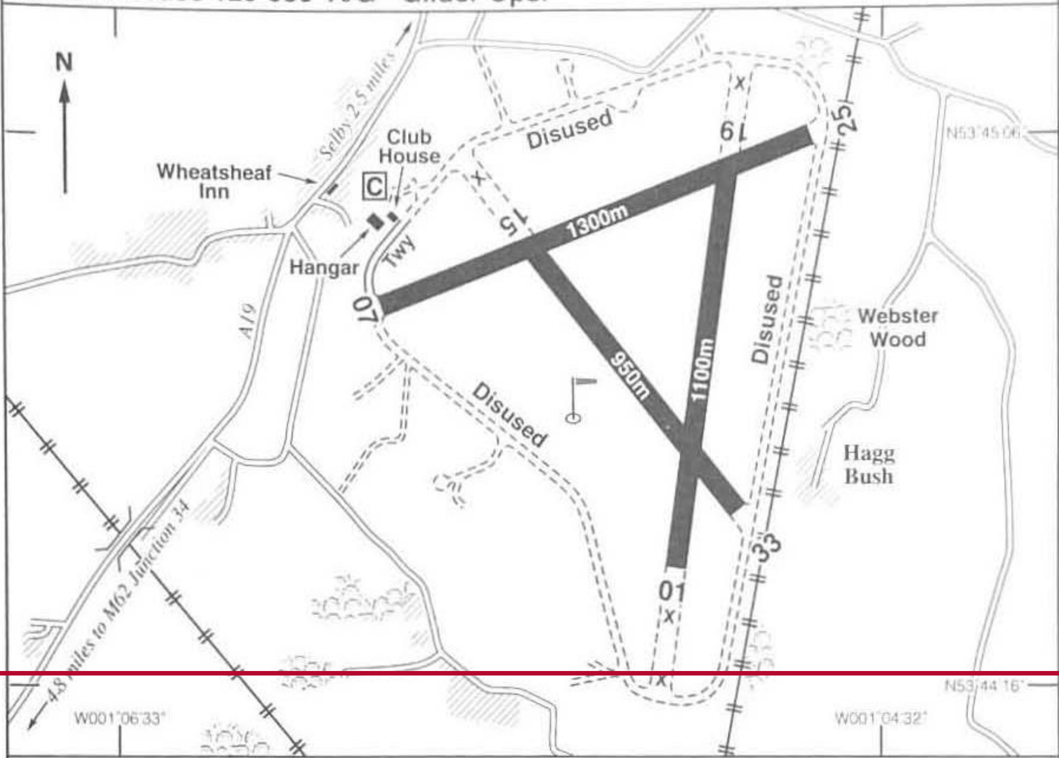
[7] Received via email on 27/01/25

[8] Burn (Selby), Pooleys Flight Guide 2021

N53 44.73 W001 04.97	BURN (SELBY)	20ft AMSL
6 nm SSE of Church Fenton. 2 nm S of Selby.		OTR 113·90 278 34·9 GAM 112·80 353 28·3

c/s **Burn Base 129·980 A/G - Glider Ops.**



Rwy	Dim(m)	Surface	TORA(m)	LDA(m)	Lighting
01/19	1100x46	Asphalt	Unlicensed		Nil
07/25	1300x46	Asphalt	Unlicensed		Nil
15/33	950x46	Asphalt	Unlicensed		Nil

Op hrs: PPR. Daylight use only.

Landing Fee: £10. BGA members free. **Customs:** Nil.

Hangarage: Nil. **Maintenance:** Nil.

Remarks: Operated by Burn Gliding Club Ltd., Park Lane, Burn, Selby, N Yorkshire YO8 8LW. Unlicensed aerodrome primarily used for gliding operations, mainly weekends and Thur. All runways have a 5m centre strip of tarmac from intersection to intersection.

All visiting pilots should obtain a briefing for safe integration with the expected gliding operation. When gliding not in progress, farming activity, horse riders and walkers use the runways.

No overhead joins. Glider launching is by winch to 3000ft agl and aerotows.

Variable circuits. Power and glider operations may not be on the same runway.

PPR preference is via website “Contact Us” form with 2 days notice.

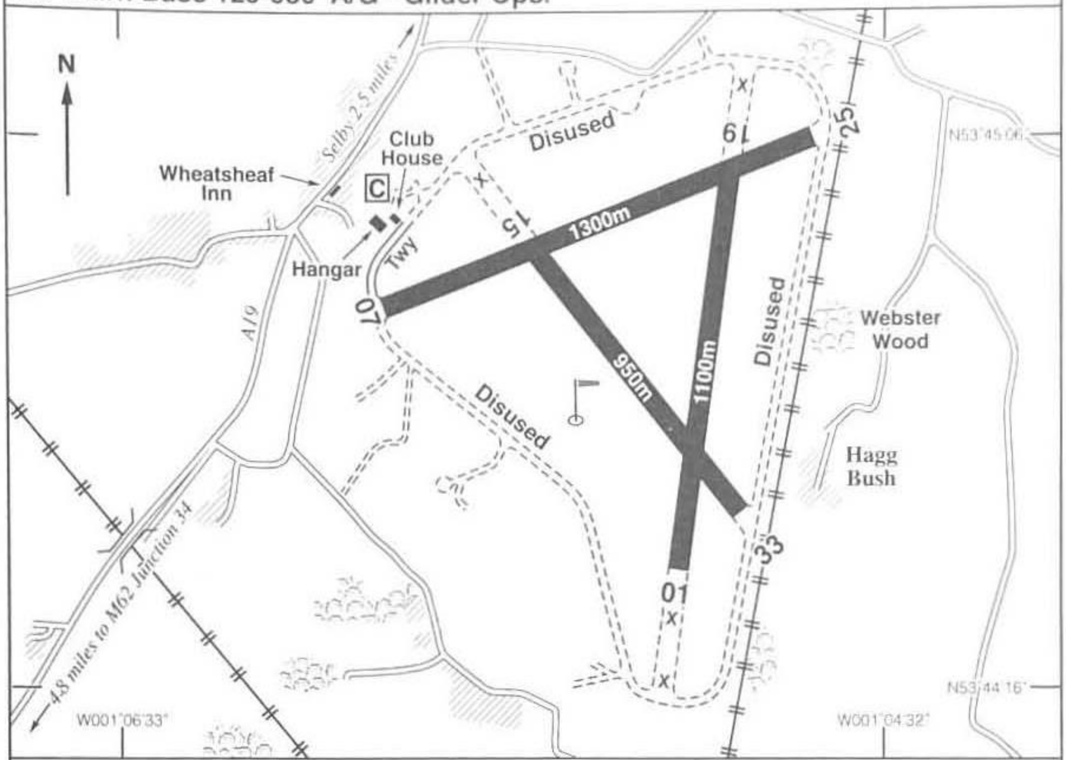
Warnings: Disused sections of the runways are very rough, do not land short.

Obstructions on stubs to runways 01,15 and 19.

Chimneys - 873ft amsl, 3nm to E, and 690ft amsl, 2.5 nm to SW of the airfield.

N53 44.73 W001 04.97	BURN (SELBY)	20ft AMSL
6 nm SSE of Church Fenton. 2 nm S of Selby.		OTR 113·90 278 34·9 GAM 112·80 353 28·3

c/s Burn Base 129·980 A/G - Glider Ops.



Rwy	Dim(m)	Surface	TORA(m)	LDA(m)	Lighting
01/19	1100x46	Asphalt	Unlicensed		Nil
07/25	1300x46	Asphalt	Unlicensed		Nil
15/33	950x46	Asphalt	Unlicensed		Nil

Op hrs: PPR. Daylight use only.

Landing Fee: £10. BGA members free. **Customs:** Nil.

Hangarage: Nil. **Maintenance:** Nil.

Remarks: Operated by Burn Gliding Club Ltd., Park Lane, Burn, Selby, N Yorkshire YO8 8LW. Unlicensed aerodrome primarily used for gliding operations, mainly weekends and Thur. All runways have a 5m centre strip of tarmac from intersection to intersection.

All visiting pilots should obtain a briefing for safe integration with the expected gliding operation. When gliding not in progress, farming activity, horse riders and walkers use the runways.

No overhead joins. Glider launching is by winch to 3000ft agl and aerotows.

Variable circuits. Power and glider operations may not be on the same runway.

PPR preference is via website "Contact Us" form with 2 days notice.

Warnings: Disused sections of the runways are very rough, do not land short.

Obstructions on stubs to runways 01,15 and 19.

Chimneys - 873ft amsl, 3nm to E, and 690ft amsl, 2.5 nm to SW of the airfield.

Figure 8 *Burn Airfield aerodrome chart*

Figure 9 *Cliffe Airfield runway 10/28*

4 GLINT AND GLARE ASSESSMENT METHODOLOGY

4.1 Guidance and Studies

Appendices A and B 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.

4.2 Background

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

4.3 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 and studies. The methodology for a glint and glare assessments is as follows:

- Identify receptors in the area surrounding the solar development.
- Consider direct solar reflections from the solar development towards the identified receptors by undertaking geometric calculations.
- Consider the visibility of the panels from the receptor's location. If the panels 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 solar 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 the process presented in Appendix D.

4.4 Assessment Methodology and Limitations

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

5 IDENTIFICATION OF RECEPTORS

5.1 Aviation Receptors

The aviation receptor details of the two identified airfields are presented in the following sub-sections. The receptor details are presented in Appendix G and the terrain elevations have been interpolated based on Ordnance Survey (OS) Terrain 50 Digital Terrain Model (DTM) data.

5.2 Burn Airfield

An overview of the receptors assessed for Burn Airfield is presented in the following sub-sections.

5.1.15.2.1 ATC Tower

It is standard practice to determine whether a solar reflection can be experienced by personnel within the ATC Tower. The identified airfields, Burn Airfield and Cliffe Airfield dodoes not have an ATC Towers presentTower and has therefore not been assessed.

5.1.21.1.1 Approaching Aircraft

5.2.2 It is Pager Power's methodology to assess whether a solar reflection can be experienced on the approach paths for the associated runways. This is considered to be the most critical stage of the flight. Burn Airfield has three operational runway with two associated approach paths, one for each bearing and Circuiting Aircraft

Cliffe Airfield has one operational runway.

Burn Airfield is a GA airfield where aviation activity is dynamic and does not necessarily follow the typical approaches / flight paths of a licensed aerodrome. It is not possible to assess every single location an aircraft may be situated in flight around an aerodrome; however, it is possible to assess the most frequently flown flight paths and the most critical stages of flight, which would cover most, or all, of the relevant locations.

As such, Pager Power's methodology is to assess whether a solar reflection can be experienced on a 5-degree splayed approach path based on the extended runway centreline, and the final sections of the visual circuits and joins on approach to the corresponding runway thresholds.

The assessed receptors are based on the following characteristics:

- 1-mile approach path with a splay angle of 5 degrees, considering 2.5 degrees either side of the extended runway centreline;
- A descent angle of 5 degrees;
- Circuit width of 1 nautical mile;
- Maximum altitude of 500 feet above the aerodrome height.

Thestandard circuits modelled for Burn Airfield are based upon information received from the airfield during consultation. The airfield state that landing aircraft descend at angles between 8 and 16 degrees; therefore, 16 degrees has been modelled for a 'worst-case' scenario.

TheConsultation with the airfield provided circuit has been modelled at a details that represent the operations and typical airspace used at the airfield, whereby it was stated that a 20-degree approach angle should be assessed, with a maximum altitude of 800 feet above the aerodrome height, based on information available regarding standard glidercircuit elevation of 1000ft above the aerodrome level. In total 24 additional circuits have therefore been modelled and assessed, with each relevant runway having left-hand and right-hand circuits. with long, mid and short-range approach paths. The paths have been assessed as a number of discrete points no more than 200m apart. Figures 10-13 on pages 27-30 show the assessed additional circuit receptors relative to the Proposed Development.

5.3 For Cliffe Airfield

An overview of the receptors assessed for Cliffe Airfield is presented in the following sub-sections.

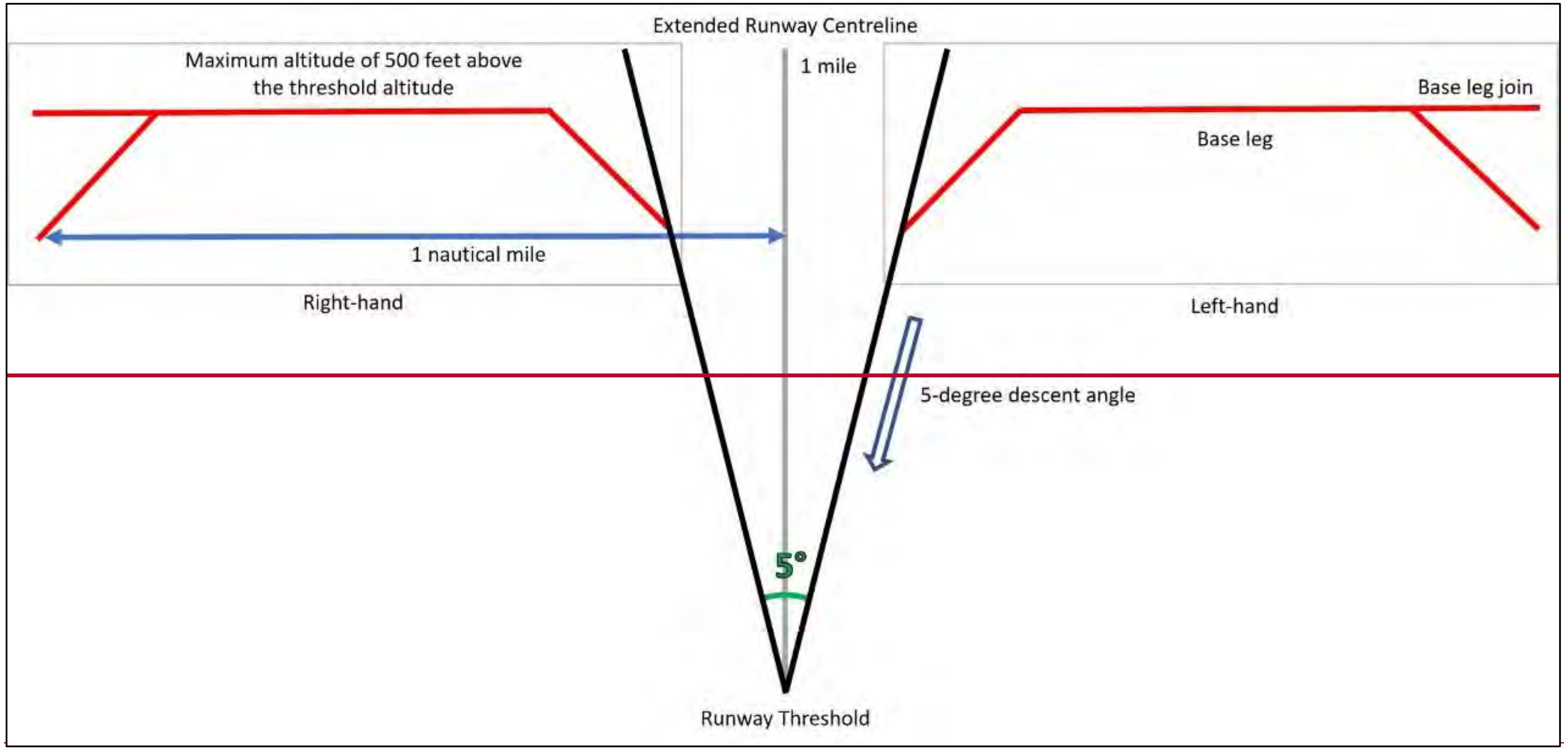
5.3.1 ATC Tower

Cliffe Airfield does not have an ATC Tower and has therefore has not been assessed.

5.3.2 Approaching Aircraft

, locationsLocations along the extended runway centre line from 50ft above the runway threshold out to a distance of 2 miles have been assessed. The height of the aircraft is determined by using a 3-degree descent path relative to the runway threshold height.

Figures 10-15Figure 14 on the following pages showpage 31 shows the assessed aviation receptors relative to the Proposed Development.


Extended Runway Centreline
Maximum altitude of 500 feet above the threshold altitude
1 mile
Base leg join
Base leg
1 nautical mile
Right-hand
Left-hand
5-degree descent angle
5°
Runway Threshold

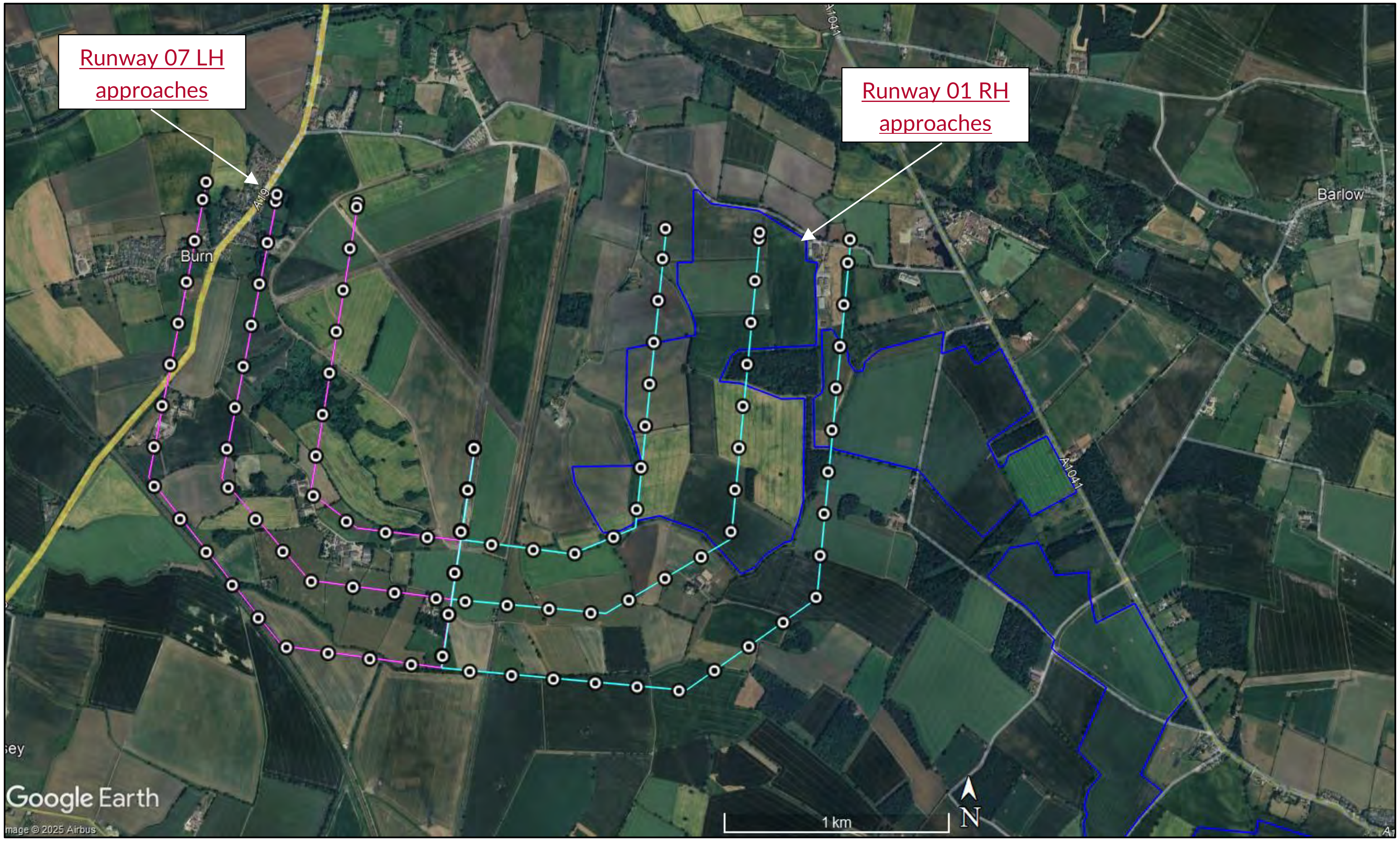


Figure 10 ~~Splayed~~Runway 01 short, mid and long approach ~~and final sections of visual circuits – GA airfields~~

left-hand and right-hand

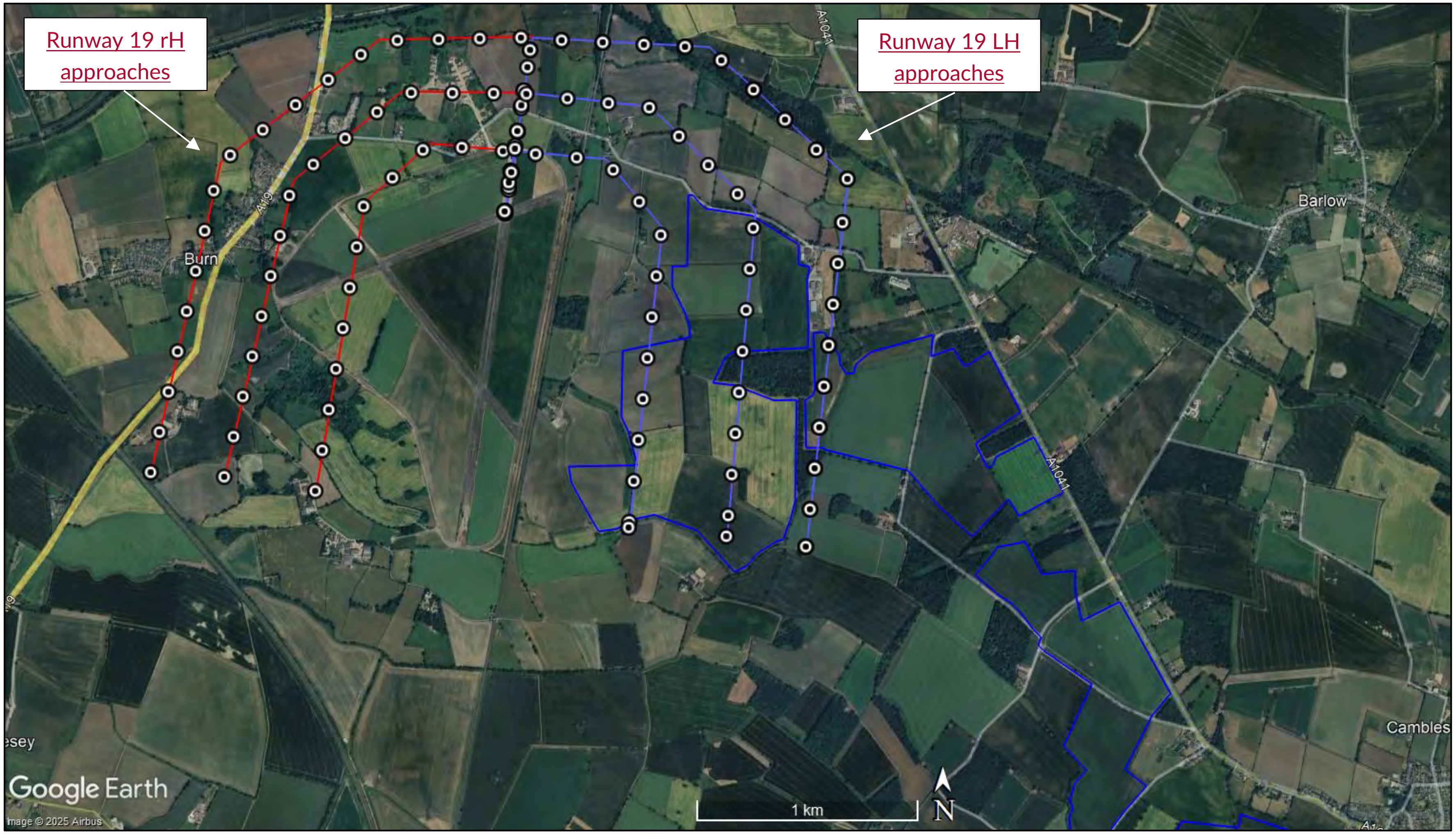

Runway 19 rH approaches
Runway 19 LH approaches
Burn
A19
A1041
Barlow
Cambles
sey
Google Earth
Image © 2025 Airbus
1 km
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Figure 11 ~~Splayed~~Runway 19 short, mid and long *approach* ~~paths for Burn Airfield~~

left-hand and right-hand

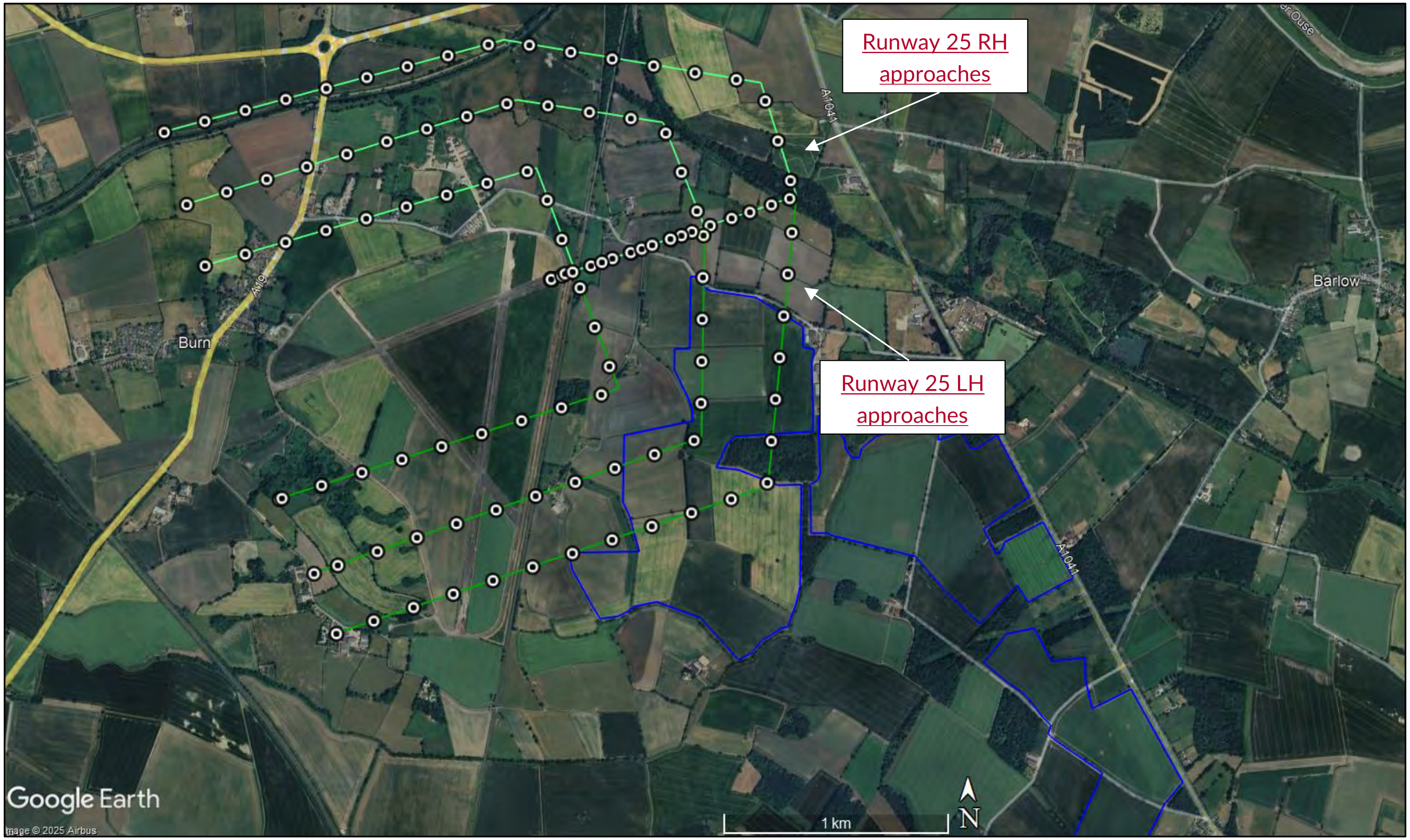
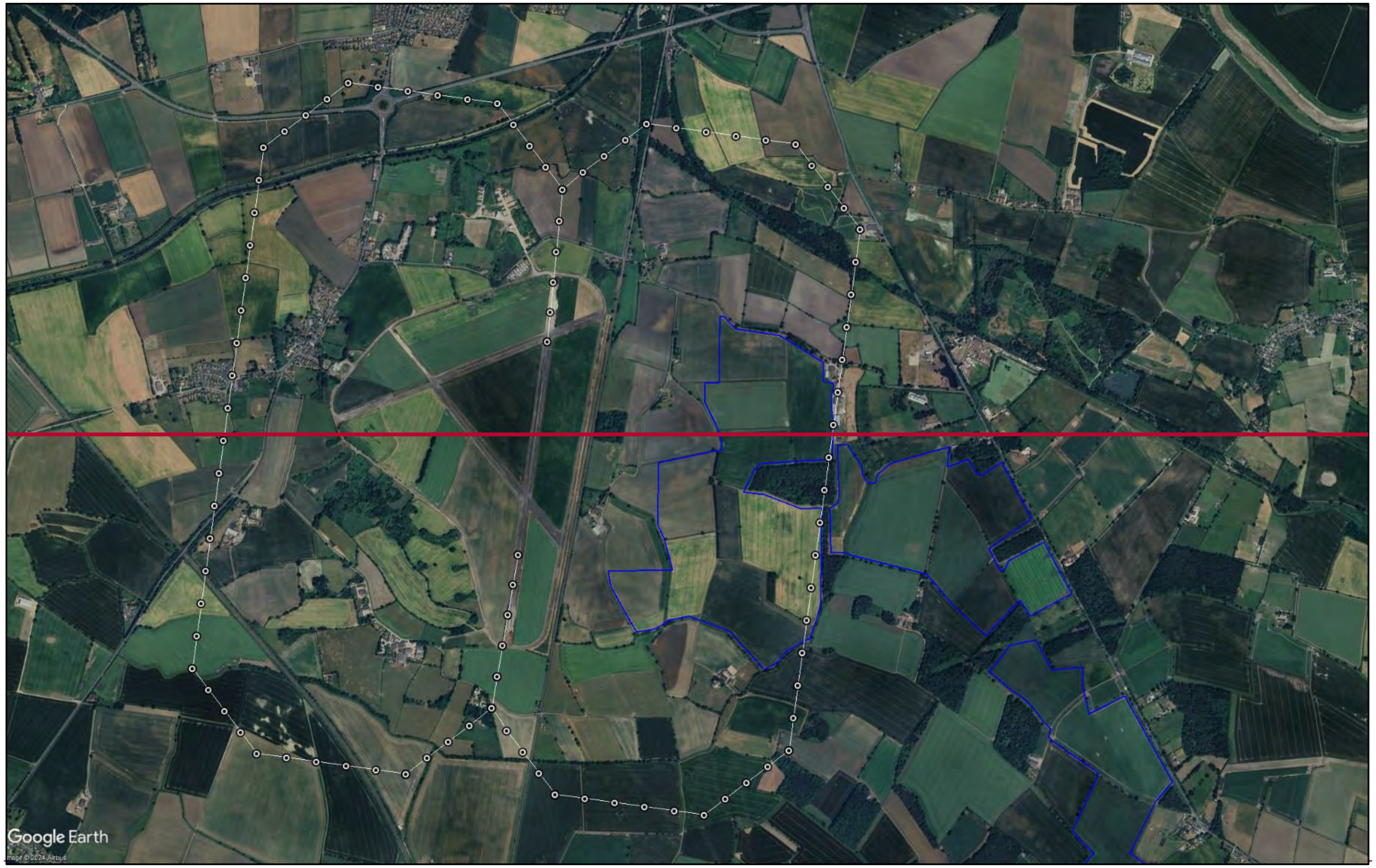


Figure 12 ~~07/~~Runway 25 ~~circuit at Burn Airfield~~



short, mid and long approach left-hand and right-hand

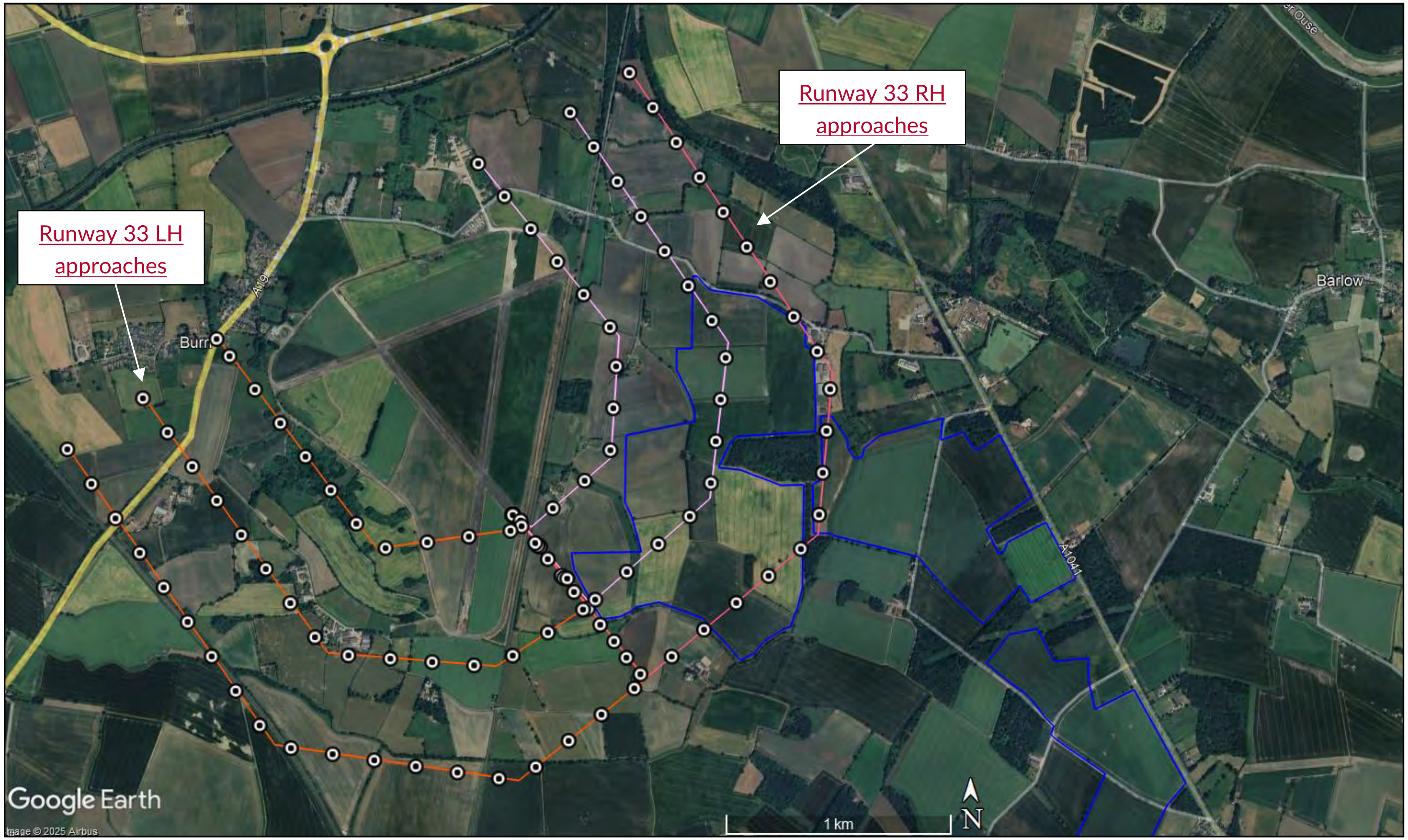


Figure 13 ~~01/19 circuit at Burn Airfield~~

Runway 33 short, mid and long approach left-hand and right-hand


Runway 10
Approach Path
Cliffe Airfield
Runway 28
Approach Path
Google Earth

Figure 14 15/33 circuit at Burn Airfield

Figure 15 *Runway approaches at Cliffe Airfield*

~~5.2~~5.4 Ground-Based Receptors

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, shows that a 1km assessment area from the proposed panel area is appropriate for glint and glare effects on ground-based receptors (road users and dwellings), and a 500m assessment area is appropriate for railway receptors. Receptors have been modelled with the panel areas respective to their 1km assessment area; however, a cumulative assessment area has been presented in the following figures.

Potential receptors within the 1km assessment areas are identified based on mapping and aerial photography of the region. The initial judgement is made based on 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 OS Terrain 50m DTM data. Receptor details can be found in Appendix G.

~~5.3~~5.5 Dwelling Receptors

The analysis has considered dwellings that:

- Are within the 1km assessment area; and
- Have a potential view of the panels.

~~The assessed dwelling receptors are shown in Figure 8 on the following page along with the 1km assessment area (the green outlined polygon).~~ A total of 176 dwelling locations have been assessed.

For the 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[9].

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

[9] This height is used for modelling purposes and all floors are considered in the results discussion.

because line of sight will be removed, or they will experience comparable effects to the closest assessed dwelling.

The dwellings, presented in the above area, buildings that are likely divided into multiple addresses. Modelling output has not been generated for every individual address independently. The sampling resolution is sufficiently high to capture the level of effect for all potentially affected dwellings.

Close-up images to illustrate the dwelling receptors are presented in Figures ~~16-39~~15-38 below and on the following pages.

Following the initial assessment, the following dwelling receptors have been excluded from the updated technical modelling where they now lie outside of the 1km assessment area: 111-133. These have been included in the following figures for completeness.

Figure 15~~16~~15 *Dwellings 1-8*

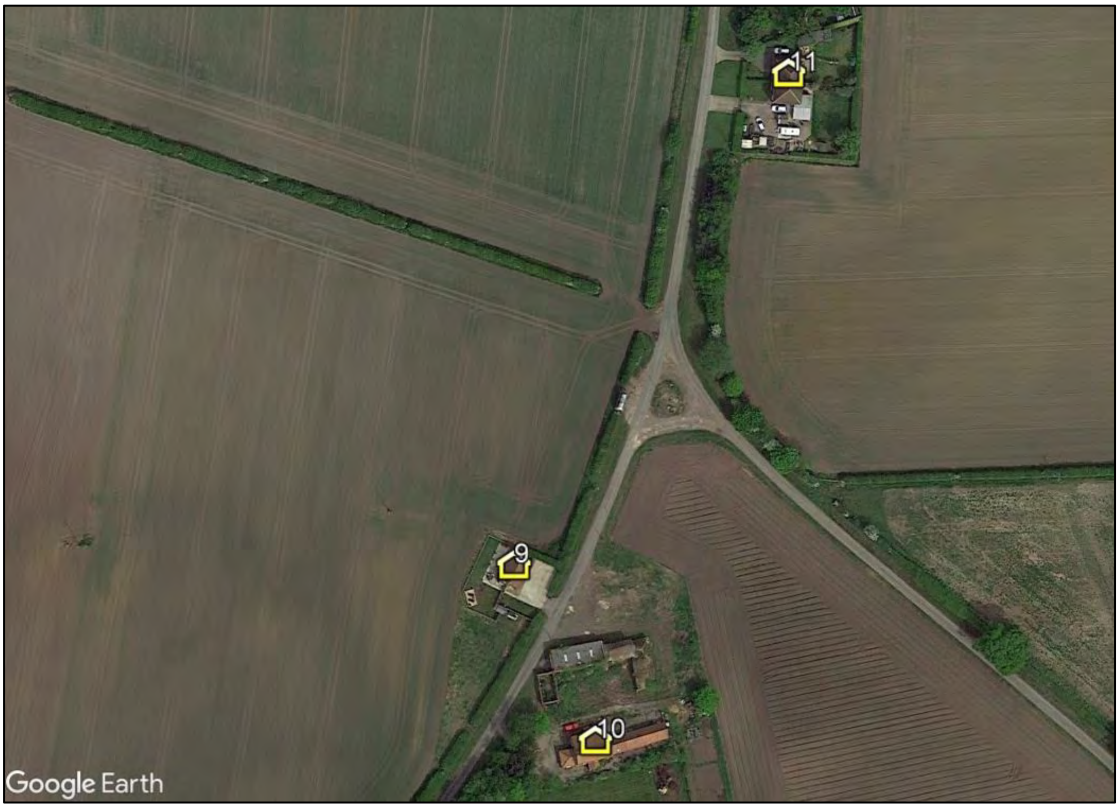


Figure 16 *Dwellings 9-11*

Figure 17 *Dwellings ~~9-11~~12-13*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Google Earth


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Google Earth

Figure 18 *Dwellings ~~12-13~~14-17*

Figure 19 *Dwellings ~~14-17~~18-21*

Figure 20 *Dwellings ~~18-21~~22-24*


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Google Earth


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Google Earth

Figure 21 *Dwellings ~~22-24~~25-39*

Figure 22 *Dwellings ~~25-39~~40-52*

Figure 23 *Dwellings ~~40-52~~53-54 and 57-77*

Figure 24 *Dwellings ~~53-54 and 57-77~~55-56*

Figure 25 *Dwellings ~~55-56~~78-80*

Figure 26 *Dwellings ~~78-80~~81-106*

Figure 27 *Dwellings ~~81-106~~107-125*

Figure 28 *Dwellings ~~107-125~~126-134*

Figure 29 *Dwellings ~~126-134~~135-136*

Figure 30 *Dwellings ~~135-136~~138-152*


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Google Earth


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Google Earth

Figure 31 *Dwellings ~~138-152~~137 and 153-160*

Figure 32 *Dwellings ~~137 and 153-160~~161-177*

Figure 33 *Dwellings ~~161-177~~178-185*

Figure 34 *Dwellings ~~178-185~~186-189*

Figure 35 *Dwellings ~~186-189~~190-192*

Figure 36 ~~Dwellings 190-192~~Dwelling 193

Figure 37 ~~Dwelling 193~~Dwellings 194-196

Figure 38 *Dwellings ~~194-196~~*

~~Figure 39 *Dwellings*~~ *197-199*

5.45.6 Road Receptors

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 therefore considered major national, national, and regional roads that:

- Are within the 1km assessment areas.
- Have a potential view of the panels.

The assessed road receptor points along the A1041 (31-80), A645 (98-105), Barlow Road (106-117), Common Lane (4-30), Hirst Road (121-159) and Station Road (81-93), are shown in Figure 4039 on the following page. A height of 1.5 metres above ground level has been taken as typical eye level for a road user[10]. The distance between road receptors is approximately 100m.

Following the initial assessment, the following receptors have been excluded from the updated technical modelling where they now lie outside of the 1km assessment area: 1-6; 94-97; 118-120, and 159-170.

[10] Views of the Proposed Development from the elevated seat of an HGV driver have been considered within the discussion section

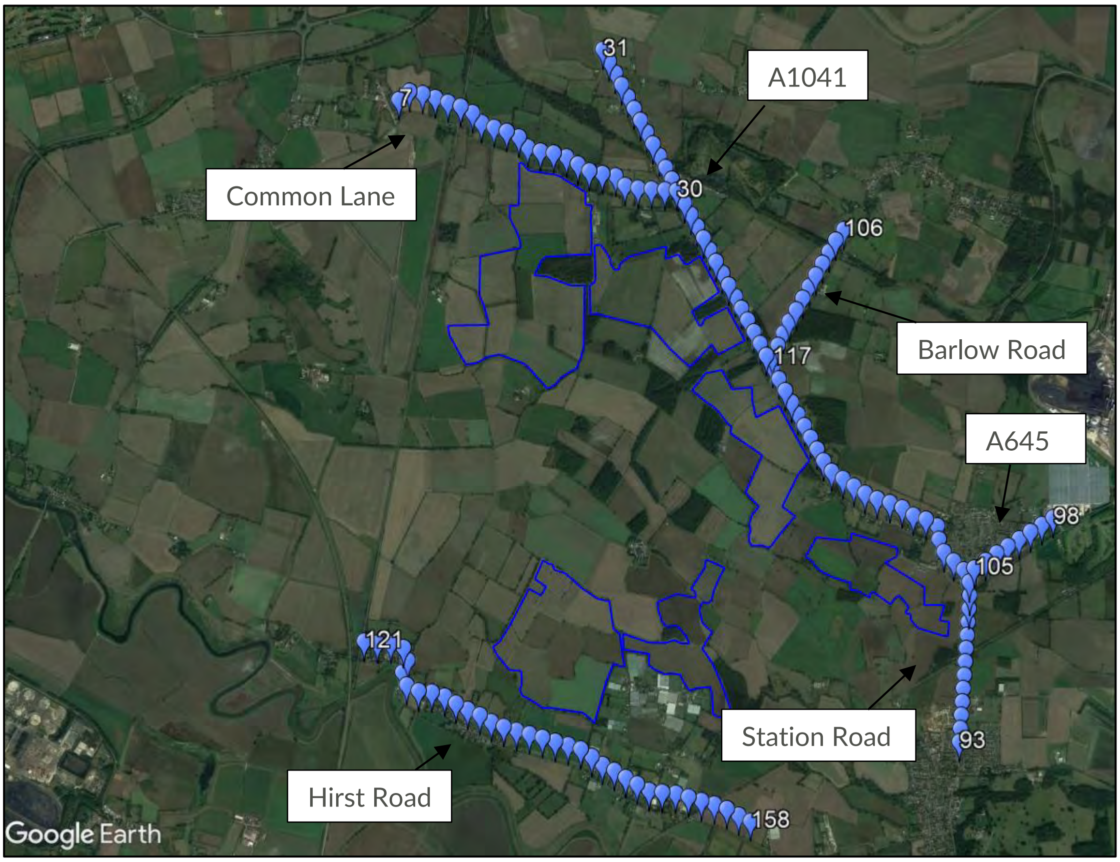

Figure 394039 *Assessed road receptors*

~~5.5~~5.7 Railway Receptors

Typical reasons stated by a railway stakeholder for requesting a glint and glare assessment often relate to the following:

1. The development producing solar reflections towards train drivers;
2. The development producing solar reflections that affect railway signals.

With respect to point 1, a reflective panel could produce solar reflections towards a train driver. If this reflection occurs where a railway signal, crossing etc., is present, or where the driver's workload is particularly high, the solar reflection may affect operations. This is deemed to be the most concern with respect to solar reflections.

Following from point 1, point 2 identifies whether a modelled solar reflection could be significant by determining its intensity. Only where a solar reflection occurs under certain conditions and is of a particular intensity may it cause a reaction from a train driver and thus potentially affect safe operations. Therefore, intensity calculations are undertaken where a solar reflection is identified and where its presence could potentially affect the safety of operations. Points 1 and 2 are completed in a 2-step approach.

With respect to all points, railway lines use light signals to manage trains on approach towards particular sections of track. If a signal is passed when not permitted, a Signal Passed At Danger (SPAD) is issued. The concerns will relate specifically to the possibility of the reflections appearing to illuminate signals that are not switched on (known as a phantom aspect illusion) or a distraction caused by the glare itself, both of which could lead to a SPAD. The definition is presented below:

'Light emitted from a Signal lens assembly that has originated from an external source (usually the sun) and has been internally reflected within the Signal Head in such a way that the lens assembly gives the appearance of being lit.[11]*'*

~~5.5.1~~5.7.1 Glint and Glare Definition

As well as the glint and glare definition presented in Section 1.3, glare can also be categorised as causing visual discomfort whereby an observer would instinctively look away, or cause disability whereby objects become difficult to see. The guidance produced by the Commission Internationale de L'Eclairage ('CIE') describes disability glare as[12]:

'Disability glare is glare that impairs vision. It is caused by scattering of light inside the eye…The veiling luminance of scattered light will have a significant effect on visibility when intense light sources are present in the peripheral visual field and contrast of objects is seen to be low.'

'Disability glare is most often of importance at night when contrast sensitivity is low and there may well be one or more bright light sources near to the line of sight, such as car headlights, streetlights or

[11] Source: Glossary of Signalling Terms, Railway Group Guidance Note GK/GN0802. Issue One. Date April 2004.
[12] CIE 146:2002 & CIE 147:2002 Collection on glare (2002).

floodlights. But even in daylight conditions disability glare may be of practical significance: think of traffic lights when the sun is close to them, or the difficulty viewing paintings hanging next to windows.'

These types of glare are of particular importance in the context of railway operations as they may cause a distraction to a train driver (discomfort) or may cause railway signals to be difficult to see (disability).

~~5.5.2~~5.7.2 Railway Signal Receptors

The analysis has considered railway signal receptors that:

- Are within 500 metres of the Proposed Development;
- Have a potential view of the panels.

The impact of solar reflections upon railway signals has been assessed by considering the height and location of any identified signals. No potential signal locations were identified along the assessed section of railway line using available imagery and have therefore not been assessed. Network Rail has been contacted to confirm the location of any signals at these locations; however, no response has been received to date. ~~Once a response has been received, the report would be updated, if required.~~

~~5.5.3~~5.7.3 Train Driver Receptors

The analysis has considered train driver receptors that:

- Are within the 500m assessment area; and
- Have a potential view of the panels.

Figure ~~41~~40 below shows the section of railway identified within 500m of the Proposed Development.

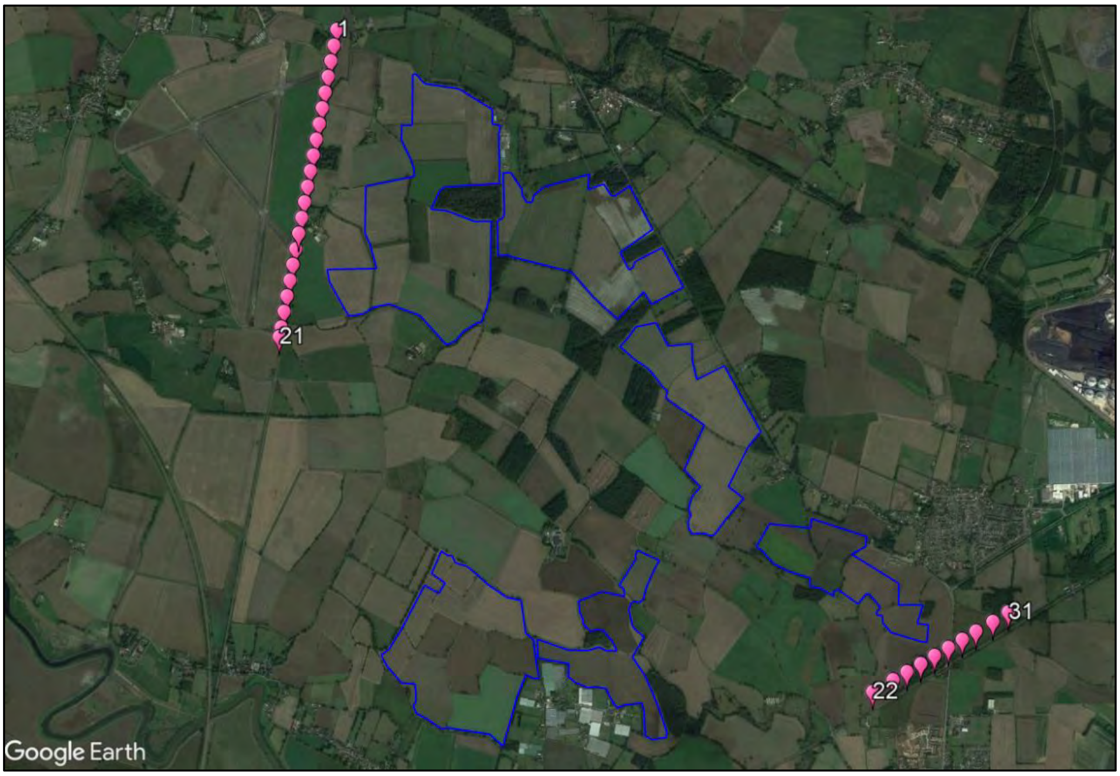

Figure 40~~41~~40 *Railway receptors - aerial image*