FENWICK SOLAR FARM

Fenwick Solar Farm
EN010152

Environmental Statement

Volume III Appendix 14-2: Glint and Glare Assessment Part 1 of 2

Document Reference: EN010152/APP/6.3

Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

October 2024
Revision Number: 00

BOOM POWER

BOOM-POWER.CO.UK

Revision History

Revision Number	Date	Details
00	October 2024	DCO application

Prepared for:
Fenwick Solar Project Limited

Prepared by:
AECOM Limited

Glint and Glare Assessment

Fenwick Solar Farm

09/08/2024

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Contents

1. EXECUTIVE SUMMARY

1.1. This assessment considers the potential impacts on ground-based receptors such as roads, rail and residential dwellings as well as aviation assets. A 1 km Study Area around the Solar PV Site is considered adequate for the assessment of ground-based (residential, road, rail and bridleway) receptors, whilst a 30 km Study Area is chosen for aviation receptors. Within the ground-based Study Areas of the Solar PV Site, there are 141 residential receptors, including 13 residential areas, 88 road receptors, 22 rail receptors and five bridleway receptors that were considered. As per the methodology section, where there are several residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been assessed in detail. 17 residential receptors, including one residential area, 20 road receptors, one rail receptor and one bridleway receptor were dismissed as they are located within the no reflection zones (see Paragraph 5.1 – 5.3). 17 aerodromes are located within the 30 km Study Area; four of which, Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield required detailed assessments as the Solar PV Site is located within their respective safeguarding buffer zones. It is noted that Doncaster Sheffield Airport is currently closed though may reopen at some stage in the future and as such is included in the assessment for thoroughness. The other 13 aerodromes did not require a detailed assessment due to their size and/or orientation in relation to the Solar PV Site.

1.2. Geometric analysis was conducted at 124 individual residential receptors, including 12 residential areas, 68 road receptors, 21 rail receptors and four bridleway receptors. Also, geometric analysis was conducted at 16 runway approach paths and one Air Traffic Control Tower (ATCT) at Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield.

1.3. The assessment concludes that:

- Solar reflections are possible at 52 of the 124 residential receptors assessed within the 1 km Study Area. Once actual visibility and mitigation measures were considered, impacts reduce to **None** at all receptors. Therefore, overall impacts on residential receptors are considered to be **None**.
- Solar reflections are possible at 59 of the 68 road receptors assessed within the 1 km Study Area. Once reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all road receptors. Therefore, overall impacts are considered to be **None**.
- Solar reflections are possible at 14 of the 21 rail receptors assessed within the 1 km Study Area. Once reviewing the actual visibility of the receptors, glint and glare impacts

reduce to **None** for all rail receptors. Therefore, overall impacts on rail receptors are considered to be **None**.

- Solar reflections are possible at one of the four bridleway receptors assessed within the 1 km Study Area. Once reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all bridleway receptors. Therefore, overall impacts on bridleway receptors are considered to be **None**.
- 16 runway approach paths and one ATCT were assessed in detailed at Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield. Green glare and yellow glare impacts were predicted for Runway 08 at Church Farm Airfield. Green glare is an **acceptable impact** upon runways according to FAA guidance. Upon inspection of the type of aircraft using Church Farm, time of impact, position of the sun and use of existing pilot mitigation strategies when landing in the direction of the sun, as well as the likely landing direction for the runway and Google Earth aerial imagery indicating the airfield is not in use, all impacts at Church Farm can be deemed **acceptable**. Overall impacts on aviation assets are **acceptable** and **Not Significant**.

1.4. **No Mitigation** is required due to the **Low** and **None** impacts at all residential receptors and the **None** impacts found for all road and rail receptors. Mitigation measures were included to screen the **Low impact** views from Residential Receptors 74, 79 and 88. This includes native hedgerows to be planted/infilled and maintained to a height of at least 3.5 m along the southern boundary of the Central Array and along a southwest section and a southern section of the South Array.

1.5. The effects of glint and glare and their impact on local receptors has been analysed in detail and there is predicted to be **Low** impacts at one runway approach path, whilst the remaining aviation receptors are predicted to have **No Impacts**. Impacts upon ground-based receptors are predicted to be **None.** Therefore, overall impacts are **Negligible**.

2. INTRODUCTION

BACKGROUND

2.1. Neo Environmental Ltd has been appointed by AECOM Ltd on behalf of Fenwick Solar Project Limited (the "Applicant") to undertake a Glint and Glare Assessment for a proposed solar farm development (the "Scheme") on lands approximately 5 km north of Doncaster.

SCHEME DESCRIPTION

2.2. The Scheme would comprise the construction, operation and maintenance, and decommissioning of solar photovoltaic (PV) panels, Battery Energy Storage Systems (BESS) and associated infrastructure. The BESS Area would be centralised with units located in a single compound within the Solar PV Site. Subject to being granted consent and following a final investment decision, the earliest that Scheme construction could start is in 2028 and the earliest date that operation could start is in 2030.

2.3. The Site comprises of three areas:

- The Solar PV Site would comprise the ground mounted Solar PV Panels, BESS Area, On-Site Substation, Grid Connection Line Drop and associated infrastructure;
- The Grid Connection Corridor would comprise the 400 kilovolt (kV) Grid Connection Cables, linking the On-Site Substation (located within the Solar PV Site) to the Existing National Grid Thorpe Marsh Substation; and
- The Existing National Grid Thorpe Marsh Substation is located approximately 5 km to the south of the Solar PV Site where the Scheme would connect to the grid.

2.4. The Solar PV Site is the focus of this assessment, as this will be where the glint and glare impacts will originate from.

SITE DESCRIPTION

2.5. The Solar PV Site comprises of approximately 1,038 acres (420 ha) of land contained within approximately 45 fields. The field boundaries consist of hedgerows. Ground levels within the Solar PV Site vary from approximately 5 m Above Ordnance Datum (AOD) to 9 m. AOD

2.6. The Solar PV Site is centred at approximate grid reference E 460480, N 416337. The wider landscape contains the village of Fenwick, which is located approximately 0.1 km to the west of the Solar PV Site and the village of Moss, which is located approximately 0.4 km to the south of the Solar PV Site.

SCOPE OF REPORT

2.7. Although there may be small amounts of glint and glare from the metal structures associated with the Solar PV Panels, this is not likely to be significant. The main source of glint and glare will be from the Solar PV Panels themselves and this will be the focus of this assessment. Since the Grid Connection Corridor comprises below ground infrastructure and does not comprise of reflective surfaces, there is no potential for glint and glare effects, therefore this is not considered further in this assessment.

2.8. Solar PV panels are designed to absorb as much light as possible and not to reflect it. However, glint can be produced as a reflection of the sun from the surface of the Solar PV Panel. This can also be described as a momentary flash. This may be an issue due to visual impact and viewer distraction on ground-based receptors and on aviation.

2.9. Glare is significantly less intense in comparison to glint and can be described as a continuous source of bright light, relative to diffused lighting. This is not a direct reflection of the sun, but a reflection of the sky around the sun, therefore being a significantly lesser of a nuisance than direct sunlight.

2.10. This report focusses on the effects of glint and glare and its impact on local receptors and will be supported with the following Figures and Appendices.

- Annex A: Figures
  - Figure 1A: Residential Receptor Map Overall;
  - Figure 1B: Residential Receptor Map Sheet 1B;
  - Figure 1C: Residential Receptor Map Sheet 1C;
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  - Figure 1E: Residential Receptor Map Sheet 1E;
  - Figure 1F: Residential Receptor Map Sheet 1F;
  - Figure 2: Road Receptor Map;
  - Figure 3: Rail Receptor Map;

- Figure 4: Bridleway Receptor Map;
- Figure 5: Site Layout;
- Figure 6: Panel Area Labels;
- Figure 7: Doncaster Sheffield Airport Aerodrome Chart;
- Figure 8: Sherburn-in-Elmet Airport Aerodrome Chart;

- Annex B: Residential Receptor Glare Results Group A (Receptors 1 – 64) (15 degrees);
- Annex C: Residential Receptor Glare Results Group B (Receptors 65 – 124) (15 degrees);
- Annex D: Residential Receptor Glare Results Group A (Receptors 1 – 64) (35 degrees);
- Annex E: Residential Receptor Glare Results Group B (Receptors 65 – 124) (35 degrees);
- Annex F: Road Receptor Glare Results (15 degrees);
- Annex G: Road Receptor Glare Results (35 degrees);
- Annex H: Rail Receptor Glare Results (15 degrees);
- Annex I: Rail Receptor Glare Results (35 degrees);
- Annex J: Bridleway Receptor Glare Results (15 degrees);
- Annex K: Bridleway Receptor Glare Results (35 degrees);
- Annex L: Aviation Receptor Glare Results (15 degrees);
- Annex M: Aviation Receptor Glare Results (35 degrees);
- Annex N: Visibility Assessment Evidence; and
- Annex O: Solar Module Glare and Reflectance Technical Memo.

STATEMENT OF COMPETENCE

2.11. This Glint and Glare Assessment has been produced by David Thomson, Tom Saddington and Michael McGhee of Neo Environmental. Having completed a civil engineering degree in 2012, Michael has produced Glint and Glare assessments for over 1GW of solar farm developments across the UK and Ireland. Tom has an undergraduate degree in Bioengineering and graduated with an MSc in Environmental and Energy Engineering in January 2020. He has been working on various technical assessments including glint and glare reports for numerous solar farms in Ireland and the UK. David has an undergraduate degree in physics, as well as a MSc in sensor design, a MSc in nanoscience and a Diploma in acoustics and noise control. He is an Environmental Engineer who has worked on numerous Glint and Glare assessments for solar farms across the UK and Ireland.

DEFINITIONS

2.12. This study examined the potential hazard and nuisance effects of glint and glare in relation to ground-based receptors, which includes the occupants of surrounding dwellings as well as road users. The US Federal Aviation Administration (FAA) in their "*Technical Guidance for Evaluating Selected Solar Technologies on Airports*"[1] have defined the terms 'Glint' and 'Glare' as meaning;

- Glint – "*A momentary flash of bright light*"; and
- Glare – "*A continuous source of bright light*".

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

2.14. The ocular impact upon a receptor will be assessed and used as the basis of categorising the magnitude of impact at each receptor. For the avoidance of doubt specular impact is a term that refers to the impact produced by the Solar PV Panels, whilst ocular impact is the impact observed by the observer.

General Nature of Reflectance from Photovoltaic Panels

2.15. In terms of reflectance, Solar PV Panels are by no means a highly reflective surface. They are designed to absorb sunlight and not to reflect it. Nonetheless, Solar PV Panels have a flat polished surface that omit 'specular' reflectance rather than a 'diffuse' reflectance, which would occur from a rough surface. Several studies have shown that Solar PV Panels (as opposed to Concentrated Solar Power) have similar reflectance characteristics to water, which is much lower than the likes of glass, steel, snow and white concrete by comparison (**See Annex O**). Similar levels of reflectance can be found in rural environments from the likes of shed roofs and

1 Harris, Miller, Miller & Hanson Inc. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at:

https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf the lines of plastic mulch used in cropping. In terms of the potential for reflectance from Solar PV Panels to cause hazard and/or nuisance effects, there have been a number of studies undertaken in respect of schemes in close proximity to airports. The most recent of these was compiled by the Solar Trade Association (STA) in April 2016 and used a number of case studies and expert opinions, including that from Neo. The summary of this report states that "*the STA does not believe that there is cause for concern in relation to the impact of glint and glare from solar PV on aviation and airports…*"[2].

Time Zones/Datums

2.16. Locations in this report are given in Eastings and Northings using the 'British National Grid' grid reference system unless otherwise stated.

2.17. England uses British Summer Time (BST, UTC + 01:00) in the summer months and Greenwich Mean Time (UTC+0) in the winter period. For the purposes of this report all time references are in GMT.

3. LEGISLATION AND GUIDANCE

3.1. There is no legislation and limited guidance or policy available in the UK at present in relation to the assessment of glint and glare from Scheme developments. Available UK guidance is reviewed below, in addition to references to international guidance where deemed suitable.

2 Solar Trade Association. (April 2016). Summary of evidence compiled by the Solar Trade Association to help inform the debate around permitted development for non - domestic solar PV in Scotland. Impact of solar PV on aviation and airports. Available at: http://www.solar-trade.org.uk/wp-content/uploads/2016/04/STA-glint-and-glare-briefing-April-2016-v3.pdf

NATIONAL PLANNING POLICY GUIDANCE (NPPG) ON RENEWABLE AND LOW CARBON ENERGY (UK) [3]

3.2. Paragraph 013 (Reference ID: 5-013-20150327) sets out planning considerations that relate to large scale ground-mounted solar PV farms. This determines that 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. Considerations to be taken into account by local planning authorities are:

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

NATIONAL POLICY STATEMENT FOR RENEWABLE ENERGY INFRASTRUCTURE, NOVEMBER 2023

3.3. Section 2.10 of the EN-3 (November, 2023) provides the following commentary in relation to Glint and Glare impacts:

> *"2.10.102 Solar panels are specifically designed to absorb, not reflect, irradiation. 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.*

[3] NPPG Renewable and Low Carbon Energy. Available at: http://planningguidance.communities.gov.uk/blog/guidance/renewable-and-low-carbon-energy/particular-planning-considerations-for-hydropower-active-solar-technology-solar-farms-and-wind-turbines/#paragraph_012

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."

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

"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."

3.4. This Glint and Glare Assessment will be taking account of impacts upon nearby homes, motorists, and aviation receptors. Due to assuming complete coverage in the area where solar panels are located within the Solar PV Site, glint and glare impacts from frames and supports are considered within this assessment.

PLANNING GUIDANCE FOR THE DEVELOPMENT OF LARGE-SCALE GROUND MOUNTED SOLAR PV SYSTEMS

3.5. As outlined within the BRE document 'Planning Guidance for the Development of Large-Scale Ground Mounted Solar PV Systems'[4]:

> *"Glint may be produced as a direct reflection of the sun in the surface of the solar PV panel. It may be the source of the visual issues regarding viewer distraction. Glare is a continuous source of brightness, relative to diffused lighting. This is not a direct reflection of the sun, but rather a reflection of the bright sky around the sun. Glare is significantly less intense than glint.*
>
> *Solar PV panels are designed to absorb, not reflect, irradiation. However, the sensitivities associated with glint and glare, and the landscape/visual impact and the potential impact on aircraft safety, should be a consideration. In some instances, it may be necessary to seek a glint and glare assessment as part of a planning application. This may be particularly important if 'tracking' panels are proposed as these may cause differential diurnal and/or seasonal impacts.*
>
> *The potential for solar PV panels, frames and supports to have a combined reflective quality should be assessed. This assessment needs to consider the likely reflective capacity of all of the materials used in the construction of the solar PV farm."*

3.6. This Glint and Glare Assessment will be taking account of impacts upon nearby homes, motorists, and aviation receptors. Due to assuming complete coverage in the area where solar panels are located within the Solar PV Site, glint and glare impacts from frames and supports are considered within this assessment.

INTERIM CAA GUIDANCE – SOLAR PHOTOVOLTAIC SYSTEMS (2010)

3.7. There is little guidance on the assessment of glint and glare from solar farms with regards to aviation safety. The Civil Aviation Authority (CAA) has published interim guidance on 'Solar Photovoltaic Systems[5]', they also intend to undertake a review of the potential impacts of solar PV developments upon aviation, however this is yet to be published.

3.8. The interim guidance identifies the key safety issues with regards to aviation, including *"glare, dazzling pilots leading them to confuse reflections with aeronautical lights."* It is outlined that solar farm developers should be aware of the requirements to comply with the Air Navigation

[4] BRE (2013) *Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems*. Available at: https://www.bre.co.uk/filelibrary/pdf/other_pdfs/KN5524_Planning_Guidance_reduced.pdf

[5] *CAA (2010) Interim CAA Guidance – Solar Photovoltaic Systems. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?catid=1&appid=11&mode=detail&id=4370*

Order (ANO), published in 2016 and amended in 2022. In particular, developers should be cognisant of the following articles of the ANO[6], including:

- ***Article 240*** *– Endangering safety of an aircraft – "A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft."*
- ***Article –24*** *- Lights liable to endanger – "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 or from landing at an aerodrome; or*
  - *b) by reason of its liability to be mistaken for an aeronautical ground light liable to endanger aircraft."*
- ***Article 225*** *– Lights which dazzle or distract – "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."*

3.9. Relevant studies generally agree that there is potential for glint and glare from photovoltaic panels to cause a hazard or nuisance for surrounding receptors, but that the intensity of such reflections is similar to that emanating from still water. This is considerably lower than for other manmade materials such as glass, steel or white concrete (SunPower – 2009).

3.10. These Articles are considered within the assessment of glint and glare for the Scheme.

CAA – CAP738: Safeguarding of Aerodromes 3rd Edition[7]

3.11. In 2003, the CAA first introduced the CAP738 document to help provide advice and guidance to ensure aerodrome safeguarding. Subsequently, there have been two updates to this document in 2006 and 2020.

3.12. Within the latest edition of CAP738, it outlines that the purpose of the document is to protect an aerodrome and to ensure safe operation. Specifically stating:

"Its purpose is to protect:

Aircraft from the risk of glint and glare e.g. solar panels."

[6] CAA (2016) Air Navigation: The Order and Regulations. Available at: https://www.caa.co.uk/media/1a2cigrq/air-navigation-order-2016-amended-april-2022-version.pdf

[7] Civil Aviation Authority (2020). CAP738 – Safeguarding of Aerodromes 3rd Edition. Available at: https://publicapps.caa.co.uk/docs/33/CAP738%20Issue%203.pdf

3.13. Within the section named as "Appendix C – Solar Photovoltaic Cells", the following is stated:

"Policy

1. In 2010 the CAA published interim guidance on Solar Photovoltaic Cells (SPCs). At that time, it was agreed that we would review our policy based on research carried out by the Federal Aviation Authorities (FAA) in the United States, in addition to reviewing guidance issued by other National Aviation Authorities. New information and field experience, particularly with respect to compatibility and glare, has resulted in the FAA reviewing its original document 'Technical Guidance for Evaluating Selected Solar Technologies on Airports', which is likely to be subject to change, see link; https://www.federalregister.gov/documents/2013/10/23/2013-24729/interimpolicy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

2. In the United Kingdom there has been a further increase in SPV cells, including some located close to aerodrome boundaries; to date the CAA has not received any detrimental comments or issues of glare at these established sites. Whilst this early indication is encouraging, those responsible for safeguarding should remain vigilant to the possibility."

3.14. In summary, the above is stating that to date, there has not been any complications on airfields due to glare originating from solar farms across the UK.

US Federal Aviation Administration Policy

3.15. The US Federal Aviation Administration (FAA) in their Solar Guide (Federal Aviation Authority, 2010)[8] incorporates a chapter on the impact and assessment of glint from solar panels. It concludes that (although subject to revision):

"...evidence suggests that either significant glare is not occurring during times of operation or if glare is occurring, it is not a negative effect and is a minor part of the landscape to which pilots and tower personnel are exposed."

3.16. The interim policy (Federal Register, 2013)[9] demands that an ocular impact assessment must be assessed at 1-minute intervals from when the sun rises above the horizon until the sun sets below the horizon. Specifically, the developer must use the 'Solar Glare Hazard Analysis Tool' (SGHAT) tool specifically and reference its results as this was developed by the FAA and Sandia National Laboratories as a standard and approved methodology for assessing potential impacts on aviation interests, although it notes other assessment methods may be considered. The

[8] FAA (2010), Technical Guidance for Evaluating Selected Solar Technologies on Airports. Available at https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide-print.pdf

[9] FAA (2013), Interim Policy, *FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Available at https://www.federalregister.gov/documents/2013/10/23/2013-24729/interim-policy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

SGHAT tool has since been licensed to a private organisation who were also involved in its development and it is the software model used in this assessment.

3.17. Crucially, the policy provides a quantitative threshold that is lacking in the English guidance. This outlines that a solar development will not automatically receive an objection on glint grounds if low intensity glint is visible to pilots on final approach. In other words, low intensity glint with a low potential to form a temporary after-image (Green Glare) would be considered acceptable under US guidance. Due to the lack of legislation and guidance within England, this US document has been utilised as guidance for this report, which is accepted as best practice in the UK with the absence of quantitative guidance.

3.18. The FAA guidance states that for a solar PV development to obtain FAA approval or to receive no objection, the following two criteria must be met:

- No potential for glint or glare in the existing or planned Air Traffic Control Tower (ATCT); and
- No potential for glare (glint) or "low potential for after-image" (Green Glare) along the final approach path for any existing or future runway landing thresholds (including planned or interim phases), as shown by the approved layout plan (ALP). The final approach path is defined as 2 miles from 50 feet above the landing threshold using a standard 3-degree glide path.

3.19. The geometric analysis included later in this report, which defines the extent and time at which glint may occur, is required by the FAA as the methodology to be used when assessing glint and glare impacts on aviation receptors. This report follows the methodology required by the FAA as it offers the most robust assessment method currently available.

FAA Policy: Review of Solar Energy Systems Projects on Federa–ly - Obligated Airports[10]

3.20. The FAA updated their Interim Policy from 2013 as part of their commitment to "*update policies and procedures as part of an iterative process as new information and technologies become available.*" The main development regarding Glint and Glare since the Interim Policy is the following:

> *"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*

[10] FAA (2021). FAA Policy: Review of Solar Energy Systems Projects on Federally – Obligated Airports. Available at: https://www.federalregister.gov/documents/2021/05/11/2021-09862/federal-aviation-administration-policy-review-of-solar-energy-system-projects-on-federally-obligated

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."

3.21. This is outlining that solar panels are similar to nuisances that are already caused by other existing infrastructure, such as car parks, glass buildings and water bodies. Furthermore, the ATCT has been outlined as the key receptor to be assessed when determining Glint and Glare impacts from a solar farm.

3.22. Again, in respect of an absence of UK guidance, this is used as the best practice when assessing aviation receptors.

REVIEW OF LOCAL PLAN

Doncaster Local Plan 2–15 - 2035

3.23. After an independent examination by a Planning Inspector, the Doncaster Local Plan[11] was adopted following a resolution of Full Council on 23 September 2021.

3.24. The plan states in **Policy 58: Low Carbon and Renewable Energy (Strategic Policy)** that:

'B) In all cases, low carbon and renewable energy proposals will be supported where they:

[...]

3. Allow the continued safe and efficient operation of Doncaster Sheffield Airport;

4. Would have no unacceptable adverse effects on highway safety and infrastructure'

[11] Doncaster Local Plan 2015 - 2035, available at: https://www.doncaster.gov.uk/services/planning/local-plan

4. METHODOLOGY

4.1. A desk-based assessment was undertaken to identify when and where glint and glare may be visible at receptors within the vicinity of the Scheme, throughout the day and the year.

SUN POSITION AND REFLECTION MODEL

Sun Data Model

4.2. The calculations in the solar position calculator are based on equations from Astronomical Algorithms[12]. The sunrise and sunset results are theoretically accurate to within a minute for locations between +/- 72° latitude, and within 10 minutes outside of those latitudes. However, due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary from calculations.

Solar Reflection Model

4.3. The position of the sun is calculated at one-minute intervals of a typical year.

4.4. In order to determine if a solar reflection will reach a receptor, the following variables are required:

- Sun position;
- Observer location; and
- Tilt, orientation, and extent of the modules in the solar array.

4.5. The model assumes that the azimuth and horizontal angle of the sun is the same across the whole Solar PV Site. This is considered acceptable due to the distance of the sun from the Scheme and the miniscule differences in location of the sun over the Solar PV Site.

4.6. Once the position of the sun is known for each time interval, a vector reflection equation determines the reflected sun vector, based on the normal vector of the solar array panels. This assumes that the angle of reflection is equal to the angle of incidence reflected across a normal plane. In this instance, the plane being the vector which the solar panels are facing.

4.7. On knowing the vector of the solar reflection, the azimuth is calculated and the horizontal reflection from multiple points within the Solar PV Site. These are then compared with the azimuth and horizontal angle of the receptor from the Solar PV Site to determine if it is within range to receive solar reflections.

[12] Jean Meeus, Astronomical Algorithms (Second Edition), 1999

4.8. The solar reflection in the model is considered to be specular as a worst-case scenario. In practice, the light from the sun will not be fully reflected as solar panels are designed to absorb light rather than reflect it. The text above and **Annex O** outlines the reflective properties of solar glass and compares it to other reflective surfaces. Although the exact figures in this report could contain a margin of error, it is included as a visual guide and it agrees with most other reports, in that solar glass has less reflective properties than other types of glass, bodies of water and snow, and that the amount of reflective energy drops as the angle of incidence decreases.

4.9. Most modern Solar PV Panels have a slight surface texture which should have a small effect on diffusing the solar radiation further. Although, this has not been modelled to conform with the worst-case scenario assessment.

4.10. The panel reflectivity has been modelled to assume an anti-reflective coating (ARC), which is the industry standard for Solar PV Panels and further reduces the reflective properties of the Solar PV Panels.

Determination of Ocular Impact

4.11. The software used for this assessment is based on the Sandia Laboratories Solar Glare Hazard Analysis Tool (SGHAT). This tool is specifically mentioned in the FAA guidance as the software that should be used in this type of assessment. Again, this is following the current best practice available due to the lack of UK guidance.

4.12. Determination of the ocular impact requires knowledge of the direct normal irradiance, Solar PV Panel reflectance, size and orientation of the array, optical properties of the Solar PV Mounting Structure, and ocular parameters. These values are used to determine the retinal irradiance and subtended source angle used in the ocular hazard plot.

4.13. The ocular impact[13] of viewed glare can be classified into three levels based on the retinal irradiance and subtended source angle: low potential for after-image (green), potential for after-image (yellow), and potential for permanent eye damage (red).

4.14. Green glare can be ignored when looking at ground based and some aviation receptors. Green glare does not cause temporary flash blindness and happens at an instant with very slight disturbance. As per FAA guidelines, mitigation is only required for green glare when affecting an Air Traffic Control Tower, but not for when affecting pilots. Therefore, it can be assumed that green glare is acceptable for ground-based receptors.

4.15. The subtended source angle represents the size of the glare viewed by an observer, while the retinal irradiance determines the amount of energy impacting the retina of the observer. Larger source angles can result in glare of high intensity, even if the retinal irradiance is low.

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[13] Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation, Journal of Solar Energy Engineering-Transactions of the Asme, 133(3).

4.16. The modelling software outputs a hazard plot for each receptor predicted to be impacted by glare from the Solar PV Site. An orange dot is plotted for each minute of glare indicating the irradiance (power density) of the reflected solar light. A yellow dot is plotted to show the irradiance of the Sun when it is viewed directly. The hazard plot shows that the irradiance of the Sun is approximately three orders of magnitude greater than the reflected irradiance, i.e. the power density of solar reflections from photovoltaic panels are approximately 0.1% that of viewing the Sun. Due to the disparity in irradiance, whenever the Sun is observed in the same frame as solar reflections from a Solar PV Site, the Sun will be main source of glare impacts upon the observer. In such a case, the impact is deemed to be **Low** as a worst-case scenario.

Relevant Parameters of the Scheme

4.17. The photovoltaic panels are oriented in a southwards direction to maximise solar gain and will remain in a fixed position throughout the day and during the year (i.e. they will not rotate to track the movement of the sun). The panels will face southwards and will be inclined at an angle of between 15 and 35 degrees.

4.18. The height of the panels above ground level is a maximum of 3.5 m and points at the top of the panels are used to determine the potential for glint and glare generation.

Identification of Receptors

Ground Based Receptors

4.19. Glint is most likely to impact upon a ground-based receptor close to dusk and dawn, when the sun is at its lowest in the sky. Therefore, any effect would likely occur early in the day or late in the day, reflected to the west at dawn and east at dusk.

4.20. A 1 km Study Area from the panels was deemed appropriate for the assessment of ground-based receptors as this seemed to contain a good spread of residential and road receptors in most directions from the Solar PV Site. The further distance a receptor is from a solar farm, the less chance it has of being affected by glint and glare due to scattering of the reflected beam and atmospheric attenuation, in addition to obstructions from ground sources, such as any intervening vegetation or buildings. This is based on best practice and our experience of completing Glint and Glare Assessments across the UK and Ireland.

4.21. An observer height of 2 m was utilised for residential receptors, as this is a typical height for a ground-floor window. With regards to road users, a receptor height of 1.5 m was employed as this is typical of eye level. Rail driver’s eye level was assumed to be 2.75 m above the rail for signal signing purposes and therefore this is the height used for assessment purposes. Horse rider eye level has been assumed to be 2.5 m above ground level for bridleway receptors.

4.22. An assessment was undertaken to determine zones where solar reflections will never be directed near ground level.

4.23. Where there are several residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been analysed in detail with the worst-case impacts attributed to that receptor.

Aviation

4.24. Glint is only considered to be an issue with regards to aviation safety when the solar farm lies within close proximity to a runway, particularly when the aircraft is descending to land. This is outlined within the FAA guidance as being the key aviation receptors to assess ad is considered best practice in the absence of UK guidance.

4.25. Should a solar farm be proposed within the safeguarded zone of an aerodrome, then a full geometric study may be required which would determine if there is potential for glint and glare at key locations, most likely on the descent to land.

4.26. Buffer zones to identify aviation assets vary depending on the safeguarding criteria of that asset. All aerodromes within 30 km will be identified, however, generally the detailed assessments are only required within: 20 km for large international aerodromes, 10 km for military aerodromes and 5 km for small aerodromes.

MAGNITUDE OF IMPACT

Static Receptors

4.27. Although there is no specific guidance set out to identify the magnitude of impact from solar reflections, the following criteria has been set out for the purposes of this report and has been accepted for assessing numerous solar farms across the UK and Ireland:

- **High -** Solar reflections impacts of over 30 hours per year or over 30 minutes per day.
- **Medium -** Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day.
- **Low -** Solar reflections impacts up to 20 hours per year or up to 20 minutes per day.
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Moving Receptors (Road and Rail)

4.28. Again, no specific guidance is available to identify the magnitude of impact from solar reflections on moving receptors except in aviation, however, it is thought that a similar approach should be applied to moving receptors as aviation, based on the ocular impact and the potential for after-image.

4.29. The FAA guidance states that for a solar PV development to obtain FAA approval or to receive no objection, the following criteria must be met:

- No potential for glare (glint) or "*low potential for after-image*" along the final approach path for any existing or future runway landing thresholds (including planned or interim phases), as shown by the approved layout plan (ALP).

4.30. The following criteria has been set out for the purposes of this report:

- **High -** Solar reflections impacts consisting of any amount of yellow glare.
- **Low -** Solar reflections impacts consisting of any amount of only green glare.
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening.

4.31. The FAA produced an evaluation of glare as a hazard and concluded in their report[14] that:

"The more forward the glare is and the longer the glare duration, the greater the impairment to the pilots' ability to see their instruments and to fly the aircraft. These results taken together suggest that any sources of glare at an airport may be potentially mitigated if the angle of the glare is greater than 25 deg from the direction that the pilot is looking in. We therefore recommend that the design of any solar installation at an airport consider the approach of pilots and ensure that any solar installation that is developed is placed such that they will not have to face glare that is straight ahead of them or within 25 deg of straight ahead during final approach."

4.32. It is reasonable to assume that although this report is assessing pilots vision impairment, it can also be applied to drivers of other road and rail vehicles. Therefore, the driver's field of view will also be analysed where required and if the glare is out with 25 degrees either side of their line of sight then any impacts will reduce to **None**.

Moving Receptors (Aviation)

Approach Paths

[14] Federal Aviation Authority, Evaluation of Glare as a Hazard for General Aviation Pilots on Final Approach (2015), Available at https://libraryonline.erau.edu/online-full-text/faa-aviation-medicine-reports/AM15-12.pdf

4.33. Each final approach path which has the potential to receive glint is assessed using the SGHAT model. The model assumes an approach bearing on the runway centreline, a 3-degree glide path with the origin 50 ft (15.24 m) above the runway threshold.

4.34. The computer model considers the pilots field of view. The azimuthal field of view (AFOV) or horizontal field of view (HFOV) as it is sometimes referred, refers to the extents of the pilot's horizontal field of view measured in degrees left and right from directly in front of the cockpit. The vertical field of view (VFOV) refers to the extents of the pilot's vertical field of view measured in degrees from directly in front of the cockpit. The HFOV is modelled at 50 degrees left and right from the front of the cockpit whilst the VFOV is modelled at 30 degrees.

4.35. The FAA guidance states that there should be no potential for glare or '*low potential for after-image*' at any existing or future planned runway landing thresholds for the Scheme to be acceptable. Given the FAA guidance and commentary on impacts, the following criteria has been set out for the purposes of this report:

- **High -** Solar reflections impacts consisting of any amount of yellow glare.
- **Low -** Solar reflections impacts consisting of any amount of only green glare.
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening.

Air Traffic Control Tower (ATCT)

4.36. An air traffic controller uses the visual control room to monitor and direct aircraft on the ground, approaching and departing the aerodrome. It is essential that air traffic controllers have a clear unobstructed view of the aviation activity. The key areas on an aerodrome are the views towards the runway thresholds, taxiways and aircraft bays.

4.37. The FAA guidance states that no solar reflection towards the ATCT should be produced by a proposed solar development, however, this should be assessed on a site by site case and will depend on the operations at a particular aerodrome.

4.38. In order to determine the impact on the ATCT, the location and height of the tower will need to be fed into the SGHAT model and where there is a potential for 'low potential for After-Image' or more, then mitigation measures will be required.

Assessment Limitations

4.39. Below is a list of assumptions and limitations of the model and methods used within this report:

- The model does not consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, vegetation, hills, buildings, etc (that is, it calculates a “bare-earth” scenario);

- The model does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the Solar PV Site, and support structures may impact actual glare results;
- Due to variations in atmospheric composition, temperature, pressure and conditions, observed values may vary slightly from calculated positions;
- The model does not account for the effects of diffraction; however, buffers are applied as a factor of safety; and
- The model assumes clear skies at all times and does not account for meteorological effects such as cloud cover, fog, or any other weather event which may screen the sun.

4.40. Due to these assumptions and limitations the model overestimates the number of minutes of glint and glare which are possible at each receptor and presents the worst-case scenario. Where glint and glare are predicted a visibility assessment is carried out to determine a more accurate, real-world prediction of the impacts.

5. BASELINE CONDITIONS (BARE-EARTH)

GROUND BASED RECEPTORS REFLECTION ZONES

5.1. Based on the relatively flat topography in the area, solar reflections between five degrees below the horizontal plane to five degrees above it are described as near horizontal. Reflections from the Scheme within this arc have the potential to be seen by receptors at or near ground level.

5.2. Further analysis showed that this will only occur between the azimuth of 238.92 degrees and 298.18 degrees in the western direction (late day reflections) and 64.36 degrees and 129.27 degrees in the eastern direction (morning reflections) and therefore any ground-based receptor outside these arcs will not have any impact from solar reflections.

5.3. **Figure 1A, 2 and 3 of Annex A** show the respective Study Areas whilst also subtracting from this the areas where solar reflections will not impact on ground-based receptors due to the reasons set out in **Paragraphs 5.1 to 5.2.**

Residential Receptors

5.4. Residential receptors located within 1 km of the Solar PV Site have been identified (**Table 5 - 1**). Glint was assumed to be possible if the receptor is located within the ground-based receptor zones as outlined previously.

5.5. There are 17 residential receptors (Receptors 125 - 141) which are within the no-reflection zones and are clearly identifiable in **Figure 1A: Annex A.** The process of how these are calculated is explained in **Paragraphs 5.1 to 5.2** of this report.

5.6. As per the methodology section, where there are a number of residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for detailed analysis as the impacts will not vary to any significant degree. Where small groups of receptors are evident, the receptors on either end of the group have been assessed in detail. The number in brackets indicates which residential area the receptor belongs.

Table 5 - 1: Residential Based Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1 (1)	459060	417988	Yes
2 (1)	459159	418004	Yes
3	459304	417987	Yes

Receptor	Easting	Northing	Glint and Glare Possible
4	459551	418018	Yes
5	458716	416145	Yes
6 (2)	458893	416223	Yes
7	459029	416253	Yes
8 (3)	459110	416276	Yes
9 (3)	459197	416283	Yes
10 (3)	459287	416291	Yes
11 (4)	459382	416254	Yes
12 (4)	459460	416271	Yes
13 (4)	459584	416257	Yes
14 (4)	459456	416206	Yes
15 (4)	459517	416198	Yes
16 (4)	459526	416136	Yes
17	459656	416251	Yes
18	459691	416238	Yes
19	459714	416185	Yes
20	459825	416180	Yes
21 (5)	459564	416034	Yes
22 (5)	459559	415958	Yes
23	459512	415948	Yes
24 (6)	459147	415987	Yes
25 (6)	459253	415986	Yes
26 (6)	459348	415957	Yes
27 (6)	459450	415902	Yes
28	460461	416391	Yes
29	460761	416327	Yes

Receptor	Easting	Northing	Glint and Glare Possible
30	461963	417288	Yes
31	462021	417262	Yes
32	462128	417318	Yes
33	462258	417358	Yes
34	462344	417303	Yes
35	462308	417243	Yes
36	462449	417327	Yes
37	462584	417312	Yes
38 (7)	462829	417082	Yes
39 (7)	462854	417028	Yes
40 (7)	462876	416927	Yes
41 (8)	462884	416877	Yes
42 (8)	462892	416829	Yes
43 (8)	462824	416812	Yes
44 (8)	462812	416753	Yes
45 (8)	462766	416775	Yes
46 (8)	462692	416783	Yes
47 (8)	462738	416730	Yes
48 (8)	462723	416698	Yes
49 (8)	462704	416639	Yes
50 (8)	462664	416570	Yes
51 (8)	462627	416489	Yes
52	462770	416654	Yes
53	462460	416837	Yes
54	462411	416787	Yes
55	462404	416557	Yes

Receptor	Easting	Northing	Glint and Glare Possible
56	462343	416521	Yes
57	462473	416337	Yes
58	462506	416300	Yes
59	462520	416201	Yes
60	462441	416203	Yes
61 (9)	462360	416340	Yes
62 (9)	462316	416335	Yes
63 (9)	462297	416271	Yes
64 (9)	462238	416256	Yes
65	462400	415937	Yes
66	462431	415885	Yes
67	461805	416090	Yes
68	461788	416067	Yes
69	461780	416046	Yes
70	461633	415892	Yes
71	461609	415870	Yes
72	461586	415860	Yes
73	461486	415817	Yes
74	461293	415676	Yes
75	461373	415056	Yes
76	458495	415644	Yes
77	458489	415614	Yes
78	458456	415625	Yes
79	458933	414700	Yes
80	458865	414633	Yes
81	458546	414351	Yes

Receptor	Easting	Northing	Glint and Glare Possible
82	458589	414352	Yes
83	458705	414334	Yes
84	458723	414336	Yes
85	458941	414351	Yes
86	459005	414314	Yes
87	459017	414274	Yes
88	459537	414626	Yes
89	459535	414509	Yes
90	459567	414491	Yes
91	459562	414436	Yes
92	459637	414423	Yes
93	459646	414415	Yes
94 (10)	459537	414321	Yes
95 (10)	459624	414329	Yes
96 (10)	459697	414351	Yes
97 (10)	459768	414331	Yes
98 (10)	459530	414268	Yes
99 (10)	459704	414281	Yes
100 (11)	459676	414142	Yes
101 (11)	459804	414157	Yes
102 (11)	459818	414120	Yes
103	459775	414052	Yes
104	459857	414097	Yes
105 (12)	459852	414138	Yes
106 (12)	459819	414221	Yes
107 (12)	459819	414325	Yes

Receptor	Easting	Northing	Glint and Glare Possible
108 (12)	459898	414356	Yes
109 (12)	459981	414391	Yes
110 (12)	460053	414414	Yes
111 (12)	460128	414443	Yes
112 (12)	459883	414288	Yes
113 (12)	459962	414312	Yes
114 (12)	460012	414345	Yes
115 (12)	460086	414357	Yes
116	460436	414486	Yes
117	460446	414500	Yes
118	460467	414494	Yes
119	460618	414523	Yes
120	460639	414490	Yes
121	460727	414498	Yes
122	460528	414356	Yes
123	460588	414380	Yes
124	460762	414402	Yes
125	459887	418092	No
126	459975	418148	No
127	460305	418331	No
128	460370	418319	No
129	460833	418288	No
130	461184	418313	No
131	458717	413833	No
132	459047	414227	No
133	459415	414276	No

Receptor	Easting	Northing	Glint and Glare Possible
134 (13)	459441	414282	No
135 (13)	459313	413811	No
136	459527	413743	No
137 (11)	459491	413807	No
138 (11)	459547	413949	No
139 (11)	459503	414006	No
140 (11)	459567	414039	No
141 (11)	459572	414125	No

Road/Rail Receptors

5.7. There are 14 roads within the 1 km Study Area that require a detailed Glint and Glare Assessment: Lowgate, Moss Road, Flashley Carr Lane, West Lane, Broad Lane, Fenwick Lane, Shaw Lane, Fenwick Common Lane, Trumfleet Lane, Bate Lane, Starkbridge Lane, Pinfold Lane, Brick Kiln Lane and Heyworth Lane. There are some minor roads that serve dwellings; however, these have been dismissed as vehicle users of these roads will likely be travelling at low speeds and therefore, there is a negligible risk of safety impacts resulting from glint and glare of the Scheme.

5.8. The ground receptor no-reflection zones are clearly identifiable on **Figure 2: Annex A** and the process of how these are calculated is explained in **Paragraphs 5.1 to 5.2** of this report.

5.9. **Table 5 - 2** shows a list of receptors points within the Study Area which are 200 m apart.

Table 5 - 2: Road Based Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	459068	418003	Yes
2	459264	417992	Yes
3	459459	418013	Yes
4	458362	414329	Yes
5	458565	414376	Yes
6	458762	414356	Yes

Receptor	Easting	Northing	Glint and Glare Possible
7	458960	414357	Yes
8	459546	414296	Yes
9	459747	414301	Yes
10	459937	414339	Yes
11	460121	414409	Yes
12	460312	414458	Yes
13	460506	414459	Yes
14	460700	414478	Yes
15	460865	414422	Yes
16	460942	414238	Yes
17	461022	414056	Yes
18	461231	414075	Yes
19	461336	414231	Yes
20	461404	414406	Yes
21	461529	414563	Yes
22	461536	414714	Yes
23	461463	414878	Yes
24	461611	414988	Yes
25	461728	415136	Yes
26	461685	415326	Yes
27	461540	415426	Yes
28	461502	415623	Yes
29	461500	415814	Yes
30	461651	415947	Yes
31	461815	416052	Yes
32	461993	416140	Yes

Receptor	Easting	Northing	Glint and Glare Possible
33	462181	416215	Yes
34	462354	416283	Yes
35	462531	416357	Yes
36	462653	416502	Yes
37	462737	416677	Yes
38	462857	416822	Yes
39	458181	414897	Yes
40	458258	415075	Yes
41	458333	415258	Yes
42	458415	415438	Yes
43	458508	415613	Yes
44	458687	416155	Yes
45	458877	416202	Yes
46	459073	416238	Yes
47	459272	416250	Yes
48	459471	416236	Yes
49	459097	416044	Yes
50	459246	415956	Yes
51	459423	415874	Yes
52	459566	416126	Yes
53	459581	415932	Yes
54	459347	415694	Yes
55	459259	415516	Yes
56	459170	415338	Yes
57	459081	415154	Yes
58	458991	414971	Yes

Receptor	Easting	Northing	Glint and Glare Possible
59	458922	414782	Yes
60	458887	414603	Yes
61	458840	414410	Yes
62	459822	414150	Yes
63	462377	416466	Yes
64	462423	416660	Yes
65	462424	416851	Yes
66	462396	417031	Yes
67	462350	417234	Yes
68	462586	416773	Yes
69	459660	418058	No
70	459853	418109	No
71	460025	418185	No
72	460199	418267	No
73	460380	418325	No
74	460569	418294	No
75	460763	418286	No
76	460948	418352	No
77	460280	418395	No
78	459150	414306	No
79	459348	414300	No
80	459890	413953	No
81	459632	414114	No
82	459521	413985	No
83	459455	413797	No
84	459621	413710	No

Receptor	Easting	Northing	Glint and Glare Possible
85	459265	413869	No
86	459083	413928	No
87	458896	413880	No
88	458704	413810	No

5.10. There is one railway line, the East Coast Main Line, within 1 km of the Solar PV Site that requires a detailed Glint and Glare Assessment.

5.11. The ground receptor no-reflection zones are clearly identifiable on **Figure 3: Annex A** and the process of how these are calculated is explained in **Paragraphs 5.1 to 5.2** of this report.

5.12. **Table 5 - 3** shows a list of receptors points within the Study Area which are 200 m apart.

Table 5 - 3: Rail Based Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	459128	418042	Yes
2	459110	417848	Yes
3	459091	417651	Yes
4	459070	417452	Yes
5	459052	417252	Yes
6	459033	417053	Yes
7	459015	416858	Yes
8	458995	416662	Yes
9	458976	416464	Yes
10	458955	416267	Yes
11	458939	416068	Yes
12	458919	415866	Yes
13	458902	415667	Yes
14	458882	415469	Yes
15	458864	415270	Yes

Receptor	Easting	Northing	Glint and Glare Possible
16	458845	415070	Yes
17	458825	414874	Yes
18	458806	414682	Yes
19	458787	414483	Yes
20	458770	414286	Yes
21	458748	414087	Yes
22	458732	413892	No

Bridleway Receptors

5.13. All bridleways within 1 km of the Scheme have been considered.

5.14. The ground receptor no-reflection zones are clearly identifiable on **Figure 4: Annex A** and the process of how these are calculated is explained in **Paragraphs 5.1 to 5.2** of this report.

5.15. **Table 5 - 4** shows a list of receptors points within the Study Area which are 200 m apart.

Table 5 - 4: Bridleway Based Receptors

Receptor	Easting	Northing	Glint and Glare Possible
1	461958	417386	Yes
2	461941	417515	Yes
3	161883	417710	Yes
4	161844	417901	Yes
5	161823	418090	No

Boat Receptors

5.16. Due to the distance between the navigable waterways and the Solar PV Site (greater than 1 km), a detailed model has not been run along the waterways given that it is located outside the 1 km Study Area used for ground-based receptors. It can therefore be concluded that impacts upon users of the waterways are unlikely to occur but if they were to, they would be no greater than **Negligible** and **Not Significant.**

Aviation Receptors

5.17. Aerodromes within 30 km of the Solar PV Site can be found in **Table 5 - 5.**

Table 5 - 5: Airfields within close proximity

Airfield	Distance (km)	Use
Church Farm	2.26	Small grass strip
Bridge Cottage Airfield	3.28	Small grass strip
Walton Wood Airfield	10.26	Small grass strip
Finningley Village Airfield	15.54	Small grass strip
Doncaster Sheffield Airport	16.69	Licensed airport
Sherburn in Elmet Airfield	16.87	Licensed aerodrome
Nostell Priory Helipad	19.61	Helipad
Grimethorpe Helipad	19.68	Helipad
Church Fenton Airfield	21.51	Licensed aerodrome
Garforth Airfield	22.77	Small grass strip
Haxey Airfield	23.14	Small grass strip
Willow Farm	25.59	Small grass strip
Pinderfields Hospital Helipad	26.41	Helipad
Wentworth Airfield	26.57	Small grass strip
North Moor Airfield	27.41	Small grass strip
RAF Melbourne	28.16	Military
Carr Gate Helipad	29.87	Helipad

5.18. As shown in **Table 5 - 5**, there are 17 aerodromes within 30 km of the Solar PV Site. However, only Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield will require a detailed assessment as the Solar PV Site is located within their safeguarding buffer zones, outlined in **Paragraph 4.24 - 4.26.** Whilst Doncaster Sheffield Airport has shut, it remains in the glint and glare assessment as a worst case in the event that the airport reopens in future.

5.19. The other 13 aerodromes do not require detailed assessments due to their location in relation to the Solar PV Site falling outside of the buffer zones outlined in **Paragraph 4.24 - 4.26.**

Doncaster Sheffield Airport

5.20. Doncaster Sheffield Airport (ICAO code EGCN) is an IFR/VFR aerodrome. It is located approximately 3 nautical miles (NM) or 5.56 km southeast of Doncaster.

5.21. The elevation of the aerodrome is 55 ft (16.76 m). It has one asphalt runway, details of which are given in **Table 5 - 6**.

Table 5 - 6: Runways at Doncaster Sheffield Airport

Runway Designation	True Bearing (°)	Length (m)	Width (m)
02	017.65	2894	60
20	197.66	2894	60

5.22. The threshold location and height of the runway at Doncaster Sheffield Airport are given in **Table 5 - 7**.

Table 5 - 7: Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
02	53° 27′ 51.17″ N	001° 00′ 36.05″ W	15.85
20	53° 29′ 10.98″ N	000° 59′ 53.61″ W	7.92

5.23. The ARP is located at the midpoint of Runway 02/20. The actual location of the ARP and the ATCT is given in **Table 5 - 8**. The height of the ATCT is estimated to be 12 m.

Table 5 - 8: Doncaster Sheffield Airport Reference Point

	Latitude	Longitude	Eastings	Northings
ARP	53° 28’ 30.59’’ N	001° 00’ 15.15’’ W	466178	398018
ATCT	53° 28’ 53.23’’ N	000° 59’ 45.61’’ W	466276	398771

Sherburn-in-Elmet Airport

5.24. Sherburn-in-Elmet Airport (ICAO code EGCJ) is an IFR/VFR aerodrome. It is located approximately 5.5 nautical miles (NM) or 10.19 km west of Selby.

5.25. The elevation of the aerodrome is 26 ft (7.92 m). It has one macadam runway and three grass runways, details of which are given in **Table 5 - 9**.

Table 5 - 9: Runways at Sherburn-in-Elmet Airport

Runway Designation	True Bearing (°)	Length (m)	Width (m)
01	008.06	581	21
19	188.06	581	21
06	058.46	771	21
24	238.46	771	21
10	103.23	828	18
28	283.23	828	18
10G	103.25	622	21
28G	283.26	622	21

5.26. The threshold location and height of the runway at Sherburn-in-Elmet Airport are given in **Table 5 - 10**.

Table 5 - 10: Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
01	53° 47′ 04.21″ N	001° 12′ 49.74″ W	7.16
19	53° 47′ 20.92″ N	001° 12′ 45.60″ W	7.04
06	53° 47′ 11.92″ N	001° 13′ 20.59″ W	7.77
24	53° 47′ 22.73″ N	001° 12′ 50.38″ W	7.19
10	53° 47′ 06.27″ N	001° 13′ 25.73″ W	7.86
28	53° 47′ 01.78″ N	001° 12′ 53.13″ W	7.59
10G	53° 47′ 08.51″ N	001° 13′ 23.00″ W	7.65
28G	53° 47′ 03.81″ N	001° 12′ 50.05″ W	7.07

5.27. The ARP is located at the midpoint of Runway 10/28. The actual location of the ARP is given in **Table 5 - 11**. There is no ATCT at Sherburn-in-Elmet Airport.

Table 5 - 11: Sherburn-in-Elmet Airport Reference Point

	Latitude	Longitude	Eastings	Northings

ARP	53° 47’ 03.76’’ N	001° 13’ 07.19’’ W	451578	432290

Church Farm

5.28. Church Farm is a private Airfield. It is located approximately 2.1 nautical miles (NM) or 3.9 km northeast of Carcroft.

5.29. The elevation of the aerodrome is approximately 16 ft (5 m). It has one grass strip runway, details of which are given in **Table 5 - 12**.

Table 5 - 12: Runway at Church Farm

Runway Designation	True Bearing (°)	Length (m)	Width (m)
Runway 08	080.8	600	21
Runway 26	260.8	600	21

5.30. The threshold locations and heights of the runway at Church Farm are given in **Table 5 - 13**.

Table 5 - 13: Church Farm Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
08	53° 36’ 35.87’’ N	001° 08’ 17.89’’ W	8
26	53° 36′ 38.85″ N	001° 07′ 46.76″ W	7

5.31. There is no Aerodrome Reference Point (ARP) or ATCT at Church Farm.

Bridge Cottage Airfield

5.32. Bridge Cottage Airfield is a private airfield. It is located approximately 1 nautical miles (NM) or 1.9 km west of Pollington.

5.33. The elevation of the aerodrome is 16 ft (5 m). It has two grass strip runways, details of which are given in **Table 5 - 14**.

Table 5 - 14: Runways at Bridge Cottage Airfield

Runway Designation	True Bearing (°)	Length (m)	Width (m)
Runway 01	012.1	450	16

Runway 19	192.1	450	16
Runway 18	182.4	370	16
Runway 36	002.4	370	16

5.34. The threshold locations and heights of the runways at Bridge Cottage Airfield are given in **Table 5 - 15**.

Table 5 - 15: Bridge Cottage Airfield Runway Threshold Locations and Heights

Runway Designation	Threshold Latitude	Threshold Longitude	Height AOD (m)
01	53° 40’ 40.20’’ N	001° 06’ 05.32’’ W	5
19	53° 40′ 54.47″ N	001° 06 00.68″ W	9
18	53° 40′ 53.03″ N	001° 06′ 04.50″ W	7
36	53° 40′ 40.47″ N	001° 06′ 06.47″ W	5

5.35. There is no Aerodrome Reference Point (ARP) or ATCT at Bridge Cottage Airfield.

6. IMPACT ASSESSMENT

6.1. Following the methodology outlined earlier in this report, geometrical analysis comparing the azimuth and horizontal angle of the receptors from the Scheme and the solar reflection was conducted. Although this model did not take into account obstructions such as vegetation and buildings, discussion on the potentially impacted receptors is provided where necessary. Such obstructions will be taken into account during the visibility assessment and will be discussed for each relevant receptor.

GROUND BASED RECEPTORS

Residential Receptors

6.2. **Table 6-1** identifies the receptors that will experience solar reflections based on solar reflection modelling and whether the reflections will be experienced in the morning (AM), evening (PM), or both. The number in brackets indicates which residential area the receptor belongs.

6.3. The Nine receptors which were within the no-reflection zones outlined previously have been excluded from the detailed modelling as they will never receive any glint and glare impacts from the Scheme.

6.4. **Annex B - E** shows the analysis with the ground mounted solar panels at a tilt angle of between 15 and 35 degrees. **Annex B and D** shows the analysis for Receptors 1 – 64 and 65 – 124 respectively with a tilt angle of 15 degrees, whilst **Annex C and E** shows the analysis for Receptors 1 – 64 and 65 – 124 respectively with a tilt angle of 35 degrees.

6.5. **Table 6 – 1** shows the **worst-case impact at each receptor, based on a theoretical modelled impact without consideration of existing or proposed local vegetation or other obstacles (i.e. a bare-earth scenario) and assuming no cloud at any point in the year.**

Table 6 - 1: Potential for Glint and Glare Impact on Residential Receptors (Bald Earth)

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
1 (1)	No	No	0	0	None	None	None	N/A
2 (1)	No	No	0	0	None	None	None	N/A
3	No	No	0	0	None	None	None	N/A
4	No	No	0	0	None	None	None	N/A
5	Yes	No	379	6.32	Low	None	None	35
6 (2)	No	No	0	0	None	None	None	N/A
7	No	No	0	0	None	None	None	N/A
8 (3)	Yes	No	85	1.42	Low	None	None	35
9 (3)	Yes	No	353	5.88	Low	None	None	35
10 (3)	Yes	No	1056	17.60	Low	None	None	35
11 (4)	Yes	No	1103	18.38	Low	None	None	35
12 (4)	Yes	No	1325	22.08	Medium	None	None	35
13 (4)	Yes	No	266	4.43	Low	None	None	35
14 (4)	Yes	No	772	12.87	Low	None	None	35

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
15 (4)	Yes	No	569	9.48	Low	None	None	15
16 (4)	Yes	No	351	5.85	Low	None	None	15
17	No	No	0	0	None	None	None	N/A
18	Yes	No	209	3.48	Low	None	None	15
19	Yes	No	36	0.60	Low	None	None	35
20	Yes	No	540	9.00	Low	None	None	35
21 (5)	Yes	No	175	2.92	Low	None	None	15
22 (5)	Yes	No	468	7.80	Low	None	None	35
23	Yes	No	223	3.72	Low	None	None	35
24 (6)	Yes	No	208	3.47	Low	None	None	15
25 (6)	Yes	No	112	1.87	Low	None	None	15
26 (6)	Yes	No	19	0.32	Low	None	None	15
27 (6)	Yes	No	210	3.50	Low	None	None	35
28	Yes	Yes	892	14.87	Low	None	None	35
29	No	Yes	32	0.53	Low	None	None	15

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
30	No	No	0	0	None	None	None	N/A
31	No	Yes	8	0.13	Low	None	None	35
32	No	No	0	0	None	None	None	N/A
33	No	No	0	0	None	None	None	N/A
34	No	No	0	0	None	None	None	N/A
35	No	Yes	2	0.03	Low	None	None	15
36	No	No	0	0	None	None	None	N/A
37	No	No	0	0	None	None	None	N/A
38 (7)	No	No	0	0	None	None	None	N/A
39 (7)	No	No	0	0	None	None	None	N/A
40 (7)	No	No	0	0	None	None	None	N/A
41 (8)	No	No	0	0	None	None	None	N/A
42 (8)	No	No	0	0	None	None	None	N/A
43 (8)	No	No	0	0	None	None	None	N/A
44 (8)	No	No	0	0	None	None	None	N/A

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
45 (8)	No	No	0	0	None	None	None	N/A
46 (8)	No	No	0	0	None	None	None	N/A
47 (8)	No	No	0	0	None	None	None	N/A
48 (8)	No	No	0	0	None	None	None	N/A
49 (8)	No	No	0	0	None	None	None	N/A
50 (8)	No	No	0	0	None	None	None	N/A
51 (8)	No	Yes	311	5.18	Low	None	None	15
52	No	No	0	0	None	None	None	N/A
53	No	No	0	0	None	None	None	N/A
54	No	No	0	0	None	None	None	N/A
55	No	No	0	0	None	None	None	N/A
56	No	No	0	0	None	None	None	N/A
57	No	No	0	0	None	None	None	N/A
58	No	No	0	0	None	None	None	N/A
59	No	Yes	40	0.67	Low	None	None	15

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
60	No	Yes	530	8.83	Low	None	None	15
61 (9)	No	Yes	362	6.03	Low	None	None	35
62 (9)	No	Yes	531	8.85	Low	None	None	35
63 (9)	No	Yes	658	10.97	Low	None	None	35
64 (9)	No	Yes	583	9.72	Low	None	None	35
65	No	Yes	318	5.30	Low	None	None	15
66	No	Yes	215	3.58	Low	None	None	15
67	No	Yes	2517	41.95	High	None	None	15
68	No	Yes	2338	38.97	High	None	None	35
69	No	Yes	2336	38.93	High	None	None	35
70	No	Yes	1546	25.77	Medium	None	None	35
71	No	Yes	1909	31.82	High	None	None	35
72	No	Yes	2125	35.42	High	None	None	35
73	No	Yes	2595	43.25	High	None	None	35
74	No	Yes	2687	44.78	High	Low	None	35

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
75	No	Yes	836	13.93	Low	None	None	35
76	Yes	No	95	1.58	Low	None	None	15
77	Yes	No	112	1.87	Low	None	None	15
78	Yes	No	101	1.68	Low	None	None	15
79	Yes	No	108	1.80	Low	Low	None	15
80	Yes	No	154	2.57	Low	None	None	15
81	Yes	No	49	0.82	Low	None	None	15
82	Yes	No	35	0.58	Low	None	None	15
83	No	No	0	0	None	None	None	N/A
84	No	No	0	0	None	None	None	N/A
85	Yes	No	17	0.28	Low	None	None	15
86	No	No	0	0	None	None	None	N/A
87	No	No	0	0	None	None	None	N/A
88	Yes	Yes	1534	25.57	Medium	Low	None	35
89	Yes	No	5	0.08	Low	None	None	15

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
90	No	No	0	0	None	None	None	N/A
91	No	No	0	0	None	None	None	N/A
92	No	No	0	0	None	None	None	N/A
93	No	No	0	0	None	None	None	N/A
94 (10)	No	No	0	0	None	None	None	N/A
95 (10)	No	No	0	0	None	None	None	N/A
96 (10)	No	No	0	0	None	None	None	N/A
97 (10)	No	No	0	0	None	None	None	N/A
98 (10)	No	No	0	0	None	None	None	N/A
99 (10)	No	No	0	0	None	None	None	N/A
100 (11)	No	No	0	0	None	None	None	N/A
101 (11)	No	No	0	0	None	None	None	N/A
102 (11)	No	No	0	0	None	None	None	N/A
103	No	No	0	0	None	None	None	N/A
104	No	No	0	0	None	None	None	N/A

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
105 (12)	No	No	0	0	None	None	None	N/A
106 (12)	No	No	0	0	None	None	None	N/A
107 (12)	No	No	0	0	None	None	None	N/A
108 (12)	No	No	0	0	None	None	None	N/A
109 (12)	No	No	0	0	None	None	None	N/A
110 (12)	No	No	0	0	None	None	None	N/A
111 (12)	No	No	0	0	None	None	None	N/A
112 (12)	No	No	0	0	None	None	None	N/A
113 (12)	No	No	0	0	None	None	None	N/A
114 (12)	No	No	0	0	None	None	None	N/A
115 (12)	No	No	0	0	None	None	None	N/A
116	No	No	0	0	None	None	None	N/A
117	No	No	0	0	None	None	None	N/A
118	No	No	0	0	None	None	None	N/A
119	No	No	0	0	None	None	None	N/A

Receptor	Glint Possible from Site		Potential Glare Impact (per year)		Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (Degrees)
	AM	PM	Minutes	Hours				
120	No	No	0	0	None	None	None	N/A
121	No	No	0	0	None	None	None	N/A
122	No	No	0	0	None	None	None	N/A
123	No	No	0	0	None	None	None	N/A
124	No	No	0	0	None	None	None	N/A

6.6. As can be seen in **Table 6 - 1**, there is a **High** impact at seven receptors, **Medium** impact at three receptors, including one residential area, **Low** impact at 42 receptors, including five residential areas and a **None** impact at 71 receptors, including six residential areas. **Annex B - E** shows detailed analysis of when the glare impacts are possible, whilst also showing which parts of the solar farm the solar glare is reflected from.

6.7. **Annex N** shows Google Earth images that give an insight into how each receptor will be impacted by the glint and glare from the Solar PV Site. There is a mixture of images used, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible. The area of the solar farm from where reflections may be possible has been drawn as a yellow polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where reflections are theoretically possible will be visible from the receptor point. Also, where appropriate images that have been taken from within the Solar PV Site have been used to show up to date imagery.

Receptor 5 (Group A Receptor 5)

6.8. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from a central section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.9. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is an image with a view towards the receptor from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 8 – 10 (Group A Receptors 8 - 10)

6.10. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from a central section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.11. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptors. The second image is an image with a view towards the receptors from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 11, 12 and 14 – 16 (Group A Receptors 11, 12 and 14 - 16)

6.12. The 'Glare Reflections on PV Footprint' chart in **Annex B and D** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.13. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptors. The second image is an image with a view towards the receptors from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 13 (Group A Receptor 13)

6.14. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.15. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is a photo taken from a southwest area of the North Array (see **Figure 5: Annex A**) with a view towards the receptor. This image confirms that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduce to **None**.

Receptors 18 and 19 (Group A Receptors 18 and 19)

6.16. The 'Glare Reflections on PV Footprint' chart in **Annex B and D** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.17. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptors. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 20 (Group A Receptor 20)

6.18. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.19. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 21 – 27 (Group A Receptors 21 - 27)

6.20. The 'Glare Reflections on PV Footprint' chart in **Annex B and D** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.21. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptors. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 28 (Group A Receptor 28)

6.22. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from a southwest and southeast section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.23. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation to the west of the receptor and intervening buildings to the east of the receptor. The second image is a street view image with a view towards the receptor. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site to the west of the receptor and the intervening buildings are sufficient to screen all views of the Solar PV Site to the east of the receptor where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 29 (Group A Receptor 29)

6.24. The 'Glare Reflections on PV Footprint' chart in **Annex B** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.25. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is a street view image with a view towards the receptor. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 31 and 45 (Group A Receptors 31 and 35)

6.26. The 'Glare Reflections on PV Footprint' chart in **Annex B** shows that reflections from a northern section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.27. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows dense vegetation and intervening buildings between the Solar PV Site. The second image is a photo taken from a northeast area of the North Array with a view east towards the receptor. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 51 (Group A Receptor 51)

6.28. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from the northern half of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.29. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is an image with a view towards the receptor from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**

Receptors 59 and 60 (Group A Receptors 59 and 60)

6.30. The 'Glare Reflections on PV Footprint' chart in **Annex B** shows that reflections from a northern section of the Central Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.31. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 61 – 64 (Group A Receptors 61 - 64)

6.32. The 'Glare Reflections on PV Footprint' chart in **Annex D** shows that reflections from a northern section of the Central Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.33. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 65 and 66 (Group B Receptors 1 and 2)

6.34. The 'Glare Reflections on PV Footprint' chart in **Annex C and E** shows that reflections from a central section of the Central Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.35. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows dense vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view of the vegetation to the west of the receptors. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 67 – 69 (Group B Receptors 3 - 5)

6.36. The 'Glare Reflections on PV Footprint' chart in **Annex C and E** shows that reflections from a central section of the Central Array, a western section of the North Array and a small southern section of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.37. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second and third images were taken (red and yellow dots respectively). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view of the vegetation to the west of the receptors and the third image is a street view image with a view towards the East Array. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 70 – 72 (Group B Receptors 6 - 8)

6.38. The ‘Glare Reflections on PV Footprint’ chart in **Annex E** shows that reflections from a southern section of the Central Array and a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.39. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 73 (Group B Receptor 9)

6.40. The ‘Glare Reflections on PV Footprint’ chart in **Annex E** shows that reflections from a southern section of the Central Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.41. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is an image with a view towards the receptor from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**

Receptor 74 (Group B Receptor 10)

6.42. The ‘Glare Reflections on PV Footprint’ chart in **Annex E** shows that reflections from a small southwest section of the Central Array and a northern section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.43. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second and third images were taken (red and blue dots respectively). This image shows vegetation between the Solar PV Site and the receptor. The second image is a photo taken from a northern area of the South Array (see **Figure 6: Annex A**) in the Solar PV Site with a view towards the receptor. These images confirm that the vegetation is sufficient to screen all views of the South Array in the Solar PV Site where glint and glare is possible. The third image is a photo taken from a southwest area of the Central Array in the Solar PV Site with a view towards the receptor. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen ground floor views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **Low**.

Receptor 75 (Group B Receptor 11)

6.44. The ‘Glare Reflections on PV Footprint’ chart in **Annex E** shows that reflections from a central section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.45. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is a photo taken from a central area of the South Array (see **Figure 6: Annex A**) with a view towards the receptor. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 76 – 78 (Group B Receptors 12 - 14)

6.46. The ‘Glare Reflections on PV Footprint’ chart in **Annex C** shows that reflections from a southwest section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptors.

6.47. The first image in **Annex N** is an aerial view which shows the location of the receptors (yellow pins) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 79 (Group B Receptor 15)

6.48. The ‘Glare Reflections on PV Footprint’ chart in **Annex C** shows that reflections from a southwest section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.49. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is insufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact remains **Low**.

Receptor 80 (Group B Receptor 16)

6.50. The 'Glare Reflections on PV Footprint' chart in **Annex C** shows that reflections from a southwest section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.51. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation and intervening buildings between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 81 and 82 (Group B Receptors 17 and 18)

6.52. The 'Glare Reflections on PV Footprint' chart in **Annex C** shows that reflections from a southwest section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.53. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptor 85 (Group B Receptor 21)

6.54. The 'Glare Reflections on PV Footprint' chart in **Annex C** shows that reflections from a southeast section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.55. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Receptors 88 (Group B Receptor 24)

6.56. The 'Glare Reflections on PV Footprint' chart in **Annex E** shows that reflections from a southeast section and a small southwest section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.57. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second and third images were taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the southwest section of the South Array in the Solar PV Site. This image confirms that the vegetation is insufficient to screen all views of the Solar PV Site where glint and glare is possible. The third image is a street view image with a view towards the southeast section of the South Array in the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the southwest section of the South Array in the Solar PV Site. Therefore, the impact reduces to **Low**.

Receptors 89 (Group B Receptor 25)

6.58. The 'Glare Reflections on PV Footprint' chart in **Annex C** shows that reflections from a small southeast section of the South Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.59. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, and the location from which the second image was taken (red dot). This image shows vegetation between the Solar PV Site and the receptor. The second image is a street view image with a view towards the Solar PV Site. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Residential Area 1

6.60. This encompasses a number of residential receptors including those at Receptors 1 and 2 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these two receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 2

6.61. This encompasses a number of residential receptors including those at Receptor 6 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments this receptor, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 3

6.62. This encompasses a number of residential receptors including those at Receptors 8 - 10 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these three receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 4

6.63. This encompasses a number of residential receptors including those at Receptors 11 - 16 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these six receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 5

6.64. This encompasses a number of residential receptors including those at Receptors 21 and 22 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these two receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 6

6.65. This encompasses a number of residential receptors including those at Receptors 24 - 27 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these four receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 7

6.66. This encompasses a number of residential receptors including those at Receptors 38 - 40 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these three receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 8

6.67. This encompasses a number of residential receptors including those at Receptors 41 - 51 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these 11 receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 9

6.68. This encompasses a number of residential receptors including those at Receptors 61 - 64 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these five receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 10

6.69. This encompasses a number of residential receptors including those at Receptors 94 - 99 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these six receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 11

6.70. This encompasses a number of residential receptors including those at Receptors 100 - 102 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these three receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Residential Area 12

6.71. This encompasses a number of residential receptors including those at Receptors 105 - 115 (assessed previously) (See **Figure 1: Annex A**). Each receptor assessed represents multiple receptors as they are in close proximity of each other, so the worst-case scenario is assumed for the impact of glint and glare. All receptors were considered within the visibility analysis, and it was concluded their impacts were similar. As per the assessments of these 11 receptors, the impacts on the other receptors within this area are assessed as being **None (worst case scenario)**.

Road Receptors

6.72. **Table 6** – 2 shows a summary of the modelling results for each of the Road Receptor Points whilst the detailed results and ocular impact charts can be viewed in **Annex F and G**.

6.73. **Annex G** shows the analysis for a tilt angle of 15 degrees, whilst **Annex F** shows the analysis for a tilt angle of 35 degrees.

6.74. The 20 receptors (69 - 88) within the no-reflection zones outlined previously have been excluded from the detailed modelling as they will never receive glint and glare impacts from the Scheme.

6.75. **Table 6 -2** shows the **worst-case impact at each receptor, based on a theoretical modelled impact without consideration of existing or proposed local vegetation or other obstacles (i.e. a bare-earth scenario) and assuming no cloud at any point in the year.**

Table 6 - 2: Potential for Glint and Glare Impact on Road Based Receptors

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
1	0	0	0	None	None	None	N/A
2	0	0	0	None	None	None	N/A
3	0	0	0	None	None	None	N/A
4	2319	191	0	High	None	None	15
5	1929	65	0	High	None	None	15
6	1137	1	0	High	None	None	15
7	685	22	0	High	None	None	15
8	176	0	0	Low	None	None	15
9	0	0	0	None	None	None	N/A
10	440	0	0	Low	None	None	15
11	1346	0	0	Low	None	None	15
12	1234	0	0	Low	None	None	15
13	1641	0	0	Low	None	None	15

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
14	1195	0	0	Low	None	None	35
15	853	0	0	Low	None	None	35
16	919	0	0	Low	None	None	15
17	772	0	0	Low	None	None	15
18	781	0	0	Low	None	None	15
19	834	0	0	Low	None	None	15
20	1092	59	0	High	None	None	15
21	1241	81	0	High	None	None	15
22	1429	630	0	High	None	None	35
23	27	0	0	Low	None	None	35
24	1360	802	0	High	None	None	35
25	35	0	0	Low	None	None	35
26	539	0	0	Low	None	None	15

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
27	1654	442	0	High	None	None	35
28	2667	984	0	High	None	None	15
29	1628	2688	0	High	None	None	35
30	1022	1701	0	High	None	None	35
31	731	2384	0	High	None	None	35
32	3949	4839	0	High	None	None	35
33	4724	1189	0	High	None	None	15
34	5536	465	0	High	None	None	35
35	5611	195	0	High	None	None	35
36	3505	0	0	Low	None	None	35
37	1154	0	0	Low	None	None	35
38	0	0	0	None	None	None	N/A
39	3361	158	0	High	None	None	35

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
40	3602	117	0	High	None	None	35
41	3889	183	0	High	None	None	35
42	3313	98	0	High	None	None	35
43	3380	88	0	High	None	None	15
44	2125	285	0	High	None	None	35
45	2622	300	0	High	None	None	35
46	2888	189	0	High	None	None	35
47	2651	964	0	High	None	None	35
48	2677	1206	0	High	None	None	35
49	3100	425	0	High	None	None	15
50	3498	117	0	High	None	None	15
51	5209	344	0	High	None	None	35
52	3426	72	0	High	None	None	15

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
53	5459	475	0	High	None	None	35
54	5390	658	0	High	None	None	35
55	4091	1473	0	High	None	None	35
56	2788	2188	0	High	None	None	35
57	2811	1704	0	High	None	None	35
58	2611	1438	0	High	None	None	35
59	2693	931	0	High	None	None	15
60	2765	153	0	High	None	None	15
61	2061	64	0	High	None	None	15
62	0	0	0	None	None	None	N/A
63	5468	354	0	High	None	None	35
64	1978	0	0	Low	None	None	35
65	0	0	0	None	None	None	N/A

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
66	0	0	0	None	None	None	N/A
67	414	22	0	High	None	None	35
68	175	0	0	Low	None	None	35

6.76. As can be seen in **Table 6 – 2**, there are 42 receptors that have potential glare impacts with the "potential for after-image" (Yellow Glare), which is a **High** impact, and 18 receptors with the "low potential for after-image" (Green Glare), which is a **Low** impact. **Annex F and G** show detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the Solar PV Site the solar glint is reflected from.

6.77. **Annex N** shows Google Earth images taken towards the Solar PV Site location at each of the receptor points where an impact is anticipated. The first image is a ground level terrain view and is based on the height data of the surrounding land showing no intervening vegetation or buildings. The Solar PV Site has been drawn as a white polygon and can be seen on the images when the Solar PV Site is theoretically visible. The area of the Solar PV Site from where reflections may be possible has been drawn as a yellow or green polygon. The second image is a street view image pointing in the same direction as the terrain image. This gives a good indication as to whether the area of the Solar PV Site where reflections are theoretically possible will be visible from the receptor point. For some receptors, a field of view (FOV) has been drawn between two red lines, where the glare is situated outside this FOV, and therefore the impact is reduced to **None**.

6.78. As can be seen in **Annex N**, views of the Solar PV Site from those with a potential glare impact, by a mixture of intervening vegetation, topography and buildings or are outside the field of view of the driver. Therefore, impacts upon these receptors reduce to **None**.

Rail Receptors

6.79. **Table 6 – 3** shows a summary of the modelling results for each of the Rail Receptor Points whilst the detailed results and ocular impact charts can be viewed in **Annex H and I**.

6.80. **Annex H** shows the analysis for a tilt angle of 15 degrees, whilst **Annex I** shows the analysis for a tilt angle of 35 degrees.

6.81. The one receptor (22) within the no-reflection zones outlined previously has been excluded from the detailed modelling as it will never receive glint and glare impacts from the Scheme.

6.82. **Table 6 - 3** shows the **worst-case impact at each receptor, based on a theoretical modelled impact without consideration of existing or proposed local vegetation or other obstacles (i.e. a bare-earth scenario) and assuming no cloud at any point in the year.**

Table 6 - 3: Potential for Glint and Glare Impact on Rail Based Receptors

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
1	0	0	0	None	None	None	N/A
2	0	0	0	None	None	None	N/A
3	0	0	0	None	None	None	N/A
4	0	0	0	None	None	None	N/A
5	0	0	0	None	None	None	N/A
6	621	90	0	High	None	None	35
7	1301	519	0	High	None	None	35
8	1309	362	0	High	None	None	35
9	968	0	0	Low	None	None	15
10	1635	0	0	Low	None	None	15
11	1474	0	0	Low	None	None	35
12	3079	138	0	High	None	None	15
13	3952	83	0	High	None	None	35
14	4471	383	0	High	None	None	35

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Impact with Actual Visibility	Impact with Actual Visibility and Mitigation	Worst Case Tilt Angle (degrees)
15	3628	284	0	High	None	None	35
16	3254	148	0	High	None	None	35
17	2861	225	0	High	None	None	35
18	2372	121	0	High	None	None	15
19	1754	29	0	High	None	None	15
20	0	0	0	None	None	None	N/A
21	0	0	0	None	None	None	N/A

6.83. As can be seen in **Table 6 - 3**, there are 11 receptor points have potential glare impacts with the "potential for after-image" (Yellow Glare), which is a **High** impact, and three receptors with the "low potential for after-image" (Green Glare), which is a **Low** impact. **Annex H and I** show detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the Solar PV Site the solar glint is reflected from.

6.84. **Annex N** shows Google Earth images that give an insight into how each receptor will be impacted by the glint and glare from the Solar PV Site. There is a mixture of images used, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible, as well as the field of view of a train driver drawn between two red lines. The area of the solar farm from where reflections may be possible has been drawn as a yellow or green polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where reflections are theoretically possible will be visible from the receptor point. Also, where appropriate images that have been taken from within the Application Site have been used to show up to date imagery.

Receptor 6

6.85. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a northern section of the North Array (see **Figure 56 Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.86. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines) and the location from which the second image was taken (red dot). The second image is an image with a view towards the receptors from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible and the areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 7

6.87. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from the northern half of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.88. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines) and the location from which the second image was taken (red dot). The second image is an image with a view towards the receptors from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible and the areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 8

6.89. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from the northern half of the North Array, a northern section of the Central Array and a small northern section of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.90. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines) and the location from which the second image was taken (red dot). The second image is an image with a view towards the receptors from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible and the areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 9

6.91. The 'Glare Reflections on PV Footprint' chart in **Annex H** shows that reflections from a central section of the North Array, a northern section of the Central Array and a northern section of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.92. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines) and the location from which the second image was taken (red dot). The second image is an image with a view towards the receptors from within the Solar PV Site. This image confirms that the vegetation within the Solar PV Site boundary is sufficient to screen all views of the Solar PV Site where glint and glare is possible and the areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 10

6.93. The 'Glare Reflections on PV Footprint' chart in **Annex H** shows that reflections from the northern half of the Central Array and most, except a southern section, of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.94. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 11

6.95. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a southwest section of the North Array, the northern half of the Central Array and all the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.96. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 12

6.97. The 'Glare Reflections on PV Footprint' chart in **Annex H** shows that reflections from a southwest section of the North Array, a small northern section of the South Array and all the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.98. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation and intervening buildings are sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 13

6.99. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a southwest section and a southeast section of the North Array, a northern section of the South Array and all the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.100. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 14

6.101. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a southeast section of the North Array, the northern half of the South Array and all the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.102. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 15

6.103. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a northern section of the South Array and all the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.104. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 16

6.105. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a central section of the South Array and all the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.106. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site t, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the Solar PV Site. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 17

6.107. The 'Glare Reflections on PV Footprint' chart in **Annex I** shows that reflections from a central section of the South Array and most, except a northern section, of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.108. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the receptor. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 18

6.109. The 'Glare Reflections on PV Footprint' chart in **Annex H** shows that reflections from a southwest section of the South Array and the southern half of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.110. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the receptor. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Receptor 19

6.111. The 'Glare Reflections on PV Footprint' chart in **Annex H** shows that reflections from a southwest section of the South Array and a southern section of the East Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.112. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site, the field of view (FOV) of a train driver (red lines), and the location from which the second image was taken (red dot). The second image is a street view image with a view towards the receptor. These images confirm that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible and areas of the Solar PV Site where glint and glare is possible is outside the driver's field of view. Therefore, the impact reduces to **None**.

Bridleway Receptors

6.113. The receptor (5) within the no-reflection zones outlined previously has been excluded from the detailed modelling as they will never receive glint and glare impacts from the Scheme.

6.114. Table 6 - 4 shows the worst-case impact at each receptor, based on a theoretical modelled impact without consideration of existing or proposed local vegetation or other obstacles (i.e. a bare-earth scenario) and assuming no cloud at any point in the year.

Table 6 - 4: Summary of Bridleway Glare Results

Receptor	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Magnitude of Impact	Magnitude of Impact	Impact with Actual Visibility	Worst Case Tilt Angle (degrees)
1	70	0	0	Low	None	None	35
2	0	0	0	None	None	None	N/A
3	0	0	0	None	None	None	N/A
4	0	0	0	None	None	None	N/A

6.115. As can be seen in **Table 6 - 4**, there is one receptor points which has potential glare impacts with the "low potential for after-image" (Green Glare), which is a **Low** impact. **Annex J and K** show detailed analysis of when the glint and glare impacts are possible, whilst also showing from which parts of the Solar PV Site the solar glint is reflected from.

6.116. **Annex N** shows Google Earth images that give an insight into how each receptor will be impacted by the glint and glare from the Solar PV Site. There is a mixture of images used, which include aerial, ground level and street level. The aerial images show the location of the receptor with the solar farm drawn as a white polygon and can be seen on the images when the solar farm is theoretically visible, as well as the field of view of a train driver drawn between two red lines. The area of the solar farm from where reflections may be possible has been drawn as a yellow or green polygon. The ground level terrain is based on the height data of the surrounding land showing no intervening vegetation or buildings. The white and yellow polygons can be seen in this view also. The street view gives a good indication as to whether the area of the solar farm where reflections are theoretically possible will be visible from the receptor point. Also, where appropriate images that have been taken from within the Application Site have been used to show up to date imagery.

Receptor 1

6.117. The 'Glare Reflections on PV Footprint' chart in **Annex K** shows that reflections from a northern section of the North Array (see **Figure 6: Annex A**) of the Solar PV Site can potentially impact on the receptor.

6.118. The first image in **Annex N** is an aerial view which shows the location of the receptor (yellow pin) in relation to the Solar PV Site and the location from which the second image was taken (red dot). The second image is a photo taken from a northern area of the North Array with a view east towards the receptor. This image confirms that the vegetation is sufficient to screen all views of the Solar PV Site where glint and glare is possible. Therefore, the impact reduces to **None**.

Aviation Receptors

6.119. **Table 6 - 5** shows a summary of the modelling results for each of the runway approach paths and the ATCT's, whilst the detailed results and ocular impact charts can be viewed in **Annex L and M.**

6.120. **Annex L** shows the analysis for a tilt angle of 15 degrees, whilst **Annex M** shows the analysis for a tilt angle of 35 degrees.

Table 6 - 5: Summary of Aviation Glare Results

Component	Green Glare (mins)	Yellow Glare (mins)	Red Glare (mins)	Worst Case Tilt Angle (degrees)
Doncaster Sheffield Airport				
Runway 02	0	0	0	N/A
Runway 20	0	0	0	N/A
ATCT	0	0	0	N/A
Sherburn-in-Elmet Airport				
Runway 01	0	0	0	N/A
Runway 19	0	0	0	N/A
Runway 06	0	0	0	N/A
Runway 24	0	0	0	N/A
Runway 10	0	0	0	N/A
Runway 28	0	0	0	N/A
Runway 10G	0	0	0	N/A
Runway 28G	0	0	0	N/A
Church Farm				
Runway 08	4294	553	0	15
Runway 26	0	0	0	N/A
Bridge Cottage Airfield				
Runway 01	0	0	0	N/A
Runway 19	0	0	0	N/A
Runway 18	0	0	0	N/A
Runway 36	0	0	0	N/A

6.121. As can be seen in **Table 6 - 5**, there are no Glare impacts for the receptors at Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Bridge Cottage Airfield or the Runway 26 approach path at Church Farm. There is yellow glare and green glare potential for the Runway 08 approach path at Church Farm. Green glare is an **acceptable impact** upon runways according to FAA guidance.

6.122. To determine the actual impact of glare for pilots upon approach at Runway 08 at Church Farm, a visibility assessment of where the sun will be located at the time of impact in relation to each array has been undertaken, with these images visible in **Annex N**. The approach path to Runway 08 has been drawn as a red line.

6.123. As can be seen in **Annex N**, potential yellow glare impacts occur from the South Array within the Solar PV Site when the sun is low in the sky and directly behind the areas of the Solar PV Site that have potential to cause glare impacts.

6.124. As outlined in **Paragraph 4.16** the sun's reflections will be far greater than those reflections from the solar array. Pilots on approach are often landing into the sun at sunset or sunrise. The sun's impact can be mitigated by wearing sunglasses, using darkened cockpit sun visors, overflying and inspecting the runway, landing in the opposite direction if wind conditions allow and planning their flight to land outside the times when sun glare if possible. In addition, given the glare impacts occur at or just after sunrise and the type of small aircraft using this airfield, it is unlikely that these aircraft will be setting off early enough (in the dark) to arrive at the times at which glare is predicted to occur for approaches to Runway 08 approach path at Church Farm. Also, given the tree line at the approach end of Runway 08, pilots will most likely use the Runway 26 approach. The most recent Google Earth aerial imagery from 26 May 2023 suggests that the airfield is currently disused.

6.125. It is important to note that these predicted results are the absolute worst-case scenario as the model does not account for variations such as cloud cover. Once cloud cover is considered, the total duration of predicted glare will decrease significantly and as such, will decrease impact further. Additionally, as outlined within the updated policy from the FAA and the CAA's CAP738 document, glare impacts have not been reported to cause pilots more impact than other existing infrastructure, such as; car parks, glass buildings and water bodies. Thus, the FAA have reduced the assessment criteria to only assess glare impacts ATCTs.

6.126. Given the following is stated within the NPS EN-3 (November, 2023) "*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*", and there are a significant number of solar farms co-located with airport land across the world with there yet to be a major issue due to glare, overall impacts on Aviation receptors is **Low** and **Not Significant**.

7. GROUND BASED RECEPTOR MITIGATION

7.1. **No Mitigation** is required due to the impacts found for the residential receptors being **Low** and **None**, and the impact found for road, rail and bridleway receptors being only **None**. Mitigation measures have been included to screen the **Low impact** views from Residential receptors 74, 79 and 88. This includes:

- Native hedgerows to be planted/infilled and maintained to a height of at least 3.5 m along the southern boundary of the Central Array and along a southwest section and a southern section of the South Array (see **Figure 5: Annex A**) in the Solar PV Site. This will screen views from Residential Receptors 74, 79 and 88. Therefore, the impacts reduce to **None**.

7.2. **Table 7 - 1, Table 7 - 2, Table 7 - 3 and Table 7 - 4** show the impacts at each stage of the glint and glare analysis, with the final residual impacts considered once the mitigation is in place.

Table 7 - 1: Residual Glint and Glare Impacts on Residential Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
1 (1)	None	None	**None**
2 (1)	None	None	**None**
3	None	None	**None**
4	None	None	**None**
5	Low	None	**None**
6 (2)	None	None	**None**
7	None	None	**None**
8 (3)	Low	None	**None**
9 (3)	Low	None	**None**
10 (3)	Low	None	**None**
11 (4)	Low	None	**None**
12 (4)	Medium	None	**None**

NEO ENVIRONMENTAL

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
13 (4)	Low	None	None
14 (4)	Low	None	None
15 (4)	Low	None	None
16 (4)	Low	None	None
17	None	None	None
18	Low	None	None
19	Low	None	None
20	Low	None	None
21 (5)	Low	None	None
22 (5)	Low	None	None
23	Low	None	None
24 (6)	Low	None	None
25 (6)	Low	None	None
26 (6)	Low	None	None
27 (6)	Low	None	None
28	Low	None	None
29	Low	None	None
30	None	None	None
31	Low	None	None
32	None	None	None
33	None	None	None
34	None	None	None
35	Low	None	None
36	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
37	None	None	None
38 (7)	None	None	None
39 (7)	None	None	None
40 (7)	None	None	None
41 (8)	None	None	None
42 (8)	None	None	None
43 (8)	None	None	None
44 (8)	None	None	None
45 (8)	None	None	None
46 (8)	None	None	None
47 (8)	None	None	None
48 (8)	None	None	None
49 (8)	None	None	None
50 (8)	None	None	None
51 (8)	Low	None	None
52	None	None	None
53	None	None	None
54	None	None	None
55	None	None	None
56	None	None	None
57	None	None	None
58	None	None	None
59	Low	None	None
60	Low	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
61 (9)	Low	None	None
62 (9)	Low	None	None
63 (9)	Low	None	None
64 (9)	Low	None	None
65	Low	None	None
66	Low	None	None
67	High	None	None
68	High	None	None
69	High	None	None
70	Medium	None	None
71	High	None	None
72	High	None	None
73	High	None	None
74	High	Low	None
75	Low	None	None
76	Low	None	None
77	Low	None	None
78	Low	None	None
79	Low	Low	None
80	Low	None	None
81	Low	None	None
82	Low	None	None
83	None	None	None
84	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
85	Low	None	None
86	None	None	None
87	None	None	None
88	Medium	Low	None
89	Low	None	None
90	None	None	None
91	None	None	None
92	None	None	None
93	None	None	None
94 (10)	None	None	None
95 (10)	None	None	None
96 (10)	None	None	None
97 (10)	None	None	None
98 (10)	None	None	None
99 (10)	None	None	None
100 (11)	None	None	None
101 (11)	None	None	None
102 (11)	None	None	None
103	None	None	None
104	None	None	None
105 (12)	None	None	None
106 (12)	None	None	None
107 (12)	None	None	None
108 (12)	None	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
109 (12)	None	None	None
110 (12)	None	None	None
111 (12)	None	None	None
112 (12)	None	None	None
113 (12)	None	None	None
114 (12)	None	None	None
115 (12)	None	None	None
116	None	None	None
117	None	None	None
118	None	None	None
119	None	None	None
120	None	None	None
121	None	None	None
122	None	None	None
123	None	None	None
124	None	None	None

Table 7 - 2: Residual Glint and Glare Impacts on Road Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
1	None	None	None
2	None	None	None
3	None	None	None
4	High	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
5	High	None	None
6	High	None	None
7	High	None	None
8	Low	None	None
9	None	None	None
10	Low	None	None
11	Low	None	None
12	Low	None	None
13	Low	None	None
14	Low	None	None
15	Low	None	None
16	Low	None	None
17	Low	None	None
18	Low	None	None
19	Low	None	None
20	High	None	None
21	High	None	None
22	High	None	None
23	Low	None	None
24	High	None	None
25	Low	None	None
26	Low	None	None
27	High	None	None
28	High	None	None
29	High	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
30	High	None	None
31	High	None	None
32	High	None	None
33	High	None	None
34	High	None	None
35	High	None	None
36	Low	None	None
37	Low	None	None
38	None	None	None
39	High	None	None
40	High	None	None
41	High	None	None
42	High	None	None
43	High	None	None
44	High	None	None
45	High	None	None
46	High	None	None
47	High	None	None
48	High	None	None
49	High	None	None
50	High	None	None
51	High	None	None
52	High	None	None
53	High	None	None
54	High	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
55	High	None	None
56	High	None	None
57	High	None	None
58	High	None	None
59	High	None	None
60	High	None	None
61	High	None	None
62	None	None	None
63	High	None	None
64	Low	None	None
65	None	None	None
66	None	None	None
67	High	None	None
68	Low	None	None

Table 7 - 3: Residual Glint and Glare Impacts on Rail Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
1	None	None	None
2	None	None	None
3	None	None	None
4	None	None	None
5	None	None	None
6	High	None	None

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
7	High	None	None
8	High	None	None
9	Low	None	None
10	Low	None	None
11	Low	None	None
12	High	None	None
13	High	None	None
14	High	None	None
15	High	None	None
16	High	None	None
17	High	None	None
18	High	None	None
19	High	None	None
20	None	None	None
21	None	None	None

Table 7 - 4: Residual Glint and Glare Impacts on Bridleway Receptors

Receptor	Magnitude of Impact		
	After Geometric Analysis (Bald Earth)	After Visibility Analysis	Residual Impacts
1	Low	None	None
2	None	None	None
3	None	None	None
4	None	None	None

7.3. **Table 7 - 5, Table 7 - 6, Table 7 - 7 and Table 7 - 8** show the overall impacts for all residential, road and rail receptors.

Table 7 - 5: Solar Reflection: Residential Receptors

Magnitude	Theoretical Visibility (Bald Earth)	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	7	0	0
Medium	3	0	0
Low	42	3	0
None	72	121	124

- **High** – Solar reflections impacts of over 30 hours per year or over 30 minutes per day
- **Medium** - Solar reflections impacts between 20 and 30 hours per year or between 20 minutes and 30 minutes per day
- **Low** - Solar reflections impacts between 0 and 20 hours per year or between 0 minutes and 20 minutes per day
- **None** - Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening

Table 7 - 6: Solar Reflection: Road Receptors

Magnitude	Theoretical Visibility (Bald Earth)	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	42	0	0
Low	18	0	0
None	8	68	68

- **High** - Solar reflections impacts with yellow glare (potential for after-image).
- **Low** - Solar reflections impacts with only green glare (low potential for after-image)
- **None** - Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening or being outside the drivers field of view

Table 7 - 7: Solar Reflection: Rail Receptors

Magnitude	Theoretical Visibility (Bald Earth)	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	11	0	0

NEO ENVIRONMENTAL

Low	3	0	0
None	7	21	21

- **High -** Solar reflections impacts with yellow glare (potential for after-image).
- **Low -** Solar reflections impacts with only green glare (low potential for after-image)
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening or being outside the drivers field of view

Table 7 - 8: Solar Reflection: Bridleway Receptors

Magnitude	Theoretical Visibility (Bald Earth)	Actual Visibility (No Mitigation)	Actual Visibility with Mitigation
High	0	0	0
Low	1	0	0
None	3	4	4

- **High -** Solar reflections impacts with yellow glare (potential for after-image).
- **Low -** Solar reflections impacts with only green glare (low potential for after-image)
- **None -** Effects not geometrically possible or no visibility of reflective surfaces likely due to high levels of intervening screening or being outside the drivers field of view

8. SUMMARY

8.1. This assessment considers the potential impacts on ground-based receptors such as roads, rail and residential dwellings as well as aviation assets. A 1 km Study Area around the Solar PV Site is considered adequate for the assessment of ground-based (residential, road, rail and bridleway) receptors, whilst a 30 km Study Area is chosen for aviation receptors. Within the ground-based Study Areas of the Solar PV Site, there are 141 residential receptors, including 13 residential areas, 88 road receptors, 22 rail receptors and five bridleway receptors that were considered. As per the methodology section, where there are several residential receptors within close proximity, a representative dwelling or dwellings is/are chosen for full assessment as the impacts will not vary to any significant degree. Where small groups of receptors have been evident, the receptors on either end of the group have been assessed in detail. 17 residential receptors, including one residential area, 20 road receptors, one rail receptor and one bridleway receptor were dismissed as they are located within the no reflection zones (see Paragraph 5.1 – 5.3). 17 aerodromes are located within the 30 km Study Area; four of which, Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield required detailed assessments as the Solar PV Site is located within their respective safeguarding buffer zones. The other 13 aerodromes did not require a detailed assessment due to their size and/or orientation in relation to the Solar PV Site.

8.2. Geometric analysis was conducted at 124 individual residential receptors, including 12 residential areas, 68 road receptors, 21 rail receptors and four bridleway receptors. Also, geometric analysis was conducted at 16 runway approach paths and one Air Traffic Control Towers (ATCT) at Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield.

8.3. The assessment concludes that:

- Solar reflections are possible at 52 of the 124 residential receptors assessed within the 1 km Study Area. Once the actual visibility and mitigation measures were considered, impacts reduce to **None** at all receptors. Therefore, overall impacts on residential receptors are considered to be **None**.
- Solar reflections are possible at 59 of the 68 road receptors assessed within the 1 km Study Area. Once reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all road receptors. Therefore, overall impacts are considered to be **None**.
- Solar reflections are possible at 14 of the 21 rail receptors assessed within the 1 km Study Area. Once reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all rail receptors. Therefore, overall impacts on rail receptors are considered to be **None**.

- Solar reflections are possible at one of the four bridleway receptors assessed within the 1 km Study Area. Once reviewing the actual visibility of the receptors, glint and glare impacts reduce to **None** for all bridleway receptors. Therefore, overall impacts on bridleway receptors are considered to be **None**.

- 16 runway approach paths and one ATCT were assessed in detailed at Doncaster Sheffield Airport, Sherburn-in-Elmet Airport, Church Farm and Bridge Cottage Airfield. Green glare and yellow glare impacts were predicted for Runway 08 at Church Farm Airfield. Green glare is an **acceptable impact** upon runways according to FAA guidance. Upon inspection of the type of aircraft using Church Farm, time of impact, position of the sun and use of existing pilot mitigation strategies when landing in the direction of the sun, as well as the likely landing direction for the runway and Google Earth aerial imagery indicating the airfield is not in use, all impacts at Church Farm can be deemed **acceptable**. Overall impacts on aviation assets are **acceptable** and **Not Significant**.

8.4. **No Mitigation** is required due to the **Low** and **None** impacts at all residential receptors and the **None** impacts found for all road and rail receptors. Mitigation measures were included to screen the **Low impact** views from Residential Receptors 74, 79 and 88. This includes native hedgerows to be planted/infilled and maintained to a height of at least 3.5 m along the southern boundary of the Central Array and along a southwest section and a southern section of the South Array.

8.5. The effects of glint and glare and their impact on local receptors has been analysed in detail and there is predicted to be **Low** impacts at one runway approach path, whilst the remaining aviation receptors are predicted to have **No Impacts**. Impacts upon ground-based receptors are predicted to be **None.** Therefore, overall impacts are **Negligible**.

9. APPENDICES

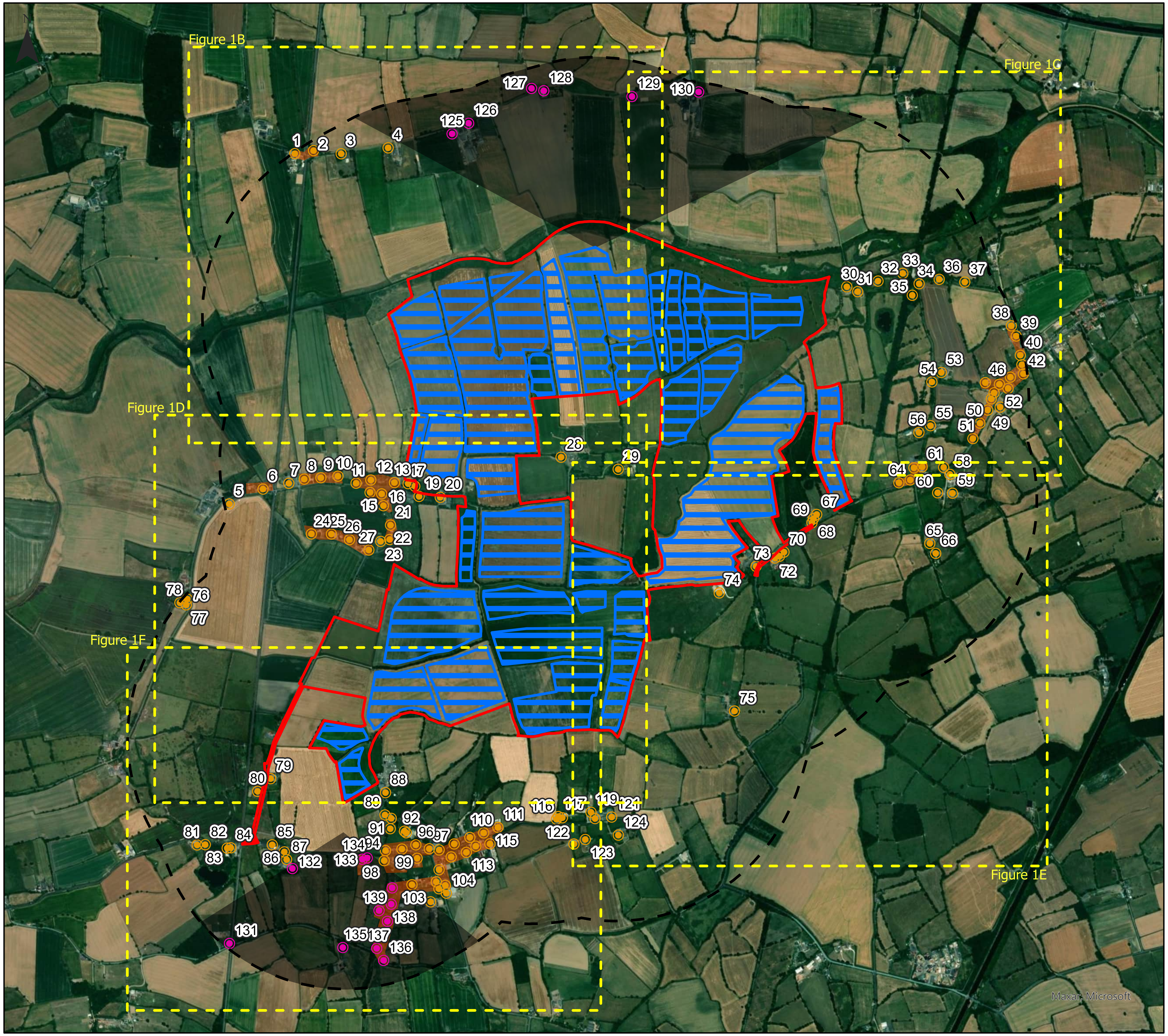
ANNEX A: FIGURES

- Figure 1A: Residential Receptor Map Overall

9. APPENDICES

ANNEX A: FIGURES

- Figure 1A: Residential Receptor Map Overall



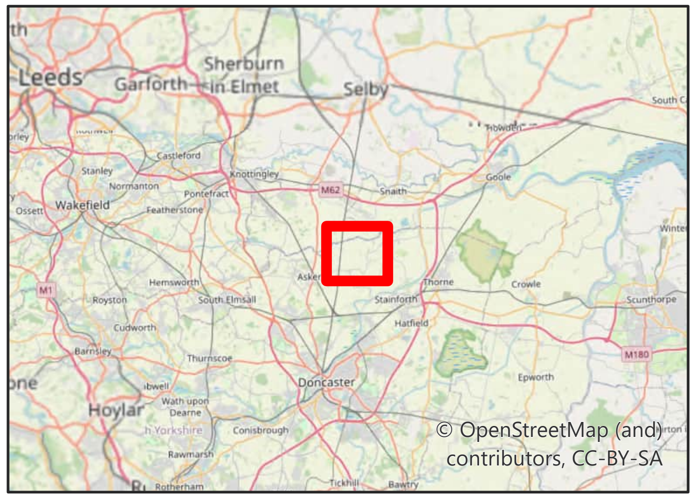
0 0.5 1 2 Kilometers

Fenwick Solar Farm
Residential Based Receptors
Figure 1A

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL

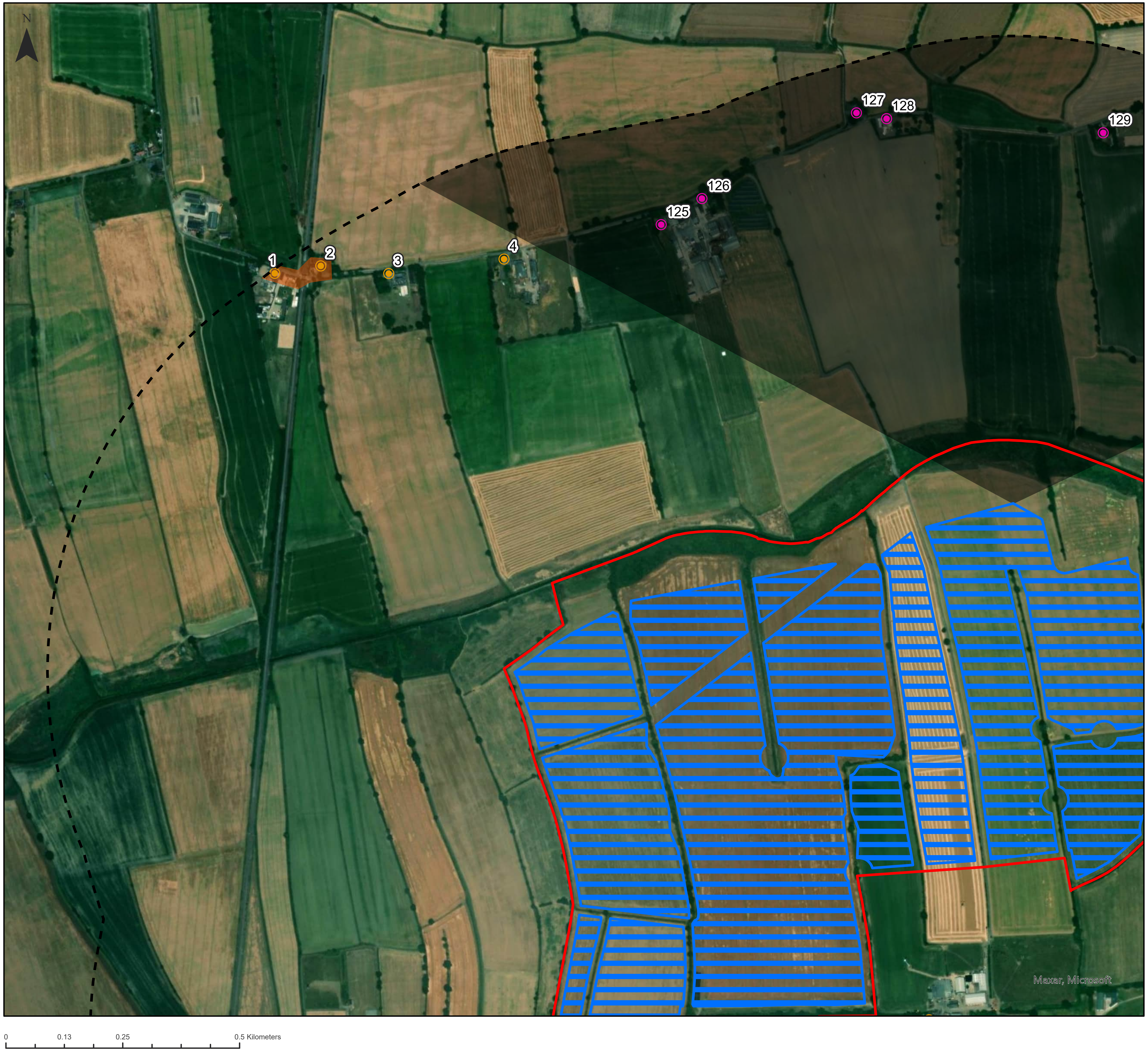


Date: 07/08/2024
Drawn By: David Thomson
Scale (A3): 1:20,000
Drawing No: NEO01233/008I/C

NEO ENVIRONMENTAL

- Figure 1B: Residential Receptor Map Sheet 1B

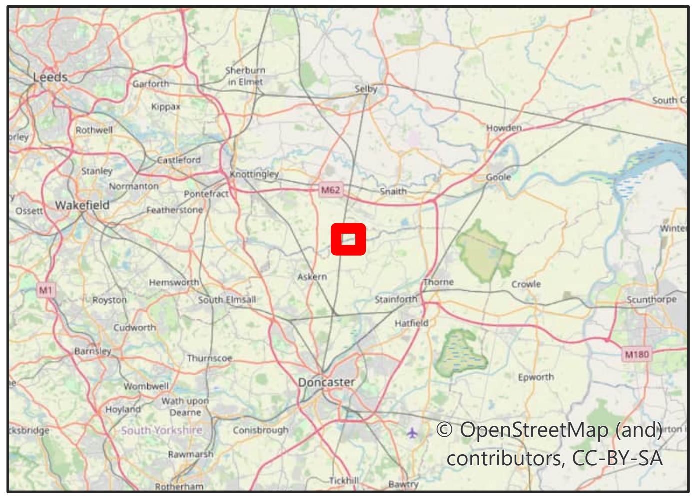
Fenwick Solar Farm
Residential Based Receptors
Figure 1B



Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL

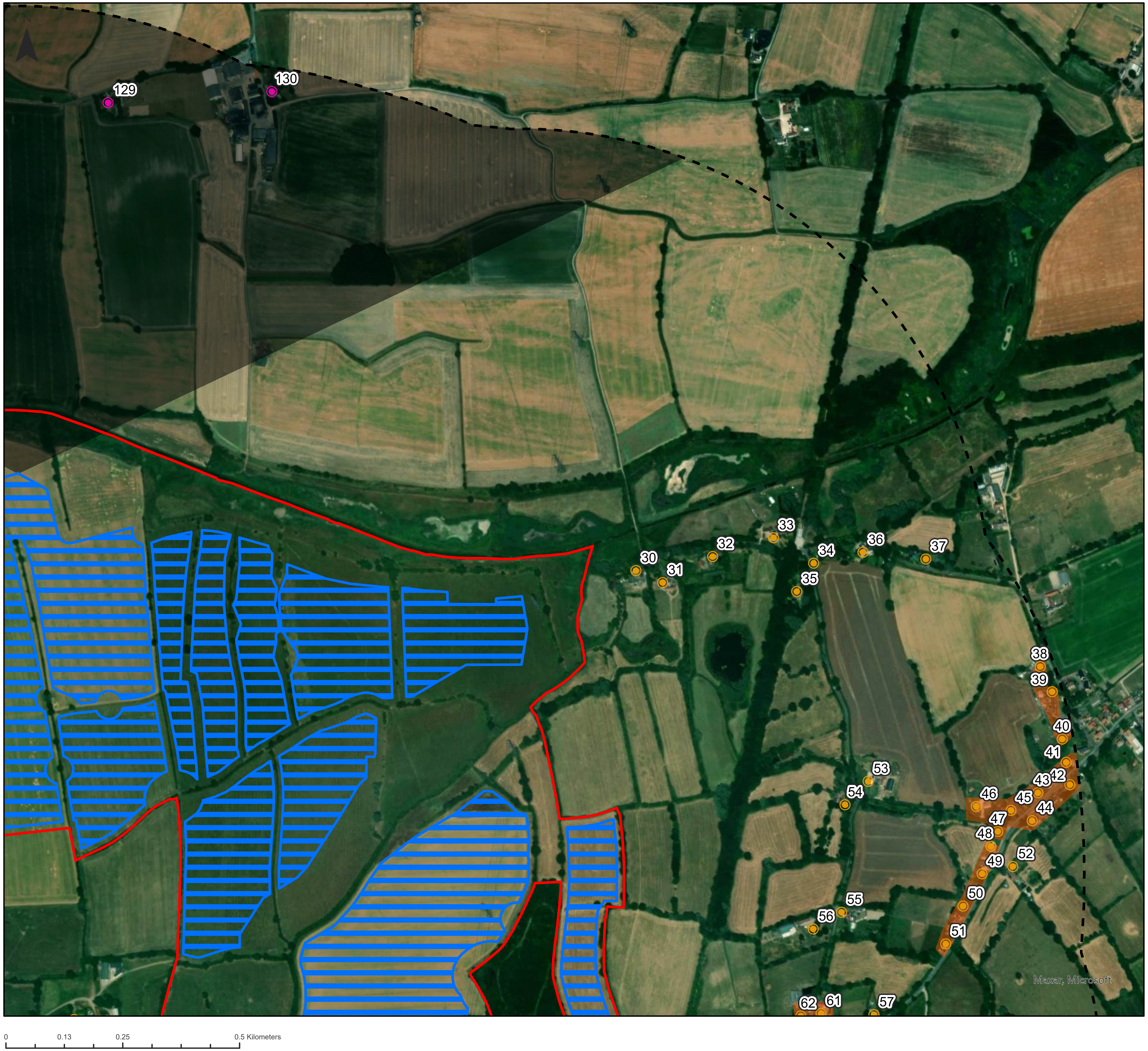


Date: 16/11/2023
Drawn By: David Thomson
Scale (A3): 1:8,000
Drawing No: NEO01233/009I/A

NEO ENVIRONMENTAL

- Figure 1C: Residential Receptor Map Sheet 1C

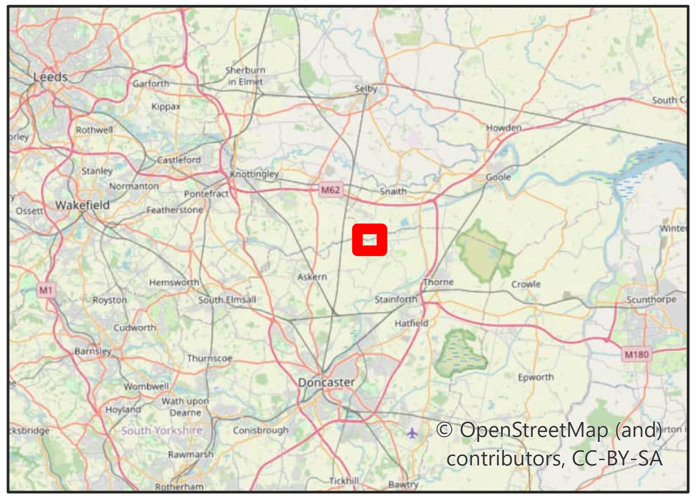
Fenwick Solar Farm
Residential Based Receptors
Figure 1C



Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL



Date: 16/11/2023
Drawn By: David Thomson
Scale (A3): 1:8,000
Drawing No: NEO01233/010I/A

ENVIRONMENTAL

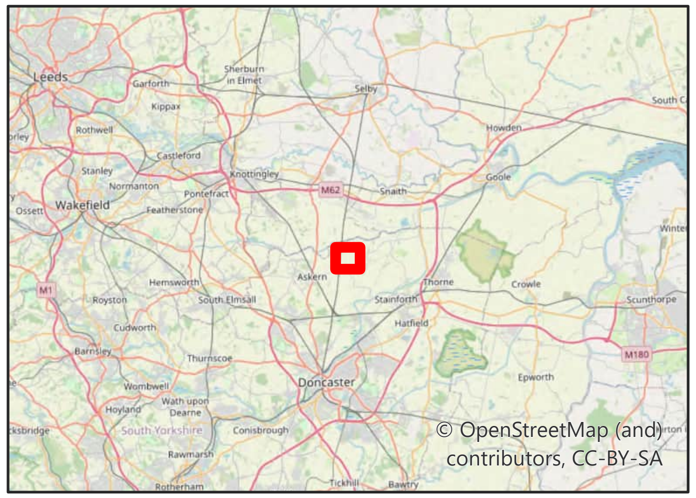
- Figure 1D: Residential Receptor Map Sheet 1D

Fenwick Solar Farm
Residential Based Receptors
Figure 1D

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL



Date: 07/12/2023
Drawn By: David Thomson
Scale (A3): 1:8,000
Drawing No: NEO01233/011I/B

NEO ENVIRONMENTAL

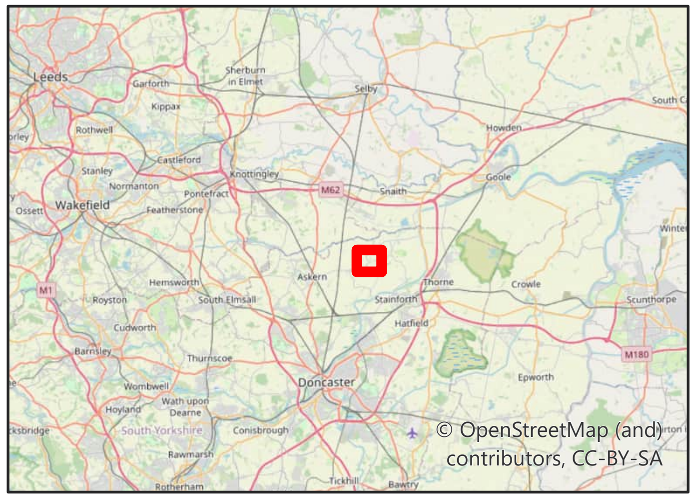
- Figure 1E: Residential Receptor Map Sheet 1E

Fenwick Solar Farm
Residential Based Receptors
Figure 1E

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL



Date: 16/11/2023
Drawn By: David Thomson
Scale (A3): 1:8,000
Drawing No: NEO01233/012I/A

neo ENVIRONMENTAL

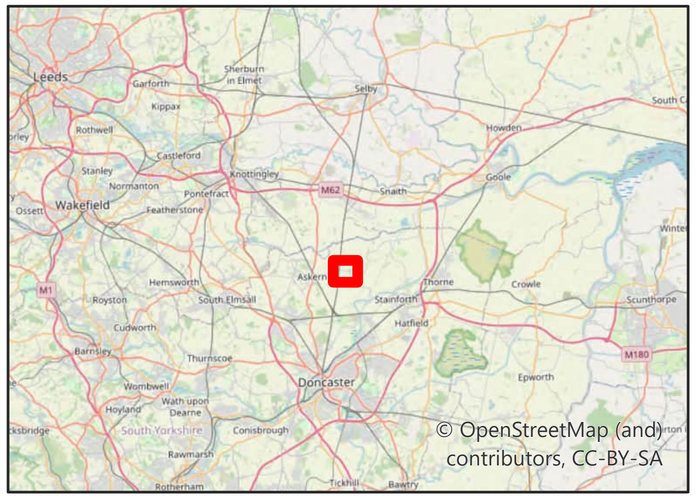
- Figure 1F: Residential Receptor Map Sheet 1F

Fenwick Solar Farm
Residential Based Receptors
Figure 1F

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Residential Area
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL

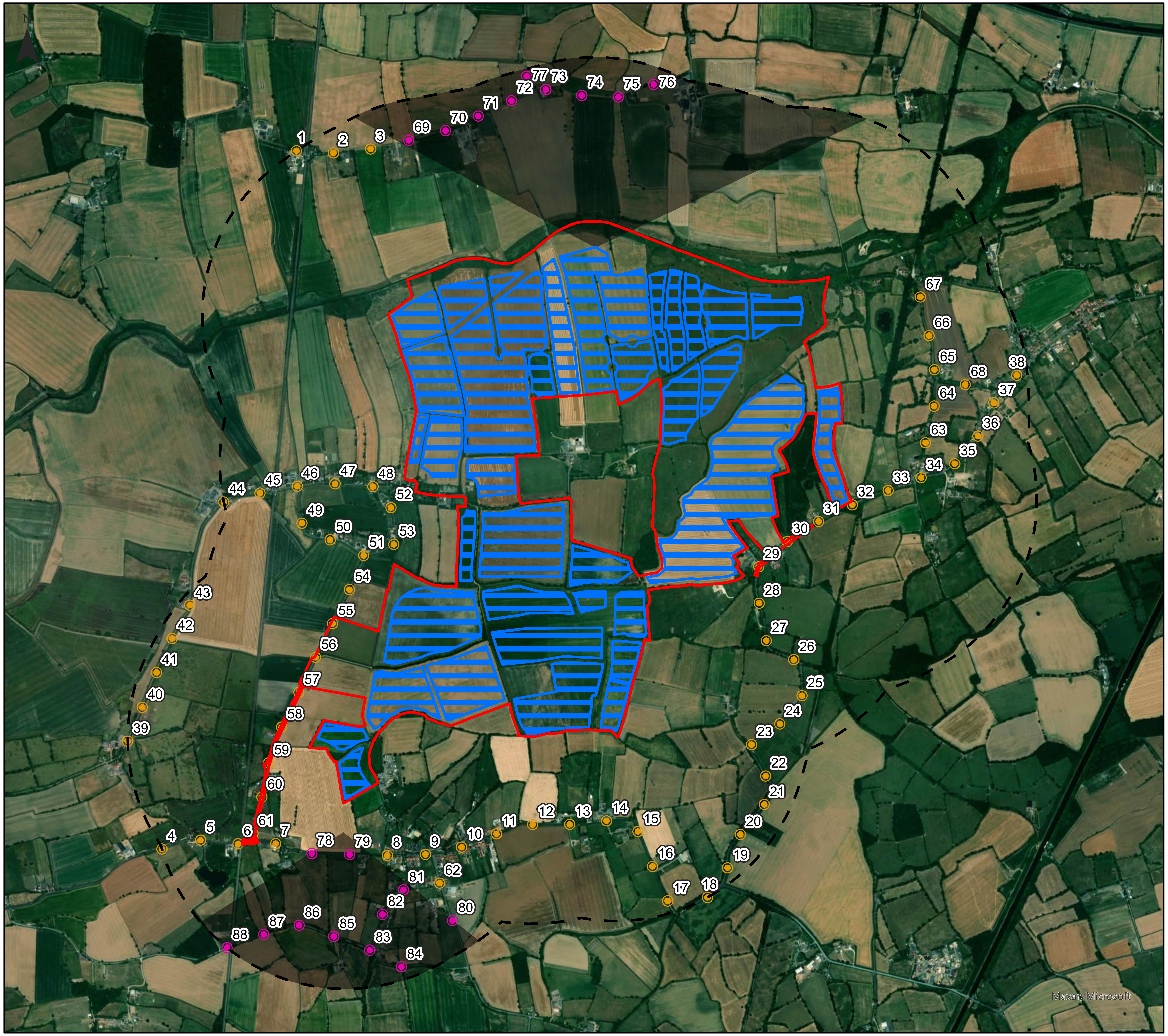


Date: 07/08/2024
Drawn By: David Thomson
Scale (A3): 1:8,000
Drawing No: NEO01233/013I/C

neo ENVIRONMENTAL

- Figure 2: Road Receptor Map

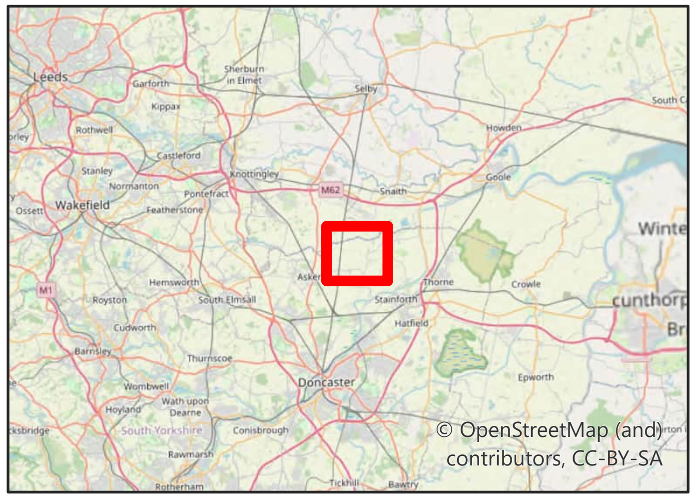
Fenwick Solar Farm
Road Based Receptors
Figure 2



Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL

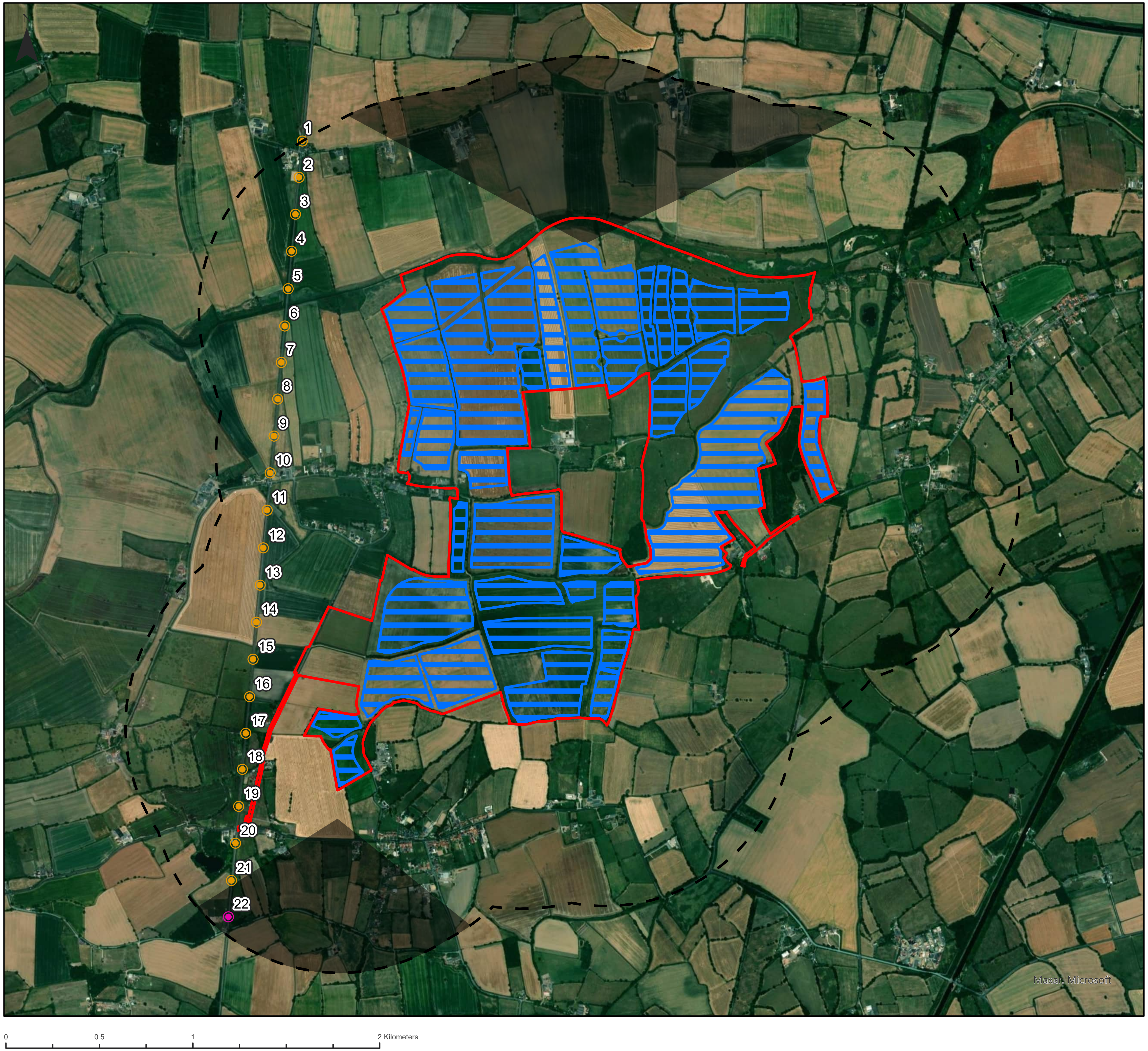


Date: 07/08/2024
Drawn By: David Thomson
Scale (A3): 1:20,000
Drawing No: NEO01233/014I/C

NEO ENVIRONMENTAL

- Figure 3: Rail receptor Map

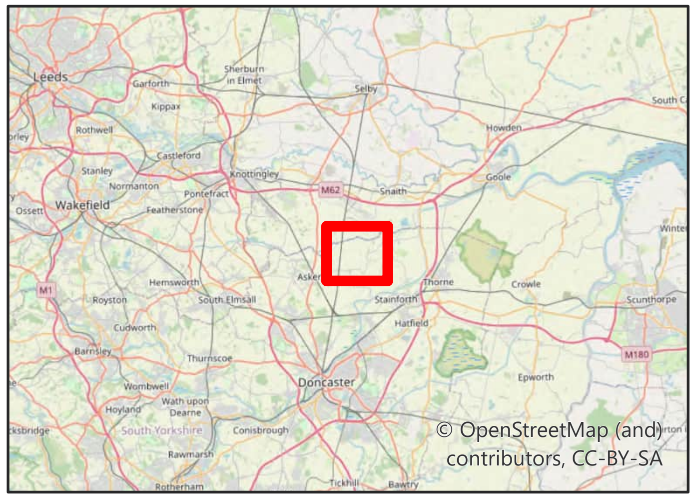
Fenwick Solar Farm
Rail Based Receptors
Figure 3



Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Non-Reflection Zone

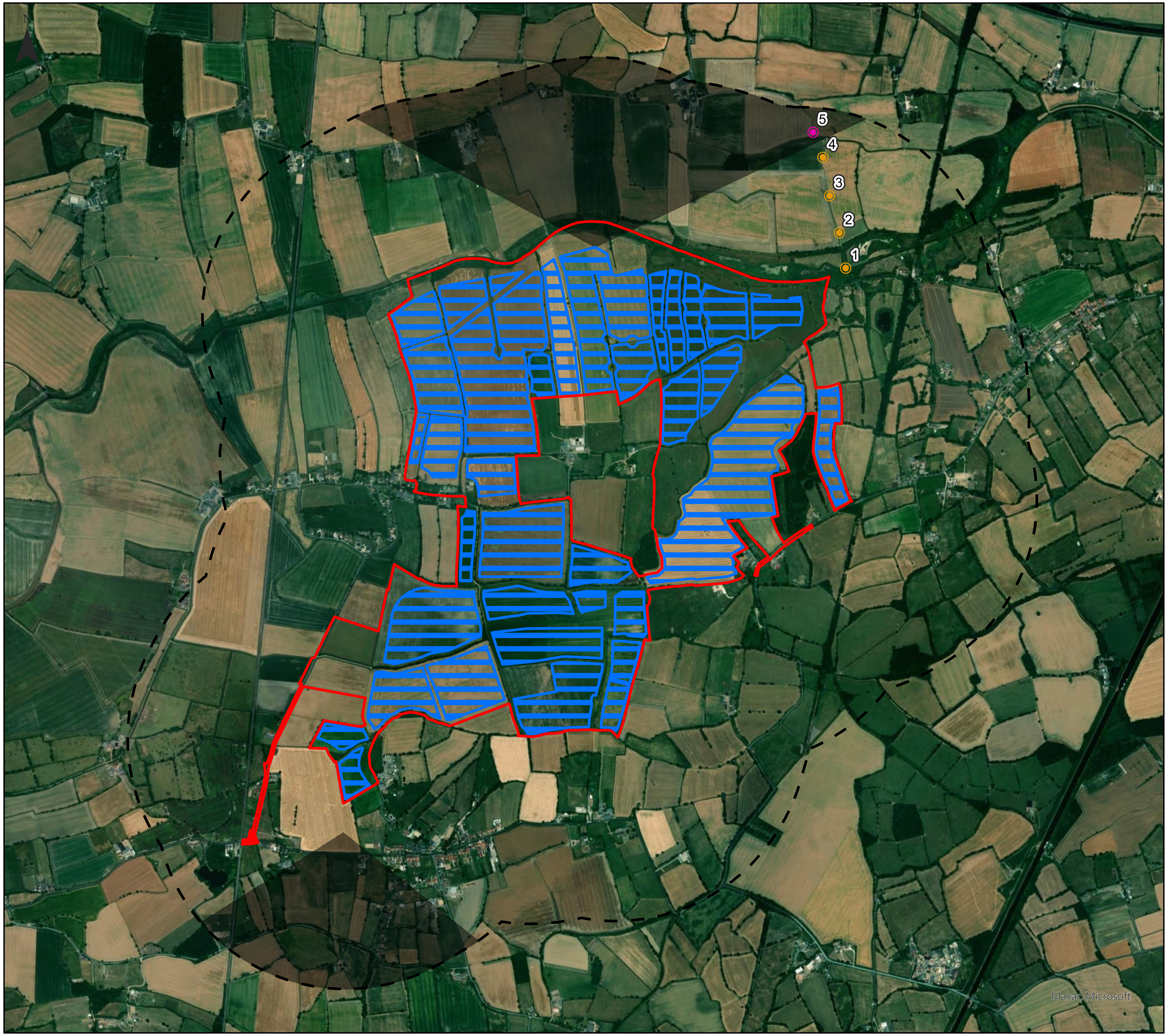
Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL



Date: 07/08/2024
Drawn By: David Thomson
Scale (A3): 1:20,000
Drawing No: NEO01233/015I/C

neo ENVIRONMENTAL

- Figure 4: Bridleway Receptor Map



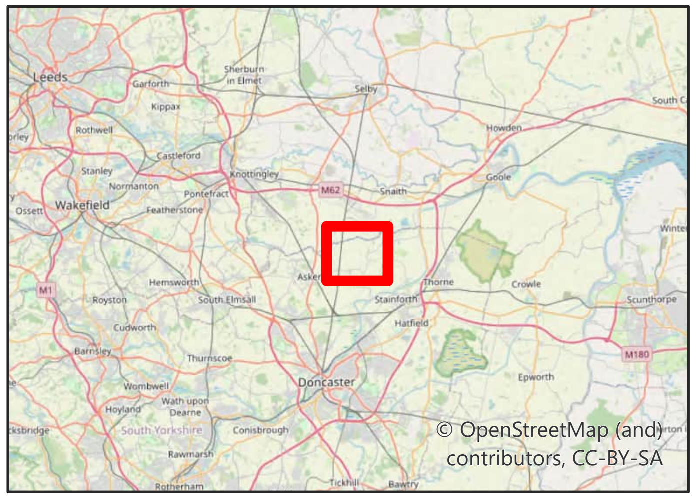
0 0.5 1 2 Kilometers

Fenwick Solar Farm
Bridleway Based Receptors
Figure 4

Key

- Development Boundary
- Panel Boundary
- 1km Study Area
- Glare Not Possible at Receptor
- Glare Possible at Receptor
- Non-Reflection Zone

Neo Office Address:
Wright Business Centre, 1 Lonmay Road, Glasgow, G33 4EL

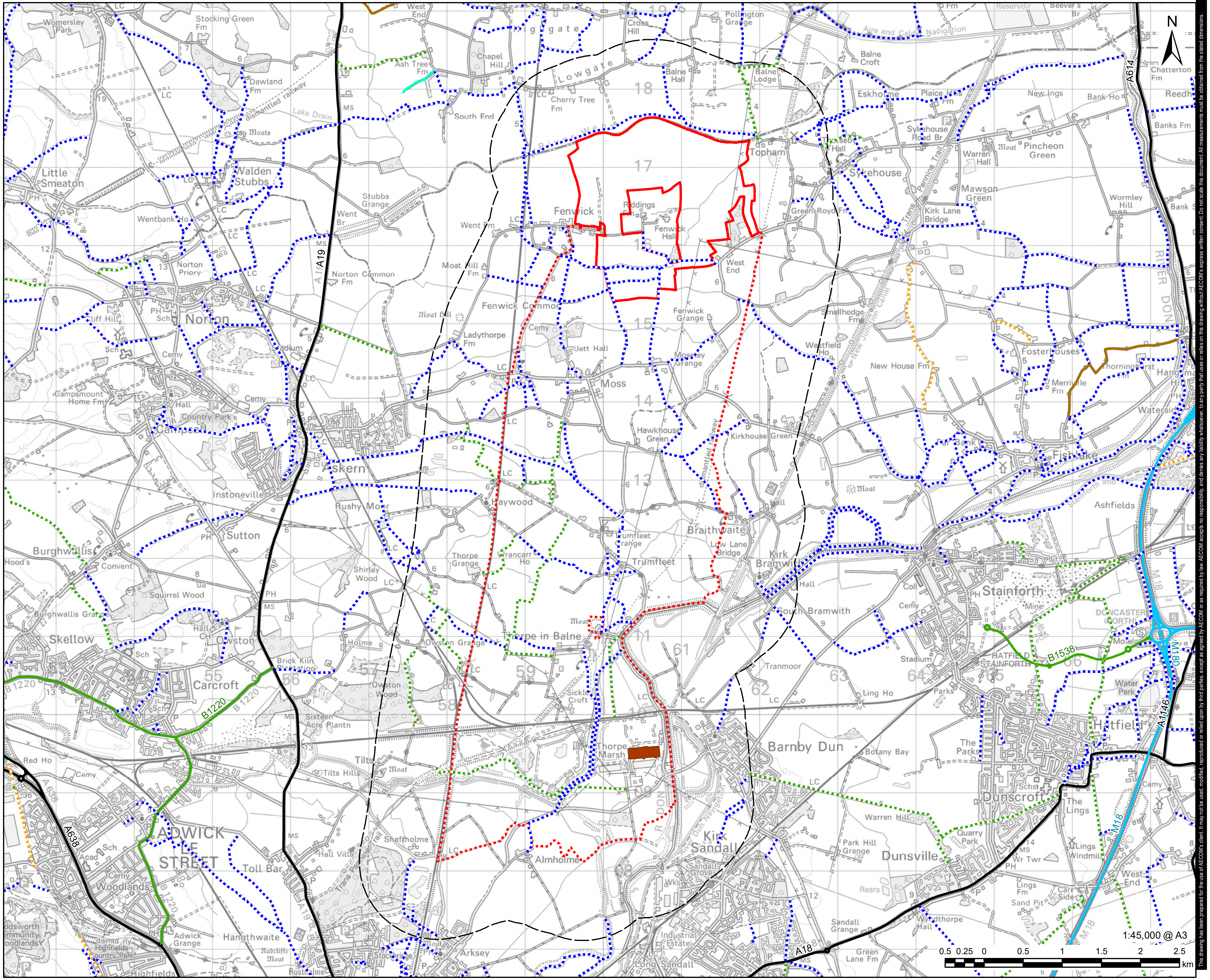


Date: 07/08/2024
Drawn By: David Thomson
Scale (A3): 1:20,000
Drawing No: NEO01233/016I/B

neo ENVIRONMENTAL

- Figure 5: Site Layout

Revision: 0 Drawn: VC Checked: OB Approved: TN Date: 2023-05-15



AECOM

PROJECT

Fenwick Solar Farm

CLIENT

Fenwick Solar Project Limited

CONSULTANT

AECOM Limited
Midpoint,
Alencon Link
Basingstoke, RG21 7PP
www.aecom.com

LEGEND

- Solar PV Site
- Grid Connection Corridor Search Area
- Existing National Grid Thorpe Marsh Substation
- 1 km Buffer of Solar PV Area and Grid Connection Corridor Search Area
- A Road
- B Road
- Motorway

Public Right of Way

- Bridleway
- Byway Open to All Traffic (BOAT)
- Footpath
- Restricted Byways
- Unsurfaced Unclassified Road

NOTES

ISSUE PURPOSE

EIA Scoping Report

PROJECT NUMBER

60698207

FIGURE TITLE

Public Rights of Way

FIGURE NUMBER

Figure 2-3

Filename: I:\60698207_Fenwick_Solar_Farm\02_Maps\Scoping Report\GEN_SCO_Fig2_3_PRoW_A3L_20230515_R0.mxd

- Figure 6: Panel Area Labels

Appendix A: Figure 6 – Panel Area Labels

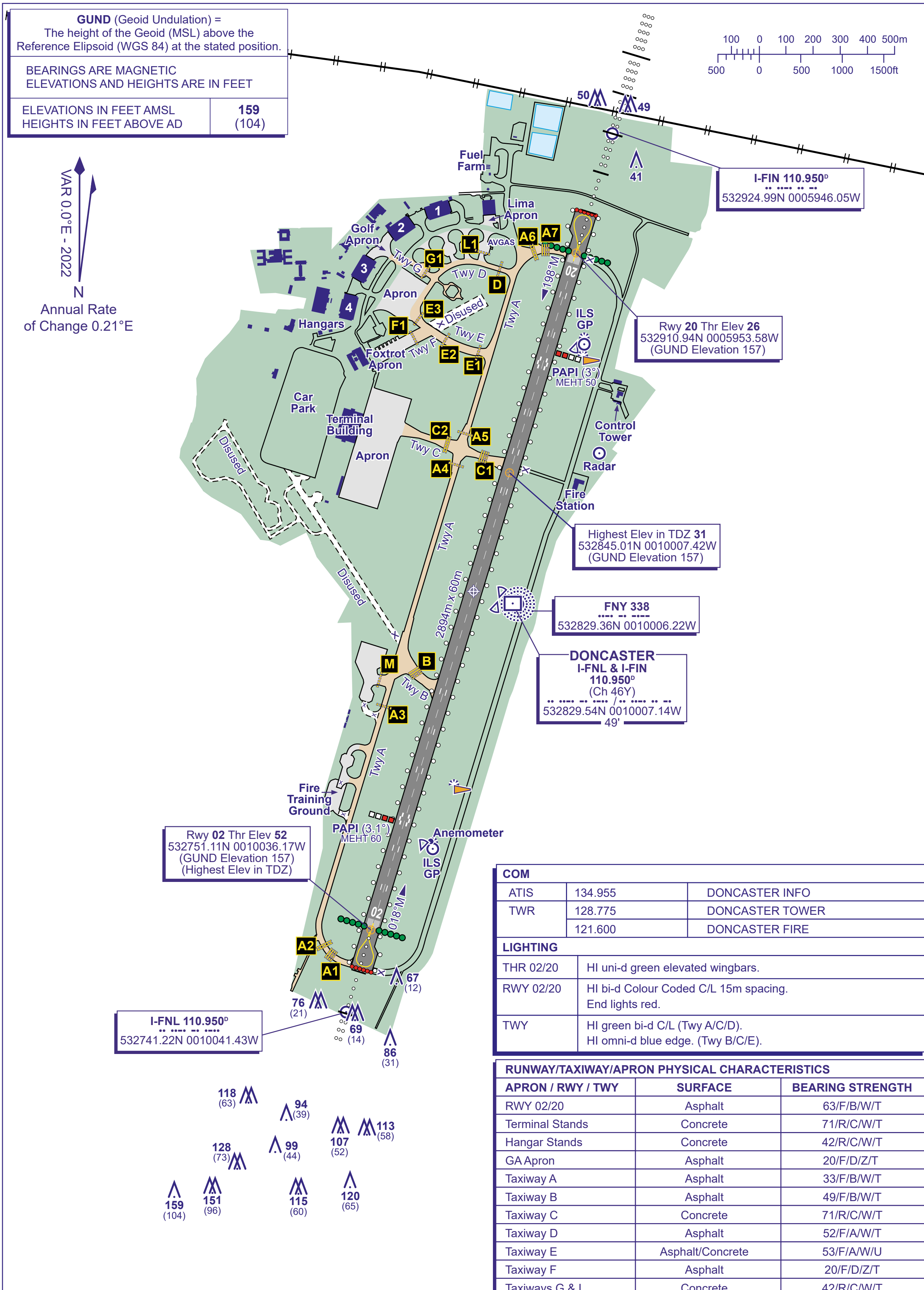
- Figure 7: Doncaster Sheffield Airport Aerodrome Chart

DONCASTER SHEFFIELD EGCN

AERODROME CHART - ICAO

ARP 532831N 0010015W

AD ELEV 55FT



COM

ATIS	134.955	DONCASTER INFO
TWR	128.775	DONCASTER TOWER
	121.600	DONCASTER FIRE

LIGHTING

THR 02/20	HI uni-d green elevated wingbars.
RWY 02/20	HI bi-d Colour Coded C/L 15m spacing. End lights red.
TWY	HI green bi-d C/L (Twy A/C/D). HI omni-d blue edge. (Twy B/C/E).

RUNWAY/TAXIWAY/APRON PHYSICAL CHARACTERISTICS

APRON / RWY / TWY	SURFACE	BEARING STRENGTH
RWY 02/20	Asphalt	63/F/B/W/T
Terminal Stands	Concrete	71/R/C/W/T
Hangar Stands	Concrete	42/R/C/W/T
GA Apron	Asphalt	20/F/D/Z/T
Taxiway A	Asphalt	33/F/B/W/T
Taxiway B	Asphalt	49/F/B/W/T
Taxiway C	Concrete	71/R/C/W/T
Taxiway D	Asphalt	52/F/A/W/T
Taxiway E	Asphalt/Concrete	53/F/A/W/U
Taxiway F	Asphalt	20/F/D/Z/T
Taxiways G & L	Concrete	42/R/C/W/T

CHANGE (5/21): RWY 20 COORD. HOLD D & A3 POSITIONS. FOXTROT APRON. OBSTACLES.

- Figure 8: Sherburn-in-Elmet Airport Aerodrome Chart

AERODROME CHART - ICAO

ARP 534703N 0011304W

AD ELEV 26FT

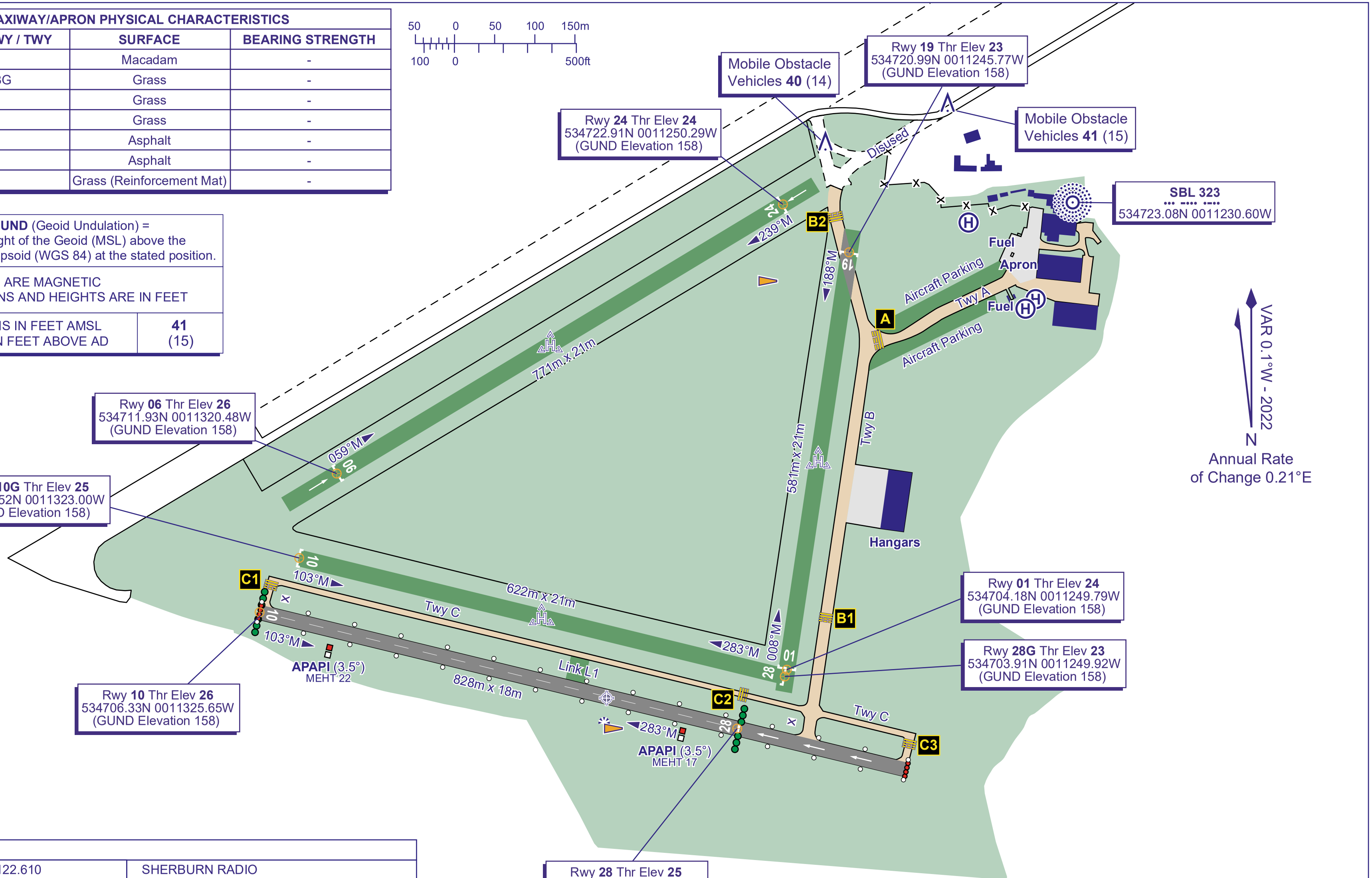
SHERBURN-IN-ELMET EGCJ

RUNWAY/TAXIWAY/APRON PHYSICAL CHARACTERISTICS		
APRON / RWY / TWY	SURFACE	BEARING STRENGTH
RWY 10/28	Macadam	-
RWY 10G/28G	Grass	-
RWY 01/19	Grass	-
RWY 06/24	Grass	-
Main Apron	Asphalt	-
TWY A/B/C	Asphalt	-
TWY Link L1	Grass (Reinforcement Mat)	-

GUND (Geoid Undulation) = The height of the Geoid (MSL) above the Reference Elipsoid (WGS 84) at the stated position.

BEARINGS ARE MAGNETIC
ELEVATIONS AND HEIGHTS ARE IN FEET

ELEVATIONS IN FEET AMSL HEIGHTS IN FEET ABOVE AD	**41** (15)



COM		
A/G	122.610	SHERBURN RADIO

LIGHTING	
THR 10/28	Green with elevated wingbars.
RWY 10/28	Omni-d white edge. End lights Red with elevated wingbars.

CHANGE (9/23): RWY DIMENSIONS. DISPLACED THRESHOLDS. EDITORIAL.