

Glint & Glare Assessment

Hilfield Solar Farm and Battery Storage

Elstree Green Limited

July, 2021



PLANNING SOLUTIONS FOR:

- Solar
- Defence
- Airports
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- Buildings
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- Wind
- Mitigation

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ADMINISTRATION PAGE

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Issue	Date	Detail of Changes
1	19 th November 2020	Initial issue
2	23 rd November 2020	Second issue – minor amendments
3	16 th December 2020	Third issue – railway high-level assessment, initial consultation with Elstree Aerodrome manager and general amendments.
4	18 th December 2020	Forth issue – minor amendments
5	30 th June 2021	Fifth issue – Atkins Comments
6	23 rd July 2021	Sixth – minor amendments

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the possible effects of glint and glare from a proposed Solar Farm and Battery Storage development on land to the North East and West of Elstree Aerodrome, Hertfordshire.

This assessment pertains to the possible effects upon surrounding road users and dwellings as well as aviation activity associated with Elstree Aerodrome.

Consultation with Elstree Aerodrome

Pager Power consulted with Elstree Aerodrome to understand their concerns regarding the proposed development. Following the consultation, layout optimisation was completed. The aim of this task was to avoid unacceptable glare towards aviation receptors at Elstree Aerodrome and to minimise impacts overall. This has been achieved by changing panel characteristics such as tilt and orientation. The findings of the layout optimisation have informed the design team and are shown in Table 1 in Section 2.2 on page 21.

Following the receipt of the glint and glare assessment Elstree Aerodrome concluded that the proposed development will not impact upon the safety of operations at the aerodrome, and, subsequently, no objection has been raised by Elstree Aerodrome (document ref: 21/0050/FULEI).

Assessment Results – Overall Conclusion

The glint and glare assessment has shown that:

- For all aviation receptors, the maximum impact is low and no mitigation is required. Following the receipt of the glint and glare assessment Elstree Aerodrome concluded that the proposed development will not impact upon the safety of operations at the aerodrome, and, subsequently, no objection has been raised by Elstree Aerodrome (document ref: 21/0050/FULEI).
- For only four dwelling receptors, the impact is moderate under the current baseline conditions and mitigation is required. However, the developer has proposed screening at these locations which should be sufficient to remove all views of the reflective areas (further information can be found in Section 9.6). Therefore, no impact is expected.
- For only four road receptors the impact is categorised as moderate under the current baseline scenario. However, the developer has proposed screening that will be sufficient to remove all views of the reflective areas (further information can be found in Section 9.7).

Assessment Results – Aviation

ATC Tower

The analysis has shown that solar reflections from the proposed solar development towards the ATC Tower are geometrically possible. However, a review of available imagery and on-site survey have shown that visibility of the reflective area is not possible due to intervening terrain.

Therefore, no impact is expected, and no mitigation is required.

Aviation Receptors – Approach 08

The Pager Power model indicates that solar reflections are possible towards the entire runway 08 approach path. Forge predicts that at a distance of 1.1 miles from the threshold, the intensity of reflections is expected to have a potential for temporary after-image meanwhile for the rest of the approach path the intensity of reflections is expected to have a low potential for temporary after-image. Solar reflections with the potential for temporary after-image will occur at circa 6:50 GMT at the beginning of March and at circa 6:20 GMT at the beginning of October. In total solar reflections with the potential for temporary after-image are predicted for a maximum of 3 minutes per year. While glare with potential for temporary after-image has been predicted, impacts upon pilots approaching runway 08 are judged to be not significant. This is because the amount of glare where the potential for after-image is possible per year is minimal (only 0.001% of daylight time per year) and the glare produced by the panels and sunlight will generate from approximately the same point in space.

Aviation Receptors – Approach 26

The Pager Power model indicates that solar reflections are possible towards the entire runway 26 approach path. Forge predicts solar reflection with potential for after-image between threshold and 0.2 miles, at 0.8 miles from the threshold and between 1.0 mile and 1.2 miles from the threshold. At all other locations, the intensity of reflections is expected to have a low potential for temporary after-image. A review of the available imagery shows that the reflective area located west of the airport is significantly obstructed from the view of a pilot by terrain and vegetation for aircraft travelling between 0.2 miles and the threshold. Therefore, at these locations, any glare with potential for after-image will be sufficiently screened and pilots approaching runway 26 will not be affected. Solar reflections with potential for temporary after-image will occur at circa 17:30 from the end of April to the end of May and from mid-July to mid-August and at circa 18:00 from the end of May until mid-July. In total solar reflections with the potential for temporary after-image are predicted for a maximum of 172 minutes per year. While glare with potential for temporary after-image has been predicted, impacts upon pilots approaching runway 26 are judged to be not significant. This is because the amount of glare where the potential for after-image is possible per year is minimal (only 0.065% of daylight time per year) and the glare will not be generated near the threshold.

Furthermore, following the consultation with the aerodrome, it has been confirmed that in the event it is unsafe to land, pilots are required to use a different approach path.

Assessment Results - Dwellings

While the results of the analysis have shown that reflections from the proposed development are possible towards 85 of 108 identified dwelling receptors, the review of available imagery showed that screening in form of vegetation or other buildings will block all views of the reflective areas from 81 out of 85 dwelling receptors. For these 81 dwellings, no impact is expected. Four dwelling receptors located immediately east of the proposed development will concurrently experience reflections for more than 3 months per year but for less than 1 hour per day and be only partially screened under baseline conditions. The addresses of the dwellings are the following:

- 99: Medburn House Watling Street Elstree Hertfordshire WD6 3AB;
- 100: Phillimore House Watling Street Elstree Hertfordshire WD6 3AB;
- 101: 1 Medburn Cottages Watling Street Elstree Hertfordshire WD6 3AB;
- 102: 2 Medburn Cottages Watling Street Elstree Hertfordshire WD6 3AB.

The developer has subsequently proposed screening at these locations which will be sufficient to remove all views of the reflective areas (see Figure 41 on page 136). Impacts upon these dwellings will be fully mitigated once the proposed screening is established. Therefore, no impact is expected, and no mitigation is required.

Assessment Results - Roads

While the results of the analysis have shown that the solar reflections from the proposed development are geometrically possible towards 57 out of the 69 identified road receptors, the review of available imagery showed that existing screening in form of vegetation will block all views of the reflective area for 53 of those road receptors. The remaining four receptors are located on Butterfly Lane where some existing screening, which will partially screen the proposed development, has been identified (see Figure 59 on page 151). The developer has however proposed further screening which will fully block all views of the proposed development (see Figure 60 on page 152). Therefore, no impact is expected and therefore further mitigation is not required.

Public Rights of Way (PRoW) Receptors

Pager Power guidance does not recommend assessing PRoW since the sensitivity of this type of receptor is considered to be low. Therefore, any impact upon PRoW receptors will be categorised maximum as low with no need for mitigation.

Additional Documents

This report should be read considering the application as a whole and in particular the reader should refer to the following documents submitted with the application: Doc Ref R018: Landscape and Visual Impact Assessment (LVIA) Dated 18/12/2020, Doc Ref R009: Landscape and Ecological Management Plan (LEMP) (v1.9) Dated 23/04/2021 and Landscape and Ecology Enhancement Plan (LEEP) (dwg ref. 7533_012 Rev G) Dated 13/04/2021.

LIST OF CONTENTS

Administration Page	2
Executive Summary	3
Report Purpose.....	3
Consultation with Elstree Aerodrome.....	3
Assessment Results – Overall Conclusion	3
Assessment Results – Aviation.....	4
Assessment Results - Dwellings.....	5
Assessment Results - Roads.....	5
Public Rights of Way (PRoW) Receptors.....	5
Additional Documents.....	5
List of Contents	6
List of Figures.....	9
List of Tables.....	12
About Pager Power.....	13
1 Introduction	14
1.1 Overview	14
1.2 Pager Power’s Experience	14
1.3 Glint and Glare Definition.....	15
2 Proposed Development Location and Details	16
2.1 Proposed Development Location.....	16
2.2 Consultation with Elstree Aerodrome.....	21
2.3 Proposed Solar Panel Characteristics.....	21
3 Elstree Aerodrome Details.....	23
3.1 Overview	23
3.2 Airport Information.....	23
3.3 Runway Details	23
3.4 Air Traffic Control Tower.....	23

4	Glint and Glare Assessment Methodology	25
4.1	Overview	25
4.2	Guidance and Studies	25
4.3	Background.....	25
4.4	Methodology	25
4.5	Assessment Methodology and Limitations	27
5	High-Level Assessment of Railway Receptors.....	28
5.1	Overview	28
5.2	High-Level Assessment	28
6	Identification of Receptors	29
6.1	Overview	29
6.2	Air Traffic Control Tower.....	29
6.3	Approaching Aircraft.....	30
6.4	Dwellings.....	32
6.5	Roads.....	41
7	Assessed Reflector Areas.....	43
7.1	Overview	43
7.2	Reflector Areas	43
8	Glint and Glare Assessment Results	44
8.1	Overview	44
8.2	Geometric Calculation Results Overview – ATC Tower	46
8.3	Geometric Calculation Results Overview – Approach for Runway 08.....	47
8.4	Geometric Calculation Results Overview – Approach for Runway 26.....	63
8.5	Geometric Calculation Results Overview – Dwellings	72
8.6	Geometric Calculation Results Overview – Roads.....	101
9	Geometric Assessment Results and Discussion	121
9.1	Overview	121
9.2	Aviation Receptors – ATC Tower	121
9.3	Aviation Receptors – Approach 08.....	122
9.4	Aviation Receptors – Approach 26.....	125

9.5	Elstree Aerodrome Consultation.....	130
9.6	Dwellings.....	131
9.7	Roads.....	141
10	Overall Conclusions.....	154
10.1	Consultation with Elstree Aerodrome.....	154
10.2	Assessment Results – Overall Conclusion.....	154
10.3	Assessment Results – Aviation.....	154
10.4	Assessment Results - Dwellings.....	155
10.5	Assessment Results - Roads.....	156
	Appendix A – Overview of Glint and Glare Guidance.....	157
	Overview.....	157
	UK Planning Policy.....	157
	Assessment Process – Ground-Based Receptors.....	157
	Aviation Assessment Guidance.....	158
	Appendix B – Overview of Glint and Glare Studies.....	164
	Overview.....	164
	Reflection Type from Solar Panels.....	164
	Solar Reflection Studies.....	165
	Appendix C – Overview of Sun Movements and Relative Reflections.....	168
	Terrain Sun Curve - From lon: -0.324437 lat: 51.661118.....	169
	Appendix D – Glint and Glare Impact Significance.....	170
	Overview.....	170
	Impact Significance Definition.....	170
	Assessment Process – ATC Tower.....	171
	Assessment Process – Approaching Aircraft.....	172
	Assessment Process – Road Users.....	173
	Assessment Process – Dwellings.....	174
	Appendix E – Pager Power’s Reflection Calculations Methodology.....	175
	Appendix F – Assessment Limitations and Assumptions.....	177
	Pager Power’s Model.....	177

Sandia National Laboratories' (SGHAT) Model	178
Appendix G – Receptor and Reflector Area Details	179
ATC Tower Receptor Details.....	179
The Approach Path for Aircraft Landing on Runway 08	180
The Approach Path for Aircraft Landing on Runway 26	181
Dwelling Receptor Details.....	182
Road Receptor Details.....	186
Appendix H – Geometric Calculation Results – Pager Power Results.....	190
Aviation	190
Dwellings.....	216
Roads 218	
Appendix I – LEEP plan.....	220

LIST OF FIGURES

Figure 1 – Proposed development	16
Figure 2 – Zoomed view of the area located south-west.....	18
Figure 3 – Zoomed view of the area located north-west.....	18
Figure 4 – Proposed solar development location.....	19
Figure 5 – Close up image of both areas.....	20
Figure 6 – Solar panel characteristics	22
Figure 7 – Elstree Aerodrome (Aerodrome Chart – ICAO)	24
Figure 8 – Railway line location relative to the proposed development	28
Figure 9 – ATC Tower at Elstree Aerodrome.....	29
Figure 10 – Approach and ATC Tower receptor locations.....	31
Figure 11 – Assessed dwellings receptors.....	33
Figure 12 – Assessed dwellings receptors (dwellings 0 to 8).....	34

Figure 13 – Assessed dwellings receptors (dwellings 9 to 22)	35
Figure 14 – Assessed dwellings receptors (dwellings 23 to 28).....	36
Figure 15 – Assessed dwellings receptors (dwellings 29 to 59).....	37
Figure 16 – Assessed dwellings receptors (dwellings 60 to 80).....	38
Figure 17 – Assessed dwellings receptors (dwellings 81 to 94 and 97 - 98).....	39
Figure 18 – Assessed dwellings receptors (dwellings 99 to 107)	40
Figure 19 – Assessed roads receptors.....	42
Figure 20 – Assessed Reflector Areas	43
Figure 21 – Reflective areas for ATC Tower.....	121
Figure 22 – View from the ATC Tower towards the proposed development.....	122
Figure 23 – Site survey picture taken from the western panel array fields by Hilfield Farm looking back up towards the aerodrome	122
Figure 24 – PV array 1 solar reflection (Forge analysis).....	123
Figure 25 – View of the reflective area at 1.1 miles from the runway 08 threshold..	124
Figure 26 – Location of the sun in the sky at the time of reflection (1 st October at 6:20am)	125
Figure 27 - View of the reflective area at 0.2 miles from the runway 26 threshold...	126
Figure 28 – PV array 13 south western section (13b) solar reflection (Forge analysis)	127
Figure 29 – PV array 16 solar reflection (Forge analysis).....	128
Figure 30 – View of the reflective area at 0.8 miles from the runway 26 threshold..	129
Figure 31 – View of the reflective area at 1.2 miles from the runway 26 threshold..	129
Figure 32 – Location of the sun in the sky at the time of reflection (1 st April at 17:30)	130
Figure 33 – Location of dwellings 23 and 24 relative to the reflective area and level of screening.....	131
Figure 34 – Proposed screening for dwelling 23 and 24.....	132
Figure 35 – Level of screening from dwelling 28	132
Figure 36 – Location of dwellings 88 to 91 relative to the reflective area and level of screening.....	134

Figure 37 – Screening (proposed and existing) dwellings 88 to 91	134
Figure 38 – Existing screening for dwelling 88, 89, 90 and 91	135
Figure 39 – Location of dwellings 99 to 102 relative to the reflective area and level of screening.....	135
Figure 40 – Screening (green line) to reduce the impact upon dwellings 99 to 102 ..	136
Figure 41 – Proposed mitigation screening for dwelling 99 to 102.....	136
Figure 42 – Existing screening for dwellings 0 to 8 and 27 and 28.....	137
Figure 43 – Existing screening for dwellings 9 to 22 and 29 to 40	138
Figure 44 – Existing screening for dwellings 60 to 87	139
Figure 45 – Existing screening for dwellings 92 to 98	140
Figure 46 – Potentially affected locations on M1.....	142
Figure 47 – Roadside screening for M1 at receptor 5 facing receptor 6	143
Figure 48 – Roadside screening for M1 at receptor 10 facing receptor 11	143
Figure 49 – Potentially affected locations on the A41	144
Figure 50 – Roadside screening for the A41 at receptor 21 proceeding south-east..	145
Figure 51 – Potentially affected locations on Hilfield Lane	146
Figure 52 – Roadside screening for Hilfield Lane at receptor 37 proceeding north...	147
Figure 53 – Roadside screening for Hilfield Lane at receptor 35 proceeding north...	147
Figure 54 – Potentially affected locations on Aldenham Road	148
Figure 55 – Roadside screening for Aldenham Road at receptor 46 proceeding north	149
Figure 56 – Roadside screening for Aldenham Road at receptor 47 proceeding north	149
Figure 57 – Roadside screening for Aldenham Road at receptor 48 proceeding north	150
Figure 58 – Potentially affected locations on Butterfly Lane	151
Figure 59 – Roadside screening for Butterfly Lane at receptor 57 proceeding towards 56	151
Figure 60 – Proposed Screening (green and light blue line) to eliminate any impact upon drivers travelling along Butterfly lane.....	152

Figure 61 – Potentially affected locations on the A5183..... 153
 Figure 62 – Roadside screening for the A5183 at receptor 62 proceeding south..... 153

LIST OF TABLES

Table 1 - Panel characteristics per each site 22
 Table 2 – Glare intensity designation 44
 Table 3 – Geometric analysis results for the ATC Tower 46
 Table 4 – Geometric analysis results for the Runway 08 Approach 62
 Table 5 – Geometric analysis results for the Runway 26 Approach 71
 Table 6 – Geometric analysis results for dwelling receptors 100
 Table 7 – Geometric analysis results for M1 receptors 103
 Table 8 – Geometric analysis results for the A41 receptors..... 106
 Table 9 – Geometric analysis results for Hilfield Lane receptors..... 111
 Table 10 – Geometric analysis results for Aldenham Road receptors 115
 Table 11 – Geometric analysis results for Butterfly Lane receptors 118
 Table 12 – Geometric analysis results for the A5183 receptors..... 120

ABOUT PAGER POWER

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 48 countries within South Africa, Europe, America, Asia and Australasia.

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

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems. Over the years, the company has expanded into numerous fields including:

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

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

With regards to aviation glint and glare assessment Pager Power has extensive experience in assessing solar developments, including those located near aerodromes for which “visual approach” is the only available approach type.

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

1 INTRODUCTION

1.1 Overview

Pager Power has been retained to assess the possible effects of glint and glare from a proposed Solar Farm and Battery Storage development on land to the North East and West of Elstree Aerodrome, Hertfordshire.

This assessment pertains to the possible effects upon surrounding road users and dwellings as well as aviation activity associated with Elstree Aerodrome. This report therefore contains the following:

- Details of the proposed solar development;
- Explanation of glint and glare;
- Overview of relevant guidance;
- Overview of relevant studies;
- Identification of aviation concerns and receptors;
- Assessment methodology;
- Glint and glare assessment for:
 - Road user locations;
 - Dwelling locations;
 - Air Traffic Control (ATC) Tower;
 - Locations on the approach paths.
- Results discussion;

The relevant technical analysis is presented in each section. Following the assessment, conclusions and recommendations are made.

This report is solely desk based and no site visit undertaken by Pager Power has taken place. However, the applicant has carried out a site visit and provided images (see Figure 23 on page 122).

1.2 Pager Power's Experience

Pager Power has undertaken over 650 Glint and Glare assessments internationally. The studies have included assessment civil and military Airports, railway infrastructure and other ground-based receptors including roads and dwellings. With regards to aviation glint and glare assessment Pager Power has extensive experience in assessing solar developments located near aerodromes, including those for which "visual approach" is the only available approach type. The company's own glint and glare guidance is based on industry experience and extensive consultation with industry stakeholders including airports and aviation regulators.

1.3 Glint and Glare Definition

The definition of glint and glare can vary however, the definition used by Pager Power is as follows:

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

These definitions are aligned with those of the Federal Aviation Administration (FAA) in the United States of America. The term 'solar reflection' is used in this report to refer to both reflection types i.e. glint and glare.

2 PROPOSED DEVELOPMENT LOCATION AND DETAILS

2.1 Proposed Development Location

The layout of the proposed development is shown in Figure 1¹ below. A closer view of the development is shown in Figure 2 and Figure 3 on pages 18 and 18 respectively), the areas considered for the assessment are shown in Figure 4² (yellow lines) on page 19.

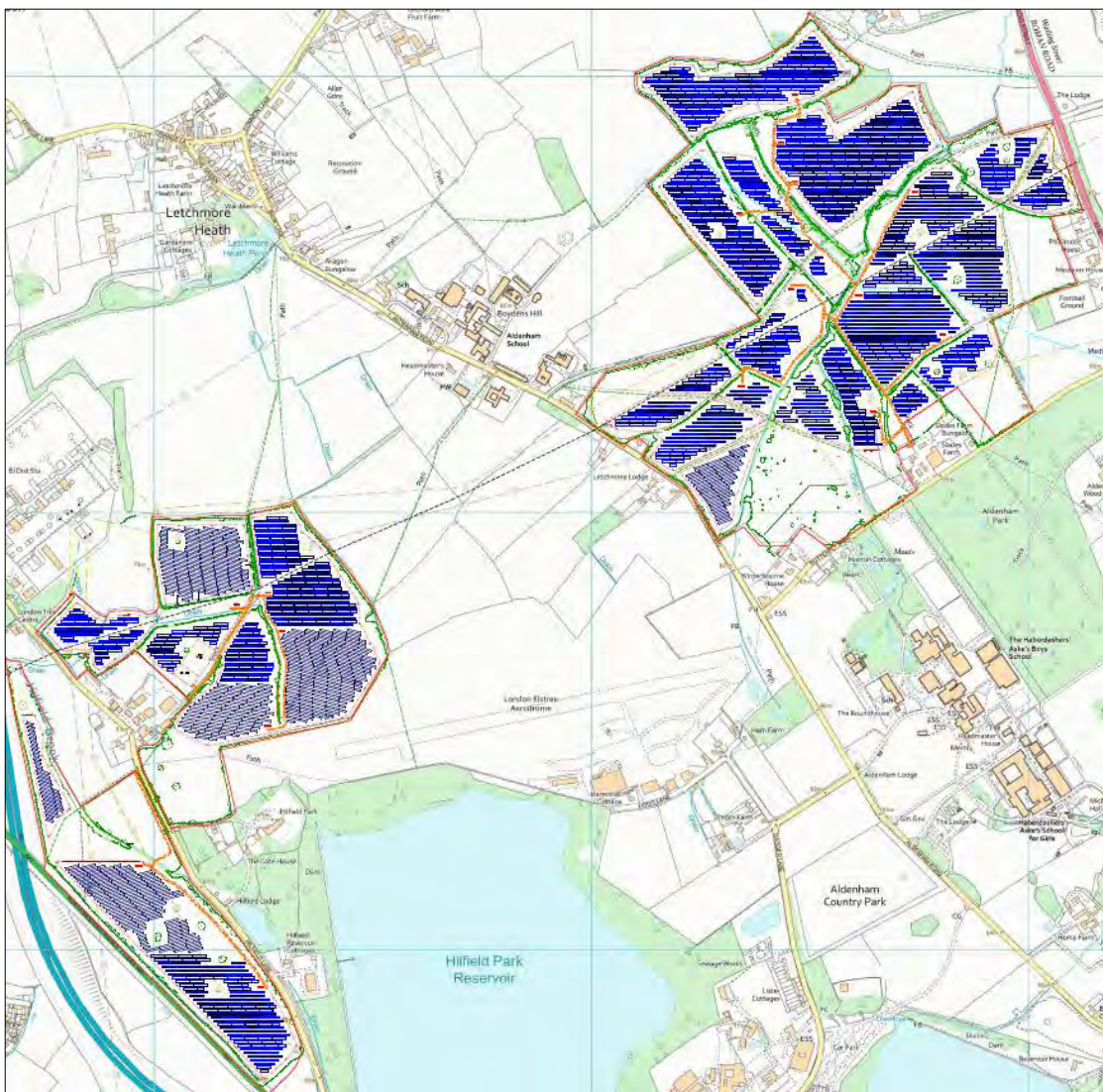


Figure 1 – Proposed development

¹ Proposed Site Layout Plan, Blueleaf Energy, date: 01/12/2020, Drawing No.: HF2.0, cropped.

² Source: Copyright © 2020 Google.

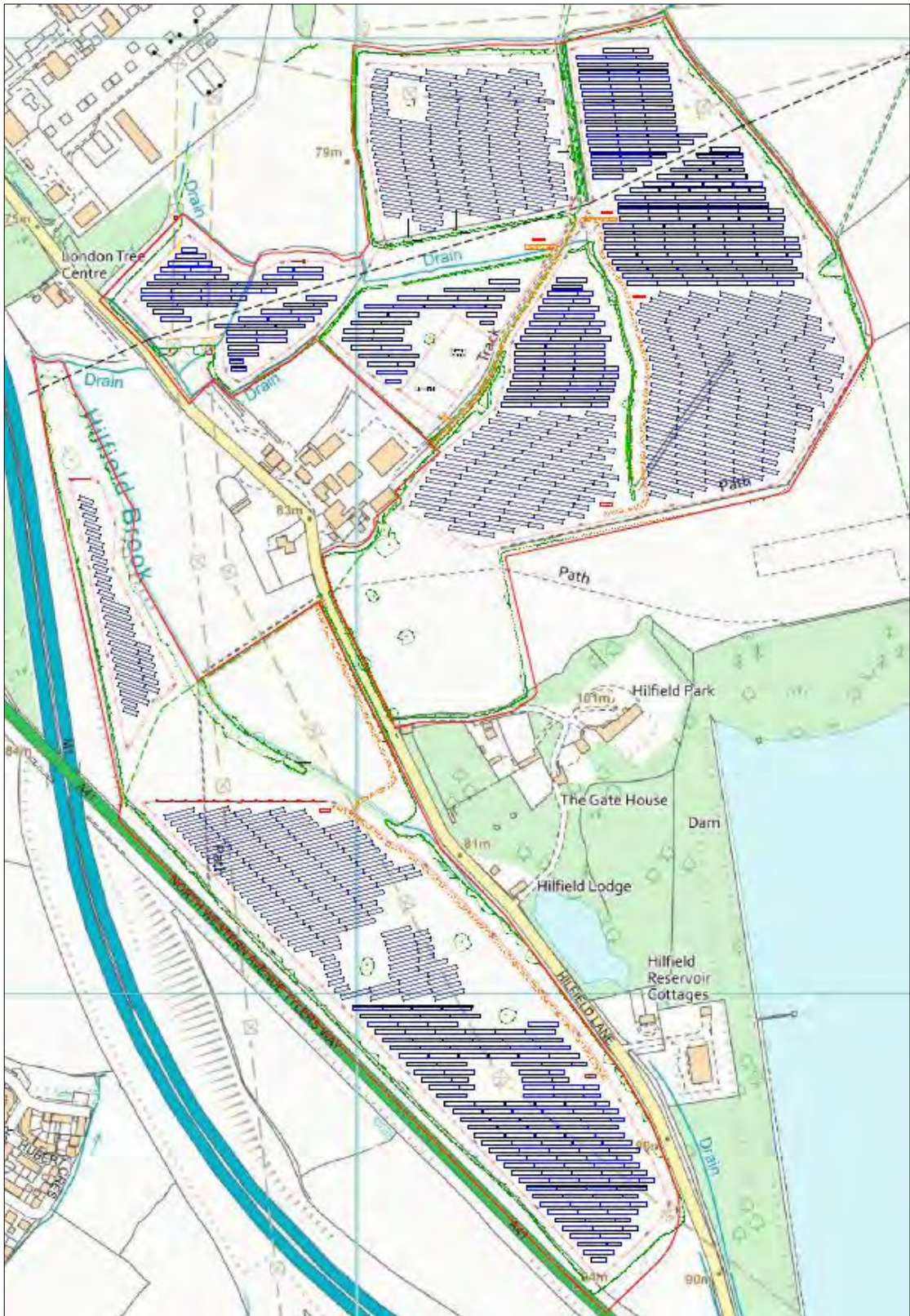


Figure 2 - Zoomed view of the area located south-west

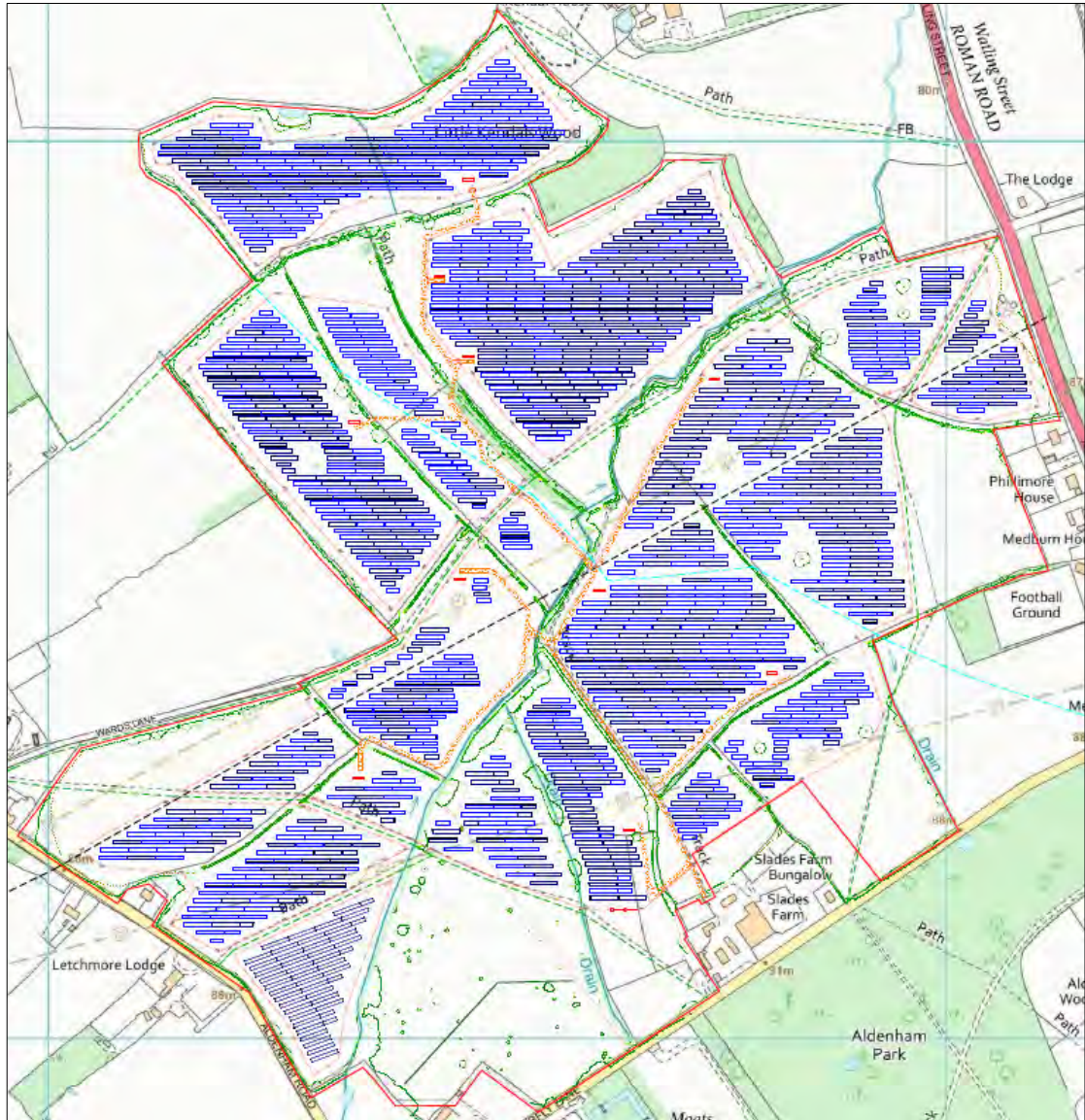


Figure 3 - Zoomed view of the area located north-west

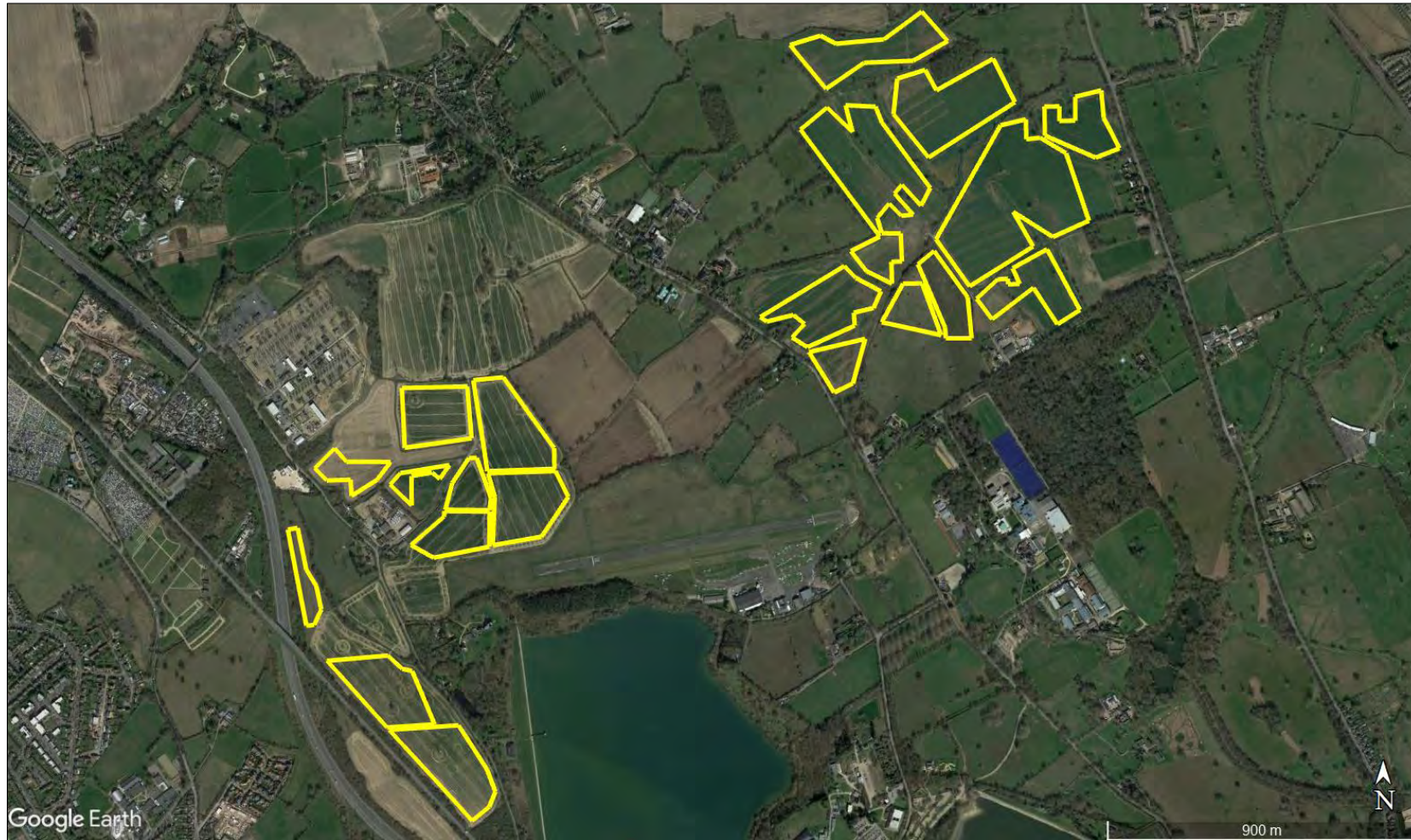


Figure 4 - Proposed solar development location



Figure 5 - Close up image of both areas

2.2 Consultation with Elstree Aerodrome

Pager Power has consulted with Elstree Aerodrome (25 November 2020) to understand their concerns regarding the proposed development (2 hours of consultation). Following the consultation, a layout optimisation has been carried out. The aim of this task was to avoid unacceptable glare towards aviation receptors at Elstree Aerodrome and to minimise impacts overall.

This has been achieved by changing panel characteristics such as tilt and orientation. The findings of the layout optimisation have informed the design team and are shown in Table 1 below.

Following the receipt of the glint and glare assessment Elstree Aerodrome concluded that the proposed development will not impact upon the safety of operations at the aerodrome, and, subsequently, no objection has been raised by Elstree Aerodrome (document ref: 21/0050/FULEI).

2.3 Proposed Solar Panel Characteristics

Different “sites” have different panel’s characteristics; however, they all share the same height above ground³. This is shown in Figure 6⁴ on the following page.

The solar panels have the following characteristics (see Table 1 below):

Site	Tilt (°)	Orientation (°)	Mid Height (m) (agl)
Site 1	20	180	1.9m The mid-height of the panel has been considered for the assessment (see red circle in Figure 6 on the following page)
Site 2	20	165	
Site 3	20	200	
Site 4	20	180	
Site 5	30	180	
Site 6	30	190	
Site 7	20	180	
Site 8	30	195	
Site 9	20	180	
Site 10	30	190	
Site 11	20	180	

³ Terrain elevation considered in the assessment was taken from Pager Power database. All ground heights have been based on OSGB36 terrain data.

⁴ PV Elevations, Blueleaf, Date: 22/09/2020, Project Name: Elstree Solar PV and Battery, Drawing No.: ET3.0 cropped.

Site	Tilt (°)	Orientation (°)	Mid Height (m) (agl)
Site 12	20	180	1.9m The mid-height of the panel has been considered for the assessment (see red circle in Figure 6 below)
Site 13	30	180	
Site 14	20	180	
Site 15	20	180	
Site 16	20	180	
Site 17	30	180	
Site 18	30	160	
Site 19	30	180	
Site 20	20	180	

Table 1 - Panel characteristics per each site

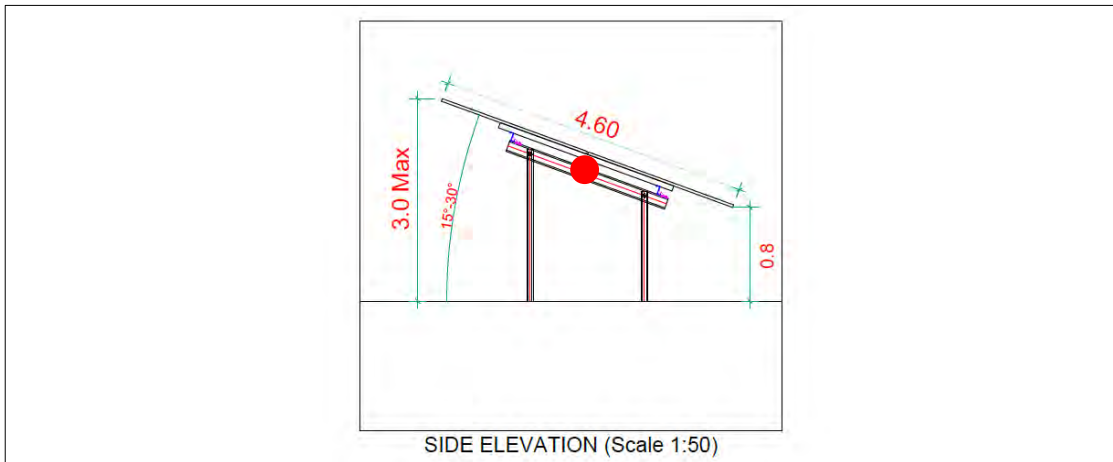


Figure 6 - Solar panel characteristics

3 ELSTREE AERODROME DETAILS

3.1 Overview

The following section presents general details regarding Elstree Aerodrome.

3.2 Airport Information

Elstree Aerodrome is a licenced Airport.

3.3 Runway Details

Elstree Aerodrome⁵ has one operational runway. The runway details are presented below:

1. 08/26 measuring 651m by 20m.

3.4 Air Traffic Control Tower

The ATC Tower is located south of the runway centre point (green circle in Figure 7⁶ on the following page). Further details are presented in Section 5.2 of this report.

⁵ Source: EGTR – ELSTREE, EGTR AD 2.12 RUNWAY PHYSICAL CHARACTERISTICS

⁶ EGTR – ELSTREE, AD 2-EGTR-2-1, AERO INFO DATE 26/11/18

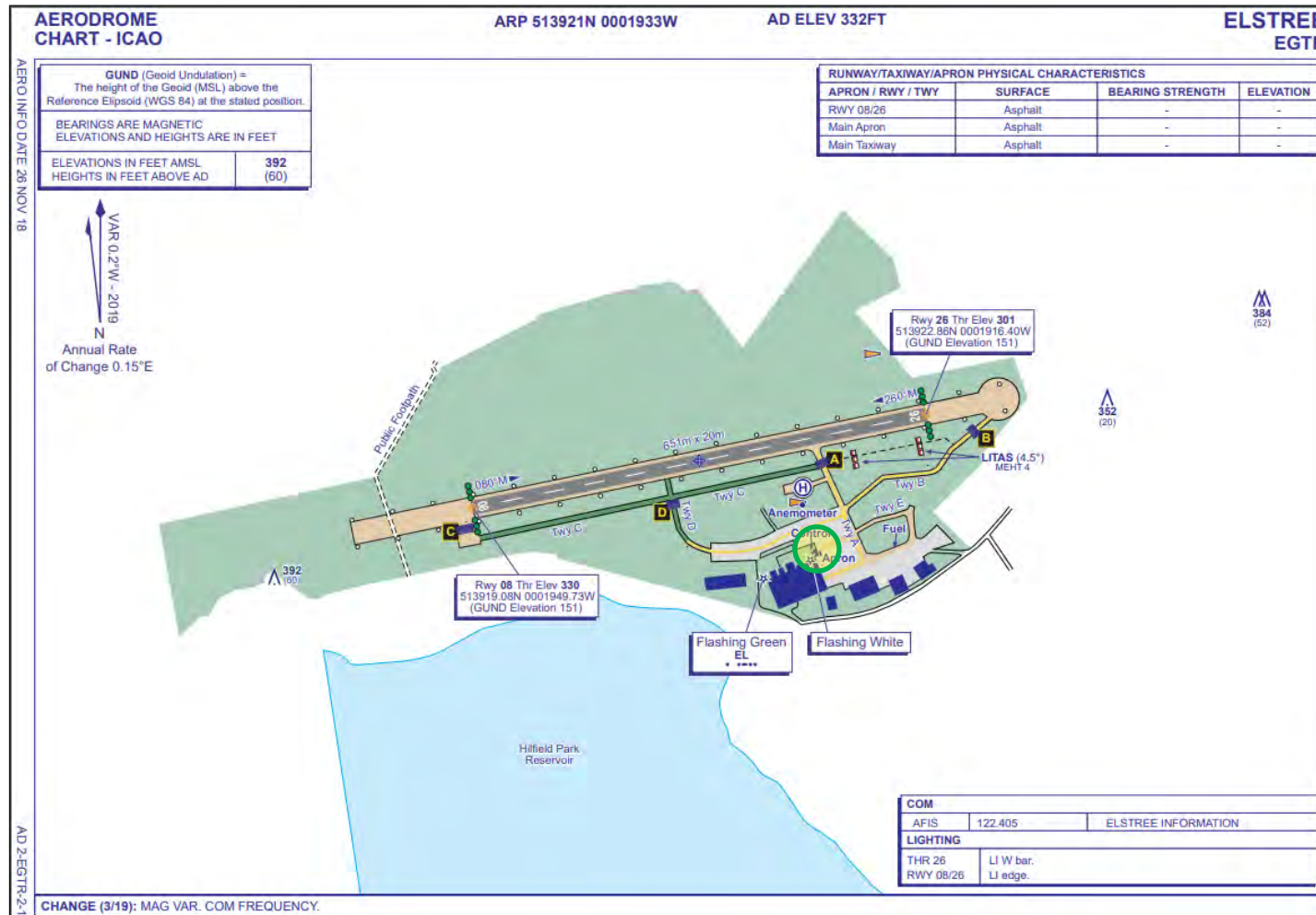


Figure 7 - Elstree Aerodrome (Aerodrome Chart - ICAO)

4 GLINT AND GLARE ASSESSMENT METHODOLOGY

4.1 Overview

The following sub-sections provide a general overview with respect to the guidance studies and methodology which informs this report.

4.2 Guidance and Studies

Guidelines exist in the UK (produced by the Civil Aviation Authority – CAA) and in the USA (produced by the Federal Aviation Administration – FAA) with respect to solar developments and aviation activity, however a specific methodology for aviation assessments in the UK, especially regarding UK civil aerodromes, has not been produced to date. The same is true for the assessment upon road safety and residential amenity. Therefore, Pager Power has reviewed existing guidelines and the available studies (discussed below) in the process of defining its own glint and glare assessment guidance. Pager Power guidance document⁷ defines the process for determining the impact upon aviation activity. Pager Power’s approach is to undertake geometric reflection calculations and, where a solar reflection is predicted, undertake solar intensity calculations in line with the Sandia National Laboratories’ FAA methodology (aviation only). The scenario in which a solar reflection can occur is identified and discussed, and a comparison is made against the available solar panel reflection studies to determine the overall impact.

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

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

4.3 Background

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

4.4 Methodology

The assessment methodology is based on guidance, studies, previous discussions with stakeholders and Pager Power’s practical experience. Information regarding the methodology of Pager Power’s and Sandia National Laboratories’ methodology is presented below.

⁷ [Pager Power’s Glint and Glare Assessment Guidance](#), Second Edition.

4.4.1 Pager Power's Methodology

The glint and glare assessment methodology has been derived from the information provided to Pager Power through consultation with stakeholders and by reviewing the available guidance. The methodology for aviation, dwelling and road receptors glint and glare assessment is as follows:

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

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

Where a solar reflection is identified for an aviation approach path receptor, intensity calculations are completed in line with the Sandia National Laboratories methodology (discussed in the following section).

4.4.2 Sandia National Laboratories' Methodology

Sandia National Laboratories developed the Solar Glare Hazard Analysis Tool (SGHAT) which is no longer available. Pager Power has since reviewed the Sandia National Laboratories model and is developing its own intensity calculation model in line with Sandia National Laboratories' methodology. Whilst strictly applicable in the USA and to solar Photovoltaic developments only, the methodology and associated guidance is widely used by UK aviation stakeholders. The following text is taken from the SGHAT model methodology.

'This tool determines when and where solar glare can occur throughout the year from a user-specified PV array as viewed from user-prescribed observation points. The potential ocular impact from the observed glare is also determined, along with a prediction of the annual energy production.'

The result was a chart that states whether a reflection can occur, the duration and predicted intensity for aviation receptors.

Pager Power has undertaken many aviation glint and glare assessments with both models (SGHAT and Pager Power's) producing similar results. Therefore, where the Pager Power geometrical analysis indicates that a solar reflection is geometrically possible, an intensity calculation in line with Sandia National Laboratories' methodology has also been completed⁸.

4.5 Assessment Methodology and Limitations

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

⁸ Currently using the Forge Solar model, based on the Sandia methodology.

5 HIGH-LEVEL ASSESSMENT OF RAILWAY RECEPTORS

5.1 Overview

There is no formal buffer distance within which railway effects must be modelled. However, in practice, concerns are most often raised for developments within 200m of a railway line. A high-level railway assessment has been undertaken considering the nearby railway line. No engagement with Network Rail has been undertaken since, in Pager Power experience, it is not required for development located more than 200m from a railway receptor.

5.2 High-Level Assessment

The railway line is located circa 660m⁹ (at its closest point) northeast of the proposed development (see Figure 8¹⁰ below).



Figure 8 – Railway line location relative to the proposed development

Either terrain or other ground-based obstruction such as existing vegetation or buildings will screen the proposed development from the railway line. Furthermore, any solar reflection will generate outside the train driver's field of focus such that the impact would be categorised as low in the worst case. Therefore, no significant impact is possible for train drivers travelling on both directions of the identified stretch of railway.

⁹ Furthermore, it is unlikely that at this distance Network Rail will raise a concern.

¹⁰ Source: Google Earth Copyright © 2020.

6 IDENTIFICATION OF RECEPTORS

6.1 Overview

The following section presents the relevant receptors assessed within this report.

6.2 Air Traffic Control Tower

It is important to determine whether a solar reflection can be experienced by personnel within the ATC Tower. The ATC Tower is located approximately 0.6km south-east of the proposed development (at its closest point).

ATC Tower co-ordinates have been extrapolated from available imagery. The ground elevation has been taken from OSGB36 terrain data, with the height of the ATC Tower being assessed as 5m¹¹ above ground level (agl). The ATC tower can be seen in a photograph presented in Figure 9¹² below. Full details are presented in Appendix G.



Figure 9 – ATC Tower at Elstree Aerodrome

¹¹ This is the height at which the ATC Tower personnel are expected to be. The actual height of the ATC Tower is predicted to be more than 5m. Small changes in tower height are not expected to result in significant changes in glint and glare modelling and results.

¹² Airfield Site. Control Tower, Richard E Flagg, 19/01/2019.

6.3 Approaching Aircraft

It is Pager Power's methodology to assess whether a solar reflection can be experienced on the approach paths for the associated runways. Elstree Aerodrome has two approach paths associated with its runway (08/26).

A geometric glint and glare assessment has been undertaken for all aircraft approach paths. This is considered to be the most critical stage of the flight. The Pager Power approach for determining receptor (aircraft) locations on the approach path is to select locations along the extended runway centre line from 15.24 metres above the runway threshold out to a distance of 2 miles. The height of the aircraft is determined by using a 3-degree¹³ descent path relative to the runway threshold height. The receptor details for each runway approach are presented in Appendix G. Figure 10¹⁴ on the following page shows the assessed aircraft receptor locations.

¹³ This is the most used descent-path inclination for aerodromes in the UK.

¹⁴ Source: Aerial imagery copyright © 2020 Google.



Figure 10 - Approach and ATC Tower receptor locations

6.4 Dwellings

The analysis has considered dwellings that:

- Are within, or close to one kilometre of the proposed development; and
- Have a potential view of the panels.

An overview of the assessed dwellings relative to the proposed development is shown in Figure 11¹⁵ on the following page. A height above ground level of 1.8 metres has been taken as the typical eye level for an observer on the ground floor of each dwelling¹⁶. In total 108 dwelling receptors points¹⁷ have been identified for the assessment. A clearer view of the dwellings considered for the assessment is shown from Figure 12 to Figure 18 on the following pages. The receptor details for each dwelling are presented in Appendix G.

¹⁵ Source: Copyright © 2020 Google.

¹⁶ Views from highest floors have been considered in the discussion.

¹⁷ The co-ordinates of the dwelling receptor points are presented in Appendix G.



Figure 11 - Assessed dwellings receptors



Figure 12 – Assessed dwellings receptors (dwellings 0 to 8)



Figure 13 – Assessed dwellings receptors (dwellings 9 to 22)



Figure 14 - Assessed dwellings receptors (dwellings 23 to 28)



Figure 15 – Assessed dwellings receptors (dwellings 29 to 59)



Figure 16 - Assessed dwellings receptors (dwellings 60 to 80)



Figure 17 – Assessed dwellings receptors (dwellings 81 to 94 and 97 - 98)

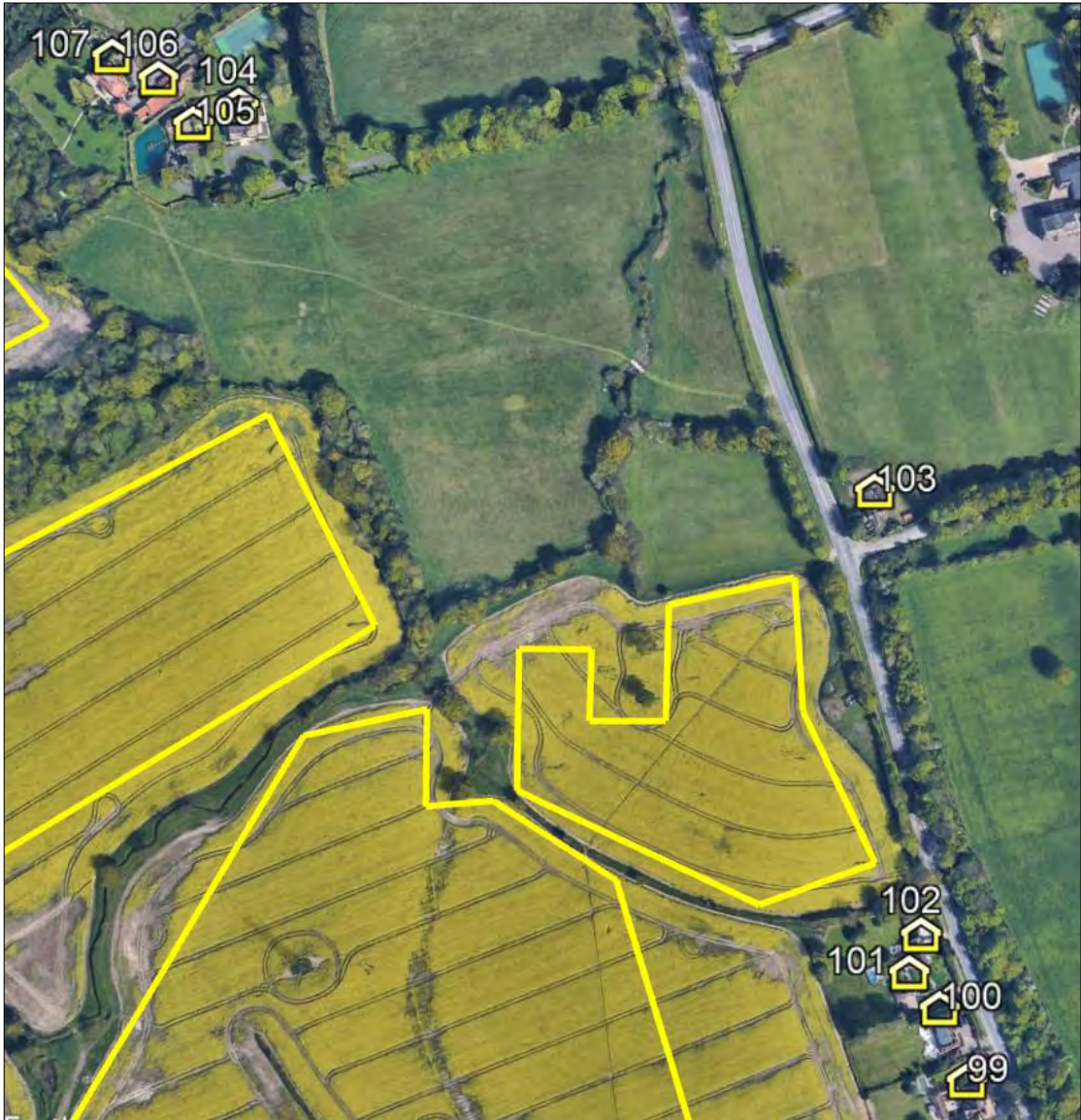


Figure 18 – Assessed dwellings receptors (dwellings 99 to 107)

6.5 Roads

The analysis has considered through-roads that:

- Are within, or close to one kilometre of the proposed development;
- Have a potential view of the panels.

The assessed road receptor points are shown as white icons in Figure 19¹⁸ on the following page. The stretch of road assessed includes six roads:

- M1 (0 to 17 – light-blue line);
- A41 (18 to 27 – purple line);
- Hilfield Lane (28 to 39 – green line);
- Aldenham Road (40 to 50 – yellow line);
- Butterfly Lane (51 to 58 – red line); and
- A5183 (59 to 68 – dark-blue line).

A height above ground level of 1.5¹⁹ metres has been taken as typical eye level for a road user for all roads. In total, 69 road receptor points²⁰⁻²¹ have been identified for the assessment.

¹⁸ Source: Copyright © 2020 Google.

¹⁹ Views from drivers driving heavy goods vehicle (HGV) have been considered in the discussion, Glint and Glare results are not expected to change significantly for drivers of HGV.

²⁰ The distance between two receptor points is 150m irrespective of speed limit .

²¹ The co-ordinates of the road receptor points are presented in Appendix G.

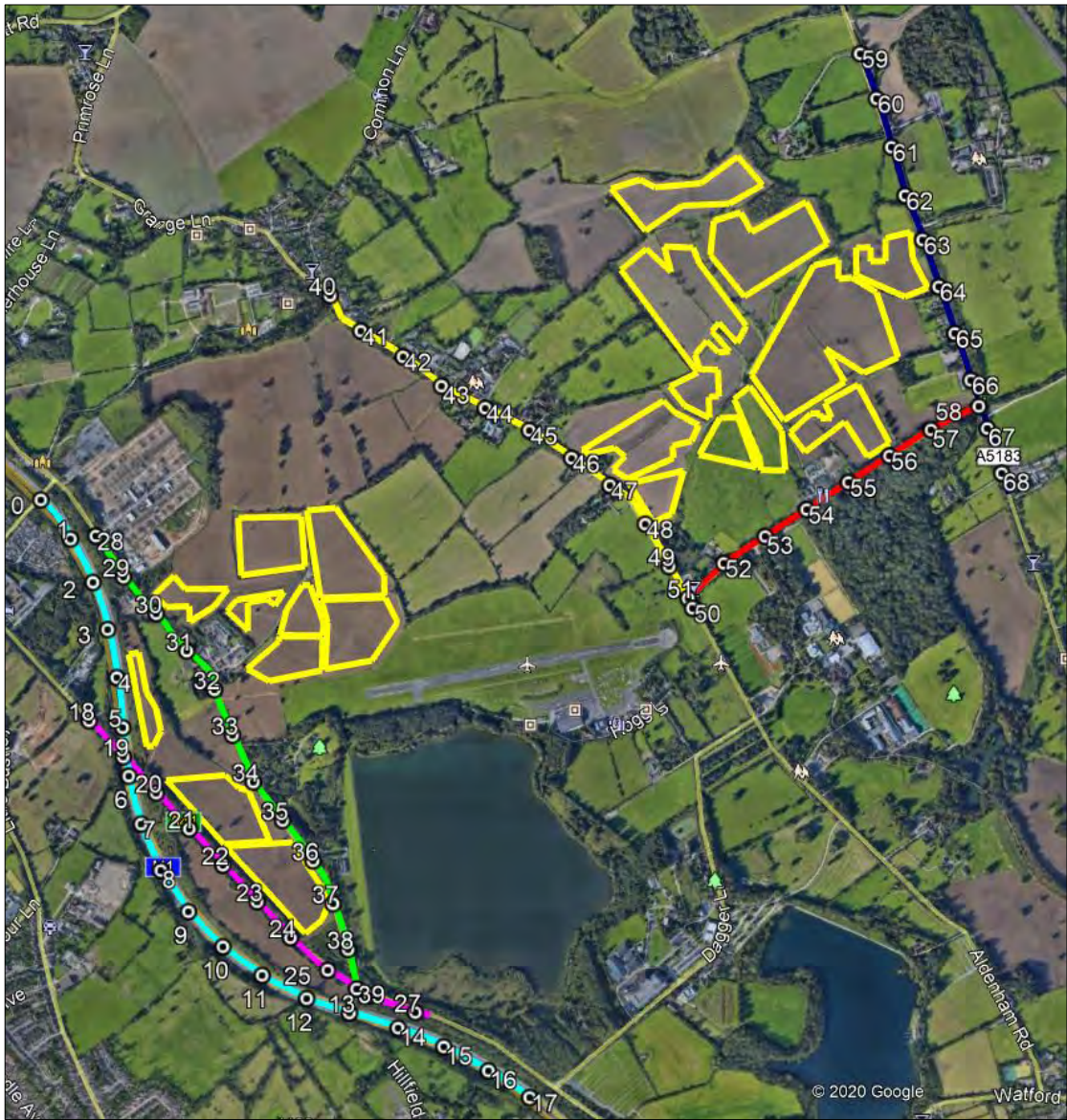


Figure 19 - Assessed roads receptors

7 ASSESSED REFLECTOR AREAS

7.1 Overview

The following section presents the modelled reflector areas.

7.2 Reflector Areas

The solar development contains 20 areas of reflective panels.

The number of modelled reflector points being determined by the size of the reflector area and the assessment resolution. The bounding co-ordinates for the proposed solar development have been extrapolated from the site plans. All ground heights have been based on OSGB36 terrain data and the panel elevation data has been provided by the client. The data can be found in Appendix G. A resolution of 20m has been chosen for this assessment. This means that a geometric calculation is undertaken for each identified receptor every 20m within the defined area. This resolution is sufficiently high to maximise the accuracy of the results – increasing the resolution further would not significantly change the modelling output. If a reflection is experienced from an assessed panel location, then it is likely that a reflection will be viewable from similarly located panels within the proposed solar development. The reflector areas assessed are shown in Figure 20²² below (blue highlighted area).



Figure 20 – Assessed Reflector Areas

²² Source: Aerial image copyright © 2020 Google.

8 GLINT AND GLARE ASSESSMENT RESULTS

8.1 Overview

The following section presents an overview of the glare intensity for the identified aviation receptors only.

The Pager Power model has been used initially. Where solar reflections have been predicted, intensity calculations in line with Sandia National Laboratories' methodology have been undertaken.

The intensity model calculates the expected intensity of a reflection with respect to the potential for an after-image (or worse) occurring. The designation used by the model is presented in Table 2 below along with the associated colour coding.





Coding Used	Intensity Key
Glare beyond 50°	
Low potential	 Glare beyond 50 deg from pilot line-of-sight
Potential	 Low potential for temporary after-image
Potential for permanent eye damage	 Potential for temporary after-image
	 Potential for permanent eye damage

Table 2 – Glare intensity designation

This coding has been used in the table where a reflection has been calculated and is in accordance with Sandia National Laboratories' methodology. The relative width of the colour band is related to the estimated percentage of each type of glare²³.

In addition, the intensity model allows for the assessment of a variety of solar panel surface materials. In the first instance, a surface material of 'smooth glass without an anti-reflective coating' is assessed. This is the most reflective surface and allows for a 'worst case' assessment. Other surfaces that could be modelled include:

- Smooth glass with an anti-reflective coating;
- Light textured glass without an anti-reflective coating;
- Light textured glass with an anti-reflective coating; or
- Deeply textured glass.

If significant glare is predicted, modelling of less reflective surfaces could be undertaken.

²³ Where two or more glare intensities are predicted for a particular receptor throughout the year.

The tables in the following subsections summarise the months and times during which a solar reflection could be experienced by a receptor.

This does not mean that reflections would occur continuously between the times shown.

The range of times at which reflections are geometrically possible is generally greater than the length of time for any particular day. This is because the times of day at which reflections could start and stop vary throughout the days/months.

The results of the analysis are presented in the following sections. Appendix H presents the results charts.

8.2 Geometric Calculation Results Overview – ATC Tower

The results of the geometric calculation for the ATC Tower is presented in Table 3 below.

Receptor	Pager Power Results		Glare Type	Comment
	Reflection possible toward the ATC Tower? ²⁴ (GMT)			
	am	pm		
ATC Tower	None.	Between 17:23 and 17:26 from mid-February to early March. Between 17:41 and 18:50 from the end of March to mid-September. Between 16:53 and 17:04 from early October to late October.	"Yellow Glare" glare with potential for after-image ²⁵	Reflections are geometrically possible. However, the reflective area is not visible from an observer located in the ATC Tower. No impact expected. No mitigation required. Discussed in Section 9.2.

Table 3 – Geometric analysis results for the ATC Tower

²⁴ This column reports the dates and times at which reflections are theoretically possible. This does not mean that glare will occur continuously throughout this time range in practice.

²⁵ "Yellow Glare" with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

8.3 Geometric Calculation Results Overview – Approach for Runway 08

The results of the geometric calculations for the approach towards runway 08 are presented in Table 4 below.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
Threshold	None.	Between 17:30 and 18:32 from late March to mid-September.	"Green Glare" with low potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.
0.1 miles	Between 05:09 and 05:16 from early June to early July.	Between 17:34 and 18:11 from the beginning of April to the end of May. Between 17:41 and 18:08 from early June to the beginning of July. Between 17:42 and 18:07 from mid-July to mid-September.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

²⁶ This column reports the dates and times at which reflections are theoretically possible. This does not mean that glare will occur continuously throughout this time range in practice.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
0.2 miles	Between 05:06 and 05:17 from mid-May to late July.	Between 18:42 and 18:43 during early April. Between 17:16 and 17:31 during mid-May. Between 17:15 and 17:27 during the end of May. At circa 17:29 during mid-July. Between 17:33 and 17:41 during late July. Between 18:38 and 18:41 during the beginning of September.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.
0.3 miles	Between 05:05 and 05:52 from mid-May to the beginning of August.	Between 18:26 and 18:29 from late March to mid-April. Between 18:31 and 18:34 during early May. Between 18:35 and 18:43 from the end of July to mid-August. Between 18:15 and 18:26 from the end of August to mid-September.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
0.4 miles	Between 05:05 and 05:54 from early May to early August.	At circa 17:23 during mid-February. At circa 17:43 during the beginning of March. Between 17:36 and 17:44 during mid-March. Between 17:37 and 17:45 during the end of March. Between 17:36 and 18:02 from mid-April to late May. At circa 18:11 during the beginning of June. At circa 18:18 during early July. Between 18:04 and 18:11 during late July. Between 17:30 and 17:55 from mid-August to mid-September. Between 17:19 and 17:26 during late September. At circa 17:18 during mid-October. At circa 16:54 during late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
0.5 miles	Between 05:05 and 07:31 from the end of April to mid-August.	Between 13:48 and 14:40 during late January. Between 13:54 and 14:45 during late February. Between 13:54 and 14:47 during the beginning of April. At circa 12:57 during late April. At circa 14:51 during early May. At circa 13:59 during late May. At circa 14:09 during late July. Between 13:28 and 14:17 during mid-October. Between 13:20 and 14:13 during mid-November.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
0.6 miles	Between 08:56 and 09:17 during early April. Between 05:05 and 09:06 from late April to mid-May. Between 05:12 and 09:10 from late May to mid-August. At circa 08:54 during the beginning of September.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.
0.7 miles	Between 05:05 and 08:01 from late April to late August.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
0.8 miles	Between 05:05 and 07:39 from late April to late August.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.
0.9 miles	Between 05:05 and 07:32 from mid-April to late August.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.
1.0 mile	Between 05:05 and 07:31 from mid-April to late August.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.1 miles	Between 06:37 and 06:39 during the beginning of March. Between 05:05 and 05:06 during mid-April. Between 05:48 and 07:30 from early May to early August. Between 05:06 and 05:12 from mid-August to the end of August. Between 06:12 and 06:14 during mid-October.	None.	"Yellow Glare" with potential for after-image ²⁷	Reflections are geometrically possible. Discussed in Section 9.3

²⁷ "Yellow Glare" with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.2 miles	<p>Between 06:33 and 06:38 during early March.</p> <p>Between 05:05 and 05:06 during mid-April. Between 05:48 and 07:29 from early May to early August.</p> <p>Between 05:06 and 05:11 during late August.</p> <p>Between 06:10 and 06:13 during early October.</p>	None.	<p>"Green Glare" with no potential for after-image</p>	<p>Reflections are geometrically possible. However, the glare intensity will have low potential for after-image.</p> <p>Low impact expected. No mitigation required. Discussed in Section 9.3.</p>

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.3 miles	<p>Between 06:31 and 06:36 from the beginning of March to mid-March.</p> <p>Between 05:05 and 05:06 during mid-April. Between 05:49 and 07:29 from early May to early August.</p> <p>Between 05:05 and 05:10 during late August.</p> <p>Between 06:09 and 06:13 during early October.</p>	None.	<p>"Green Glare" with no potential for after-image</p>	<p>Reflections are geometrically possible. However, the glare intensity will have low potential for after-image.</p> <p>Low impact expected. No mitigation required. Discussed in Section 9.3.</p>

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.4 miles	<p>Between 06:29 and 06:35 from early March to mid-March. At circa 05:06 during mid-April. Between 05:49 and 07:28 from early May to early August. Between 05:05 and 05:09 during late August. Between 06:09 and 06:13 from the end of September to early October.</p>	None.	<p>"Green Glare" with no potential for after-image</p>	<p>Reflections are geometrically possible. However, the glare intensity will have low potential for after-image.</p> <p>Low impact expected. No mitigation required. Discussed in Section 9.3.</p>

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.5 miles	Between 06:26 and 06:33 from early March to mid-March. At circa 05:06 during mid-April. Between 05:49 and 07:28 from early May to early August. Between 05:05 and 05:09 during the end of August. Between 06:08 and 06:12 from late September to early October.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.6 miles	Between 06:25 and 06:32 from early March to late March. At circa 05:06 during mid-April. Between 05:49 and 07:28 from the beginning of May to mid-August. Between 05:06 and 05:08 during the end of August. Between 06:07 and 06:12 from late September to early October.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.7 miles	Between 06:23 and 06:31 from early March to late March. At circa 05:06 during mid-April. Between 05:49 and 07:27 from the beginning of May to mid-August. Between 05:05 and 05:07 during the end of August. Between 06:07 and 06:11 from late September to early October.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.8 miles	Between 06:22 and 06:30 from early March to late March. At circa 05:06 during mid-April. Between 05:49 and 07:27 from the beginning of May to mid-August. Between 05:05 and 05:07 during the end of August. Between 06:07 and 06:11 from mid-September to early October.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
1.9 miles	Between 06:21 and 06:28 from mid-March to late March. At circa 05:06 during mid-April. Between 05:49 and 07:27 from the beginning of May to mid-August. Between 05:05 and 05:06 during the end of August. Between 06:07 and 06:11 from mid-September to the beginning of October.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 08 Approach? ²⁶ (GMT)			
	am	pm		
2.0 miles	Between 06:21 and 06:28 from mid-March to late March. At circa 05:06 during mid-April. Between 05:49 and 07:27 from the end of April to mid-August. Between 06:07 and 06:10 from mid-September to the beginning of October.	None.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.3.

Table 4 – Geometric analysis results for the Runway 08 Approach

8.4 Geometric Calculation Results Overview – Approach for Runway 26

The results of the geometric calculations for the approach towards runway 26 are presented in Table 5 below.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
Threshold	None.	Between 17:22 and 17:24 during mid-February. Between 17:49 and 18:31 from late March to mid-September. Between 16:52 and 16:55 during late October.	“Yellow Glare” with potential for after-image ²⁹	Reflections are geometrically possible. However, the reflective area is not visible from pilots travelling across this receptor point. No impact expected. No mitigation required. Discussed in Section 9.4.
0.1 miles	None.	Between 17:21 and 17:23 during mid-February. Between 17:54 and 18:33 from late March to mid-May. Between 17:48 and 18:28 from late July to late September. Between 16:51 and 16:55 during late October.	“Yellow Glare” with potential for after-image ³⁰	Reflections are geometrically possible. However, the reflective area is not visible from pilots travelling across this receptor point. No impact expected. No mitigation required. Discussed in Section 9.4.

²⁸ This column reports the dates and times at which reflections are theoretically possible. This does not mean that glare will occur continuously throughout this time range in practice.

²⁹ “Yellow Glare” with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

³⁰ “Yellow Glare” with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
0.2 miles	None.	Between 17:20 and 17:22 from mid-February to late February. Between 17:57 and 18:33 from mid-March to early May. Between 17:48 and 18:26 from early August to late September. Between 16:50 and 16:54 during late October.	"Yellow Glare" with potential for after-image ³¹	Reflections are geometrically possible. However, the reflective area is not visible from pilots travelling across this receptor point. No impact expected. No mitigation required. Discussed in Section 9.4.
0.3 miles	None.	Between 17:20 and 17:22 from mid-February to late February. Between 17:58 and 18:34 from mid-March to late April. Between 17:45 and 18:25 from mid-August to late September. Between 16:49 and 16:55 from mid-October to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

³¹ "Yellow Glare" with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
0.4 miles	None.	Between 17:19 and 17:22 from mid-February to late February. Between 18:00 and 18:33 from mid-March to mid-April. Between 17:43 and 18:24 from late August to the end of September. Between 16:49 and 16:55 from mid-October to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
0.5 miles	None.	Between 17:19 and 17:22 from mid-February to late February. Between 18:00 and 18:05 from mid-March to mid-April. Between 17:29 and 17:32 from mid-June to late June. At circa 17:33 during the beginning of July. Between 17:42 and 18:01 from the end of August to the beginning of October. Between 16:48 and 16:54 from mid-October to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
0.6 miles	None.	Between 17:18 and 17:21 from mid-February to the end of February. Between 18:00 and 18:05 from mid-March to early April. Between 16:18 and 17:41 from mid-May to the beginning of August. Between 17:41 and 17:59 from the beginning of September to the beginning of October. Between 16:48 and 16:54 from mid-October to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
0.7 miles	None.	Between 17:18 and 17:21 from mid-February to the end of February. Between 18:00 and 18:05 from mid-March to early April. Between 16:19 and 17:43 from late April to mid-August. Between 16:48 and 17:56 from early September to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
0.8 miles	None.	Between 17:18 and 17:21 from mid-February to the end of February. Between 18:00 and 18:05 from mid-March to the beginning of April. Between 16:20 and 18:03 from mid-April to late August. Between 16:47 and 17:54 from early September to late October.	"Yellow Glare" with potential for after-image ³²	Reflections are geometrically possible. However, the glare intensity will have potential for after-image. Discussed in Section 9.4.
0.9 miles	None.	Between 17:18 and 18:05 from mid-February to the end of March. Between 16:21 and 18:09 from mid-April to the end of August. Between 16:47 and 17:52 from mid-September to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

³² "Yellow Glare" with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
1.0 mile	None.	Between 16:23 and 18:08 from mid-February to the beginning of September. Between 16:48 and 17:50 from mid-September to late October.	"Yellow Glare" with potential for after-image ³³	Reflections are geometrically possible. However, the glare intensity will have potential for after-image. Discussed in Section 9.4.
1.1 miles	None.	Between 16:25 and 18:11 from mid-February to late October.	"Yellow Glare" with potential for after-image ²⁶	Reflections are geometrically possible. However, the glare intensity will have potential for after-image. Discussed in Section 9.4.
1.2 miles	None.	Between 16:27 and 18:12 from mid-February to late October.	"Yellow Glare" with potential for after-image ²⁶	Reflections are geometrically possible. However, the glare intensity will have potential for after-image. Discussed in Section 9.4.

³³ "Yellow Glare" with potential for after-image is not the worst-case scenario predicted by Forge and it is not expected to occur at all times.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
1.3 miles	None.	Between 16:29 and 18:11 from mid-February to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
1.4 miles	None.	Between 16:30 and 18:11 from late February to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
1.5 miles	None.	Between 16:32 and 18:12 from late February to late October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
1.6 miles	None.	Between 16:32 and 18:11 from late February to mid-October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
1.7 miles	None.	Between 16:34 and 18:04 from late February to early June. Between 16:32 and 18:10 from early July to mid-October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
1.8 miles	None.	Between 16:35 and 18:00 from late February to late May. Between 16:32 and 18:10 from mid-July to mid-October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

Receptor	Pager Power Results		Glare Type	Reflection Expected
	Reflection possible toward the Runway 26 Approach? ²⁸ (GMT)			
	am	pm		
1.9 miles	None.	Between 16:36 and 18:00 from late February to mid-May. Between 16:32 and 18:08 from late July to mid-October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.
2.0 miles	None.	Between 16:37 and 18:00 from late February to mid-May. Between 16:32 and 18:07 from the beginning of August to mid-October.	"Green Glare" with no potential for after-image	Reflections are geometrically possible. However, the glare intensity will have low potential for after-image. Low impact expected. No mitigation required. Discussed in Section 9.4.

Table 5 – Geometric analysis results for the Runway 26 Approach

8.5 Geometric Calculation Results Overview – Dwellings

The results of the geometric calculations towards identified dwellings receptors are presented in Table 6 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
0	Between 05:37 and 06:57 from the beginning of March to mid-June. Between 05:41 and 06:33 from the end of June to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.
1	Between 05:37 and 06:57 from the end of February to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.
2	Between 05:37 and 06:57 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
3	Between 05:37 and 06:57 from the end of February to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.
4	Between 05:37 and 06:57 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.
5	Between 05:37 and 06:57 from the end of February to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.
6	Between 05:37 and 06:57 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
7	<p>Between 07:13 and 07:17 from mid-February to late February. At circa 07:06 during mid-March.</p> <p>Between 05:36 and 07:08 from late March to late September. At circa 06:45 during the beginning of October. Between 06:46 and 06:47 from mid-October to late October.</p>	None.	<p>Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified.</p> <p>No impact expected. Discussed in Section 9.6.</p>

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
8	Between 07:12 and 07:18 from mid-February to the end of February. Between 05:36 and 07:08 from mid-March to mid-September. At circa 06:46 during the end of September. Between 06:46 and 06:48 from mid-October to late October.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation or buildings has been identified. No impact expected. Discussed in Section 9.6.
9	Between 04:58 and 05:21 from early April to early September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
10	Between 05:03 and 06:09 from mid-March to mid-June. Between 05:07 and 05:56 from late June to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
11	Between 05:02 and 06:08 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
12	Between 05:00 and 06:07 from late March to early June. Between 05:06 and 05:56 from early July to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
13	Between 05:00 and 06:04 from late March to mid-June. Between 05:04 and 05:08 during the beginning of July. Between 05:09 and 05:56 from mid-July to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
14	Between 04:59 and 06:06 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
15	Between 04:58 and 06:05 from late March to early June. Between 05:05 and 05:55 from early July to mid-September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
16	Between 04:59 and 06:06 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
17	Between 05:00 and 06:06 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
18	Between 05:02 and 06:06 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
19	Between 05:02 and 06:05 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
20	Between 05:03 and 06:03 from late March to mid-September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
21	Between 05:02 and 06:03 from the end of March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
22	Between 05:41 and 06:02 from the end of March to mid-September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
23	None.	<p>At circa 18:05 during mid-March. Between 17:31 and 18:10 from late March to mid-April. Between 17:26 and 19:11 from the end of April to early June. Between 17:42 and 17:44 during late June.</p> <p>Between 17:33 and 19:17 from early July to mid-September. Between 17:46 and 17:47 during late September.</p>	<p>Reflections from the proposed development are possible. Some existing screening has been identified. The developer has proposed further screening in the form of vegetation.</p> <p>No impact expected. Discussed in Section 9.6.</p>

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
24	None.	<p>Between 17:30 and 17:34 from the beginning of March to late March. Between 17:29 and 17:33 during the beginning of April. Between 17:30 and 19:14 from mid-April to early June. Between 19:18 and 19:19 during late June. Between 17:24 and 19:20 from early July to early September. Between 17:04 and 17:18 from late September to early October.</p>	<p>Reflections from the proposed development are possible. Some existing screening has been identified. The developer has proposed further screening in the form of vegetation.</p> <p>Low impact expected. Discussed in Section 9.6.</p>

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
25	None.	Between 17:16 and 17:25 from mid-February to mid-March. Between 18:59 and 19:09 from mid-April to early June. Between 19:01 and 19:16 from early July to the end of August. Between 16:45 and 17:07 from late September to late October.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
26	None.	Between 17:15 and 17:23 from mid-February to early March. Between 18:59 and 19:11 from mid-April to early June. Between 19:02 and 19:16 from the beginning of July to late August. Between 16:46 and 17:04 from the beginning of October to late October.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
27	Between 04:54 and 07:05 from mid-April to the end of August.	Between 19:03 and 19:04 during the end of April. At circa 19:15 during early August. At circa 19:10 during mid-August.	Reflections from the proposed development are possible. Existing screening has been identified. Low impact expected. Discussed in Section 9.6.
28	Between 04:54 and 07:04 from early April to early September. At circa 06:18 during late September.	None.	Reflections from the proposed development are possible. Some existing screening has been identified. Low impact expected. Discussed in Section 9.6.
29	Between 05:03 and 05:59 from early April to early September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
30	Between 05:41 and 05:56 from mid-April to the end of August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
31	Between 05:41 and 05:55 from late April to late August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
32	Between 05:41 and 05:55 from late April to late August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
33	Between 05:41 and 05:55 from the end of April to mid-August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
34	Between 05:41 and 05:55 from late April to mid- August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
35	Between 05:41 and 05:54 from the beginning of May to early August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
36	Between 05:41 and 05:54 from early May to the beginning of August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
37	Between 05:41 and 05:54 from mid-May to the beginning of August.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
38	Between 05:42 and 05:43 from mid-May to mid-June. At circa 05:44 during late June. Between 05:47 and 05:53 from the beginning of July to the end of July.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
39	Between 05:42 and 05:52 from late May to late July.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
40	At circa 05:42 during early June. At circa 05:44 during late June. At circa 05:48 during early July.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
41 – 60	None.	None.	None.
61	Between 06:00 and 06:08 from mid-March to the beginning of April. Between 05:51 and 05:53 from mid-September to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
62	Between 05:58 and 06:08 from mid-March to early April. Between 05:51 and 05:53 from early September to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
63	Between 05:56 and 06:07 from late March to early April. Between 05:51 and 05:53 from early September to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
64	Between 05:55 and 06:07 from mid-March to mid-April. Between 05:51 and 05:53 from the beginning of September to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
65	Between 05:53 and 06:07 from mid-March to mid-April. Between 05:50 and 05:53 from the end of August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
66	Between 05:52 and 06:07 from mid-March to mid-April. Between 05:50 and 05:53 from the end of August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
67	Between 05:51 and 06:07 from mid-March to mid-April. Between 05:50 and 05:53 from late August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
68	Between 05:49 and 06:07 from late March to late April. Between 05:51 and 05:53 from late August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
69	Between 05:47 and 06:07 from late March to late April. Between 05:51 and 05:53 from late August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
70	Between 05:46 and 06:06 from late March to late April. Between 05:50 and 05:53 from mid-August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
71	Between 05:44 and 06:07 from late March to the end of April. Between 05:49 and 05:53 from mid-August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
72	Between 05:41 and 06:07 from late March to early May. Between 05:49 and 05:54 from early August to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
73	Between 05:38 and 06:07 from late March to mid-May. Between 05:48 and 05:57 from late July to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
74	Between 05:37 and 06:07 from late March to the beginning of June. Between 05:45 and 05:59 from mid-July to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
75	Between 05:37 and 06:07 from late March to mid-June. Between 05:41 and 06:01 from late June to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
76	Between 05:37 and 06:07 from late March to mid-June. Between 05:42 and 06:01 from the end of June to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
77	Between 05:37 and 06:07 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
78	Between 05:37 and 06:07 from late March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
79	Between 05:36 and 06:08 from late March to late May. At circa 05:39 during mid-June. Between 05:41 and 05:44 from late June to the end of June. Between 05:46 and 06:09 from mid-July to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
80	Between 05:37 and 06:13 from mid-March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
81	Between 05:40 and 06:18 from mid-March to the end of September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
82	Between 05:40 and 06:22 from mid-March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
83	Between 05:40 and 06:22 from mid-March to the end of September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
84	Between 05:41 and 06:23 from mid-March to the end of September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
85	Between 05:41 and 06:23 from mid-March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
86	Between 05:41 and 06:23 from mid-March to the end of September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
87	Between 05:41 and 06:23 from mid-March to late September.	None.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
88	Between 05:41 and 06:23 from mid-March to late September.	None.	Reflections from the proposed development are possible. Some screening in the form of existing vegetation has been identified. Furthermore, the developer has proposed screening to block all view of the proposed development. No impact expected. Discussed in Section 9.6.
89	Between 05:42 and 06:24 from mid-March to late September.	None.	Reflections from the proposed development are possible. Some screening in the form of existing vegetation and other buildings has been identified. Low impact expected. Discussed in Section 9.6.
90	Between 05:41 and 06:25 from mid-March to late September.	None.	Reflections from the proposed development are possible. Some screening in the form of existing vegetation has been identified. Low impact expected. Discussed in Section 9.6.
91	Between 04:58 and 06:22 from mid-April to the end of August.	None.	Reflections from the proposed development are possible. Some screening in the form of existing vegetation and other buildings has been identified. Low impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
92	None.	Between 18:08 and 18:10 from mid-March to early April. Between 17:55 and 18:06 from early September to late September.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
93	None.	Between 18:08 and 18:10 from mid-March to early April. Between 17:54 and 18:08 from the end of August to late September.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
94	None.	Between 18:08 and 18:36 from mid-March to mid-April. Between 17:51 and 18:31 from late August to late September.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
95	None.	Between 17:26 and 17:27 from late February to early March. Between 17:47 and 18:51 from mid-April to the end of August. Between 16:57 and 17:05 from early October to late October.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
96	None.	Between 17:26 and 17:28 from late February to early March. Between 17:49 and 18:51 from early April to the beginning of September. Between 16:57 and 17:05 from early October to late October.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
97	None.	Between 18:09 and 18:10 from mid-March to mid-April. Between 17:51 and 18:07 from the beginning of September to late September.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
98	None.	Between 18:08 and 18:10 from late March to early April. Between 17:55 and 18:04 from early September to late September.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
99	None.	Between 17:41 and 18:26 from mid-March to late September.	Reflections from the proposed development are possible. Some screening in the form of vegetation has been identified. Furthermore, the developer has proposed screening which will block views of the reflective area. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
100	None.	Between 17:41 and 18:27 from mid-March to late September.	Reflections from the proposed development are possible. Some screening in the form of vegetation has been identified. Furthermore, the developer has proposed screening which will block views of the reflective area. No impact expected. Discussed in Section 9.6.
101	None.	Between 17:42 and 18:27 from mid-March to late September.	Reflections from the proposed development are possible. Some screening in the form of vegetation has been identified. Furthermore, the developer has proposed screening which will block views of the reflective area. No impact expected. Discussed in Section 9.6.
102	None.	Between 17:43 and 18:27 from mid-March to late September.	Reflections from the proposed development are possible. Some screening in the form of vegetation has been identified. Furthermore, the developer has proposed screening which will block views of the reflective area. No impact expected. Discussed in Section 9.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward the dwelling receptors? (GMT)		
	am	pm	
103	None.	Between 18:09 and 18:14 from late March to mid-May. Between 17:55 and 18:24 from the beginning of August to late September.	Reflections from the proposed development are possible. However, existing screening in the form of vegetation has been identified. No impact expected. Discussed in Section 9.6.
104 - 107	None.	None.	None.

Table 6 – Geometric analysis results for dwelling receptors

8.6 Geometric Calculation Results Overview – Roads

8.6.1 M1

The results of the geometric calculations for drivers travelling in both direction of the M1 are presented in Table 7 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on M1? (GMT)		
	am	pm	
0	Between 05:37 and 06:40 from early March to early October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
1	Between 05:37 and 06:57 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
2	Between 05:38 and 06:57 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
3	Between 05:35 and 07:01 from early March to early October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on M1? (GMT)		
	am	pm	
4	Between 04:53 and 07:07 from mid-March to early October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
5	Between 07:07 and 07:12 during early March. At circa 07:00 during late March. At circa 06:48 during early April. Between 04:54 and 07:07 from late April to mid-August. At circa 06:46 during the beginning of September. At circa 06:46 during late September. Between 06:46 and 06:47 during early October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
6	Between 04:55 and 05:45 from mid-May to the beginning of August.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
7	Between 05:00 and 05:18 from mid-April to the beginning of September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on M1? (GMT)		
	am	pm	
8	Between 04:57 and 06:05 from late March to late May. Between 04:58 and 05:03 during early June. Between 05:02 and 05:56 from the beginning of July to late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
9	Between 05:38 and 06:04 from late March to early June. Between 05:42 and 05:43 during late June. Between 05:43 and 05:53 from early July to mid-September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
10	Between 05:39 and 05:53 from mid-April to the end of August.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.1.
11 - 17	None.	None.	None.

Table 7 – Geometric analysis results for M1 receptors

8.6.2 A41

The results of the geometric calculations for drivers travelling in both direction of the A41 are presented in Table 8 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on A41? (GMT)		
	am	pm	
18	At circa 07:17 during mid-February. Between 07:00 and 07:08 from early March to late March. At circa 06:50 during early April. Between 04:54 and 07:08 from late April to late August. At circa 06:46 during early September. At circa 06:46 during late September. At circa 06:46 during early October. At circa 06:47 during mid-October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.2.
19	Between 04:54 and 05:47 from early May to early August.	None.	Reflections from the proposed development are possible. However, visibility of the reflective surface will not be possible. No impact expected. Discussed in Section 9.7.2.
20	At circa 05:19 during early April. At circa 05:09 during late April. Between 04:57 and 05:13 from late May to late July. Between 05:16 and 05:17 from mid-August to early September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.2.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on A41? (GMT)		
	am	pm	
21	Between 04:58 and 05:16 from mid-April to late May. At circa 05:05 during mid-June. At circa 05:09 during the end of June. Between 05:07 and 05:17 from late July to late August.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.2.
22	Between 05:11 and 06:08 from late March to the end of May. Between 05:20 and 06:01 from mid-July to mid-September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.2.
23	Between 06:07 and 06:09 during late March. Between 05:41 and 05:58 from early April to the end of May. At circa 05:43 during early June. At circa 05:48 during the beginning of July. Between 05:50 and 05:56 from mid-July to early September. Between 05:53 and 05:54 during late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.2.
24	At circa 05:43 during late April. At circa 05:48 during late August.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.2.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on A41? (GMT)		
	am	pm	
25 – 27	None.	None.	None.

Table 8 – Geometric analysis results for the A41 receptors

8.6.3 Hilfield Lane

The results of the geometric calculations for drivers travelling in both direction of Hilfield Lane are presented in Table 9 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Hilfield Lane? (GMT)		
	am	pm	
28	Between 05:38 and 06:57 from the end of February to mid-October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Hilfield Lane? (GMT)		
	am	pm	
29	Between 05:38 and 06:57 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.
30	Between 05:34 and 06:56 from the beginning of March to mid-October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.
31	Between 05:34 and 07:06 from early March to early October.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Hilfield Lane? (GMT)		
	am	pm	
32	Between 04:54 and 07:04 from late April to late August.	Between 19:04 and 19:05 from late April to early May. Between 19:10 and 19:12 during mid-August.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.
33	Between 04:55 and 05:44 from mid-May to the end of July.	Between 19:04 and 19:06 from late April to early May. Between 19:09 and 19:12 during late May. At circa 19:16 during mid-June. At circa 19:19 during the end of June. Between 19:18 and 19:20 from mid-July to late July. At circa 19:14 during early August. At circa 19:08 during late August.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Hilfield Lane? (GMT)		
	am	pm	
34	None.	Between 17:30 and 19:16 from the end of February to mid-June. Between 17:34 and 19:21 from the beginning of July to late August. Between 17:05 and 17:28 from early September to mid-October.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.
35	None.	Between 17:28 and 17:36 from mid-March to late March. Between 17:29 and 19:19 from early April to late June. Between 17:30 and 19:20 from early July to early September. Between 17:07 and 17:23 from mid-September to the beginning of October.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Hilfield Lane? (GMT)		
	am	pm	
36	None.	At circa 18:04 during mid-March. Between 17:33 and 18:16 from the end of March to the beginning of June. Between 17:43 and 17:46 from mid-June to the end of June. Between 17:42 and 18:25 from mid-July to mid-September. At circa 17:49 during late September	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.
37	None.	Between 18:10 and 18:23 from late March to mid-June. Between 18:00 and 18:27 from late June to mid-September.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.
38	None.	At circa 18:11 during mid-May. At circa 18:21 during the end of July.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Hilfield Lane? (GMT)		
	am	pm	
39	None.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation or roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.3.

Table 9 – Geometric analysis results for Hilfield Lane receptors

8.6.4 Aldenham Road

The results of the geometric calculations for drivers travelling in both direction of Aldenham Road are presented in Table 10 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Aldenham Road? (GMT)		
	am	pm	
40	Between 05:38 and 06:07 from late March to late May. Between 05:48 and 05:58 from late July to late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.
41	Between 05:37 and 06:07 from late March to late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.
42	Between 05:36 and 06:07 from late March to early June. Between 05:42 and 06:11 from early July to late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Aldenham Road? (GMT)		
	am	pm	
43	Between 05:39 and 06:19 from mid-March to late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.
44	Between 05:41 and 06:22 from mid-March to late September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.
45	Between 05:41 and 06:23 from mid-March to the end of September.	None.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Aldenham Road? (GMT)		
	am	pm	
46	Between 05:42 and 06:23 from mid-March to the end of September.	None.	Reflections from the proposed development are possible. However, screening in the form of roadside hedgerow has been identified. No to low impact expected. Discussed in Section 9.7.4.
47	Between 05:40 and 06:24 from the end of March to mid-September.	None.	Reflections from the proposed development are possible. However, screening in the form of roadside hedgerow has been identified. No to low impact expected. Discussed in Section 9.7.4.
48	At circa 04:57 during late April. Between 04:59 and 05:52 from early May to early August. At circa 05:02 during late August.	Between 18:09 and 18:11 during late March. Between 17:56 and 17:59 during mid-September.	Reflections from the proposed development are possible. However, screening in the form of roadside hedgerow has been identified. No to low impact expected. Discussed in Section 9.7.4.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Aldenham Road? (GMT)		
	am	pm	
49	None.	Between 18:09 and 18:11 from late March to mid-April. Between 17:55 and 18:10 from the end of August to late September.	Reflections from the proposed development are possible. However, screening in the form of roadside hedgerow has been identified. No impact expected. Discussed in Section 9.7.4.
50	None.	Between 18:05 and 18:37 from mid-March to the end of April. Between 17:51 and 18:31 from mid-August to late September.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerow or buildings has been identified. No impact expected. Discussed in Section 9.7.4.

Table 10 – Geometric analysis results for Aldenham Road receptors

8.6.5 Butterfly Lane

The results of the geometric calculations for drivers travelling in both direction of Butterfly Lane are presented in Table 11 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Butterfly Lane? (GMT)		
	am	pm	
51	None.	Between 18:08 and 18:37 from mid-March to late April. Between 17:51 and 18:31 from mid-August to late September.	Reflections from the proposed development are possible. However, terrain will block all views of the reflective area. No impact expected. Discussed in Section 9.7.5.
52	None.	Between 18:09 and 18:10 from late March to early April. Between 17:55 and 18:07 from the beginning of September to late September.	Reflections from the proposed development are possible. However, terrain will block all views of the reflective area. No impact expected. Discussed in Section 9.7.5.
53	None.	Between 18:09 and 18:10 during late March. At circa 16:41 during the end of April. Between 16:36 and 17:45 from mid-May to mid-June. Between 16:43 and 17:52 from the end of June to the beginning of August. At circa 16:48 during mid-August. Between 17:55 and 18:00 during mid-September.	Reflections from the proposed development are possible. The developer has proposed screening in the form of vegetation which will be sufficient to block all view of the proposed development. No impact expected. Discussed in Section 9.7.5.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Butterfly Lane? (GMT)		
	am	pm	
54	None.	Between 16:36 and 18:10 from mid-March to late September.	Reflections from the proposed development are possible. The developer has proposed screening in the form of vegetation which will be sufficient to block all view of the proposed development. No impact expected. Discussed in Section 9.7.5.
55	None.	Between 16:43 and 18:16 from mid-March to mid-June. Between 16:41 and 18:22 from the end of June to the beginning of October.	Reflections from the proposed development are possible. The developer has proposed screening in the form of vegetation which will be sufficient to block all view of the proposed development. No impact expected. Discussed in Section 9.7.5.
56	None.	Between 16:41 and 18:26 from late February to mid-October.	Reflections from the proposed development are possible. The developer has proposed screening in the form of vegetation which will be sufficient to block all view of the proposed development. No impact expected. Discussed in Section 9.7.5.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on Butterfly Lane? (GMT)		
	am	pm	
57	None.	Between 16:40 and 18:26 from mid-February to late October.	Reflections from the proposed development are possible. The developer has proposed screening in the form of vegetation which will be sufficient to block all view of the proposed development. No impact expected. Discussed in Section 9.7.5.
58	None.	Between 16:41 and 18:26 from mid-February to late October.	Reflections from the proposed development are possible. The developer has proposed screening in the form of vegetation which will be sufficient to block all view of the proposed development. No impact expected. Discussed in Section 9.7.5..

Table 11 – Geometric analysis results for Butterfly Lane receptors

8.6.6 A5183

The results of the geometric calculations for drivers travelling in both direction of the A5183 are presented in Table 12 below.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on the A5183? (GMT)		
	am	pm	
59 – 61	None.	None.	None.
62	None.	Between 18:11 and 18:12 from late March to late April. Between 17:58 and 18:17 from late August to late September.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation and roadside hedgerows has been identified. No impact expected. Discussed in Section 9.7.6.
63	None.	Between 18:06 and 18:23 from late March to mid-June. Between 17:54 and 18:27 from the end of June to late September.	Reflections from the proposed development are possible. Some existing screening in the form of roadside hedgerows has been identified. Low impact expected. Discussed in Section 9.7.6.
64	None.	Between 17:48 and 18:27 from late March to late September.	Reflections from the proposed development are possible. Some existing screening in the form of existing vegetation has been identified. Low impact expected. Discussed in Section 9.7.6.

Receptor	Pager Power Results		Reflection Expected
	Reflection possible toward drivers travelling on the A5183? (GMT)		
	am	pm	
65	None.	Between 17:42 and 18:26 from mid-March to late September.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation, roadside hedgerows and buildings has been identified. No impact expected. Discussed in Section 9.7.6.
66	None.	Between 17:09 and 17:12 from mid-February to late February. Between 17:42 and 18:26 from mid-March to late September. Between 16:41 and 16:42 during late October.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.6.
67	None.	Between 16:41 and 18:26 from late February to mid-October.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.6.
68	None.	Between 16:43 and 18:25 from mid-March to late September.	Reflections from the proposed development are possible. However, screening in the form of existing vegetation has been identified. No impact expected. Discussed in Section 9.7.6.

Table 12 – Geometric analysis results for the A5183 receptors

9 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

9.1 Overview

The results of the glint and glare calculations are presented in the following sub-sections.

9.2 Aviation Receptors – ATC Tower

The analysis has shown that solar reflections from the proposed solar development towards the ATC Tower are geometrically possible. Reflections will generate from the sites located west of the ATC Tower (Site 2 to 10 see Figure 21³⁴ below).



Figure 21 – Reflective areas for ATC Tower

³⁴ Source: Copyright © 2020 Google.

A review of available imagery (Figure 22³⁵ on the following page) and on-site survey (Figure 23³⁶ on the following page) have shown that visibility of the reflective area is not possible due to intervening terrain.

Therefore, no impact is expected and no mitigation is required.



Figure 22 – View from the ATC Tower towards the proposed development

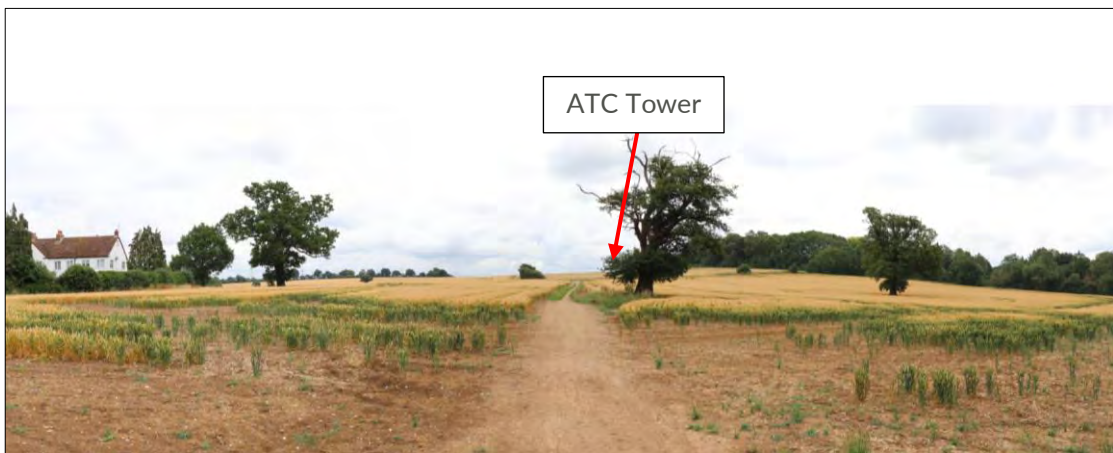


Figure 23 – Site survey picture taken from the western panel array fields by Hilfield Farm looking back up towards the aerodrome

9.3 Aviation Receptors – Approach 08

The Pager Power model indicates that solar reflections are possible towards the entire runway 08 approach path. Forge has predicted that at a distance of 1.1 miles from the threshold, the intensity of reflections is expected to have a potential for temporary after-image meanwhile for

³⁵ Source: Copyright © 2020 Google.

³⁶ Site survey photograph taken by Aardvark EM 01/10/2020.

the rest of the approach path the intensity of reflections is expected to have a low potential for temporary after-image.

Solar reflections with the potential for temporary after-image will occur at circa 6:50 GMT at the beginning of March and at circa 6:20 GMT at the beginning of October. In total solar reflections with the potential for temporary after-image are predicted for a maximum of 3 minutes per year (see Figure 24 below³⁷).

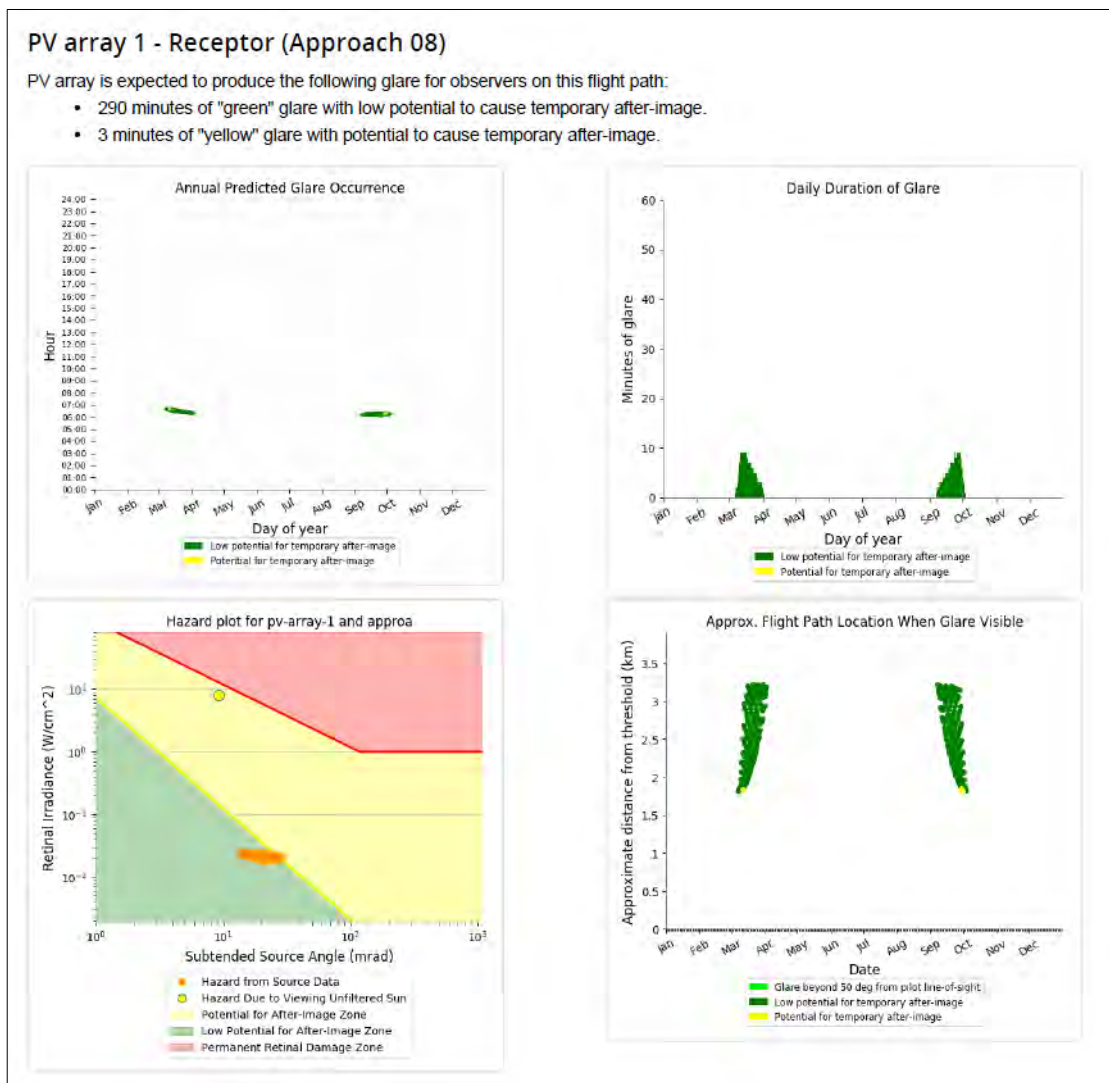


Figure 24 – PV array 1 solar reflection (Forge analysis)

³⁷ The Forge analysis showed that the only site that can generate glare with potential for after-image is Site 1

Although predicted glare with potential for temporary after-image towards pilots approaching the runway is not acceptable based on the FAA guidance, Pager Power recommends a pragmatic approach within its guidance document. Therefore, the following should be considered:

- Visibility of the solar panel areas;
- The glare duration;
- Glare location relative to key operational areas;
- Existing reflecting surfaces.

Considering the above, the points below are applicable:

- Visibility of the reflecting solar panel area producing glare with potential for after-image is expected at 1.1 miles from the threshold, Furthermore, some existing vegetation is likely to partially screen the view of the reflective area (Figure 25³⁸ below);

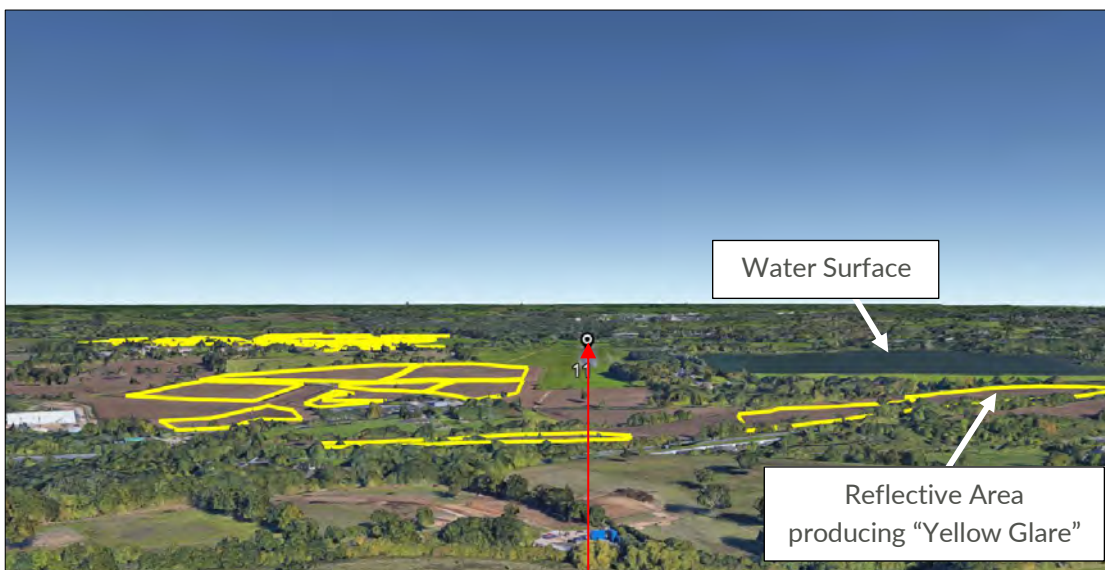


Figure 25 - View of the reflective area at 1.1 miles from the runway 08 threshold

- Solar reflections with potential for temporary after-image are predicted to occur for only 3 minutes per year. This is equivalent to 0.001% of daylight time per year – this is based on the assumption of 12 hours of daylight per day.
- Sunlight and reflections will always generate from approximately the same point in space (see Figure 26³⁹ on the following page).

³⁸ Source: Copyright © 2020 Google.

³⁹ Source: Copyright © 2020 Google.

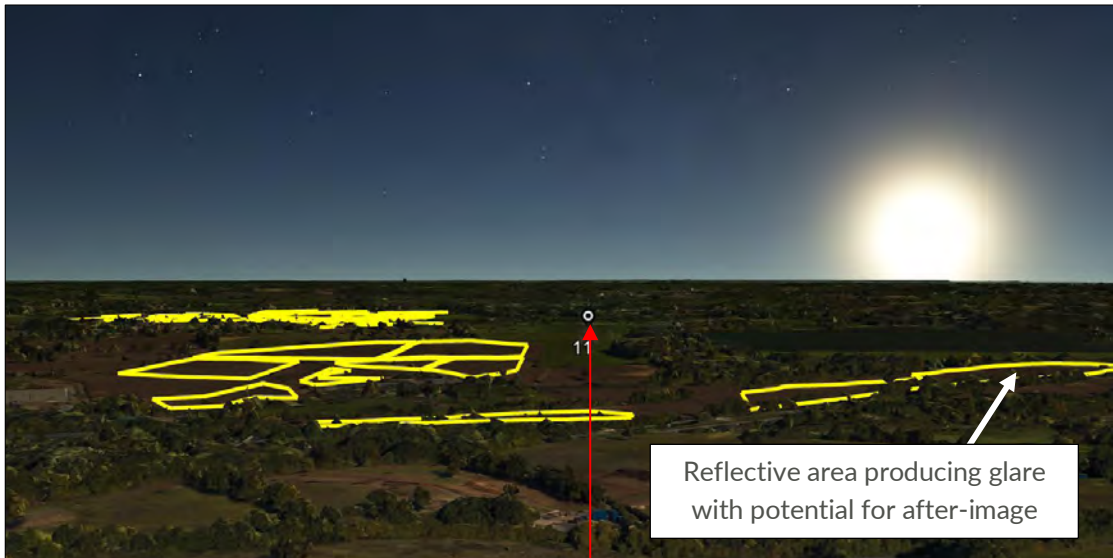


Figure 26 – Location of the sun in the sky at the time of reflection (1st October at 6:20am)

- Existing reflective surfaces located near the proposed development (water surface) have been identified (see Figure 25 on the previous page).
- Furthermore, the following will have to occur concurrently:
 - Clear sky (worst-case scenario) when glare with potential for after-image is predicted; and
 - An aircraft approaching at this specific time.

While glare with potential for temporary after image has been predicted, impacts upon pilots approaching the runway 08 are judged to be not significant. This because the amount of glare where potential for after-image is possible per year is minimal (only 0.001% of daylight time per year) and glare produced by the panels and sunlight will generate from approximately the same point in space. The airport's position regarding this potential glare should be confirmed. Mitigation strategies are not recommended.

9.4 Aviation Receptors – Approach 26

The Pager Power model indicates that solar reflections are possible towards the entire runway 26 approach path. Forge predicts solar reflection to have potential for after-image between the runway threshold and 0.2 miles, at 0.8 miles from the threshold and between 1.0 mile and 1.2 miles from the threshold meanwhile for the rest of the approach path the intensity of reflections is expected to have low potential for temporary after-image.

A review of the available imagery shows that the views of Site 6 are significantly obstructed from view of a pilot by terrain and vegetation for aircrafts travelling between 0.2 miles and the

threshold (see Figure 27⁴⁰ on the following page). Therefore, any glare with potential for after-image will be sufficiently screened and pilots approaching runway 26 will not be affected.



Figure 27 - View of the reflective area at 0.2 miles from the runway 26 threshold

Therefore, glare with potential for afterimage is expected to be experienced at 0.8 miles from the threshold and between 1.0 mile and 1.2 miles from the threshold. Solar reflections with potential for temporary after-image will occur at circa 17:30 from the end of April to the end of May and from mid-July to mid-August and at circa 18:00 from the end of May until mid-July. In total solar reflections with potential for temporary after-image are predicted to for a maximum of 172 minutes per year (see Figure 28 and Figure 29⁴¹ on the following page).

⁴⁰ Source: Copyright © 2020 Google.

⁴¹ The Forge analysis showed that the only sites that can generate glare with potential for after-image are Site 13 (only the southwestern portion – 13b) and Site 16.

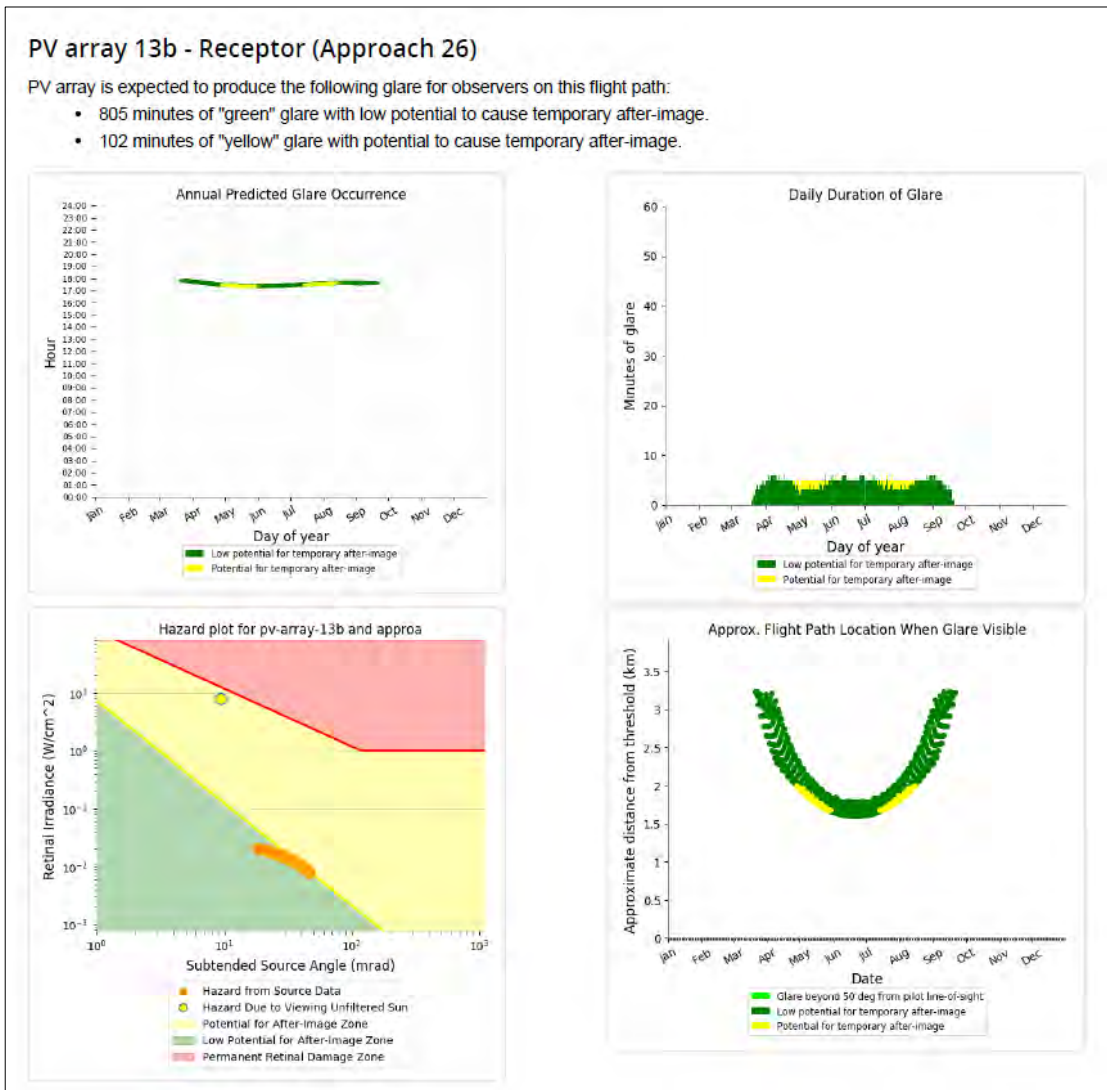


Figure 28 – PV array 13 south western section (13b) solar reflection (Forge analysis)

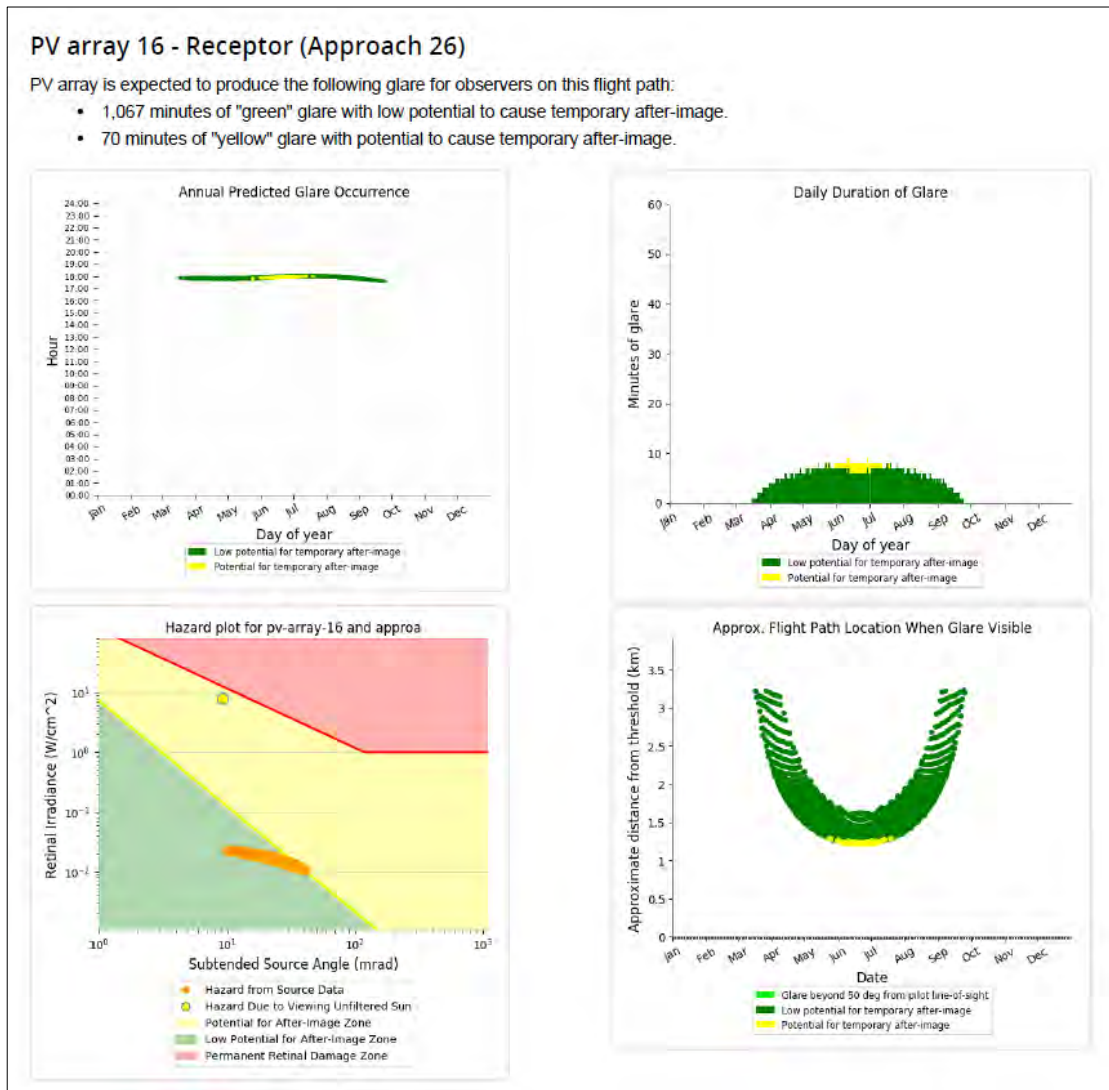


Figure 29 – PV array 16 solar reflection (Forge analysis)

As stated in the previous page Pager Power recommends a pragmatic approach within its guidance document. Considering the above, the points below are applicable:

- Visibility of the reflecting solar panels area producing glare with potential for after-image is expected at 0.8 miles from threshold and between 1.0 mile and 1.2 miles from threshold (Figure 30 and Figure 31⁴² on the following page). However, the reflective area generating glare with potential for after-image will not be directly in front of the pilot approaching the runway and far from the threshold;

⁴² Source: Copyright © 2020 Google.

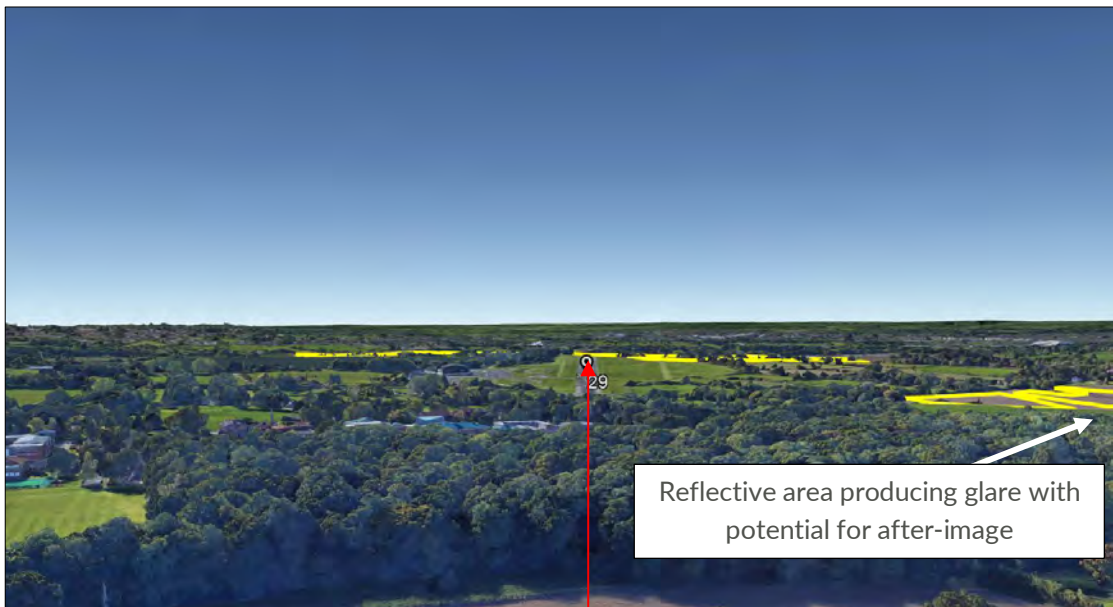


Figure 30 – View of the reflective area at 0.8 miles from the runway 26 threshold

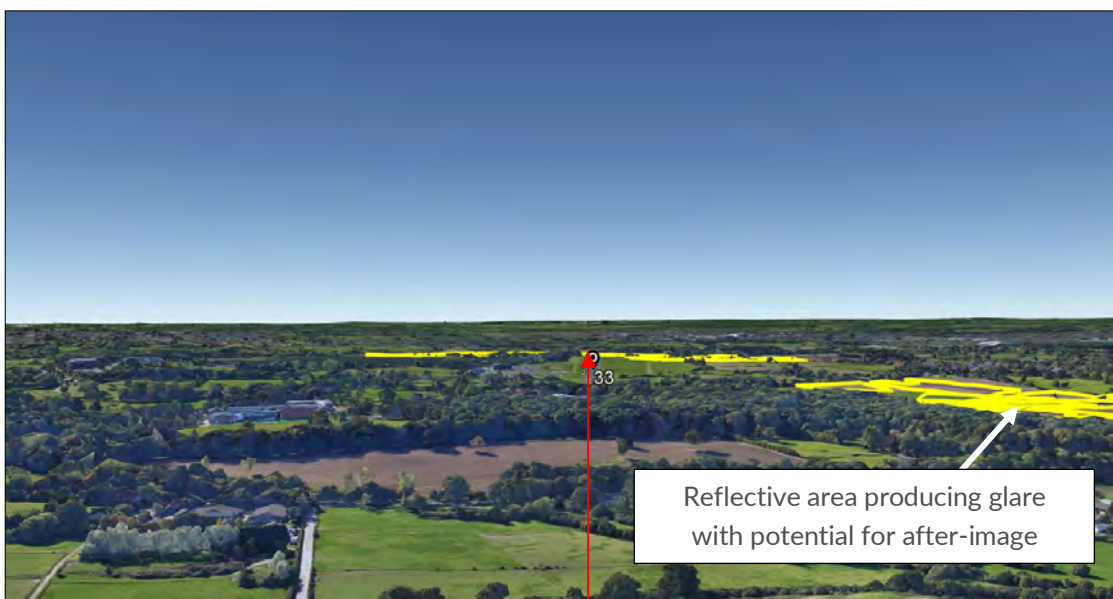


Figure 31 – View of the reflective area at 1.2 miles from the runway 26 threshold

- Solar reflections with the potential for temporary after-image is predicted to occur for only 172 minutes per year. This is equivalent to 0.065% of daylight time per year – this is based on the assumption of 12 hours of daylight per day.
- The Sun, which is a much brighter source of light, is expected to be directly in front of a pilot on the 2-mile approach path at the time a reflection with potential for temporary after-image is possible (see Figure 32⁴³ on the following page).

⁴³ Source: Copyright © 2020 Google.

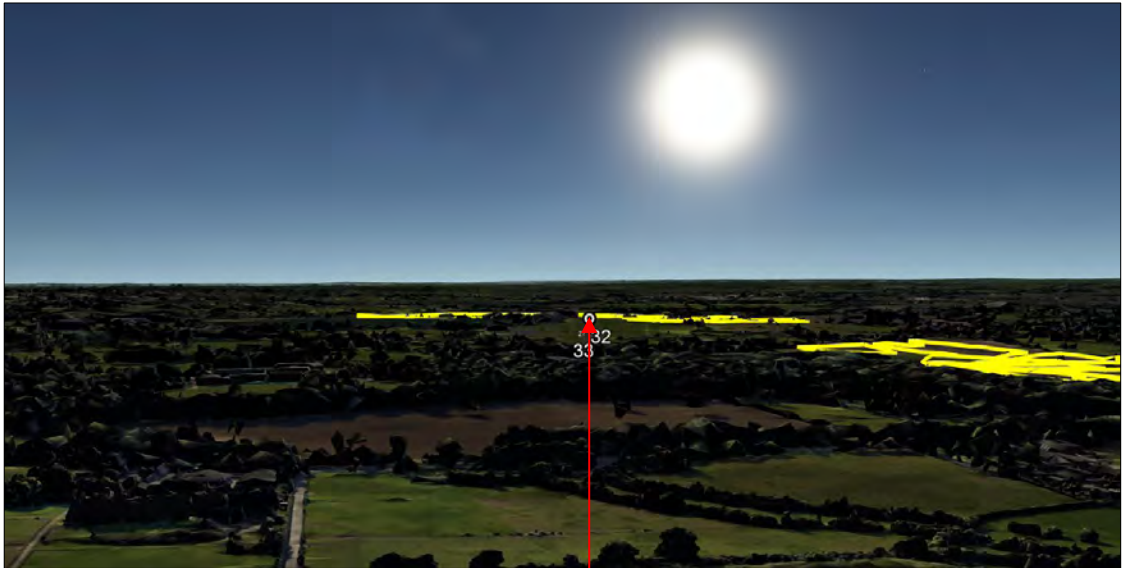


Figure 32 – Location of the sun in the sky at the time of reflection (1st April at 17:30)

- Furthermore, the following will have to occur concurrently:
 - Clear sky (worst-case scenario) when glare with potential for after-image is predicted; and
 - An aircraft approaching at this specific time.

While glare with potential with potential for temporary after-image has been predicted, impacts upon pilots approaching runway 26 are judged to be not significant. This because the amount of glare where potential for after-image is possible per year is minimal (only 0.065% of daylight time per year) and the glare will not generate near the threshold. The airport's position regarding this potential glare should be confirmed. Mitigation strategies are not recommended.

9.5 Elstree Aerodrome Consultation

Following the receipt of the glint and glare assessment Elstree Aerodrome concluded that the proposed development will not impact upon the safety of operations at the aerodrome, and, subsequently, no objection has been raised by Elstree Aerodrome⁴⁴ (document ref: 21/0050/FULEI).

⁴⁴ Consultation with Elstree Aerodrome was carried out on the 25th November 2020

9.6 Dwellings

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards 85 of the 108 identified dwelling receptors. Impact significance is determined on the level of visibility, the duration of effects and the relative position of the sun. For 10 dwellings where reflections are expected to last for more than 3 months per year but for less than 1 hour per day, some or no screening will result in low or moderate impact:

- Dwelling 23 and 24: a review of the available imagery showed some intervening screening in the form of existing vegetation (Figure 33⁴⁵ on the following page) which will significantly reduce the duration of effects. Furthermore, the developer has proposed screening in the form of vegetation (Figure 34⁴⁶ on page 132). No impact expected, and no further mitigation required.



Figure 33 – Location of dwellings 23 and 24 relative to the reflective area and level of screening

⁴⁵ Source: Copyright © 2020 Google.

⁴⁶ LEEP Plan is shown in Appendix I

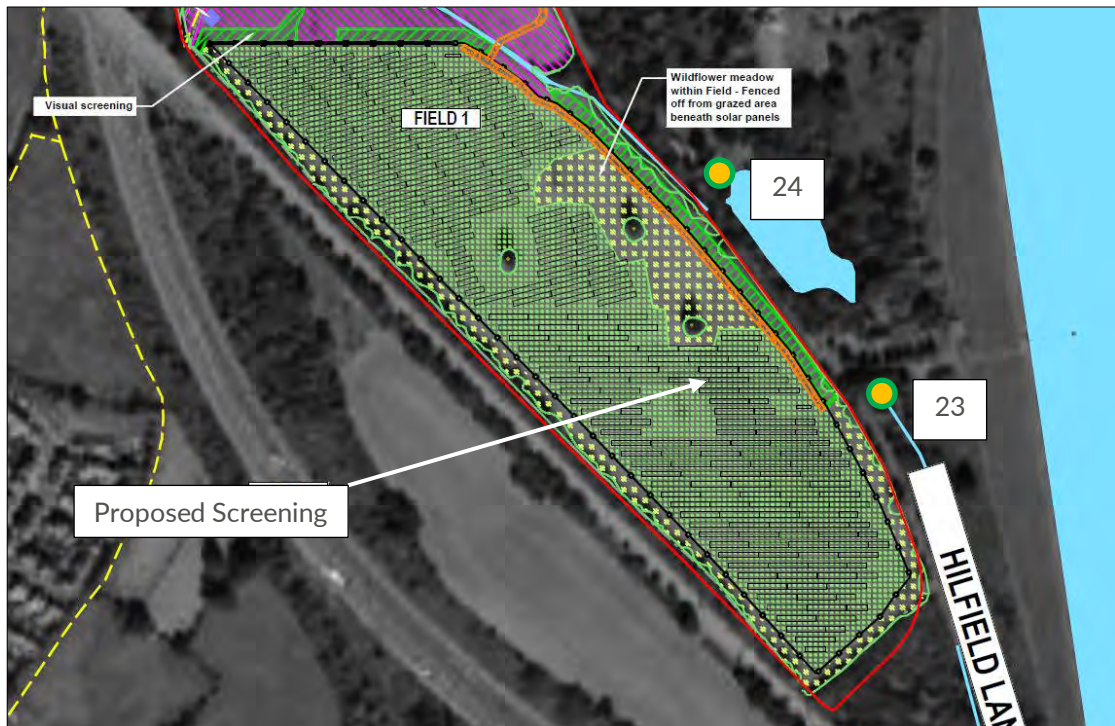


Figure 34 – Proposed screening for dwelling 23 and 24

- Dwelling 28: a review of the available imagery showed some intervening screening in the form of existing vegetation (Figure 35⁴⁷ on page 132) which will significantly reduce the duration of effects. Furthermore, sunlight and reflections will generate approximately in the same point in space with sun being a much brighter source of light. Low impact expected, and no further mitigation required.

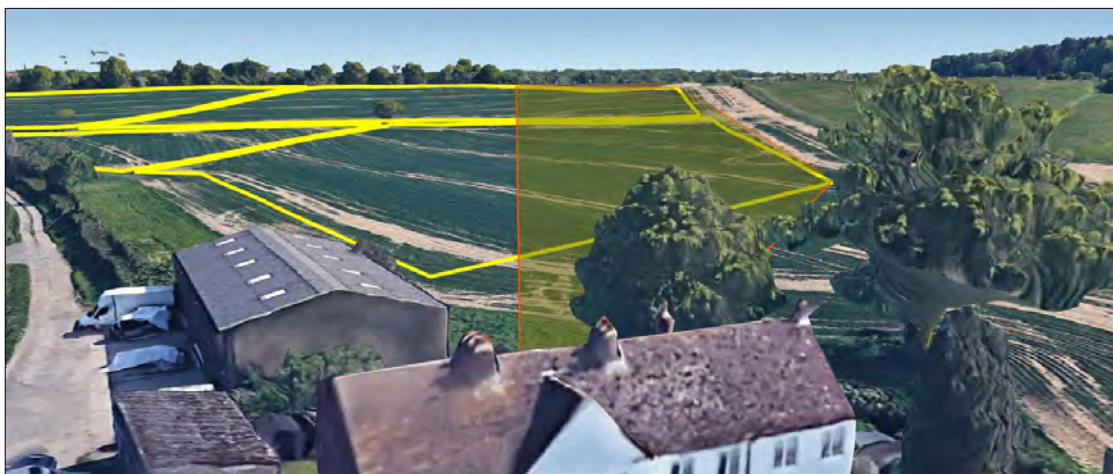


Figure 35 – Level of screening from dwelling 28

⁴⁷ Source: Copyright © 2021 Google.

- Dwelling 88: a review of available imagery shows that, under the current baseline scenario, an observer located in the dwelling will have a clear view of the closest two areas however existing vegetation will fully or partially block the view of the rest of the reflective area (yellow area in Figure 36 on page 134). Under the current baseline scenario, a moderate impact is predicted. However, the developer has proposed screening in the form of vegetation next to the dwellings which will block all view of the closest two sites (see Figure 37⁴⁸ on page 134). No impact expected once the vegetation will be fully grown, and no further mitigation required.
- Dwelling 89: a review of available imagery shows that views of the reflective area will be either significantly or fully blocked by existing vegetation and buildings (green area in Figure 36 on the following page). Low impact expected and no mitigation required.
- Dwelling 90: a review of available imagery shows that an observer located in the dwelling will have a partially obstructed view of the reflective area (red area in Figure 36 on the following page). This means that reflections will last less than 3 months per year. Furthermore, sunlight and reflections will generate approximately in the same point in space with sun being a much brighter source of light. Low impact expected and no mitigation required.
- Dwelling 91: a review of available imagery shows that views of the reflective area will be either significantly or fully blocked by existing vegetation and buildings (red area in Figure 36 on page 134). This means that reflections will last less than 3 months per year. Furthermore, sunlight and reflections will generate approximately in the same point in space with sun being a much brighter source of light. Low impact expected and no further mitigation is required.

The addresses of the discussed dwelling are shown below:

- 23: 1 Hilfield Reservoir Cottage Hilfield Lane Aldenham Watford Hertfordshire WD25 8DA;
- 24: Hilfield South Lodge Hilfield Lane Aldenham Watford Hertfordshire WD25 8DA;
- 88: 6 Wards Cottages Aldenham Road Elstree Hertfordshire WD6 3AH;
- 89: 2 Players Cottage Aldenham Road Elstree Hertfordshire WD6 3AQ;
- 90: 1&2 Sidney Cottages Aldenham Road Elstree Hertfordshire WD6 3AQ;
- 91: Letchmore Lodge Aldenham Road Elstree Hertfordshire WD6 3AQ;
- 99: Medburn House Watling Street Elstree Hertfordshire WD6 3AB;
- 100: Phillimore House Watling Street Elstree Hertfordshire WD6 3AB;
- 101: 1 Medburn Cottages Watling Street Elstree Hertfordshire WD6 3AB;
- 102: 2 Medburn Cottages Watling Street Elstree Hertfordshire WD6 3AB.

⁴⁸ LEEP Plan is shown in Appendix I



Figure 36 - Location of dwellings 88 to 91 relative to the reflective area and level of screening

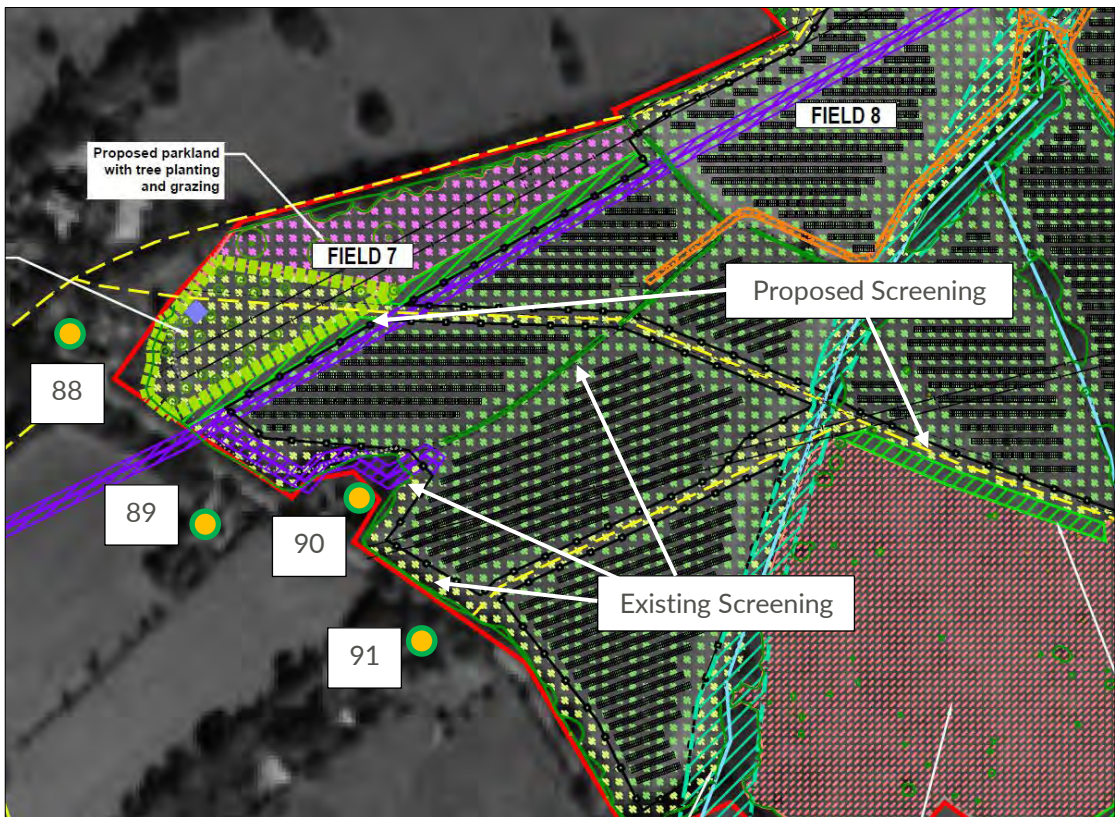


Figure 37 - Screening (proposed and existing) dwellings 88 to 91

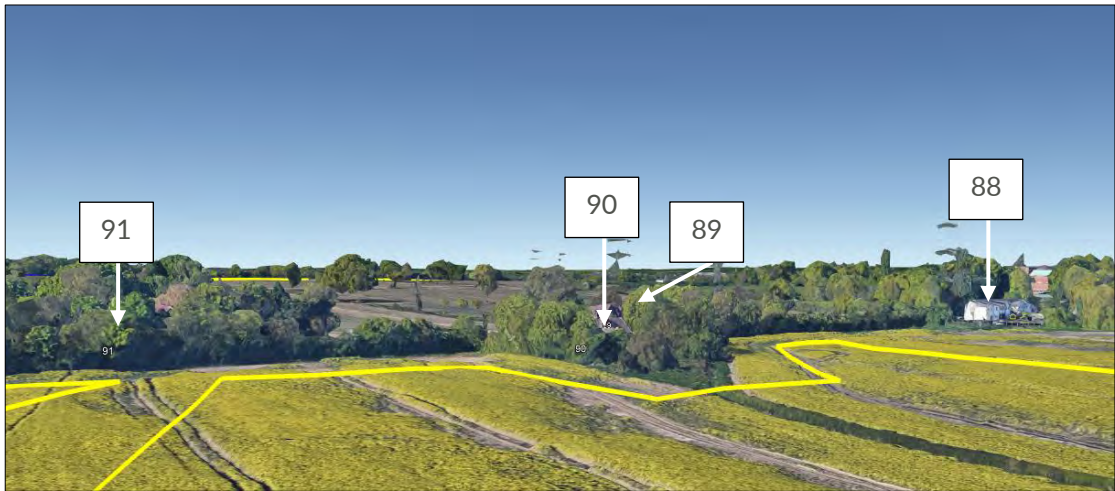


Figure 38 – Existing screening for dwelling 88, 89, 90 and 91

- Dwellings 99 to 102: a review of available imagery shows that an observer located in each dwelling will have a partial view of the reflective area under current baseline scenario (yellow area in Figure 39 on page 135) and a moderate impact is predicted. An example of where mitigation should be installed is shown in Figure 40 on page 136. The developer has proposed screening at these locations (Figure 41⁴⁹ on page 136) which will be sufficient to remove all views of the reflective areas. Therefore, no impact is expected once the proposed mitigation will be in place.



Figure 39 – Location of dwellings 99 to 102 relative to the reflective area and level of screening

⁴⁹ LEEP Plan is shown in Appendix I



Figure 40 – Screening (green line) to reduce the impact upon dwellings 99 to 102



Figure 41 – Proposed mitigation screening for dwelling 99 to 102

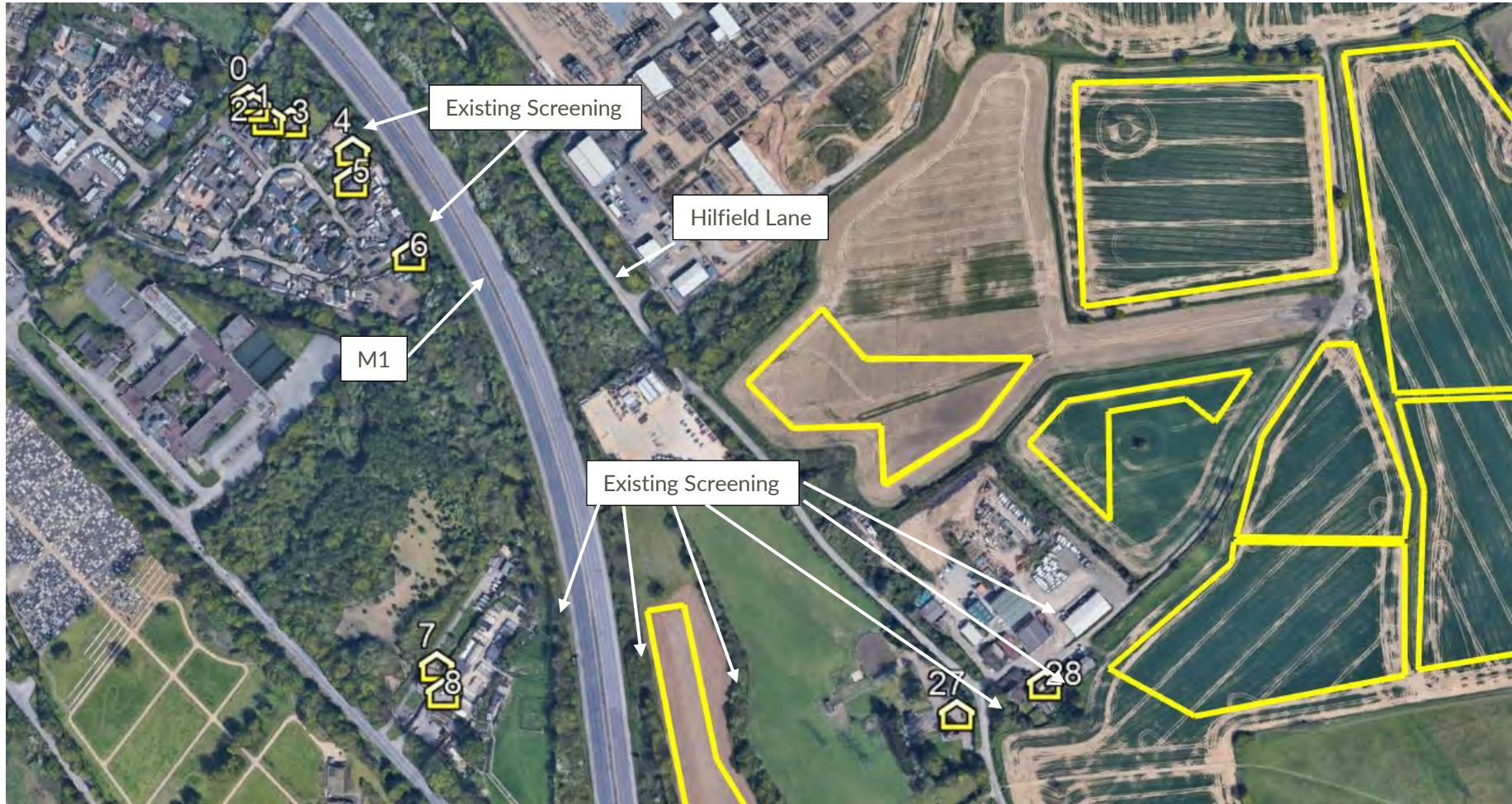


Figure 42 – Existing screening for dwellings 0 to 8 and 27 and 28



Figure 43 - Existing screening for dwellings 9 to 22 and 29 to 40

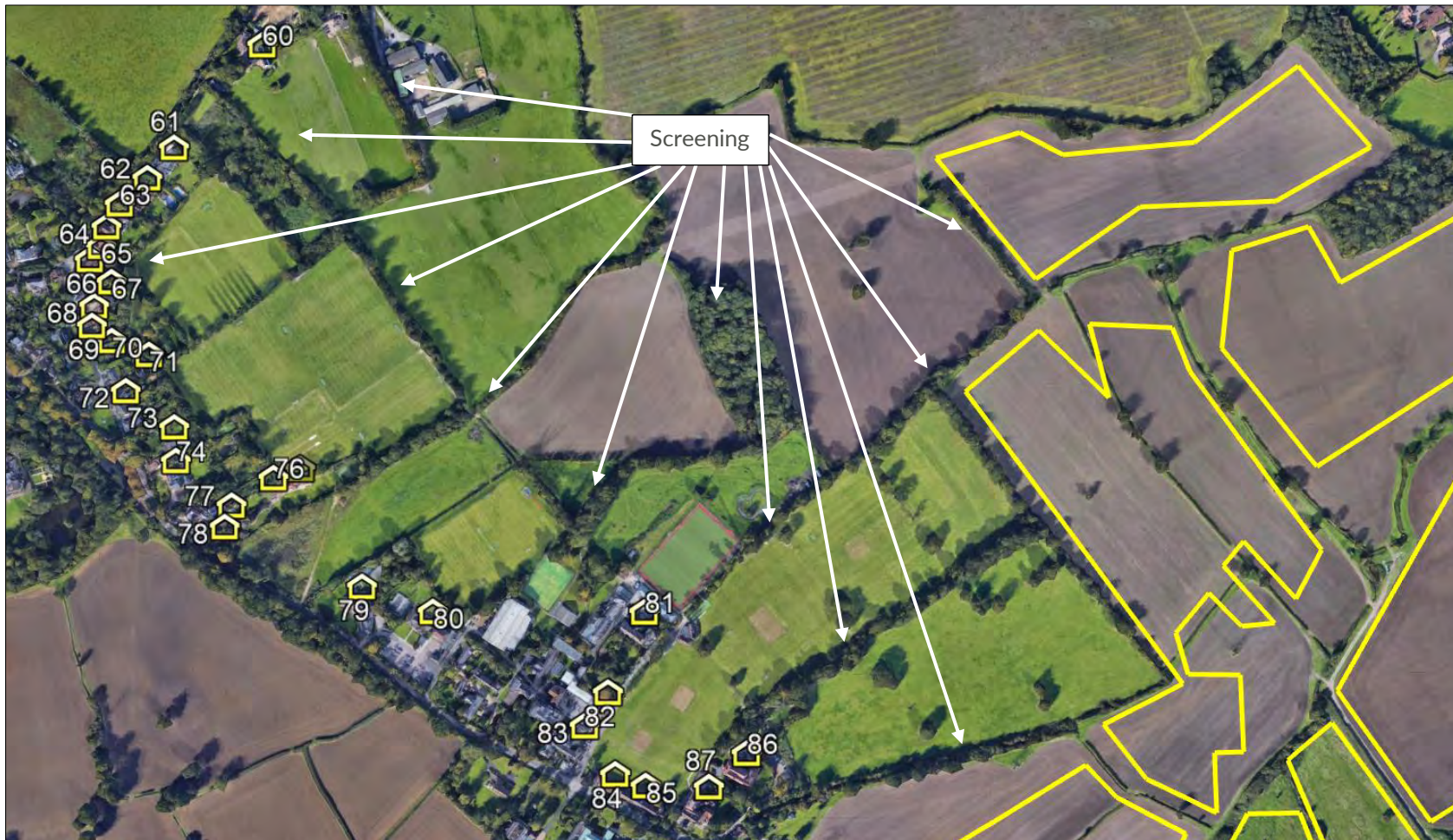


Figure 44 - Existing screening for dwellings 60 to 87



Figure 45 – Existing screening for dwellings 92 to 98

9.7 Roads

9.7.1 M1

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards 12 out of the 18 identified road receptors along the M1. Impact significance is determined on the level of visibility, the classification of the road and its relative traffic volumes, the location of the reflection relative to the road, and the relative position of the sun.

The potentially affected road locations are shown in the Figure 46⁵⁰ below. It can be seen from the same image that screening in the form of existing vegetation or buildings will block any view of the reflective surface for all identified locations.

⁵⁰ Source: Copyright © 2020 Google.



Figure 46 – Potentially affected locations on M1

Roadside screening has also been identified, which will further reduce the visibility of the proposed development (see Figure 47 and Figure 48⁵¹ below).

No impact is expected and therefore, no further mitigation is required.

⁵¹ Source: Copyright © 2021 Google.

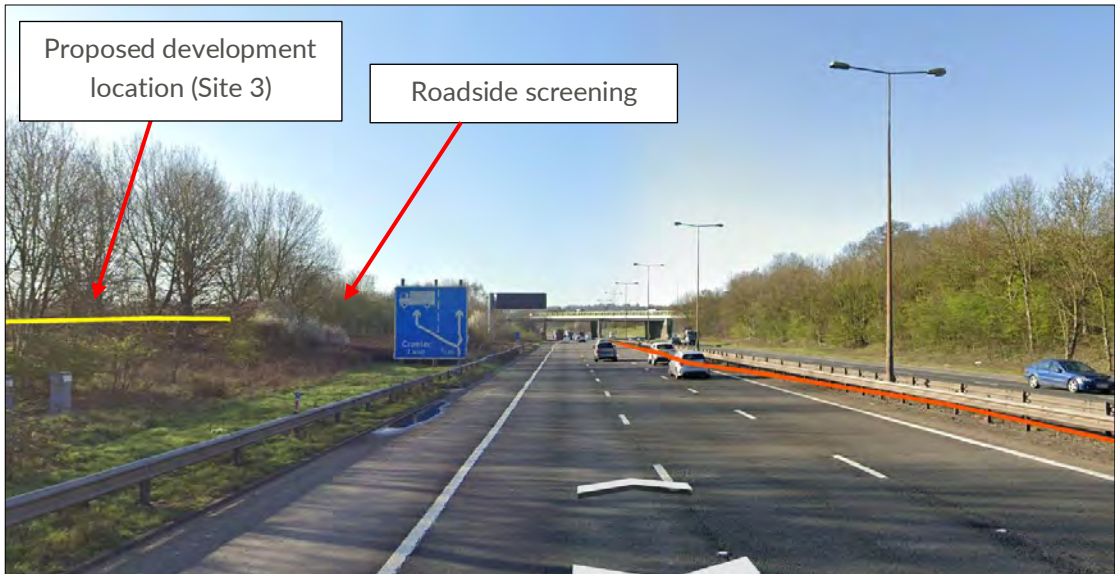


Figure 47 – Roadside screening for M1 at receptor 5 facing receptor 6

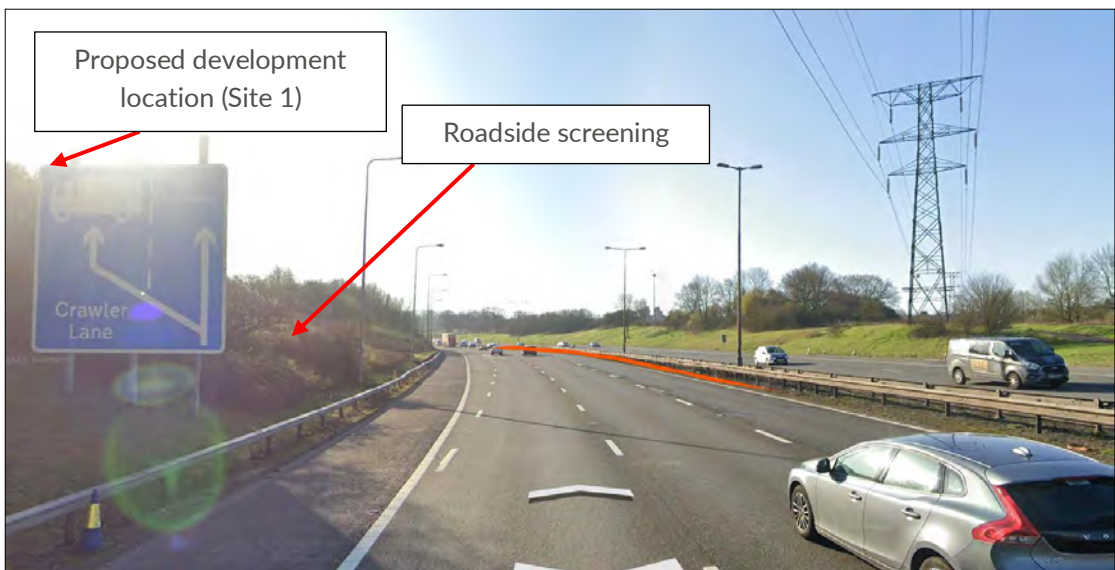


Figure 48 – Roadside screening for M1 at receptor 10 facing receptor 11

9.7.2 A41

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards seven out of the nine identified road receptors along the A41.

The potentially affected road locations are shown in the Figure 49⁵² below. It can be seen from the same image that screening in the form of vegetation will block any view of the reflective surface for some of the receptor locations (18 and 20 to 24), an example of the roadside screening is shown in Figure 50 on the following page. For drivers travelling across receptor location 19 views of the reflective area of Site 15 to 18 will not be possible.

No impact is expected and therefore, no further mitigation is required.



Figure 49 – Potentially affected locations on the A41

⁵² Source: Copyright © 2020 Google.



Figure 50 – Roadside screening for the A41 at receptor 21 proceeding south-east

9.7.3 Hilfield Lane

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards all the 12 identified road receptors along Hilfield Lane.

The potentially affected road locations are shown in the Figure 51⁵³ on the following page. It can be seen from the same image and from Figure 52⁵⁴ and Figure 53 on pages 147 and 147 respectively that screening in the form of vegetation will block any view of the reflective surface for all assessed locations.

No impact is expected and therefore, no further mitigation is required.

⁵³ Source: Copyright © 2020 Google.

⁵⁴ Drivers of HGVs will have a view of the reflective area under the current baseline scenario. However, reflections will not generate in front of the drivers and the developer has proposed further screening which will eliminate all views.

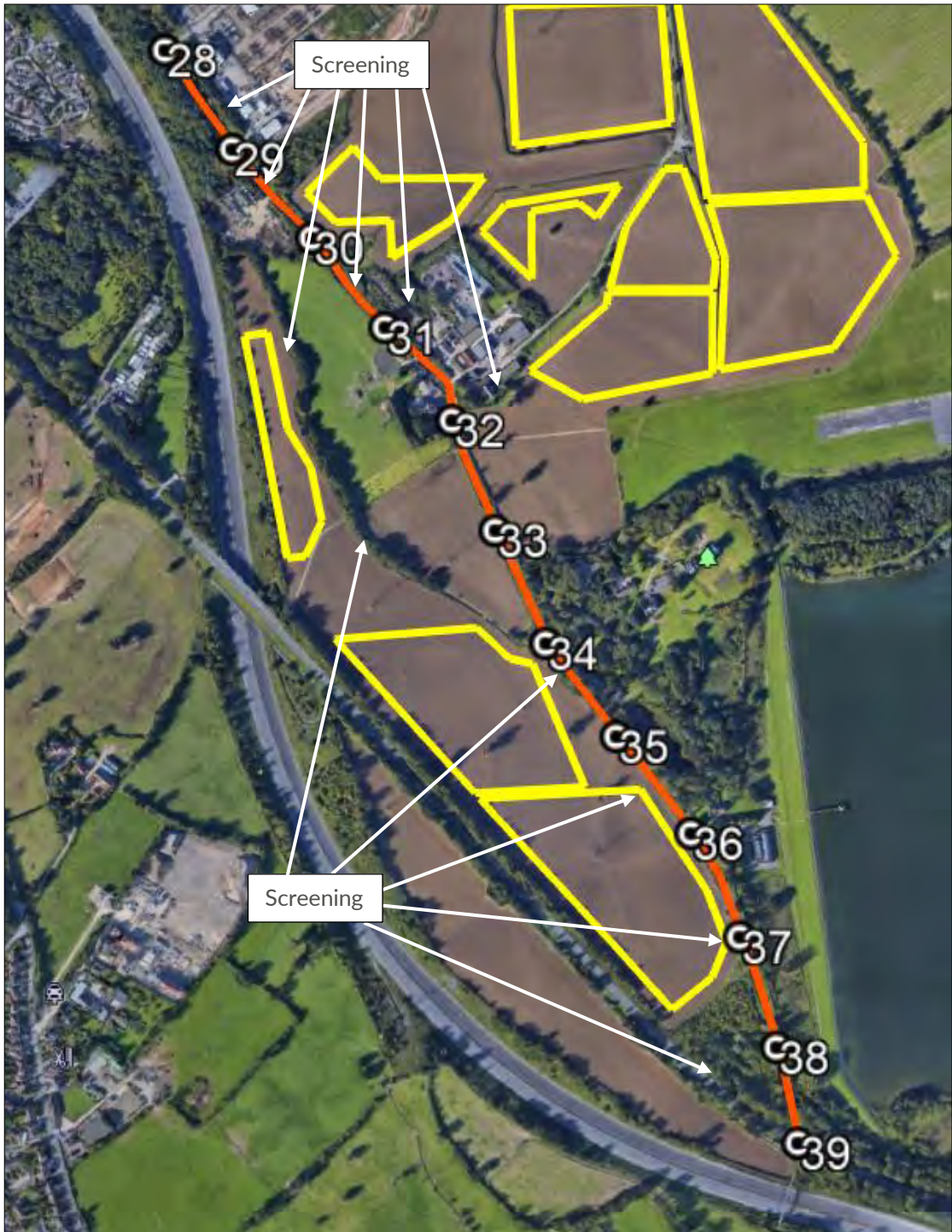


Figure 51 - Potentially affected locations on Hilfield Lane

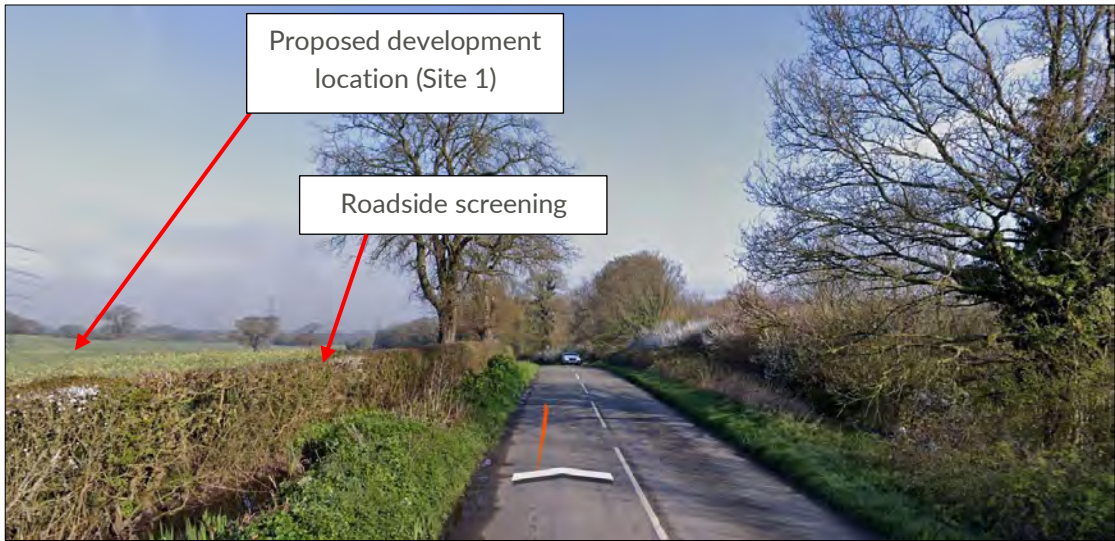


Figure 52 – Roadside screening for Hilfield Lane at receptor 37 proceeding north

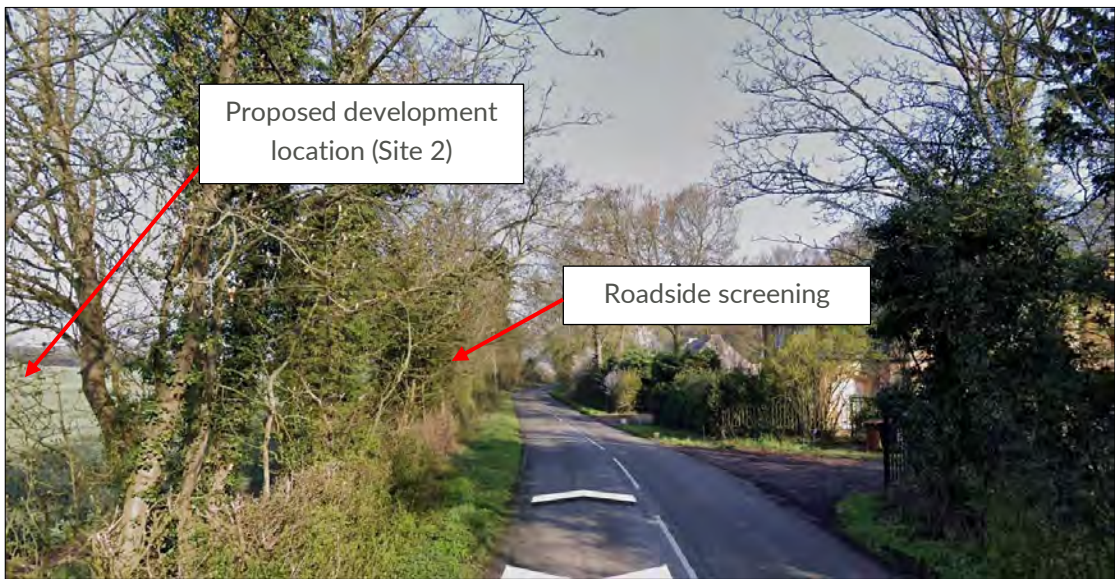


Figure 53 – Roadside screening for Hilfield Lane at receptor 35 proceeding north

9.7.4 Aldenham Road

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards all the 11 identified road receptors along Aldenham Road.

The potentially affected road locations are shown in the Figure 54⁵⁵ below. For locations 40 to 45 and 49 and 50 visibility of the reflective area will be blocked by either existing vegetation or terrain. For these locations, no impact is expected, and no mitigation will be required.

For road location 46, 47 and 48 visibility of the reflective area will be significantly reduced by roadside vegetation (see Figure 55, Figure 56 and Figure 57 on the following pages). Further considerations should be made:

- Despite reflections generating within the drivers' field of view, they will not generate in front of the drivers;
- Traffic volumes on Aldenham Road are not expected to be high;
- Sunlight and reflection will generate approximately in the same point in space with sun being a much brighter source of light;

Therefore, no to low impact is expected and no mitigation is required.



Figure 54 – Potentially affected locations on Aldenham Road

⁵⁵ Source: Aerial image copyright © 2020 Google.

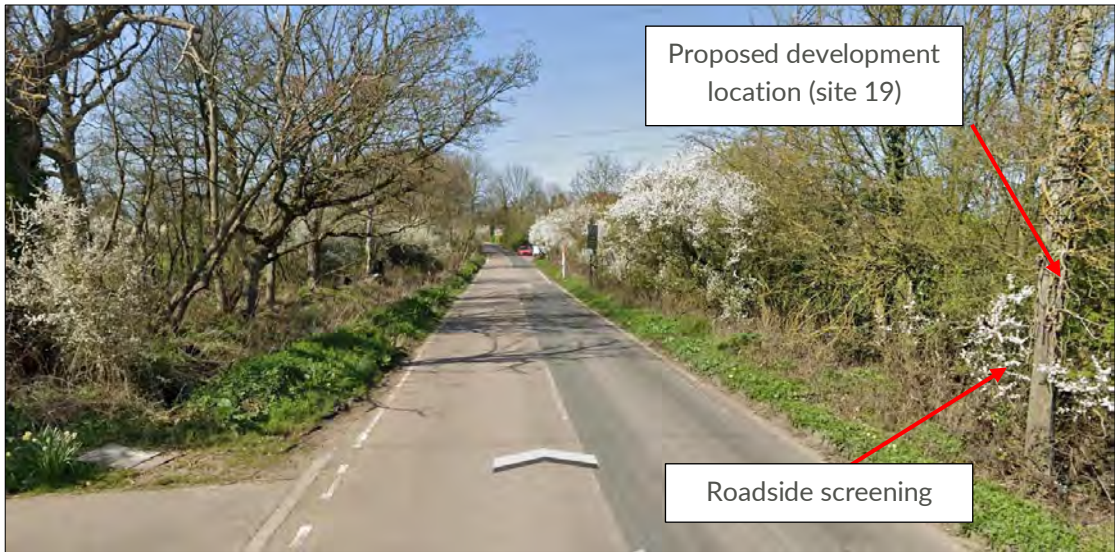


Figure 55 – Roadside screening for Aldenham Road at receptor 46 proceeding north



Figure 56 – Roadside screening for Aldenham Road at receptor 47 proceeding north



Figure 57 – Roadside screening for Aldenham Road at receptor 48 proceeding north

9.7.5 Butterfly Lane

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards all the 8 identified road receptors along the Butterfly Lane.

For receptor 51 and 52 reflection will be screened by terrain and no impact is expected meanwhile buildings will block reflection for reflector points 55 and 56. The potentially remaining affected road locations are shown in the Figure 58⁵⁶ on the following page. It can be seen from Figure 59 on the following page that, under the current baseline scenario, some screening in the form of vegetation exists. However, this level of screening is not expected to remove views of the reflective area. The developer has therefore proposed screening in the form of vegetation on the southern boundary which is expected to eliminate all view of the proposed development (see Figure 60⁵⁷ on page 152).

Therefore, no impact is expected, and no further mitigation is required.

⁵⁶ Source: Aerial image copyright © 2020 Google.

⁵⁷ LEEP Plan is shown in Appendix I

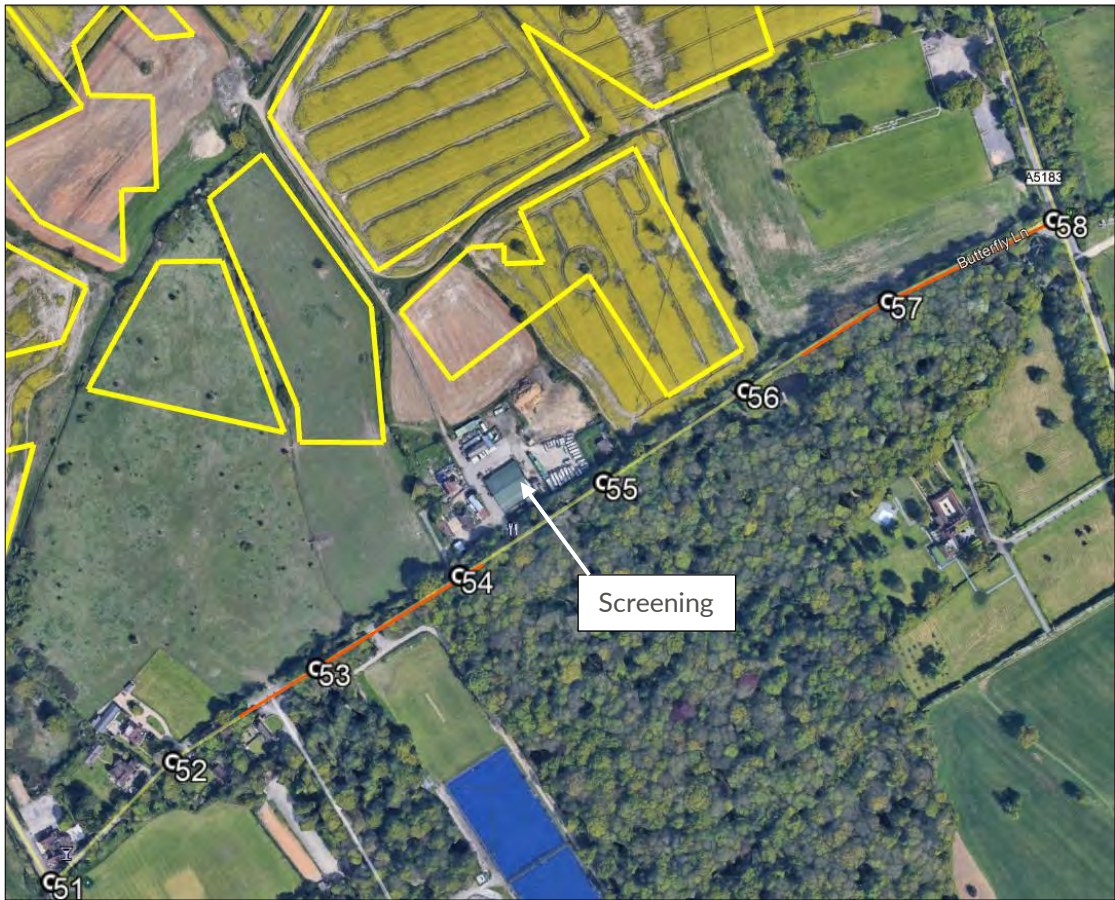


Figure 58 – Potentially affected locations on Butterfly Lane



Figure 59 – Roadside screening for Butterfly Lane at receptor 57 proceeding towards 56

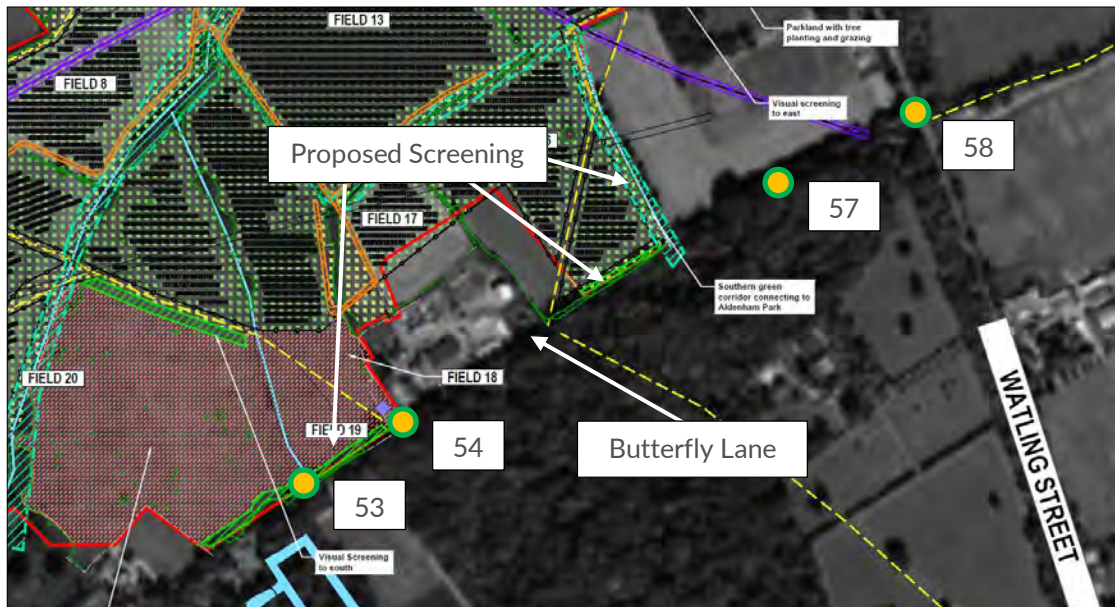


Figure 60 – Proposed Screening (green and light blue line) to eliminate any impact upon drivers travelling along Butterfly lane

9.7.6 A5183

The results of the analysis have shown that the reflections from the proposed development are geometrically possible towards all the 12 identified road receptors along the A5183.

The potentially affected road locations are shown in the Figure 61⁵⁸ on the following page. It can be seen from the Figure 61 and from Figure 62 on the following page that screening in the form of vegetation will block any view of the reflective surface for all assessed locations. Furthermore, reflections are expected not to generate in front of drivers travelling across the A5183.

No impact is expected and therefore, no further mitigation is required.

⁵⁸ Source: Aerial image copyright © 2020 Google.



Figure 61 – Potentially affected locations on the A5183

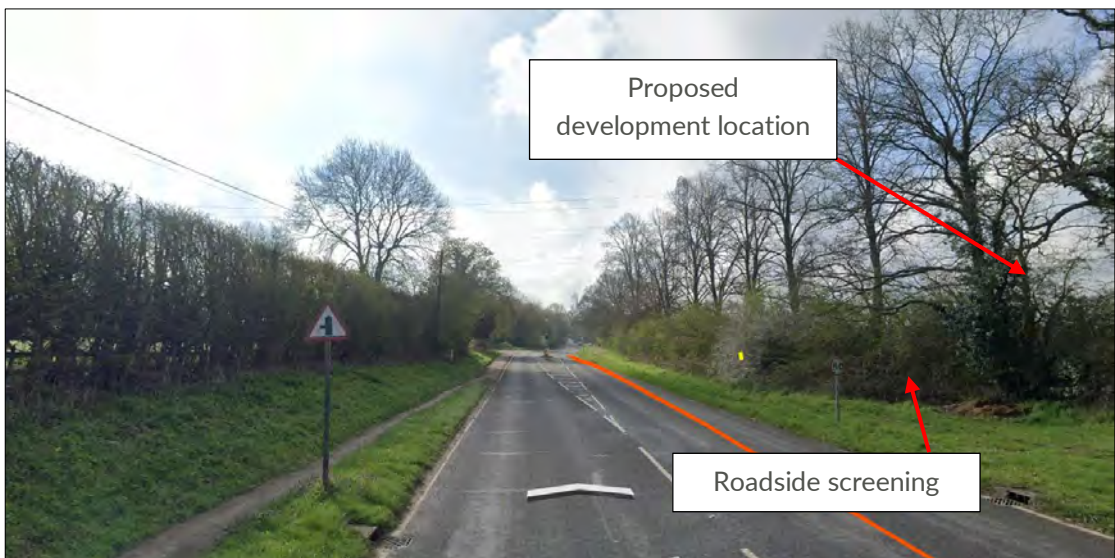


Figure 62 – Roadside screening for the A5183 at receptor 62 proceeding south

10 OVERALL CONCLUSIONS

10.1 Consultation with Elstree Aerodrome

Pager Power consulted with Elstree Aerodrome to understand their concerns regarding the proposed development. Following the consultation, layout optimisation was completed. The aim of this task was to avoid unacceptable glare towards aviation receptors at Elstree Aerodrome and to minimise impacts overall. This has been achieved by changing panel characteristics such as tilt and orientation. The findings of the layout optimisation have informed the design team.

Following the receipt of the glint and glare assessment Elstree Aerodrome concluded that the proposed development will not impact upon the safety of operations at the aerodrome, and, subsequently, no objection has been raised by Elstree Aerodrome (document ref: 21/0050/FULEI).

10.2 Assessment Results – Overall Conclusion

The glint and glare assessment has shown that:

- For all aviation receptors, the maximum impact is low and no mitigation is required. Following the receipt of the glint and glare assessment Elstree Aerodrome concluded that the proposed development will not impact upon the safety of operations at the aerodrome, and, subsequently, no objection has been raised by Elstree Aerodrome (document ref: 21/0050/FULEI).
- For only four dwelling receptors, the impact is moderate under the current baseline conditions and mitigation is required. For these dwelling receptors, no impact is expected once the mitigation strategy shown on the LEEP plan is implemented which will be sufficient to remove all views of the reflective areas.
- For only four road receptors the impact is moderate, and mitigation is recommended.

10.3 Assessment Results – Aviation

10.3.1 ATC Tower

The analysis has shown that solar reflections from the proposed solar development towards the ATC Tower are geometrically possible. However, a review of available imagery and on-site survey have shown that visibility of the reflective area is not possible due to intervening terrain.

Therefore, no impact is expected, and no mitigation is required.

10.3.2 Aviation Receptors – Approach 08

The Pager Power model indicates that solar reflections are possible towards the entire runway 08 approach path. Forge predicts that at a distance of 1.1 miles from the threshold, the intensity of reflections is expected to have a potential for temporary after-image meanwhile for the rest of the approach path the intensity of reflections is expected to have a low potential for temporary after-image. Solar reflections with potential for temporary after-image will occur at

circa 6:50 GMT at the beginning of March and at circa 6:20 GMT at the beginning of October. In total solar reflections with potential for temporary after-image are predicted to for a maximum of 3 minutes per year. While glare with potential for temporary after-image has been predicted, impacts upon pilots approaching runway 08 are judged to be not significant. This because the amount of glare where potential for after-image is possible per year is minimal (only 0.001% of daylight time per year) and the glare produced by the panels and sunlight will generate from approximately the same point in space.

10.3.3 Aviation Receptors – Approach 26

The Pager Power model indicates that solar reflections are possible towards the entire runway 26 approach path. Forge predicts solar reflection with potential for after-image between threshold and 0.2 miles, at 0.8 miles from the threshold and between 1.0 mile and 1.2 miles from the threshold. At all other locations, the intensity of reflections is expected to have low potential for temporary after-image. A review of the available imagery shows that the reflective area located west of the airport is significantly obstructed from view of a pilot by terrain and vegetation for aircrafts travelling between 0.2 miles and the threshold. Therefore, at these locations, any glare with potential for after-image will be sufficiently screened and pilots approaching runway 26 will not be affected. Solar reflections with potential for temporary after-image will occur at circa 17:30 from the end of April to the end of end of May and from mid-July to mid-August and at circa 18:00 from the end of May until mid-July. In total solar reflections with potential for temporary after-image are predicted to for a maximum of 172 minutes per year. While glare with potential with potential for temporary after-image has been predicted, impacts upon pilots approaching runway 26 are judged to be not significant. This because the amount of glare where potential for after-image is possible per year is minimal (only 0.065% of daylight time per year) and the glare will not generate near the threshold.

10.4 Assessment Results - Dwellings

Four dwelling receptors located immediately east of the proposed development will concurrently experience reflections for more than 3 months per year but for less than 1 hour per day and be only partially screened under baseline conditions. The addresses of the dwellings are the following:

- 99: Medburn House Watling Street Elstree Hertfordshire WD6 3AB;
- 100: Phillimore House Watling Street Elstree Hertfordshire WD6 3AB;
- 101: 1 Medburn Cottages Watling Street Elstree Hertfordshire WD6 3AB;
- 102: 2 Medburn Cottages Watling Street Elstree Hertfordshire WD6 3AB.

While the results of the analysis have shown that the solar reflections from the proposed development are geometrically possible towards four dwelling receptors under the baseline, the review of available imagery showed that existing screening in form of vegetation and the proposed screening as shown the LEEP will sufficiently remove all views of the reflective areas from dwelling receptors.

Therefore, no impact is expected, and no further mitigation is required.

10.5 Assessment Results - Roads

While the results of the analysis have shown that the solar reflections from the proposed development are geometrically possible towards 57 out of the 69 identified road receptors, the review of available imagery showed that existing screening in form of vegetation will block all views of the reflective area for 53 of those road receptors. The remaining four receptors are located on Butterfly Lane (53, 54, 57 and 58) where some existing screening, which will partially screen the proposed development, has been identified. The developer has however proposed further screening which will fully block all views of the proposed development.

Therefore, no impact is expected and therefore further mitigation is not required.