Great North Road Solar and Biodiversity Park

Environmental Statement

Volume 4 – Technical Appendices

Technical Appendix A16.1 – Glint and Glare

Document reference – EN010162/APP/6.4.16.1

Revision number 1

June 2025

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, APFP Regulation 5(2)(a)

Contents

A16.1.1 INTRODUCTION

1 This Environmental Statement (ES) Technical Appendix (TA) presents the assessment of glint and glare effects associated with Great North Road Solar and Biodiversity Park (the Development). The significance of such effects in terms of the Environmental Impact Assessment (EIA) Regulations are considered in the respective technical discipline chapters, referencing this TA where appropriate.

2 This TA is supported by the following figures:

- Figure A16.1.1: Area GG1;
- Figure A16.1.2: Area GG2;
- Figure A16.1.3: Area GG5;
- Figure A16.1.4: Area GG6;
- Figure A16.1.5: Area GG7;
- Figure A16.1.6: Area GG8;
- Figure A16.1.7: Area GG9;
- Figure A16.1.8: BESS Compound;
- Figure A16.1.9: Glint & Glare Overview & Aerodrome Study Areas; and
- Figure A16.1.10: Cumulative Assessment.

3 This TA is also supported by the following Annexes:

- Annex A16.1.1: Result Charts by Receptor.

4 It should be noted that Area GG3 and Area GG4 in the Preliminary Environmental Information Report (PEIR) assessment have been entirely removed as part of the Development's design evolution. However, the numbering of all GG Areas has been retained for this current assessment, for ease of comparison.

A16.1.1.1 GLINT AND GLARE DEFINITION

5 Whilst solar photovoltaic (PV) panels are specifically designed to absorb, rather than reflect light, they may reflect the sun's rays at certain angles, causing glint and glare. Paragraph 2.10.102 of the UK Government's National Policy Statement for Renewable Energy Infrastructure[1] (EN-3: See Section 3.1.2) defines these terms as follows:

- Glint: *"a momentary flash of light that may be produced as a direct reflection of the sun in the solar panel"*; and
- Glare: *"a continuous source of excessive brightness experienced by a stationary observer located in the path of reflected sunlight from the face of the panel".*

6 The UK Government has published a draft revision[2] of EN-3 (the EN-3 2025 draft'). This is discussed further in Section A16.1.3; however it is confirmed that the definition of glint and glare set out above is the same in both the extant and draft versions of EN-3.

[1] UK Department for Energy Security and Net Zero (2023) National Policy Statement for Renewable Energy Infrastructure (EN-3).
[2] UK Department for Energy Security and Net Zero (2024) Draft National Policy Statement for Renewable Energy Infrastructure (EN-3).

A16.1.2 CONSULTATION

7 Consultation was primarily undertaken through the EIA Scoping Report[1], which set out the proposed approach to glint and glare. The EIA Scoping Report was initially submitted to PINS in November 2023. The Scoping Opinion[3] was received from PINS on 20th December 2023.

8 The Planning Inspectorate agreed with the approach to scope out a standalone glint and glare chapter, and instead prepare a Technical Appendix to be used to inform the chapters of any potentially-affected technical disciplines. Since receipt of the Scoping Opinion, this approach has been formalised in planning guidance[4].

9 As part of the consultation process, further consultation comments were received in response to the Glint and Glare assessment. Table A16.1.1 summarises the key comments received, and describes how / where they have been addressed in this ES. Further information on the wider consultation process is provided in the Consultation Report [EN010162/APP/5.1].

Table A16.1.1: Consultation Summary

Consultee and Communication Type	Consultee Comment	Response
Planning Inspectorate Scoping Opinion	The Scoping Report proposes to include road users, residents, rail users and aviation. The Inspectorate also considers that given the current rural nature of the surrounding area, and requirement to scope in recreation in the socioeconomic chapter, the ES should assess other receptors such as users of vessels on waterways within the ZTV, agricultural workers including when using farm machinery, ecological receptors and recreational users (e.g. walkers, cyclists and horse riders). The assessment should also consider the implications of	The assessment includes consideration of watercraft, ecological receptors, and vehicles / road traffic of varying height; see Section A16.1.4.1.4 for details.. As set out in Section A16.1.4.2.1 of this TA, a typical worst case of 2.5 m AGL has been used, being representative of the head height of horse riders, HGV and agricultural vehicle drivers. The potential for a line of a sight to the Development decreases with decreasing receptor height, due to the increasing likelihood of screening

[1] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010162/EN010162-000008-GNR%20EIA%20Scoping%20Report%2020231108.pdf
[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010162/EN010162-000012-EN010162%20Great%20North%20Road%20Solar%20Park%20-%20Scoping%20Opinion.pdf
[4] UK Planning Inspectorate (2024). Nationally Significant Infrastructure Projects: Technical Advice Page for Scoping Solar Development (Online). Available at https://www.gov.uk/guidance/nationally-significant-infrastructure-projects-technical-advice-page-for-scoping-solar-development [accessed 10/10/2024]

Consultee and Communication Type	Consultee Comment	Response
	these users being at varying heights from ground level, as for example, a horse rider would experience glint and glare at a different angle than a pedestrian.	effects. As such, effects for lower height receptors such as car drivers, cycles and pedestrians are likely to be less than those for more elevated receptors, and therefore do not require individual assessment.
	Paragraph 592 states that "*significant effects may be lessened by utilising standard mitigation methods used by pilots flying in the direction of the sun*". The Inspectorate is unclear if this is to be relied upon as a mitigation measure to conclude no significant effects. The ES should clarify this, and also justify how this could be relied on as the safety features on aircraft are outside of the control of the Applicant.	The assessment considers effects on aircraft pilots using standard best practice guidance, and does not assume the presence or otherwise of any specific safety features being present on aircraft.
	Paragraph 593 states that *"Mitigation measures will be recommended in order to screen any High or Medium impacts upon ground-based receptors."* It is not clear if the use of the terms medium and high are in relation to the magnitude of change, or the significance of effects. If they relate to significance, this is a different methodological approach than the overarching methodology. The methodology used should be provided in full, including the criteria used to define significance.	Glint and glare effects have been assessed against current best practice guidance. The magnitude and significance of such effects in are considered in the respective technical discipline chapters, referencing this TA where appropriate.
	The Scoping Report uses a study area of 30 km for aerodromes and 5 km for small aerodromes, however no criteria are given to define	Aerodrome study areas have been applied in accordance with Civil Aviation Authority

Consultee and Communication Type	Consultee Comment	Response
	how an aerodrome will be classified as small. The ES should provide the criteria and the rationale for the selection, and a justification of the distances used.	(CAA) guidance (see Section A16.1.4.1.2).
Nottinghamshire Council Scoping Opinion	The Council agrees this matter should be 'scoped in' and appropriate assessments included as part of the ES. Glint and glare assessors often rely on a circa 1.5m AGL [Above Ground Level] receptor height assumption. However, for the purposes of scoping in, The Council believes that the assessment should vary the receptor height when analysing the effects on transport. This should be for all major roads frequently used by HGVs.	Road users have been assessed at a typical worst case height of 2.5 m, as described in Section A16.1.4.1.1. All major roads within the respective study area have been assessed.
	The Council believes that sample points covering the A1 northbound carriageway and the East Coast Mainline (ECML) should be significantly closer than 200m apart and their data should be scoped in. It is also believed that the glint and glare assessment should include proposed future height changes in the A46 carriageways.	The 200 m distance between points is the minimum distance between route vertices, rather that discrete receptor points. The entire length of roads with the relevant study areas has been assessed. The A46 is located 2.2 km from the Development PV array at the closest point. This is comfortably outwith the study area for roads, and there is no reasonable prospect of unacceptable level of glint and glare occurring, regardless of the carriageway height.
Canal and River Trust Scoping Opinion	Solar panels have the potential to result in glint and glare impacts which could impact boaters on the River Trent. In the worst case scenario, this could affect	Boaters on the River Trent have been considered, as discussed in Section A16.1.4.1.4.2.

Consultee and Communication Type	Consultee Comment	Response
	navigational safety. The inclusion of a 'Glint and Glare' chapter in the Scoping Report is welcome. However, we advise that some revisions to ensure that the impact on boaters is fully considered may be required.	
Kneesall, Kersall & Ompton Parish Council Scoping Opinion	The applicant states they will consider the effects to nearby road and rail receptors such as the A1 and North-eastern Railway Line. The council consider the A616 should be considered in this assessment, as it the diversion route for the A1, in both the Northbound and Southbound directions.	The A1, A646, and ECML have all been considered in this assessment, being within the respective study area stated in Section A16.1.4.1.1.
Laxton and Moorhouse Parish Council Scoping Opinion	Section 13.1.2 (Para 583) lists some of the surrounding airfields, but misses Retford Gamston Airport, which is quite significant in the area and runs a number of training flights over the area with both fixed wing and helicopters. In addition, the Lincs & Notts Air ambulance regularly flies over the proposed development. The Council proposes that the scope is expanded to include these omissions and that both establishments are consulted.	Retford Gamston Airport and air ambulance overflights have been considered, as discussed in Section A16.1.5.3.1.5.
	The road and rail height vary along the edge of the proposed development this would not be possible with an office-based assessment.	A site visit was undertaken as stated in Section A16.1.5.3. The effect of any local terrain variations is described in Section A16.1.5.5.
Ministry of Defence: Email consultation re	The MoD confirms agreement with the standard assessment method for RAF Syreston (i.e. assessment of a 2-mile	The assessment has been carried out using the agreed parameters, as discussed in Section A16.1.5.3.1.1

Consultee and Communication Type	Consultee Comment	Response
RAF Syerton (4th October 2024)	approach path from runway thresholds, with a 3-degree glideslope).	
Network Rail Scoping Opinion	It should include a Glint and Glare study assessing the impact of the scheme upon train drivers (including distraction from glare and potential for conflict with railway signals).	All stretches of rail line within the respective study area have been assessed in their entirety at a height of 2.75 m, in line with current best practice.
Newark and Sherwood District Council (NSDC), Environmental Health Officer Scoping Opinion	A glint and glare assessment should be carried out to: Determine the locations, numbers and orientations of the solar panels. Identify local areas that could be affected by glint or glare from the panels throughout the year. Identify geographical and vegetation features that might shield sensitive locations from glint and glare.	A detailed glint and glare assessment has been undertaken in line with best practice, as presented in this TA.
North Muskham Parish Council Scoping Opinion	The proposed elevated section of the A46 dualling project should be re-considered for such impact. The Council suggests that this be scoped in and also the sample points for the A1 and East Coast Main Line should be closer than the stated 200m centres.	The A46 is comfortably outwith the study area for roads and there is no reasonable prospect of unacceptable level of glint and glare occurring. The 200 m distance between points is the minimum distance between route vertices, rather that discrete receptor points. The entire length of roads and rail lines with the relevant study areas have been assessed.
Norwell Parish Council Scoping Opinion	The Council believe that the assessment should vary the receptor height when analysing the effects on transport.	Road users have been assessed at a typical worst case height of 2.5 m, covering a variety of receptor types as described in Section A16.1.4.1.4.3.

Consultee and Communication Type	Consultee Comment	Response
South Muskham & Little Carlton Parish Council Scoping Opinion	The Council would also want scoping in an additional viewpoint from the A1 bridge to the north of South Muskham, particularly in relation to glint and glare.	All stretches of the A1 within the respective study area have been assessed. The bridge being referred to is entirely outwith the study area, and has been found to have minimal line of sight to the PV arrays due to existing screening; there is no reasonable prospect of unacceptable glint and glare effects occurring at this location.
Newark and Sherwood District Council PEIR Response	NSDC note that a preliminary Glint and Glare assessment has been undertaken and is presented from section 16.3 onwards. It is noted that the assessment has identified possible significant glint and glare effects on parts of the A1 and A616 and that of one property (which is assumed to be a residential property, although this is not specified). Whilst it is understood that mitigation measures are being considered, NSDC would recommend direct engagement with both NCC as LHA [Local Highway Authority] and the individual property is discussed, so as to produce a solution that reduces these potentially significant effects to a reduced and acceptable level.	As part of the Development's design evolution, the previously significant effect identified at one property (residential dwelling 36) has been removed through a reduction of the solar array area closest to that receptor; updated results are presented in Section 6 of this report. With regard to effects on the A1 and A616, in order to ensure that the final mitigation properly responds to the actual design to be constructed, the detailed mitigation will be designed based on the final PV design. That final mitigation scheme will be designed in consultation with relevant parties including both NSDC and NCC and secured by an appropriate DCO Requirement. This is discussed further in Section A16.1.8.

Consultee and Communication Type	Consultee Comment	Response
National Highways	The study provided appears fairly robust and covers the expected receptors plus additional receptors and/or additional context considerations identified as part of scoping opinion consultations. Based on the mixed results which include receptors that exceed the recommended benchmarks, mitigation is recommended. The report concludes that a detailed mitigation strategy is required and will be developed to manage these issues. No mitigation measures are proposed as part of the TA A16.1 Glint and Glare assessment. The study area provided in the glint and glare assessment indicates that the majority of effects will not be significant.	All methodology and input parameters for this assessment remain as those applied in the PEIR assessment. In order to ensure that the final mitigation properly responds to the actual design to be constructed, the detailed mitigation will be designed based on the final PV design, ensuring that any residual effects are not significant. That final mitigation scheme will be designed in consultation with relevant parties including both NSDC and NCC and secured by an appropriate DCO Requirement. This is discussed further in Section A16.1.8.

A16.1.3 GUIDANCE

A16.1.3.1 PLANNING POLICY

10 The following planning policies are pertinent to this assessment:

- National Policy Statement for Renewable Energy Infrastructure (EN3); and
- The National Planning Policy Framework (NPPF)[5].

A16.1.3.1.1 National Policy Statement for Renewable Energy Infrastructure

11 With regard to glint and glare impacts, EN-3 does not provide specific assessment criteria, or give guidance on what is considered to be an acceptable level of impact. EN-3 states in footnote 93 that solar PV panels are specifically designed to absorb, rather than reflect light:

12 *"Most commercially available solar panels are designed with anti-reflective glass or are produced with anti-reflective coating and have a reflective*

[5] UK Government (February 2025). National Planning Policy Framework

capacity that is generally equal to or less hazardous than other objects typically found in the outdoor environment, such as bodies of water or glass buildings".

13 Notwithstanding the above, PV panels may reflect the sun's rays at certain times / angles, potentially causing glint and glare effects. EN-3 recommends a two-stage approach to determining the potential for glint and glare impacts. As a first stage, receptors should be mapped qualitatively to identify any potential glint and glare issues and determine whether a detailed glint and glare assessment is necessary as part of a given planning application.

14 When a quantitative glint and glare assessment is found to be necessary, the geometric possibility of glint and glare affecting nearby receptors should be investigated through modelling, and an assessment of potential impact provided, based on the angle and duration of incidence and the intensity of the reflection.

15 With specific reference to aviation, Paragraph 2.10.159 of EN-3 states that:

"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".

A16.1.3.1.1.1 EN-3 2025 Draft

16 In April 2025, the UK Department for Energy Security & Net Zero published draft updates to a number of National Policy Statements including EN-3, reinforcing the government's ambition to deliver Clean Power by 2030 and net zero.

17 Whilst not an extant document, it is of note that the EN-3 2025 Draft also does not contain any specific assessment criteria, or give guidance on what is considered to be an acceptable level of impact.

18 However, Paragraph 2.10.151 of the 2024 Draft clarifies and strengthens the position on the effects of glint and glare on aviation, stating that…" w*hilst 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."*

A16.1.3.1.2 The National Planning Policy Framework

19 The NPPF sets out the Government's planning policies for England, providing a framework within which local policies can be developed. The key principle of the NPPF is a presumption in favour of sustainable development, although no specific references to solar PV development or glint and glare effects are made.

A16.1.3.2 TECHNICAL GUIDANCE

20 UK planning guidance does not provide a specific methodology for assessing the impact of glint and glare. However, the following guidance is regularly applied to assessments in the UK and together is considered to provide a reasonable and robust approach:

- Measurement and Assessment of Light Immissions[6];
- Rail Industry Standard (RIS) RIS-0737-CCS[7];
- Renewable Energy Developments: Solar Photovoltaic Developments[8]; and
- Review of Solar Energy System Projects on Federally-Obligated Airports (2013 Interim Policy and 2021 Update)[9].

A16.1.3.2.1 Measurement and Assessment of Light Immissions

21 The German Ministry for Environment, Health and Consumer Protection published the Measurement and Assessment of Light Immissions in 1993, and was most recently updated in 2014. Paragraph 8 of the most recent version of the guidelines is dedicated to the assessment of reflections from solar PV panels.

22 Appendix 2 of the guidelines state [translated from German]:

> *"Experience has shown that immission locations that are more than approximately 100 m away from a photovoltaic system only experience short-term glare effects. Only in the case of extensive photovoltaic parks could more distant emission locations still be relevant."*

23 In addition, the guidelines note that where a reflection source is located in the same direction (+/- 10 degrees) as the sun itself, the direct glare from the sun masks any reflections, and can therefore be scoped out of further assessment.

24 For those receptors[10] within the area described above, Appendix 2 of the guidelines state that effects are acceptable providing that glare is experienced for no more than 30 minutes on any given day, or more than 30 hours per year.

A16.1.3.2.2 RIS-0737-CCS

25 Network Rail guidance does not provide a specific methodology for the assessment of glint and glare effects on rail infrastructure. However, Paragraph 2.1.5(b) of RIS 0737-CCS states that…*"a planned change external to the railway could affect signal sighting, for example changes that*

[6] German Ministry for the Environment, Health and Consumer Protection (2014). Light Guidelines (Leitlinie des Ministeriums für Umwelt, Gesundheit und Verbraucherschutz zur Messung und Beurteilung vonm Lichtimmissionen,
[7] Rail Industry Standard (RIS) RIS-0737-CCS 'Signal Sighting Assessment Requirements'
[8] CAA (2023). Solar photovoltaic Developments CAST Aerodrome Safeguarding Guidance Note
[9] Federal Aviation Administration (2013) Review of Solar Energy System Projects on Federally-Obligated Airports. Last Updated May 2021. 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 [access 02/10/2024]
[10] In this context, 'receptors' are primarily residential dwellings, but where relevant, can also include hotels, hospitals, schools and offices.

affect the built environment (for example, a new structure causing obscuration, a solar farm causing reflection).”

A16.1.3.2.3 Renewable Energy Developments: Solar Photovoltaic Developments

26 The UK Civil Aviation Authority (CAA) issued a guidance note, Renewable Energy Developments, in July 2023. This guidance note was prepared by the Combined Aerodrome Safeguarding Team (CAST), supported by the CAA, and aims to provide safeguarding advice in relation to solar photovoltaic developments on a range of matters, including glint and glare.

27 With specific reference to glint and glare effects, section 2 of the guidance note states that:

“In most cases, an assessment should be undertaken for a solar PV development which is being proposed within a specific distance (indicated by the aerodrome authority) from an aerodrome. For many aerodromes, 5 km is the distance of choice but it could be considered out to 10 km. In exceptional circumstances, assessments may be required beyond 10 km.”

28 No specific methodology or assessment criteria are defined for assessing the impact of glint and glare on aviation infrastructure.

A16.1.3.2.4 Review of Solar Energy System Projects on Federally-Obligated Airports

29 In 2013, the United States' Federal Aviation Administration (FAA) published interim guidance which stated that for a solar PV development to obtain FAA approval or to receive no objection, there should be no more than a *“low potential for after-image”* along the final 2-mile approach path for any existing or proposed runway, as defined by Sandia Laboratories' Solar Glare Hazard Analysis Tool (SGHAT).

30 SGHAT categorises glint and glare into three tiers of severity (ocular hazards) that are referred to as different colours in the model output. These categories show the potential impact of retinal irradiance as a function of subtended source angle as defined by Ho et al. (2011)[11], and implemented by SGHAT software and its successors. It should be noted that these categories are based upon the glare intensity as defined in SGHAT, and are not duration-dependent:

- Red glare: Glare predicted with a potential for permanent eye damage (retinal burn);
- Yellow glare: Glare predicted with a potential for temporary after-image; and
- Green glare: Glare predicted with a low potential for temporary after-image.

31 It also notes that no significant impacts are possible for reflections located more than 50 degrees either side of the direction of travel.

[11] Ho, C. K., Ghanbari, C. M., and Diver, R. B., 2011. Methodology to Assess Potential Glint and Glare Hazards From Concentrating Solar Power Plants: Analytical Models and Experimental Validation.

32 Page 2 of the Interim guidance stated that *"the FAA expects to continue to update these policies and procedures as part of an iterative process as new information and technologies become available."*

A16.1.3.2.4.1 2021 Update

33 In accordance with the above, the Interim FAA guidance was updated in 2021 to reflect the state of knowledge at the time.

34 As part of the update, the FAA withdrew the requirement to undertake glint and glare analysis using SGHAT as the software is no longer available. The assessment of glint and glare impacts due to the Development therefore uses modelling alternative industry standard software which utilises the same methodology as SGHAT.

35 With regard to the potential for solar glint and glare impacts in general, the 2021 update states the following in the section entitled *'Developments Since Interim Policy'*:

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

36 Given the above, it is clear that the FAA now consider that with the exception of ATCTs, no unacceptable glint and glare impacts are expected from solar PV panels in terms of aviation safety.

A16.1.4 ASSESSMENT METHODOLOGY

37 Glint and glare impacts would not occur until panels have been installed, and as such this assessment focuses on the operational phase of the Development. Whilst panel reflections could occur during construction (i.e., whilst the individual modules are being manoeuvred into position), these would be very short term and random, and have not been considered further.

38 This assessment has been undertaken on the basis of Work Area 1 (Solar PV) being fully populated with PV panels. In addition, the Battery Energy Storage System (BESS) compound (Work Area 5a), and all substations (Work Areas 4 and 5b) may contain solar panels if the final design for construction is found not to require these area for electrical infrastructure; all such areas have therefore been assumed to contain PV panels as a worst case scenario.

39 This assessment is limited to the assessment of reflections from the solar panels themselves. Any effects due to reflections from the panel framework would be negligible due to the very low framework surface area in relative terms, combined with the fact that the panels will shade the large majority, if not all of the framework from direct sunlight.

A16.1.4.1 STUDY AREAS

A16.1.4.1.1 Road and Rail Infrastructure

40 In the absence of specific guidance on the assessment of glint and glare impacts on road and rail infrastructure, the FAA 2013 guidance has become the *de facto* methodology in the UK for drivers of such vehicles.

41 The assessment criteria for road and rail infrastructure relate purely to glare intensity, rather than duration of effects. In line with FAA 2013 guidance (see Section A16.1.3.2.4), whilst 'green' glare is acceptable, any incidence of 'yellow' or 'red' glare is it is considered an adverse impact, regardless of duration.

42 For the purposes of this assessment, an appropriate study area for road and rail infrastructure was determined by the authors (Metrica Environmental Consulting Ltd) through modelling. It was found that for typical large-scale solar developments in the UK, there is no likelihood of 'yellow glare' occurring beyond approximately 375 m, based on the following typical worst-case parameters:

- A 2 km^2 (2 km x 1 km) south-facing PV array;
- No anti-reflective coating;
- Tilt angles of 20 to 30 degrees; and
- Receptors located at heights between 1.5 m and 50 m above ground level (AGL).

43 Notwithstanding the above, a study area of 500 m for road and rail infrastructure has been adopted to ensure a precautionary approach.

A16.1.4.1.2 Aerodromes And Aviation Infrastructure

44 The study areas for aerodromes based on CAA guidance (See Section A16.1.3.2.3) are as follows:

- 10 km for safeguarded civil or military aerodromes[12]; and
- 5 km for other / non-safeguarded aerodromes.

45 Notwithstanding the above, CAA guidance also states that: "*in exceptional circumstances, assessments may be required beyond 10 km".*

46 In line with the above, and as a conservative approach, an additional screening exercise was undertaken to identify additional safeguarded civil or military aerodromes, between 10 and 15 km from the Development. The screening exercise identified no additional aerodromes requiring consideration.

47 It should be noted that any approach paths within the respective study area have been included, regardless of whether the aerodrome itself is located within that study area.

A16.1.4.1.3 Residential Receptors

48 As stated in Section A16.1.3.2.1, guidance states that glint and glare effects are unlikely to be an issue for residential receptors more than approximately

[12] As defined in UK Government (2016) 'town and country planning (safeguarded aerodromes, technical sites and military explosives storage areas)', Annex 3.

100 m from PV panels. However, as this distance is approximate and dependent upon the extent of the Development and the height of receptors, the residential receptor study area for this assessment has been based upon a 200 m buffer distance in order to ensure a precautionary approach.

A16.1.4.1.4 Other Receptor Types

A16.1.4.1.4.1 Hotels, Hospitals, Schools, Offices

49 In addition to residential dwellings, fixed, ground-based receptors can also include hotels, hospitals, schools and offices. However, no such receptors have been identified within the respective 200 m study area, and have therefore not been considered further.

50 In addition, and in order to ensure a robust assessment, a planning search was conducted to identify any further properties either in planning or awaiting construction within the 200 m study area. No such properties were identified.

A16.1.4.1.4.2 Watercraft

51 The effect of glint and glare on watercraft is not typically considered in the assessment of a solar PV development, as along with their low speed, water vessels are inherently surrounded by a surface (i.e. water) which is as reflective as any proposed solar panels (see Section A16.1.1). However, as requested in the Scoping Opinion, any / all sections of the River Trent within in the study area for road and rail (i.e. 500 m) have been included in this assessment.

A16.1.4.1.4.3 Transport / Vehicles of Varying Height

52 As part of the Scoping process, consultees made reference to HGVs, agricultural vehicles and horse riders as examples of methods of transport with an increased rider / operator height AGL. These receptor types have been considered as part of the assessment of roads, as described in Section A16.1.4.2.1.

A16.1.4.1.4.4 Ecological Receptors

53 The effect of glint and glare on ecological receptors is not typically considered in the assessment of a solar PV development. Best practice guidance and assessment criteria focus on human receptors, being the most sensitive receptor type. However, as requested in the Scoping Opinion, consideration of the potential impact of glint on glare on ecological receptors has been undertaken as part of the Ecology assessment. ES Chapter 8: Ecology and Biodiversity [EN010162/APP/6.2.8] concludes that there is no potential for significant ecological effects from glint and glare to any Important Ecological Features, including designated sites and their qualifying or notified features.

A16.1.4.1.4.5 Public Rights of Way (PRoW)

54 In line with widely accepted best practice, and as accepted in previous glint and glare assessments for consented solar DCO applications[13], solar

[13] Examples include but not limited to Cottam (EN010133) and Mallard Pass (EN010127) Solar Projects

reflections experienced by users[14] of PRoWs, bridleways, or permissive paths have not been assessed in detail for the following reasons:

- Any reflections which do occur at any given location will be limited in area, infrequent, transient, and cannot occur on all routes / directions simultaneously;
- Reflections from solar panels are generally equal to or less hazardous those from waterbodies or glass windows, both of which are common features of the outdoor environment in the vicinity of PRoWs, bridleways and other routes; and
- As the PV panels do not focus light, any glint and glare effects are not injurious to health, and are easily avoidable if considered necessary.

55 With regard to bridleways and equestrian interests in general, British Horse Society guidance[15] states that…*"the incidence of glare or dazzle [from solar PV panels] is very low compared with glass"* and… *"any reflection is unlikely to be a direct problem to horses, riders or carriage-drivers because of the angles and distances involved".*

56 Taking all the above into account, there is considered to be no reasonable prospect of a significant effect in terms of the EIA Regulations, and effects have not been considered further.

A16.1.4.1.5 Exclusion Areas

57 For the ground-based receptors (i.e., residential receptors / road / rail infrastructure), no visible reflections can occur when located 'behind' the proposed PV panels; for reflections to occur, the receptor has to have line of sight to the front of a solar PV panel. For south-facing panels (as is the case for the Development), this covers bearings from 270, through 0, to 90 degrees from the northernmost panel, for receptors at the same elevation as the panels.

58 In line with the guidance detailed in Section A16.1.3.2.1, the excluded sector has been increased by a further 10 degrees on either side. In these 10-degree sectors, reflections could only occur shortly after sunrise / before sunset, and any reflections would appear to come from the same direction the direct glare from the sun itself, thereby masking any additional effects.

59 For south-facing panels (as is the case for the Development), the above process results in an exclusion area of 100 degrees either side of north, from the northernmost point in a given array area.

60 It should be noted that these exclusion areas do not apply to tall buildings (e.g., apartment blocks) and airborne receptors (i.e., aircraft). Under certain combinations of sun elevation and panel tilt angle, reflections could theoretically be observed from 'behind' the panels when viewed from a high elevation. The study areas for aerodromes and aviation infrastructure therefore remain as described in Section A16.1.4.1.2. and any buildings of more than three stories within 200 m of the PV arrays are assessed regardless of position relative to the solar arrays (no such buildings have been identified with respect to the Development).

[14] Typically ppedestrians, cyclists or horse riders.
[15] British Horse Society (April 2024) Advice on Solar Farms near routes used by equestrians.

A16.1.4.2 ASSESSMENT CRITERIA

A16.1.4.2.1 Route Receptors (Road, Rail, Waterways and Aircraft Approach Paths)

61 The assessment criteria for road, rail and aviation receptors are those described in Section A16.1.3.2.4, i.e., that the glint and glare effects are acceptable providing there is found to be no more than a low potential for after-image (i.e., 'green glare') in either direction of travel, when assessed in accordance with the SGHAT methodology. As previously stated, the SGHAT methodology is based purely upon the intensity of the glare and is not duration-dependant.

62 All national and regional routes within 500 m of the Development have been considered in both directions of travel. In line with widely accepted best practice, and as accepted in previous glint and glare assessments for consented solar DCO applications[16], modelling has been limited to national and regional routes (motorways, A roads and B roads). Local (unnumbered / unclassified)[17] roads within the 500 m study area are not modelled due to their reduced traffic densities and speeds, meaning the potential impact of any temporary reflection is inherently low.

63 By their nature, roads carry a range of traffic of varying heights. For the purposes of this assessment, a typical worst case of 2.5 m AGL has been used, being representative of the head height of horse riders, HGV and agricultural vehicle drivers. The potential for a line of a sight to the Development decreases with decreasing receptor height, due to the increasing likelihood of screening effects. As such, effects for lower height receptors such as car drivers, cyclists and pedestrians are likely to be less than those for more elevated receptors, and therefore do not require individual assessment.

A16.1.4.2.2 Air Traffic Control Towers

64 With specific regard to Air Traffic Control Towers (ATCT), FAA guidance requires that that…"*a proposed solar project will not result in ocular (i.e. glint or glare) impacts to the airport's ATCT*".

65 In the absence of more detailed guidance, the glint and glare threshold for ATCTs is therefore zero (i.e. no glint and glare is acceptable, regardless of intensity). Consequently, the Development's glint and glare impact on ATCTs has been assessed on this basis.

A16.1.4.2.3 Residential Receptors

66 The assessment criteria for residential receptors are those described in Section A16.1.3.2.1, i.e., that the glint and glare effects are acceptable providing that it occurs for no more than 30 minutes per day, or 30 hours (equivalent to 1,800 minutes) per year.

[16] Recent examples include but not limited to Cottam (EN010133) and Mallard Pass (EN010127) Solar Projects
[17] As defined in Section 1.13 of 'Guidance on road classification and the primary route network' UK Department for Transport, 2012.

A16.1.5 METHODOLOGY

A16.1.5.1 DEVELOPMENT PARAMETERS

67 For a number of design parameters relevant to the assessment of glint and glare, there is no single worst case scenario in the Development's design envelope. For example, whilst one particular tilt angle / azimuth combination may represent a worst case for one receptor, a different combination may be worst case for another receptor. It is therefore not practicable to fully assess every possible combination of parameters within the design envelope. As a worst case approach, this assessment therefore assesses glint and glare effects arising from all potential PV areas as described in Section A16.1.4 (i.e. Work Areas 1, 4, 5a and 5b). Specific parameters have been taken to be in the middle of the ranges being applied for, as follows:

- Panel Type: Fixed (non-tracking);
- Panel Surface: Smooth glass with standard anti-reflective coating;
- Panel Centre: 1.5 m AGL;
- Tilt Angle: 20 degrees; and
- Azimuth: 180 degrees (south-facing).

A16.1.5.2 MODELLING PARAMETERS

68 As discussed in Section A16.1.3.2.4, modelling and assessment of glint and glare effects has been conducted using software implementing the SGHAT methodology, which accounts for the following site-specific parameters:

- Reflection Source:
- Latitude, longitude and elevation of the Development;
- Panel tilt, height, and azimuth;
- Panel technology (fixed / tracking, and presence of textured glass and / or anti-reflective coatings);
- Propagation path;
- Local terrain;
- Existing or proposed obstructions[18] (e.g., forestry, non-sensitive buildings, etc.);
- Receptor:
- Receptor type e.g. (dwelling, road, rail, flight path, ground-based aviation assets);
- Receptor location;
- Receptor height (AGL) taken as:
  - 2 m for residential receptors;
  - 2.5 m for roads;
  - 2.75 m for train drivers; and
  - Tall structures such as Air Traffic Control Towers are modelled on a case-by case basis;
- A pupil diameter of 2 mm, focal length of 17 mm, and an ocular transmission coefficient 0.5; and

[18] Screening afforded by obstructions or intervening terrain is not calculated by the modelling software, and has therefore been determined on a receptor-specific basis where relevant.

- Field of view either side of the direction of travel (50 degrees for road, 30 degrees for rail).

A16.1.5.3 IDENTIFICATION OF RECEPTORS

69 Receptors within each study area were initially identified via online mapping, aerial imagery, and OS Addressbase data (a database which combines Royal Mail address data with buildings identified on large-scale OS mapping and provides addresses, descriptions and grid references).

70 Each receptor identified within their respective study area has then been analysed using Geographic Information Software (GIS) to exclude any derelict buildings or those which clearly have no line of sight to the Development, either through screening from local terrain, vegetation or other buildings / infrastructure.

71 In order to verify the above filtering, site visits were undertaken on the 16th and 17th July 2024. Following the site visit, where the status of a receptor or the extent of the screening present remained unclear / uncertain, the receptor has been included, to ensure a robust assessment.

72 Due to the Work Area changes since the PEIR assessment, some receptors which required assessment in the PEIR are no longer in the ES study areas. As such, these receptors no longer require detailed assessment and have therefore not been considered further. However, the numbering of all receptors remains as per the PEIR in the interest of consistency.

73 To facilitate glint and glare modelling for the purposes of this assessment, the Development's PV arrays were divided into separate areas (GG1 to GG9). It should be noted that Area GG3 and Area GG4 in the PEIR assessment have been entirely removed as part of the Development's design evolution. However, the numbering of all GG Areas has been retained for this current assessment, for ease of comparison.

74 As stated in Section 4, the PV areas assessed include all Work Areas with the potential to host solar panels (Work Areas 1, 4, 5a and 5b), thereby ensuring a worst case approach.

75 Figures A16.1.1 to A16.1.7 show a series of large scale maps for areas GG1 to GG9, showing the individual road / rail / waterway and residential dwelling study areas, and the assessed receptors. Similarly, Figure A16.1.8 presents the study areas associated with the BESS compound (Work Area 5a), should it be utilised for PV panels.

76 Figure A16.1.9 presents a small-scale figure showing an overview of the entire Development, with the numbering applied to each area, along with the study areas applicable to aviation receptors.

Figure A16.1.10 presents the study areas associated with the Development in combination with the assessed cumulative scheme (see Section A16.1.7 for details).

A16.1.5.3.1 Site Specific Aerodrome Details

A16.1.5.3.1.1 RAF Syrestron

77 RAF Syrestron is a military aerodrome located approximately 8 km south of the Development at the closest point, with three asphalt runways (Runways 06/24,15/33, and 11/29).

78 Consultation was undertaken with the Ministry of Defence (MoD) Safeguarding department (see Table A16.1.1), who confirmed that the standard assessment parameters recommended in FAA guidance are acceptable, specifically a 2-mile approach path with a 3-degree glide slope for each runway approach.

79 RAF Syrestron operates an ATCT is located at grid reference 473180, 347485, with a height of approximately 10 m AGL. A receptor height of 8 m AGL has therefore been assumed for this assessment, approximating a controller's head height when working in the ATCT cab.

A16.1.5.3.1.2 Darlton Gliding Club

80 Darlton Gliding Club operate a non-safeguarded airfield with a single grass strip located approximately 5 km north of the Development, as detailed in Figure A16.1.9 The airfield opens from 10:00 until sunset three days per week, launching winch-operated gliders for leisure purposes.

Only the airfield's southern approach to the airstrip (runway 05) is within the study area, which has been included to ensure a robust assessment.

A16.1.5.3.1.3 Beeches Farm

81 Beeches farm is a private, non-safeguarded grass airstrip located approximately 6 km east of the Development.

82 Despite this aerodrome being located wholly outwith the 5 km study area, the western approach to the airstrip (runway 10) is partially located within the study area, and has therefore been included to ensure a robust assessment.

A16.1.5.3.1.4 Caunton Airfield

83 Caunton Airfield is a non-safeguarded aerodrome with two grass airstrips (runways 03/21 and 11/29), approximately 0.5 km east of the closest Development PV array. Caunton Flying Club operate out of this airfield, flying microlights and small fixed-wing aircraft for personal use and leisure purposes.

84 Knapthorpe Lodge[19] and Muskham Wood[20] Solar Farms are proposed developments located on land immediately adjacent to the Caunton Airfield runways, between the runways and the Development. As part of the planning applications for these two developments, potential glint and glare impacts were initially identified for Caunton Airfield. However, the applicant undertook post-submission consultation with Caunton Flying Club (the

[19] Newark and Sherwood Council Planning Application Number 22/00975/FULM. Planning Appeal Reference APP/B3030/W/24/3344502
[20] Newark and Sherwood Council Planning Application Number 22/00976/FULM. Planning Appeal Reference APP/B3030/W/24/3344500

operators of the airfield) and a memorandum was submitted by the applicant including Caunton Flying Club comments, who stated:

"With the option of four different directional runways, pilots can land on any runway at their discretion...If a pilot experienced any glare that made them feel uncomfortable landing on the planned runway, then they would evaluate the situation and make a professional decision, to land on a different runway. Pilots are trained to make such decisions for all stages of flight.

85 *The Glint & Glare assessment methodology is applicable to large aircraft using large, licensed airports and aerodromes, that incorporate a long final approach, which is not applicable to Caunton Airfield."*

86 The memorandum concluded that any / all glint and glare impacts on Caunton Airfield were acceptable. No objections were raised by Caunton Airfield, National Air Traffic Safeguarding, Ministry of Defence or the Nottinghamshire Council's Environmental Health Officer for either Muskham Wood or Knapthorpe Lodge Solar Farms. Both were consented at Appeal on 31st March 2025, with the Inspector stating in both decisions:

87 *"I have no reason to disagree with the conclusion that the predicted glare would not pose an unacceptable risk towards airfield operations which should not prevent pilots from using any of the four runways or endanger them during the landing process."*

It is clear that despite the Knapthorpe Lodge and Muskham Wood Solar Farm glint and glare assessments predicting a substantial amount of 'yellow' glare for the airfield approach paths, it was determined that such reflections would not affect the safety of flights in or out of the airfield, and the impact of the solar panels was therefore acceptable. This opinion is supported by EN-3 (both extant and draft), FAA 2021 guidance as discussed in Section A16.1.3.2.4.1, and The Planning Inspectorate as described above.

88 Given the above, coupled with the fact that all Development Work Areas with the potential to host solar panels are located further from Caunton Airfield than either Knapthorpe Lodge or Muskham Wood, there is no reasonable prospect of the Development constituting a significant impact in terms of glint and glare. Notwithstanding this, modelling has been undertaken for Caunton Airfield, in the interest of transparency.

A16.1.5.3.1.5 Other Aviation Receptors

89 In addition to the above, two former military aerodromes were identified within the 10 km study area; the former RAF Gamston (now known as Retford Gamston Airport), and the former RAF Winthorpe (now Newark Air Museum).

90 RAF Gamston became a private aerodrome in 1993, and is used for small private aircraft and flying schools. This aerodrome is 10 km from the Development, and is therefore outwith the 5 km study area for non-safeguarded facilities.

91 Newark Air Museum is located approximately 4 km southeast of the Development, on the site of the former RAF Winthorpe, which became inactive in 1959. Newark Air museum does not have a serviceable runway and as such, does not require further consideration.

92 General aircraft overflights are expected to occur, however no unacceptable effects are anticipated. EN-3 states that *PV panels: "have a reflective capacity that is generally equal to or less hazardous than other objects typically found in the outdoor environment, such as bodies of water or glass buildings", and: "there is no evidence that glint and glare from solar farms results in significant impairment on aircraft safety*".

93 Given this, combined with the fact that aircraft in level flight have a more limited view of the ground that those flying a runway approach, aircraft overflights have been scoped out of a detailed assessment on the basis of there being no reasonable prosect of unacceptable glint and glare effects.

A16.1.5.4 METEOROLOGICAL FACTORS

94 For much of a given year, weather conditions will be such that bright sunshine does not occur, and thus would not give rise to glint and glare effects. At the closest Met Office long term weather station to the Development (RAF Waddington circa 25 km east of the Development), the average annual duration of sunshine is 1,631 hours[21], which is approximately 34 % of the total daylight hours during the same period. The likely total daylight hours have been accounted for as part of this assessment, as set out in Section A16.1.6.

A16.1.5.5 UNCERTAINTY AND DATA GAPS

95 As previously stated and as a worst case approach, this assessment has been undertaken to determine the potential effects of the maximum extent of all Work Areas with the potential to host PV panels.

96 The final mitigation required to mitigate glint and glare effects is dependent upon many factors, including the final location of the PV panels, their height, orientation, type and tilt, as well as screening in terms of buildings, vegetation, hedgerows etc. As such, there are a virtually infinite number of potential configurations at this stage. It is therefore a standard approach to assess an indicative layout based on the largest potential array area, with typical parameters for tilt, orientation etc. However, in order to ensure that the final mitigation properly responds to the actual design to be constructed, the detailed mitigation will be designed to match the final PV design. That final mitigation scheme will be designed will be designed in consultation with relevant parties and secured by an appropriate DCO Requirement.

97 A site visit was undertaken to confirm the presence of receptors, potential screening from vegetation and to identify any substantial deviations from the mapped terrain heights. Whilst the modelling aims to represent the real-world scenario as far as is practicable, some minor discrepancies are to be expected.

98 This assessment utilises industry standard glint and glare computer modelling software. Whilst the results are as accurate as is reasonably practicable based on the current state of knowledge, the complexity of glint

[21] Average annual sunshine hours for the most recent available period 1991-2020. Available from: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gcrws0hwg [Accessed 20/09/2024]

and glare effects inherently results in some modelling limitations. The key limitations/ assumptions are as follows:

- The modelling algorithm does not rigorously represent the detailed geometry of a PV system; detailed features such as gaps between modules, variable height of the PV array, and support structures may affect actual glare results;
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ; and
- Random number computations are utilised by various steps of the algorithm, and predicted minutes of glare can vary between runs as a result.

99 Overall, this assessment represents a typical worst case, and any uncertainties arising from the above are unlikely to affect the overall outcome and conclusions of the assessment.

A16.1.6 ASSESSMENT OF LIKELY EFFECTS

100 Table A16.1.2 presents the results of the modelling exercise. For each receptor, the table presents the total theoretical maximum annual glare duration from all potential array areas, assuming continuous sunshine during all daylight hours, along with the likely values after accounting for the likely percentage of sunshine as described in Section A16.1.5.4. As previously stated in in Section A16.1.4.2.1 the assessment criteria for mobile receptors (road, rail and aircraft) relate to glare intensity, rather than duration of effects.

101 Observation Points (OP) or linear receptors where exceedances of the assessment criteria have been predicted are highlighted in bold, and the associated result charts are presented in Annex A16.1.1. As the PV panels do not focus light, no ‘red’ glare is possible at any time at any receptor; columns for red glare have therefore excluded from Table A16.1.2 in the interest of brevity.

Table A16.1.2: Predicted Effects

Receptor	Daily Maximum Glare Duration (mins)	Theoretical Maximum Annual Glare Duration, hours			Likely Annual Glare Duration, hours		
		Green Glare	Yellow Glare	Total	Green Glare	Yellow Glare	Total
Aerodrome / Aviation Receptors							
Beeches RW10	-	0	0	0	0	0	0
Caunton RW3	-	124	232	356	42	79	121
Caunton RW11	-	326	628	954	111	214	324
Caunton RW21	-	0	1	1	0	<1	<1
Caunton RW29	-	229	522	751	78	177	255
Darlton RW5	-	0	0	0	0	0	0
Syerston RW6	-	0	0	0	0	0	0
Syerston RW11	-	0	0	0	0	0	0
Syerston RW15	-	0	0	0	0	0	0
Syerston RW24	-	0	0	0	0	0	0
Syerston RW29	-	0	0	0	0	0	0
Syerston RW 33	-	0	0	0	0	0	0
Syerston ATCT	-	0	0	0	0	0	0
Road and Rail Receptors[22]							
Road: A1	-	49	82	131	16	28	44
Road: A616	-	50	30	79	17	10	27
Road: A617	-	1	0	1	<1	0	<1
Rail: ECML	-	0	0	0	0	0	0
Residential Receptors							
Dwelling 1	0	0	0	0	0	0	0
Dwelling 2	0	0	0	0	0	0	0
Dwelling 3	29	40	0	40	13	0	13
Dwelling 4	22	15	0	15	5	0	5
Dwelling 5	22	15	0	15	5	0	5
Dwelling 6	24	20	0	20	7	0	7

[22] Results for road and rail receptors present the combined total duration of all relevant road sections within the 500 m study area.

Receptor	Daily Maximum Glare Duration (mins)	Theoretical Maximum Annual Glare Duration, hours			Likely Annual Glare Duration, hours		
		Green Glare	Yellow Glare	Total	Green Glare	Yellow Glare	Total
Dwelling 7	0	0	0	0	0	0	0
Dwelling 9	18	4	0	4	1	0	1
Dwelling 36	18	35	0	35	12	0	12
Dwelling 37	0	0	0	0	0	0	0
Dwelling 38	0	0	0	0	0	0	0
Dwelling 39	0	0	0	0	0	0	0
Dwelling 40	0	0	0	0	0	0	0
Dwelling 41	10	5	0	5	2	0	2
Dwelling 42	11	4	0	4	1	0	1
Dwelling 43	0	0	0	0	0	0	0
Dwelling 44	0	0	0	0	0	0	0
Dwelling 45	0	0	0	0	0	0	0
Dwelling 46	0	0	0	0	0	0	0
Dwelling 47	0	0	0	0	0	0	0
Dwelling 48	0	0	0	0	0	0	0
Dwelling 49	0	0	0	0	0	0	0
Dwelling 50	2	<1	0	<1	<1	0	<1
Dwelling 51	0	0	0	0	0	0	0
Dwelling 52	0	0	0	0	0	0	0
Dwelling 53	0	0	0	0	0	0	0
Dwelling 54	2	0	0	0	0	0	0
Dwelling 55	0	0	0	0	0	0	0
Dwelling 56	7	1	0	1	<1	0	<1
Dwelling 57	0	0	0	0	0	0	0
Dwelling 58	0	0	0	0	0	0	0

102 The findings arising from the above results are summarised below, for each receptor type.

A16.1.6.1 AERODROMES / AVIATION

103 With the exception of Caunton airfield, no glint and glare impacts have been predicted for any other aerodrome, either with regard to approach paths or ATCTs.

104 As discussed in Section A16.1.5.3.1.4, any glint and glare impacts that occur at Caunton Airfield would not increase the level of glare (retinal irradiance) over and above that already anticipated due to Knapthorpe Lodge and Muskham Wood Solar Farms, which have previously been confirmed as being acceptable by both the gliding club that operates from this airfield, and the Planning Inspectorate. Given this, along with the guidance in EN-3 (Section A16.1.3.2.4) and the FAA's 2021 Review of Solar Energy System Projects on Federally-Obligated Airports (Section A16.1.3.2.1), any glint and glare due to the Development is not expected to affect the safety or use of the airfield, and effects are therefore acceptable.

A16.1.6.2 ROADS

105 Based upon the worst case approach in this assessment (i.e. assuming all Work Areas with the potential for PV panels are fully utilised), the assessment has identified limited exceedances of the criterion for roads (i.e., no glare of a hazard greater than 'green' in terms of SGHAT described in Section A16.1.4.2.1).

106 These exceedances have been identified for certain stretches of the A1 (northbound), A616 (northwest-bound) and A617 (southbound) only; details of these effects are presented in Charts A16.1.19 to A16.1.33 of Annex A16.1.1.

107 Due to the revision of the Development's Work Areas since the PEIR stage, the B6325 is located entirely outwith the ES study area, and therefore has been discounted from further consideration.

A16.1.6.3 RAIL

108 The preliminary assessment has identified no exceedances of the respective criterion for the East Coast Main Line (i.e. no 'yellow' glare as defined in SGHAT and described in Section A16.1.4.2.2).

A16.1.6.4 WATERWAYS

109 As a result of the Development's design changes since the PEIR, the River Trent is now located entirely outwith the respective study area, and has therefore been discounted from further consideration.

110 No impacts on boaters are therefore anticipated.

A16.1.6.5 RESIDENTIAL RECEPTORS

111 The PEIR assessment identified one property (Dwelling 36) as likely to experience glint and glare effects in excess of the assessment criteria (i.e., 30 minutes per day or 30 hours per year). As stated in Table 16.1.1, the PV panel Works Areas which were located closest to Dwelling 36 were therefore reduced in size as part of the Development's design evolution. This has resulted in the maximum daily duration of glint and glare effects at Dwelling 36 to be reduced to 18 minutes, with a likely total duration of 12 hours per year.

112 Effects at all residential dwellings have been found to be below the respective assessment criteria, in all cases.

A16.1.7 CUMULATIVE EFFECTS

113 For those receptors where the assessment criteria are based purely on intensity (i.e. road, rail, and aviation receptors), any additional glare experienced from other developments would need to occur at precisely the same time as the glare from the Development, at the same point along the route, and from the same direction in order to result in a cumulative effect. There is considered to be no reasonable prospect of this occurring in practice and as such, the assessment of cumulative effects for these receptors has been scoped out.

114 Notwithstanding the above, cumulative effects are a consideration for receptors where the total duration is a factor (i.e., residential dwellings), as other sources of glare may increase the overall duration that glare effects are experienced, if they occur at different times.

115 The potential for cumulative impacts is therefore limited to receptors within the area where a cumulative development's 200 m study area overlaps with that of the Development.

116 The cumulative 'short list' for the Development is provided in ES Technical Appendix A2.1 [EN010162/APP/6.4.2.1], identifying any other developments either operational, consented or in planning with the potential for cumulative effects for one or more disciplines. The short list was interrogated, and 200 m buffers applied to all developments with PV arrays located within 400 m of the Development's PV arrays. This process found that only one development, Muskham Wood Solar Farm, was found to have residential dwellings within the overlapping study areas; the cumulative assessment is therefore limited to the assessment of Muskham Wood Solar Farm in combination with the Development.

117 Table A.16.1.3 presents the results of this cumulative modelling at the four receptors requiring assessment, as presented in Figure A16.1.10.

Table A16.1.2: Predicted Cumulative Effects

Receptor	Daily Maximum Glare Duration (mins)	Theoretical Maximum Annual Glare Duration, hours			Likely Annual Glare Duration, hours		
		Green Glare	Yellow Glare	Total	Green Glare	Yellow Glare	Total
Dwelling 37	0	0	0	0	0	0	0
Dwelling 38	0	0	0	0	0	0	0
Dwelling 39	22	3	2	4	1	1	2
Dwelling 40	0	0	0	0	0	0	0

118 As can be seen cumulative effects at all receptors remain below the respective assessment criteria.

119 It is also of note that the 'cumulative' effects predicted for Dwelling 39 are entirely due to Muskham Wood; there are no effects predicted at any of the four assessed properties as a direct result of the Development.

A16.1.8 POTENTIAL MITIGATION MEASURES

120 Glint and glare effects were considered throughout the design process, in order to reduce the requirement for additional mitigation measures as far as practicable, given other site-specific constraints.

121 The Development's design changes have resulted in a substantial reduction in the number of receptors affected. Where effects remain, they have been found to be below the respective assessment criteria in all cases with the exception of certain stretches of road. The locations along the roads where glare is predicted to occur are presented in Charts A16.1.19 to A16.1.33 of Annex A16.1.1.

122 The final mitigation design is dependent upon many factors, including the final PV array layouts, the precise height, orientation, type and tilt of the panels, as well as screening in the form of buildings, trees, hedgerows etc. As stated in Section A16.1.5.1, it is therefore not practicable to fully assess every possible combination of parameters within the design envelope.

123 It is therefore a standard approach to assess a layout based on the largest potential array area, with typical parameters for tilt, orientation etc, and discuss potential mitigation options for that design. However, in order to ensure that the mitigation properly responds to the actual design to be constructed, the detailed mitigation scheme will be designed to match the final PV array design.

124 A number of potential mitigation options exist, including but not limited to:

- The use of textured glass PV panels in key areas;
- Additional visual screening in the form of fencing and / or planting;
- Changes to the azimuth and / or tilt angle of the PV arrays; or
- Modifying the extent of the PV array areas.

A16.1.8.1 RESIDUAL EFFECTS

125 The mitigation options presented above are capable of reducing effects to an acceptable level. These will be incorporated into the final design to be constructed, ensuring that all residual effects are not significant in terms of the EIA Regulations.

126 The detailed mitigation scheme will be designed in consultation with relevant stakeholders, and will be submitted to the Council for their approval prior to construction. This will be secured by an appropriate DCO Requirement.

A16.1.9 CONCLUSION

127 An assessment of the potential glint and glare impacts associated with the Development has been undertaken.

128 Glint and glare effects were considered throughout the design process, in order to reduce the requirement for additional mitigation measures. This has resulted in effects being found to be acceptable at the large majority of receptors. However, based upon on assessment of the largest potential

array area, with typical parameters for tilt, orientation and panel type, some additional mitigation will be required to ensure that glint and glare effects are acceptable in all cases. In order to ensure that the mitigation properly responds to the actual design to be constructed, the detailed mitigation scheme will be designed to match the final PV array design in consultation with relevant stakeholders, and will be submitted to the Council for their approval prior to construction.

129 The EIA significance of the effects identified in this TA are determined in the respective technical discipline chapters, referencing this TA as appropriate.

A16.1.10 GLOSSARY

After-Image: An image that continues to appear in the eyes after exposure to the original image has ceased.

Axis Tracking: Motorised PV array modules which are able change their tilt and / or azimuth angle in order to face the sun as it tracks across the sky.

Azimuth: A direction or bearing defined a horizontal angle between 0° and 359° measured clockwise from North.

Elevation: height above mean sea level.

Elevation Angle: An angle that is formed between the horizontal line (0°) and the line of interest.

Field of View: The angular extent of the observable world that is seen at any given moment. For the assessment of glint and glare effects, this is typically taken as being 50° either side of the direct line of sight.

Glare: A continuous source of bright light typically received by static receptors or from large reflective surfaces.

Glare Hazard Plot: A graphical representation ocular impact as function of retinal irradiance and subtended source angle.

Glint: A momentary flash of bright light typically received by moving receptors or from moving reflectors.

Green Glare: Glare predicted with a low potential for temporary after-image.

Local Road: Smaller ‘C’ or Unclassified roads, often linking a housing estate or a village to the rest of the network, and all roads within residential areas unless specifically classified otherwise.

National Road: ‘A’ Roads or Motorways, typically with a speed limit of up to 60 mph or 70 mph, intended to provide large-scale transport links within or between geographical areas.

Ocular Impact: In this context, ocular impact is a function of retinal irradiance and subtended source angle, as plotted on a Glare Hazard Plot.

Receptor: In this context, a receptor is a potential viewer of glint and glare effects, either static or mobile.

Red Glare: Glare predicted with a potential for permanent eye damage (retinal burn),

Regional Road: Typically classed as 'B' roads in the UK, intended to connect different areas, and to feed traffic between A roads and smaller roads on the network.

Retinal Irradiance: The amount of light or other radiant energy striking the retina, measured in watts per cm^2

Subtended Source Angle: The subtended source angle is the angle formed by hypothetical lines projecting from the eye to the top and bottom (or left and right sides) of a source of glare. The subtended source angle therefore represents the size of the glare viewed by an observer.

Yellow Glare: glare predicted with a potential for temporary after-image.

ANNEX A16.1.1: RESULT CHARTS BY RECEPTOR

CAUNTON AIRFIELD

Runway 3 Approach

Area GG5

Chart A16.1.1: Times of Glare (GMT)

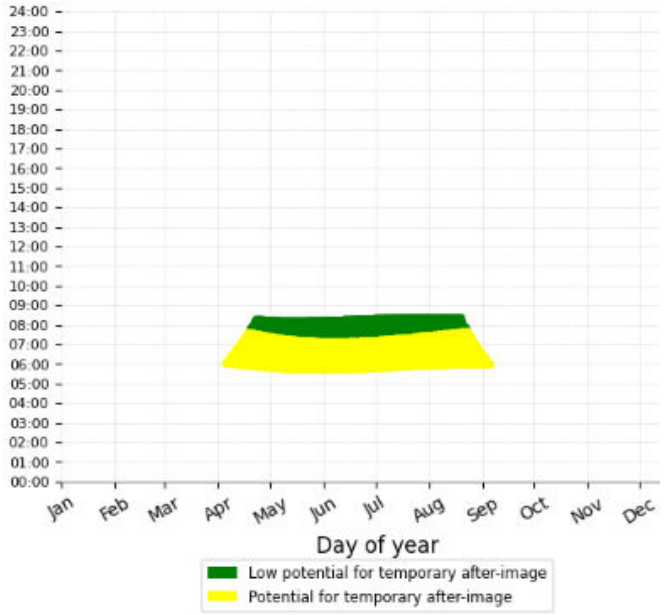


Chart A16.1.2: Position of Glare

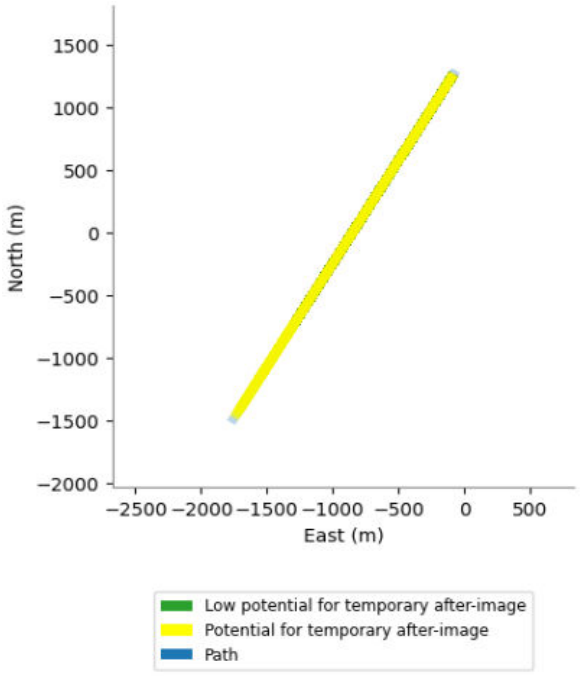
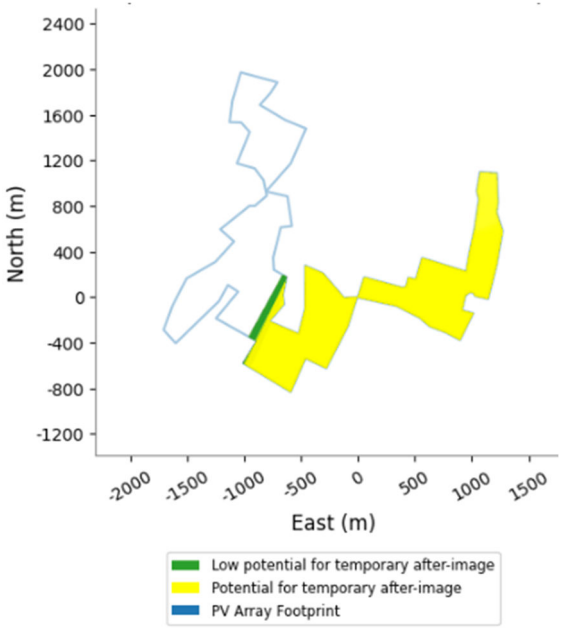


Chart A16.1.3: Approx. Source Area



CAUNTON AIRFIELD

Runway 11 Approach

Area GG5

Chart A16.1.4: Times of Glare (GMT)

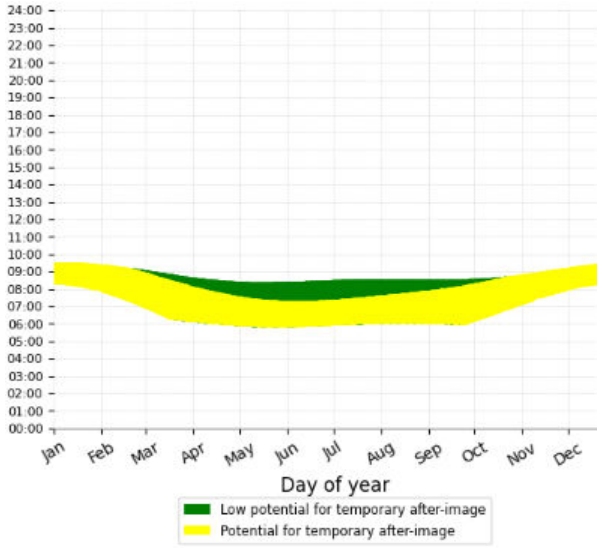


Chart A16.1.5: Position of Glare

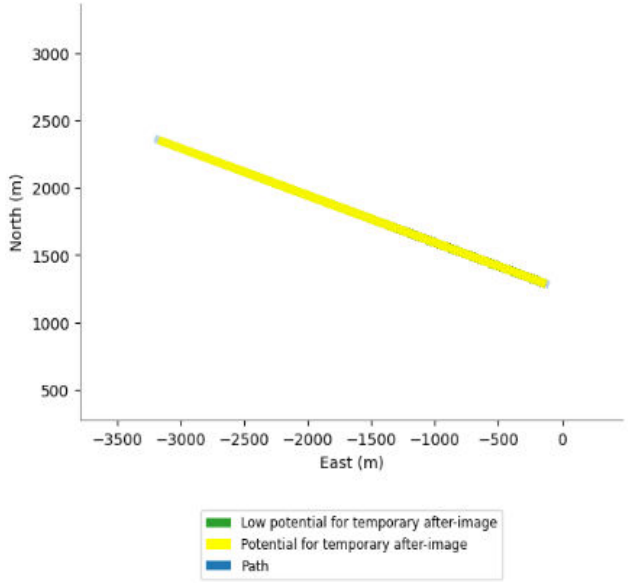
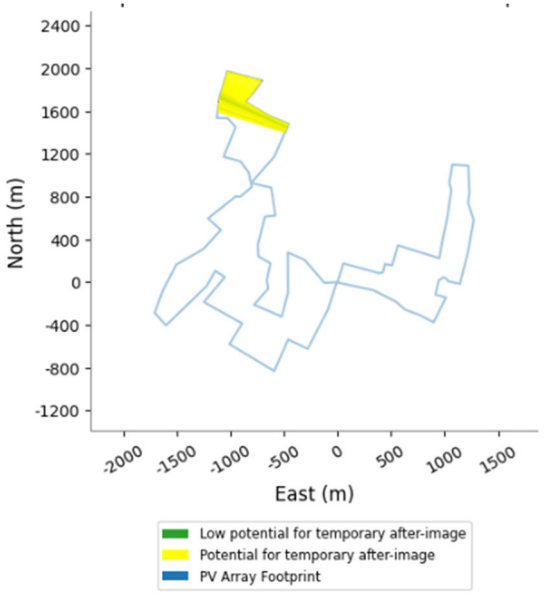


Chart A16.1.6: Approx. Source Area



CAUNTON AIRFIELD

Runway 11 Approach

Area GG6

Chart A16.1.7: Times of Glare (GMT)

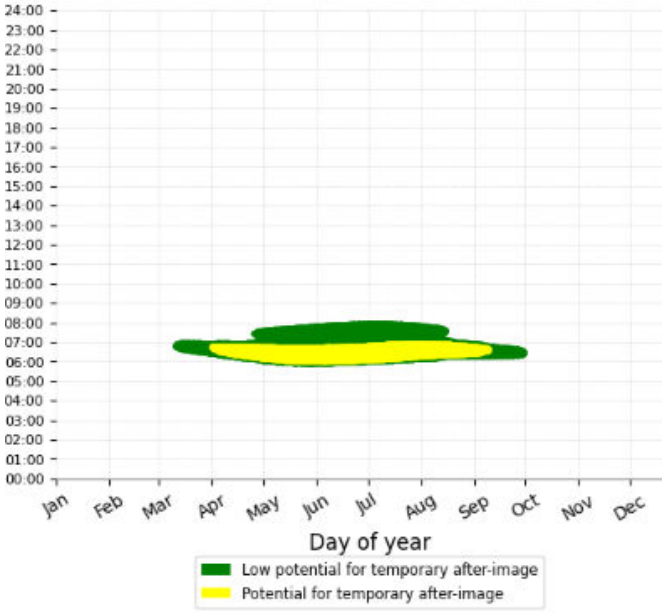


Chart A16.1.8: Position of Glare

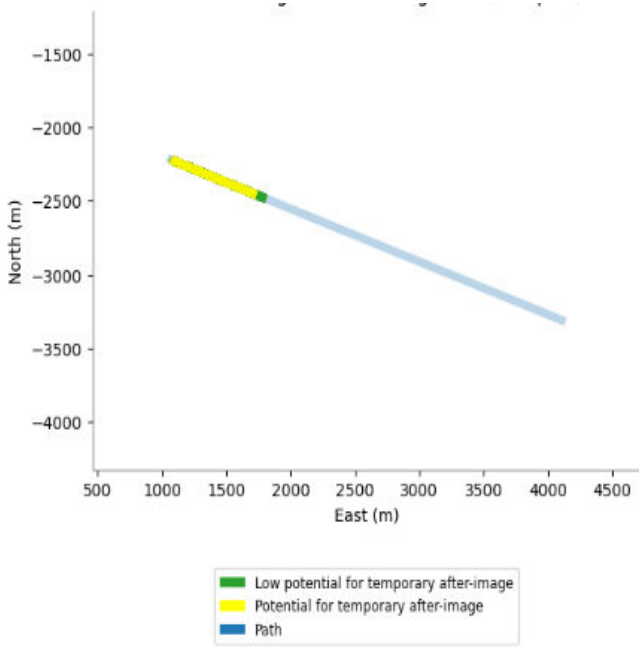
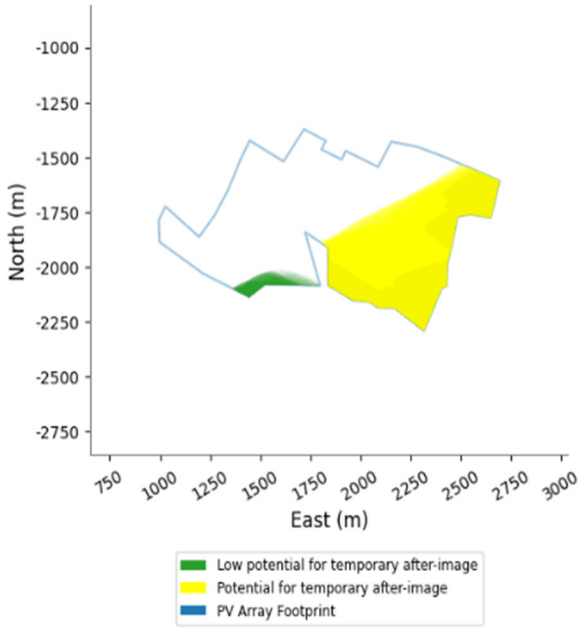


Chart A16.1.9: Approx. Source Area



CAUNTON AIRFIELD

Runway 21 Approach

Area GG5

Chart A16.1.10: Times of Glare (GMT)

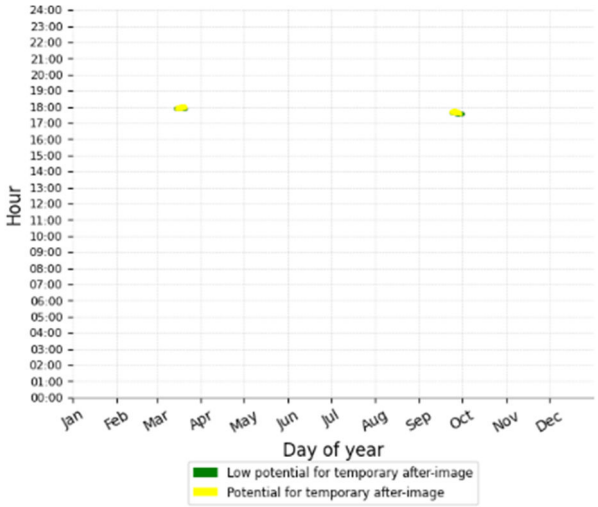


Chart A16.1.11: Position of Glare

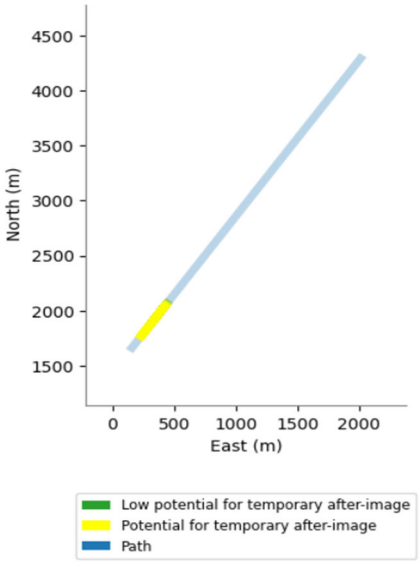
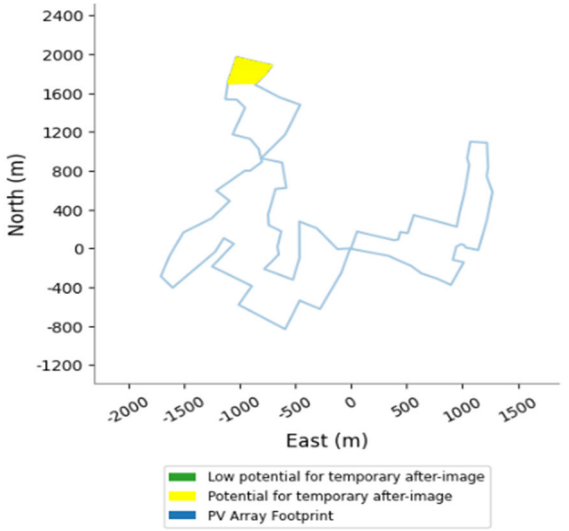


Chart A16.1.12: Approx. Source Area



CAUNTON AIRFIELD

Runway 29 Approach

Area GG5

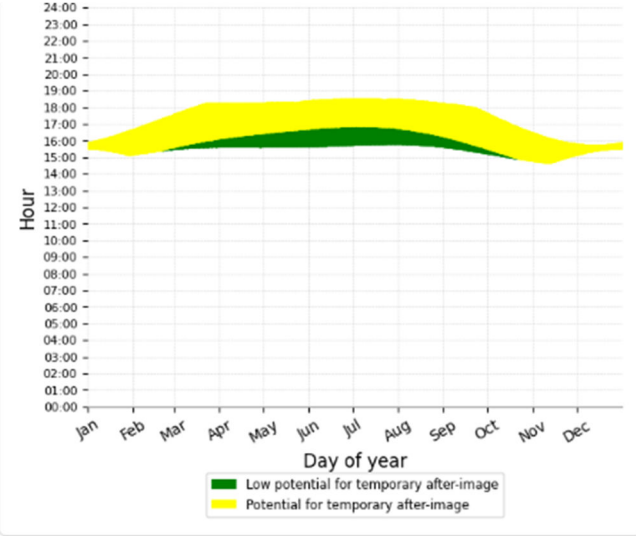
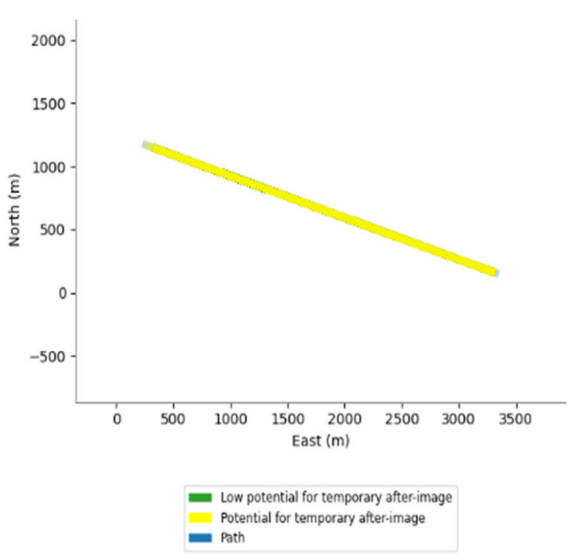
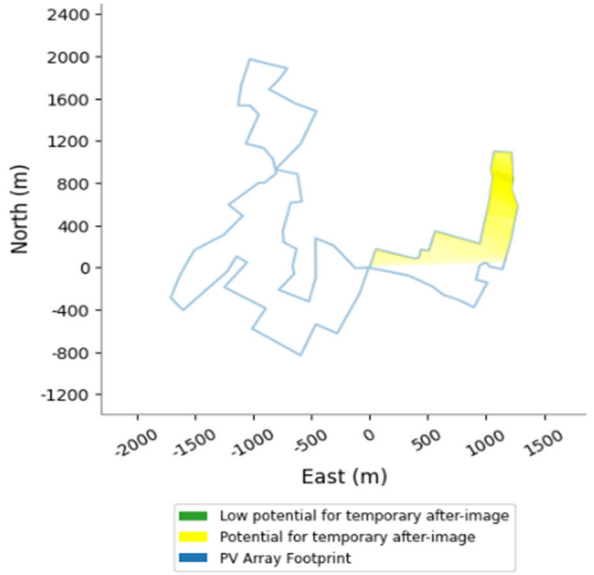


Chart A16.1.13: Times of Glare (GMT)

Chart A16.1.14: Position of Glare

Chart A16.1.15: Approx. Source Area


2000
1500
1000
500
0
−500
North (m)
0
500
1000
1500
2000
2500
3000
3500
East (m)
Low potential for temporary after-image
Potential for temporary after-image
Path


2400
2000
1600
1200
800
400
0
-400
-800
-1200
North (m)
-2000
-1500
-1000
-500
0
500
1000
1500
East (m)
Low potential for temporary after-image
Potential for temporary after-image
PV Array Footprint

CAUNTON AIRFIELD

Runway 29 Approach

Area GG6

Chart A16.1.16: Times of Glare (GMT)

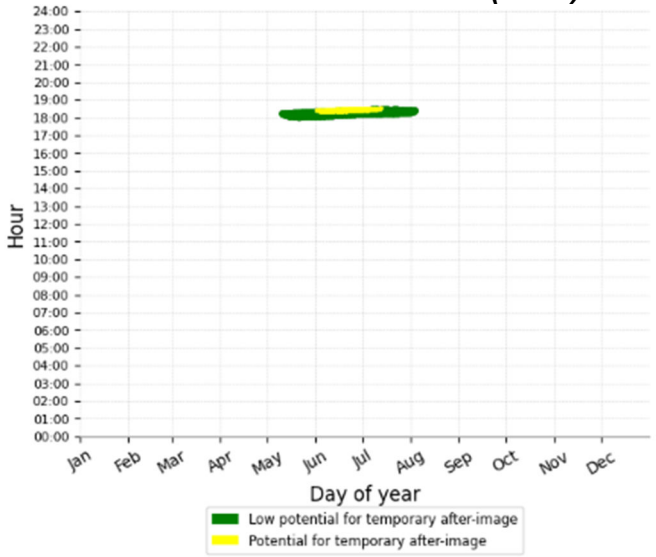


Chart A16.1.17: Position of Glare

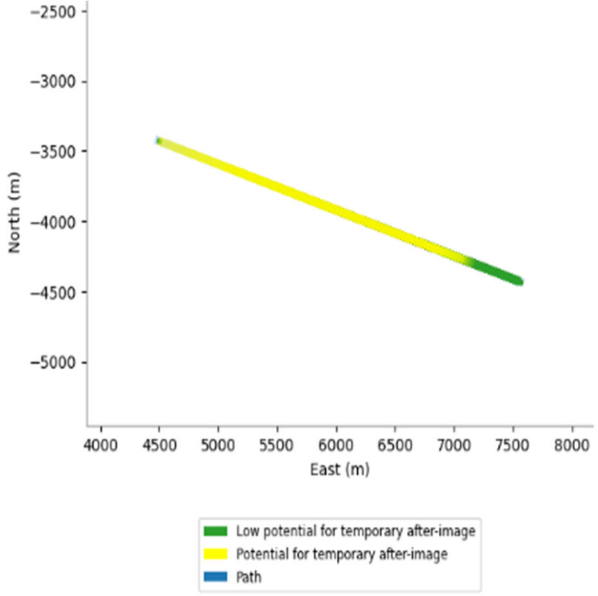
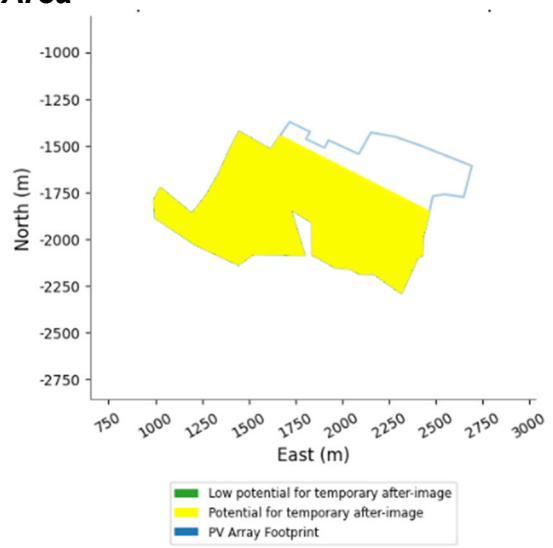


Chart A16.1.18: Approx. Source Area



ROAD: A1 (NORTHBOUND)

Area GG1

PV Array Area 1

Chart A16.1.19: Times of Glare (GMT)

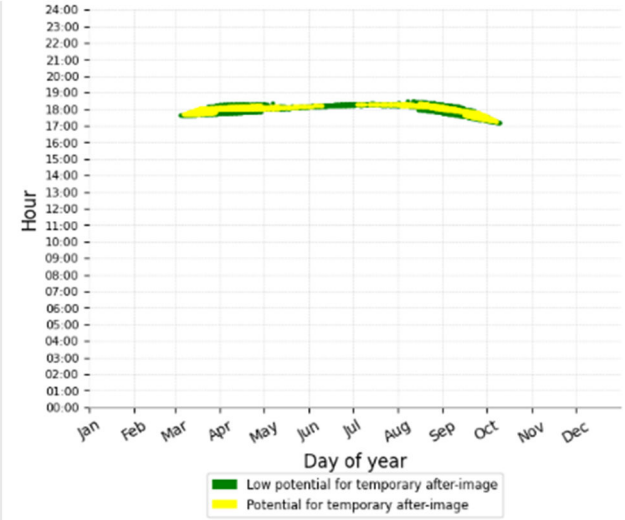


Chart A16.1.20: Position of Glare

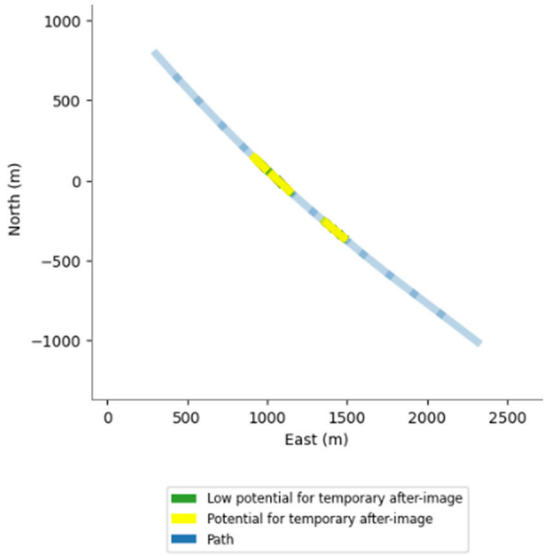
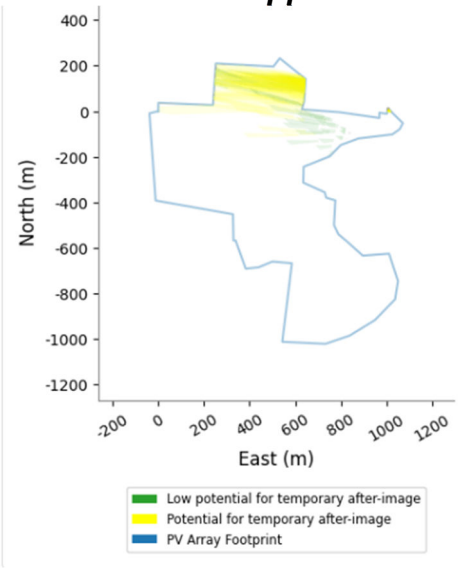


Chart A16.1.21: Approx. Source Area



ROAD: A1 (NORTHBOUND)

Area GG1

PV Array Area 2

Chart A16.1.22: Times of Glare (GMT)

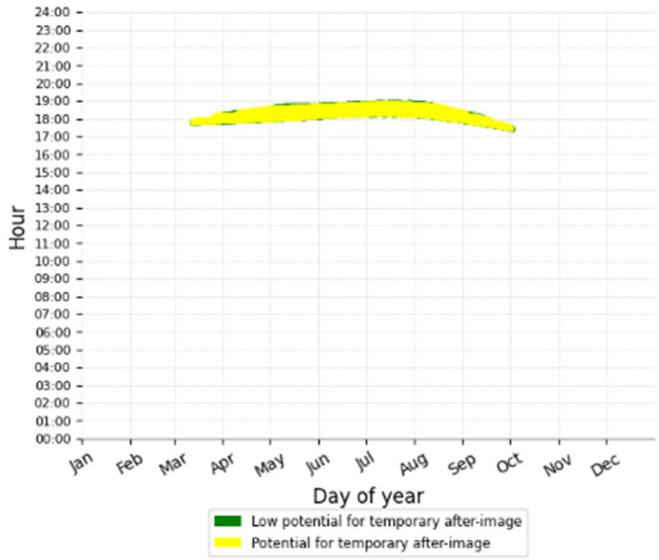


Chart A16.1.23: Position of Glare

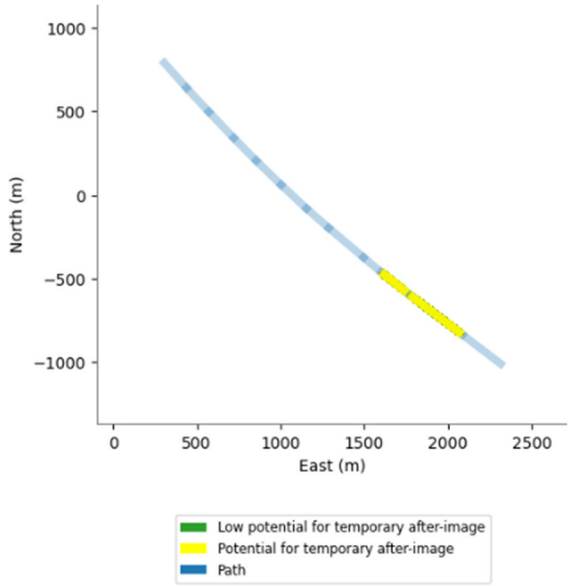
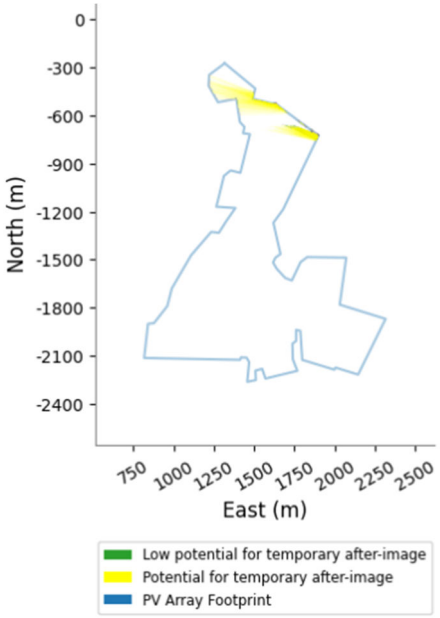


Chart A16.1.24: Approx. Source Area



ROAD: A616 (NORTHWEST-BOUND)

Area GG6

PV Array Area 3

Chart A16.1.25: Times of Glare (GMT)

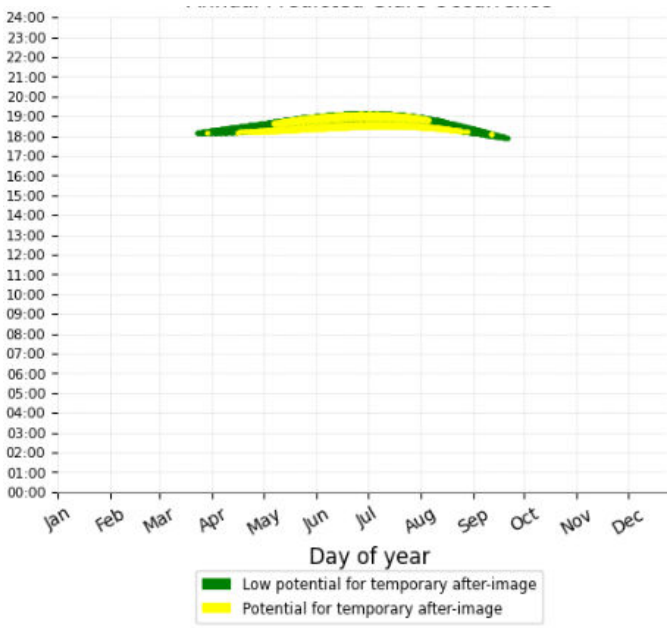


Chart A16.1.26: Position of Glare

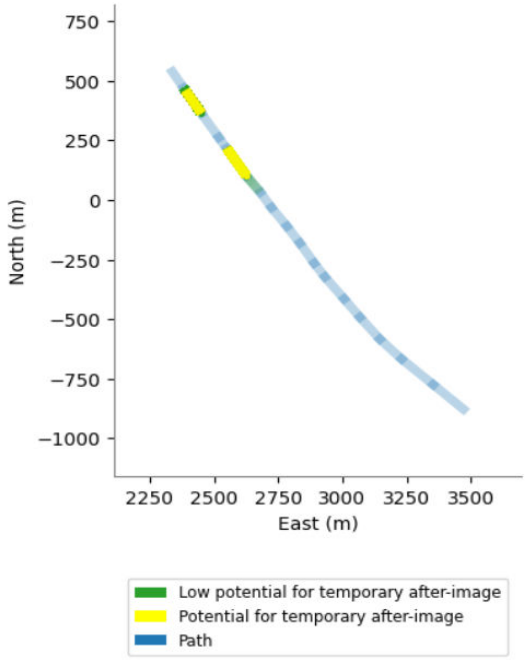
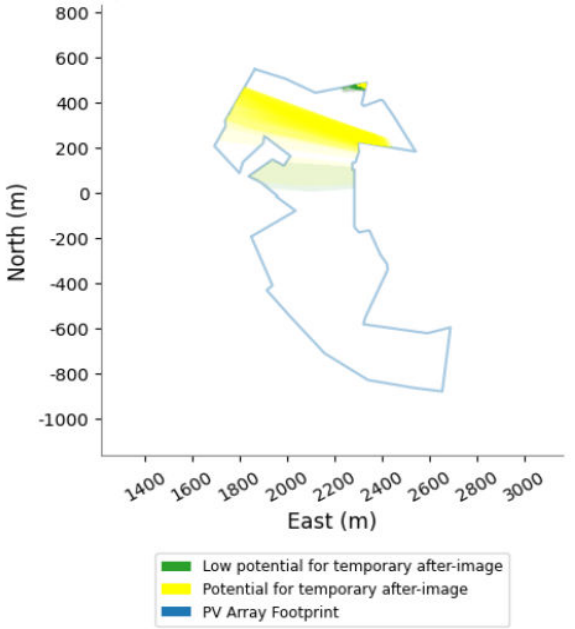


Chart A16.1.27: Approx. Source Area



ROAD: A616 (NORTHWEST-BOUND)

Area GG6

PV Array Area 4

Chart A16.1.28: Times of Glare (GMT)

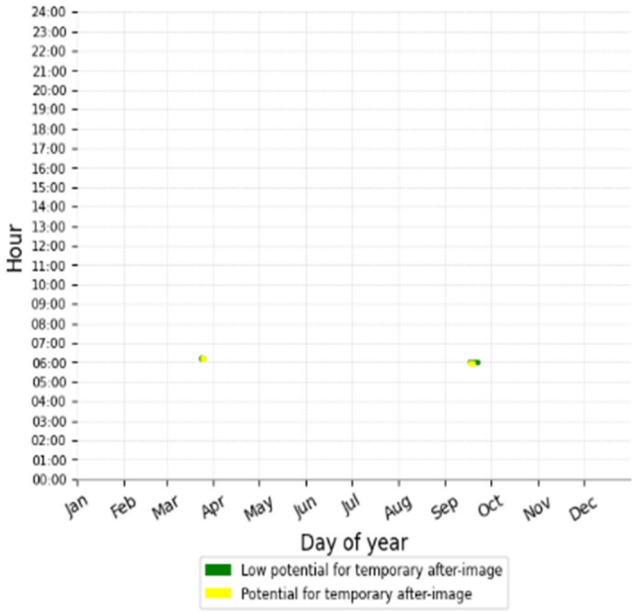


Chart A16.1.29: Position of Glare

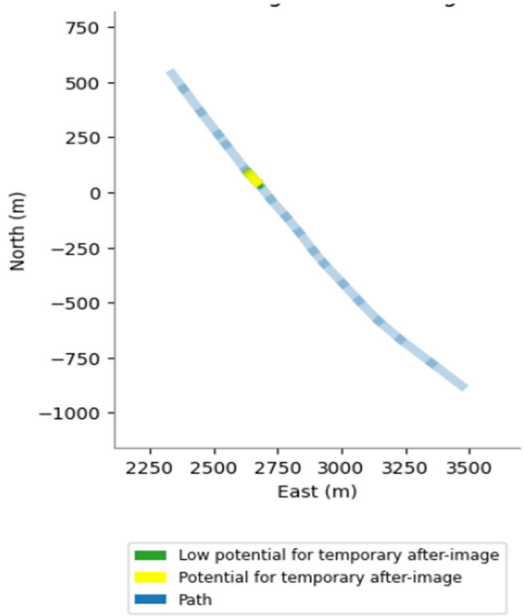
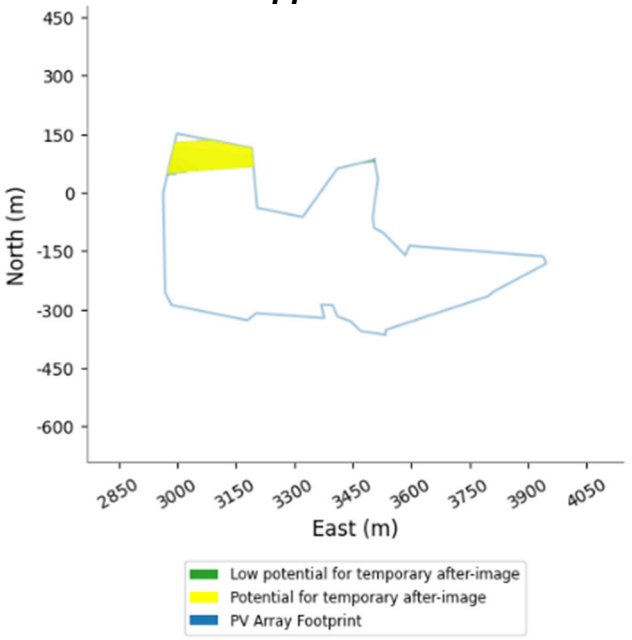
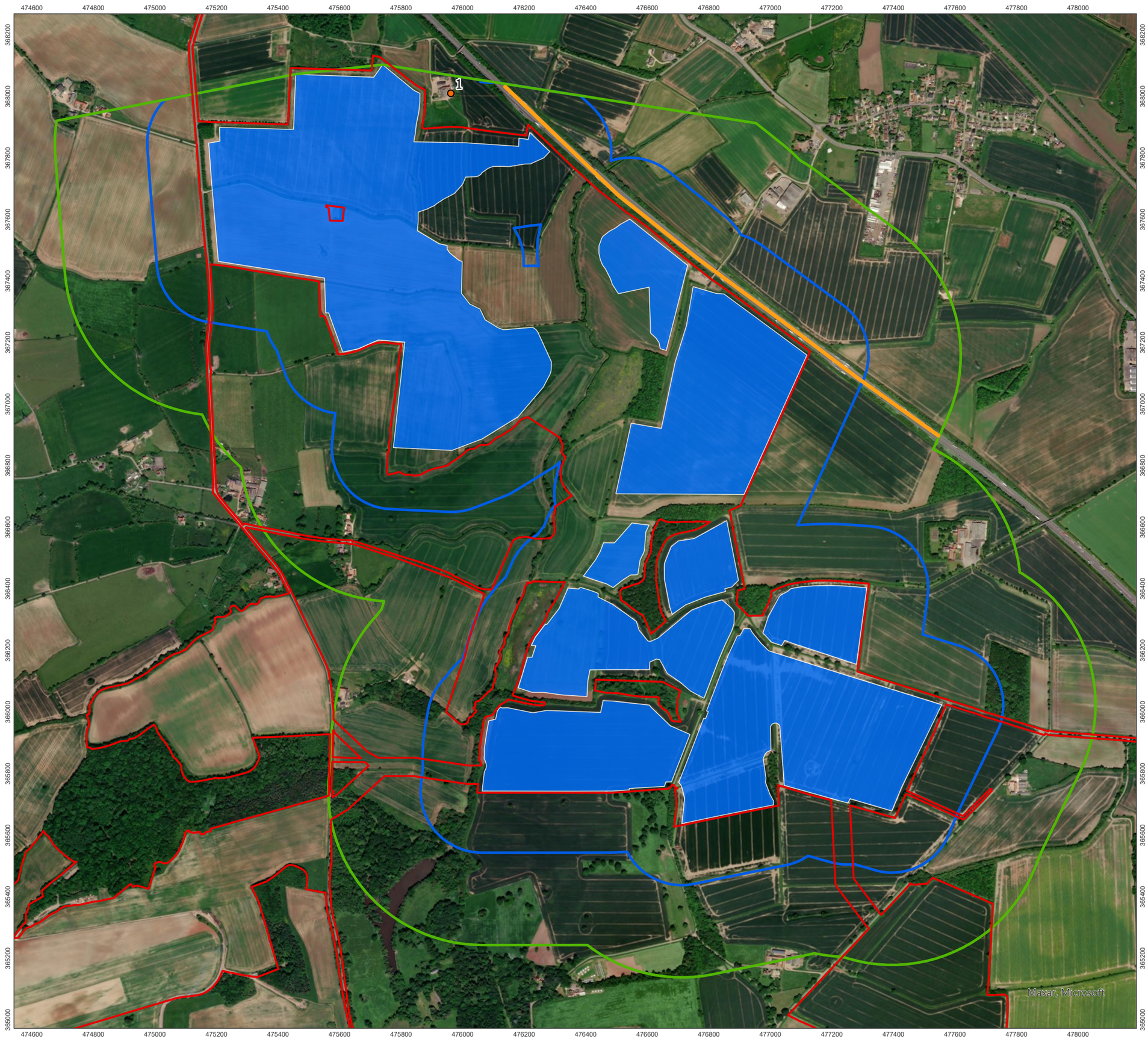


Chart A16.1.30: Approx. Source Area





Solar & Biodiversity Park

- Order Limits
- GG1
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assessed Road Receptor: A1
- Assessed Properties

1:12,000 Scale @ A3

0 125 250 500 Meters

Ref: 026-ES-A16.1.1	Date: 20/06/2025

Glint and Glare GG1 Solar Area
Figure A16.1.1

Great North Road Solar and Biodiversity Park
Environmental Statement

Solar & Biodiversity Park

- Order Limits
- GG2
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assessed Train Line East Coast Main Line
- Assessed Road A1
- Assessed Properties

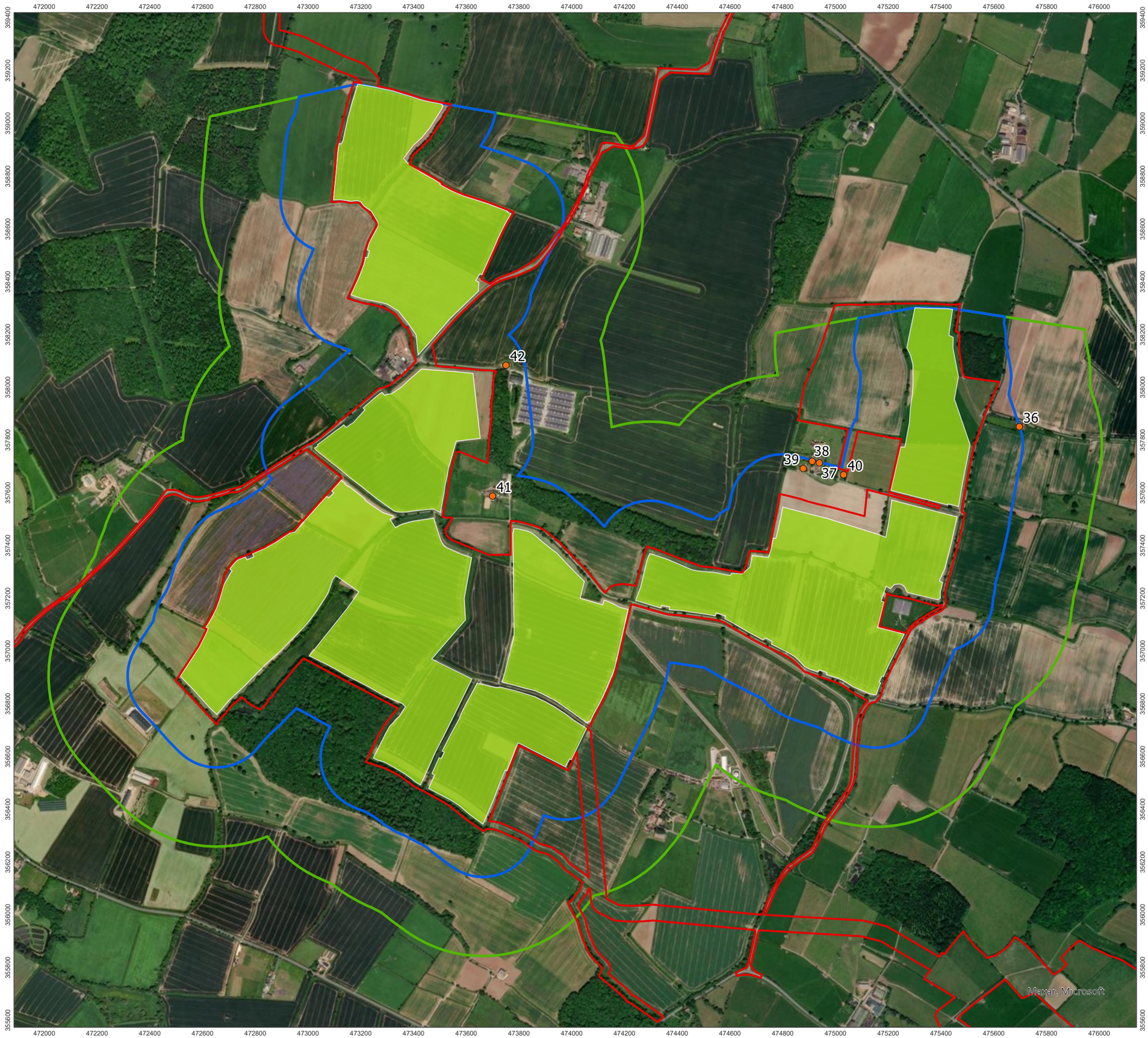
1:14,500 Scale @ A3

0 125 250 500 Meters

Ref: 026-ES-A16.1.2	Date: 20/06/2025

Glint and Glare GG2 Solar Area
Figure A16.1.2

Great North Road Solar and Biodiversity Park
Environmental Statement



Solar & Biodiversity Park

- Order Limits
- GG5
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assessed Properties

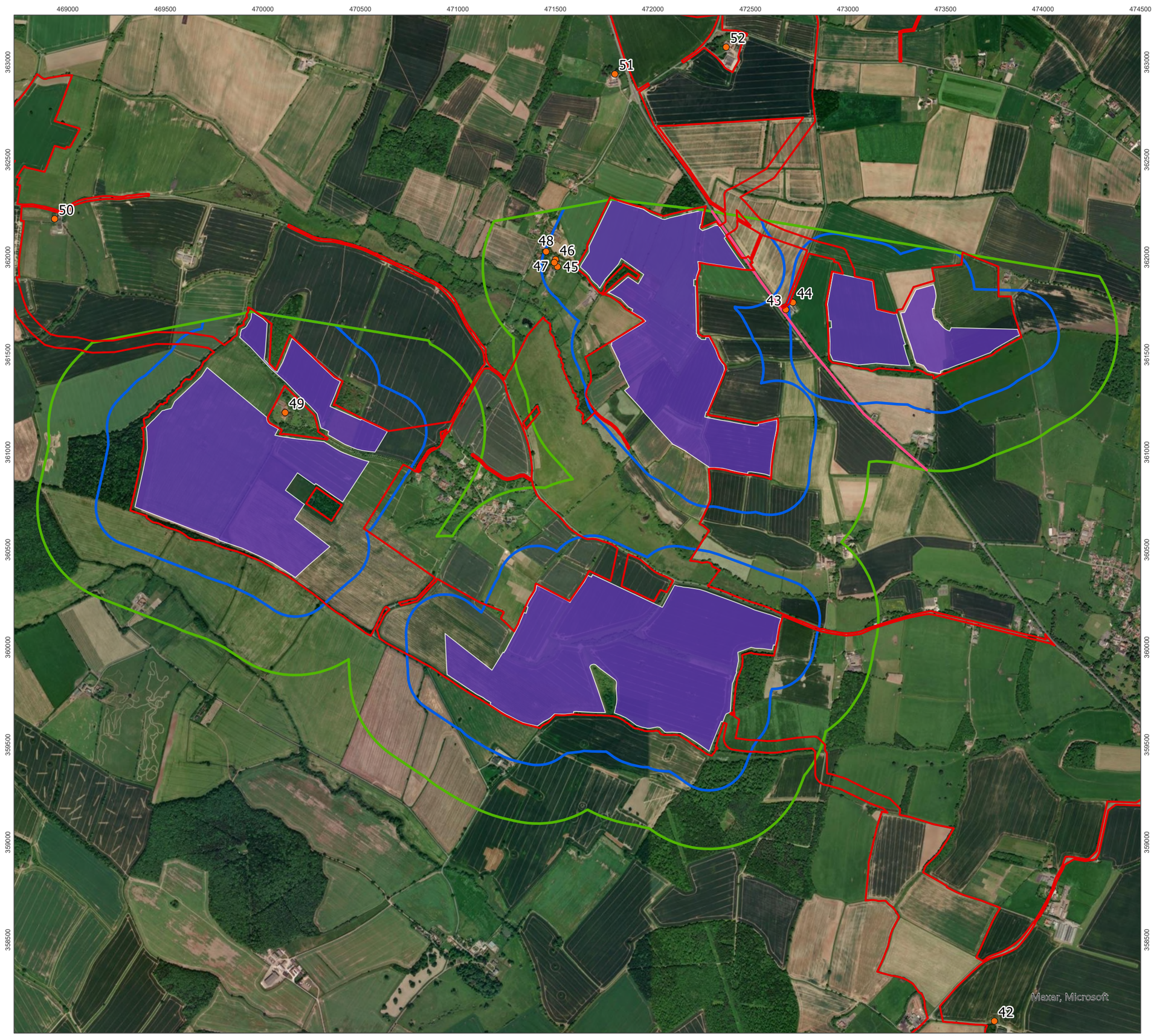
1:14,000 Scale @ A3

0 125 250 500 Meters

Ref: 026-ES-A16.1.3	Date: 20/06/2025

Glint and Glare GG5 Solar Area
Figure A16.1.3

Great North Road Solar and Biodiversity Park
Environmental Statement



Solar & Biodiversity Park

- Order Limits
- GG6
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assesed Road: A616
- Assessed Properties

1:19,000 Scale @ A3

0 125 250 500 Meters

Ref: 026-ES-A16.1.4	Date: 20/06/2025

Glint and Glare GG6 Solar Area
Figure A16.1.4

Great North Road Solar and Biodiversity Park
Environmental Statement

Solar & Biodiversity Park

- Order Limits
- GG7
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assessed Properties

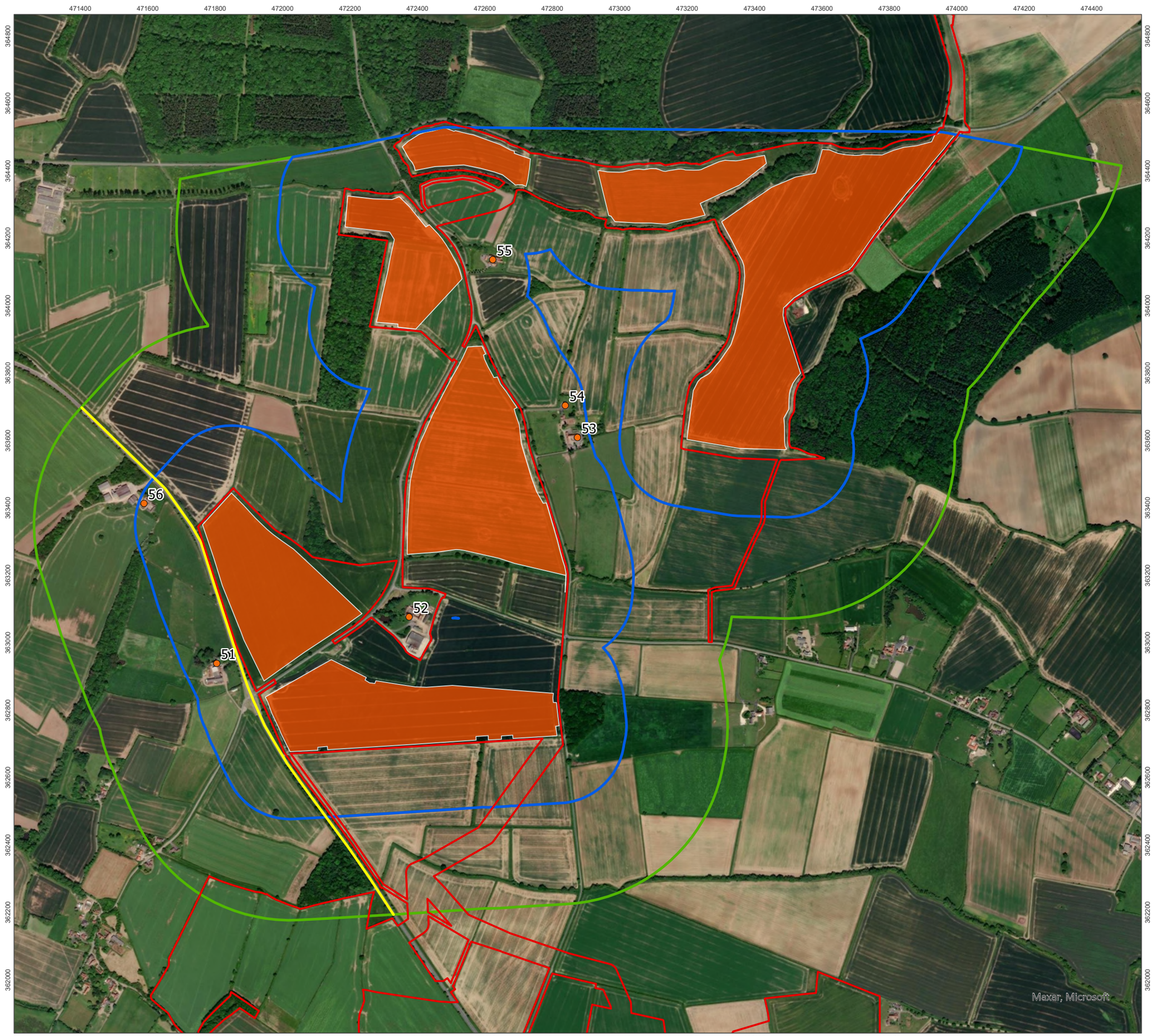
1:8,000 Scale @ A3

0 62.5 125 250 Meters

Ref: 026-ES-A16.1.5	Date: 20/06/2025

Glint and Glare GG7 Solar Area
Figure A16.1.5

Great North Road Solar and Biodiversity Park
Environmental Statement



Solar & Biodiversity Park

- Order Limits
- GG8
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assesed Road A616
- Assessed Properties

1:11,000 Scale @ A3

0 125 250 500 Meters

Ref: 026-ES-A16.1.6	Date: 20/06/2025

Glint and Glare GG8 Solar Area
Figure A16.1.6

Great North Road Solar and Biodiversity Park
Environmental Statement

Solar & Biodiversity Park

- Order Limits
- GG9
- 200 m Residential Study Area
- 500 m Road & Rail Study Area
- Assessed Properties

1:9,000 Scale @ A3

0 100 200 400 Meters

Ref: 026-ES-A16.1.7	Date: 20/06/2025

Glint and Glare GG9 Solar Area
Figure A16.1.7

Great North Road Solar and Biodiversity Park
Environmental Statement

Solar & Biodiversity Park

- Order Limits
- BESS Compound
- 400kV Substation
- 200 m BESS Study Area
- 500 m BESS Study Area
- Assessed Road A617

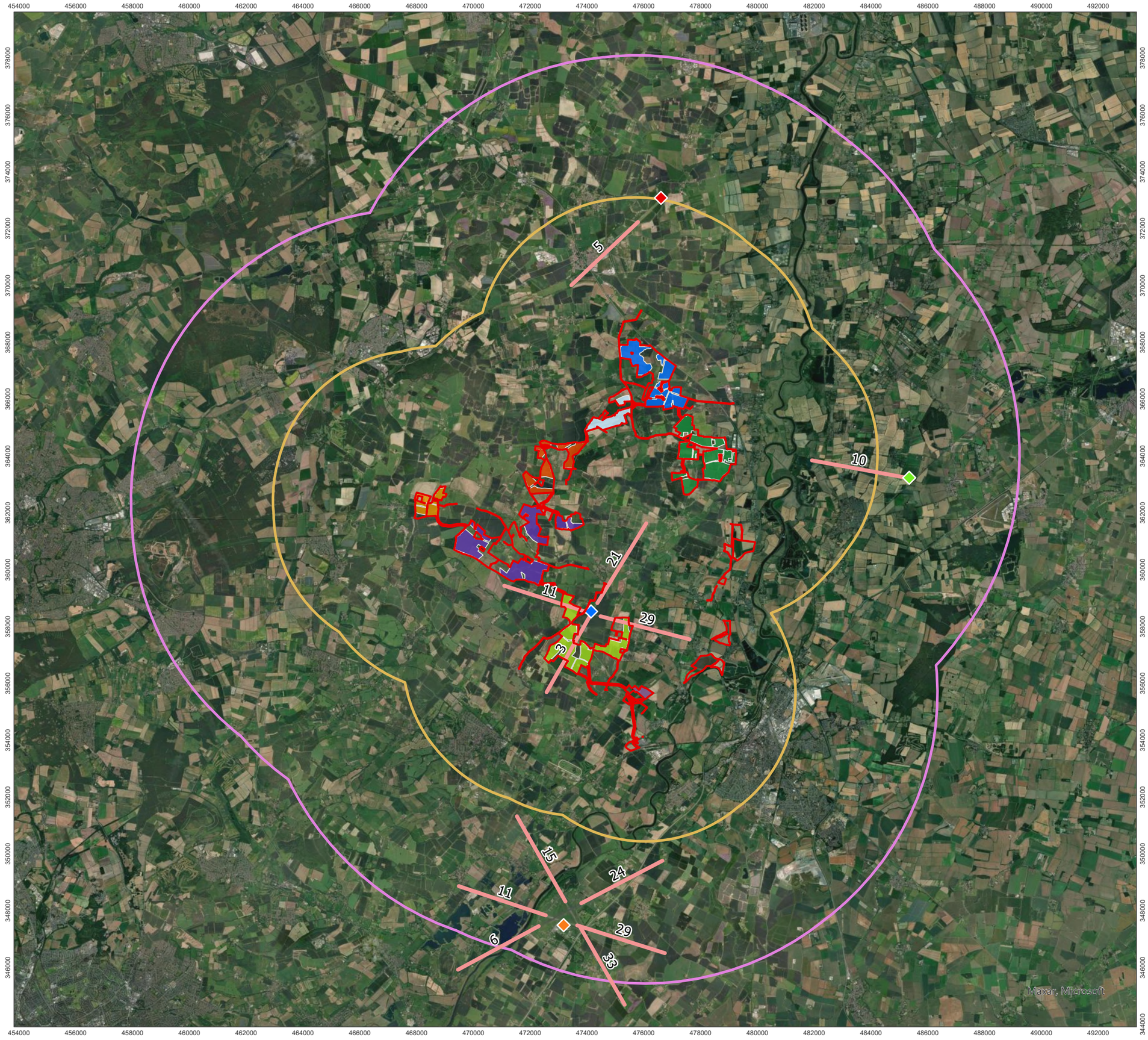
1:7,000 Scale @ A3

0 62.5 125 250 Meters

Ref: 026-ES-A16.1.8	Date: 20/06/2025

Glint and Glare BESS Area
Figure A16.1.8

Great North Road Solar and Biodiversity Park
Environmental Statement



Solar & Biodiversity Park

- Order Limits
- GG1
- GG2
- GG5
- GG6
- GG7
- GG8
- GG9
- BESS Compound
- 5 km Aviation Study Area
- 10 km Aviation Study Area
- Assessed Flight Paths
- RAF Syerston
- Beeches Farm Airstrip
- Caunton Airfield
- Darlton Gliding Club

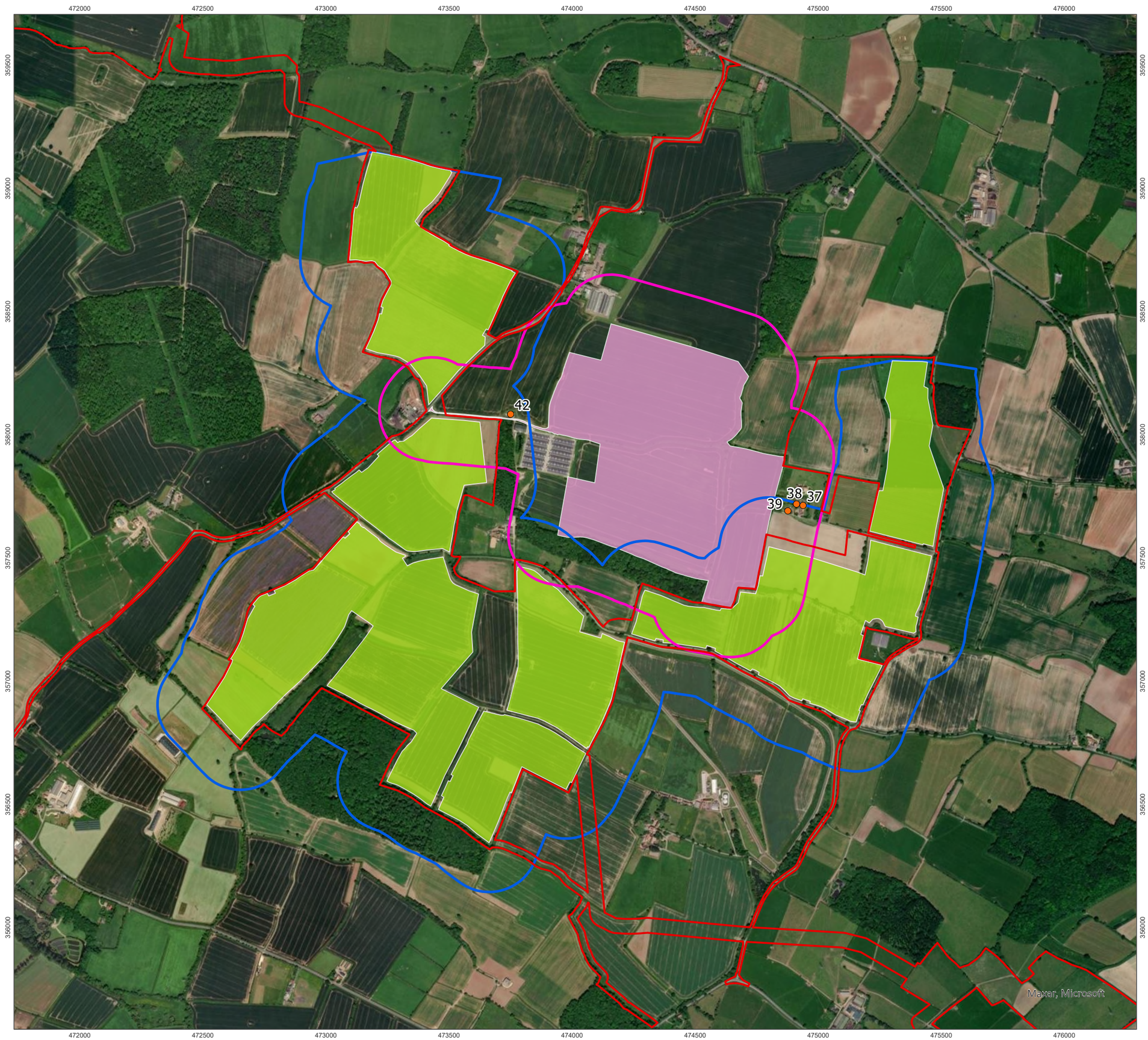
1:130,000 Scale @ A3

0 1.25 2.5 5 km

Ref: 026-ES-A16.1.9	Date: 20/06/2025

Glint and Glare Overview and Aerodrome Study Areas
Figure A16.1.9

Great North Road Solar and Biodiversity Park
Environmental Statement



Solar & Biodiversity Park

- Order Limits
- GG5
- GG5 200m Residential Study Area
- Muskham Wood Solar Farm
- Muskham Wood Solar Farm 200 m Residential Study Area
- Properties Requiring Cumulative Assessment

1:15,000 Scale @ A3

0 125 250 500 Meters

Ref: 026-ES-A16.1.10	Date: 20/06/2025

Glint and Glare Cumulative Assessment
Figure A16.1.10

Great North Road Solar and Biodiversity Park
Environmental Statement