Aviation Glint & Glare Analysis

for the proposed Solar Array at

Eatto,

John F Kennedy Road, Dublin

Prepared for Lochna Investments Limited
by Charles Morelli BEng, Renewable Energy Analyst

12 April 2022

1 Executive Summary

This report is an independent analysis of glint and glare effects – particularly with respect to aviation and including cumulative effects – from the proposed rooftop solar cells at Eatto (formerly The Reliance Bearing & Gear Co.), John F Kennedy Road, John F Kennedy Industrial Estate, Dublin 12, D12 ED68. The analysis uses predicted sun positions on a minute-by-minute basis for a whole year (2019), and predicted the directions, dates and times (and other pertinent factors) of solar reflections from the proposed solar panels.

This analysis considered effects on nearby aviation interests, including flight operations at Dublin and Weston airports, Baldonnel/Casement Aerodrome and a helicopter landing site at Tallaght Hospital.

It was concluded that effects on the above aviation interests – including cumulative effects in association with a similar Artizan Catering project nearby – will be negligible.

2 Introduction

The author: Charles Morelli, Renewable Energy Analyst, has been retained to conduct an independent aviation glint and glare effects from the proposed rooftop solar cells at Eatto (formerly The Reliance Bearing & Gear Co.), John F Kennedy Road, John F Kennedy Industrial Estate, Dublin 12, D12 ED68.

2.1 Analysis Method

Reflections of sunlight from the solar cells are assumed to come from the whole roof areas that have solar panels and are considered significant when close to horizontal (taken for this report as 10° above, to 5° below, horizontal) – these are described as 'near-horizontal reflections'. Flight profiles are almost invariably close to horizontal over built-up areas and in proximity to airfields (typical glideslopes on approach to land are 3°). Although aircraft may encounter solar reflections from steeper angles, they will fly through them almost instantly and so such reflections are not significant.

Unless otherwise stated, all map locations are based on the OSi IRENET95 Irish Transverse Mercator (ITM) Eastings/ Northings coordinates and azimuths/ bearings are given as Grid bearings.

Ireland uses the Greenwich Mean Time (GMT) time zone, but daylight saving time (i.e., Irish Standard Time, IST) is used from the last Sunday of March to the last Sunday of October. Unless otherwise specified, all times in this report are given in coordinated universal time (UTC) – equivalent to GMT for the purposes of this assessment.

2.2 Description of the Proposal

The building has a main roof and a smaller roof, each roof is of the ridge-style, with its ridge running approximately north-northeast to south-southwest (on a grid bearing of 20.3°/ 200.3°). This orientation is slightly different from that of the rooftops considered at Annex A.

The rooftops have 2 planar surfaces each, one pointing slightly south of due east, the other slightly north of due west.

The proposal is for solar voltaic cells to be installed on 3 out of 4 planar rooftop surfaces: both surfaces on the main roof, and the eastern-facing surface of the smaller roof. These are all inclined at 14.65° to the horizontal. This inclination is marginally different from that used at the Annex A.

2.3 Previous Artizan Catering Report

Whilst working for AARDVaRC Ltd, the author analysed glint and glare for a nearby rooftop solar panel development and wrote a report that is copied at Annex A to this report for ease of reference. All relevant permissions have been received to refer to that report and to reuse and republish it and its findings in part or in entirety as required.

Now working as an independent freelance analyst, the author has prepared this report using the same methodologies as used in that prior report. His biography can be read at Annex A.

Sun data for 2019 was used in this analysis for consistency and comparison with Annex A. Annual changes to the position of the sun through the day and year are small and significant changes are corrected every leap year. The findings of this report are therefore valid for the lifetime of the building and the solar panels mounted on it.

3 Solar Reflections Analysis

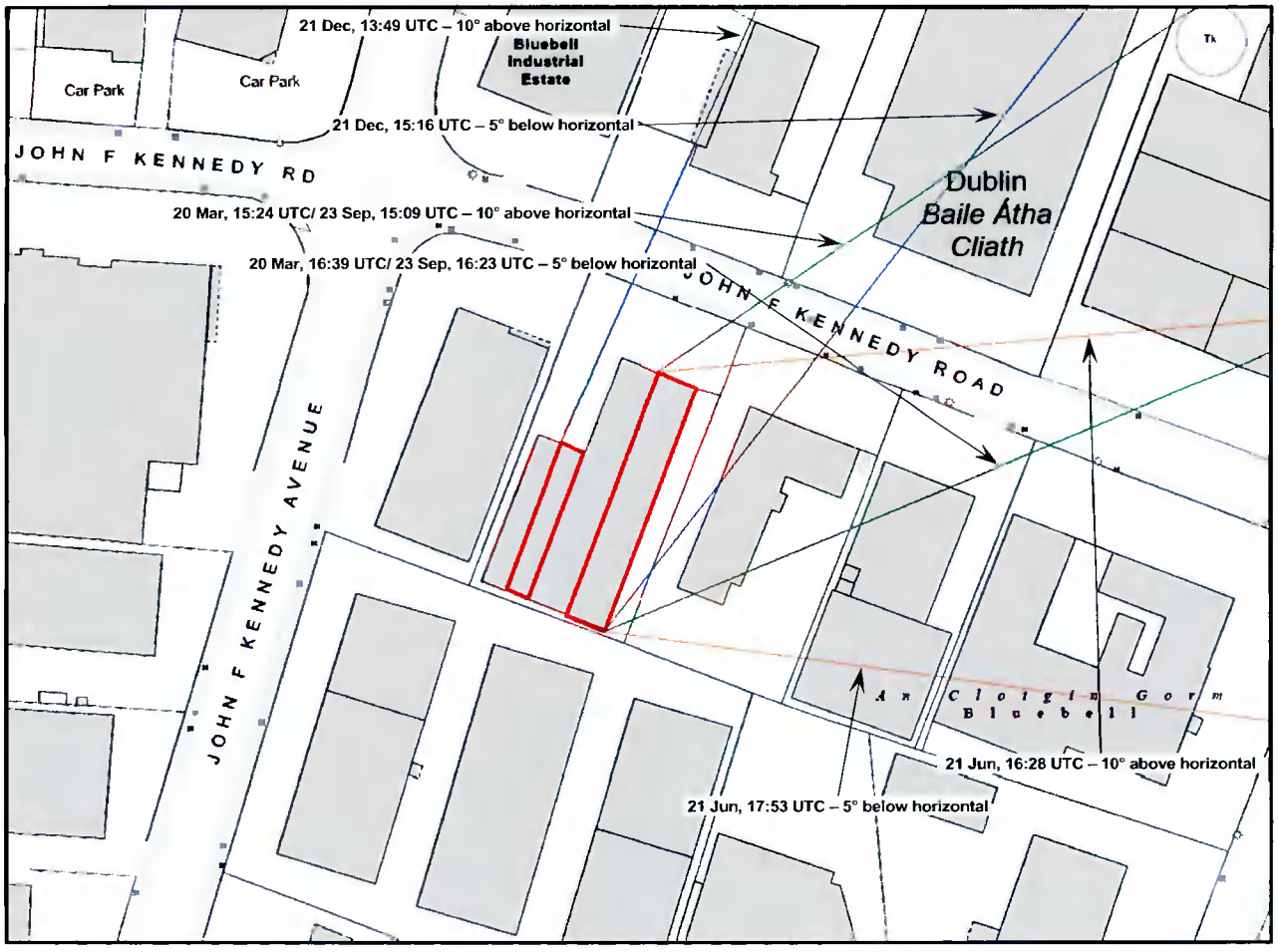
Solar reflections were considered separately for the east- and west-facing sides of the rooves, and then combined. These are summarised through the year in the following charts, overlaid on the 1:1,000-scale Planning Pack Map. Maps shown are copyright © Ordnance Survey Ireland, 2022.

3.1 East Facing Roof Panels

Near-horizontal reflections can occur for limited times on any day of the year. The east-facing roof is outlined in red on the following chart, and the arc boundaries for near-horizontal reflections are shown, colour coded for significant days of the year. Throughout the year, the dates shown encompass the arcs of all near-horizontal solar reflections from these panels.

Such reflections from the east-facing main and small rooves are high to begin with, and tend to get lower through the day as the sun sweeps through the sky; they tend to move clockwise (as viewed from above) through the day. The reflection arcs also tend to sweep clockwise through the year from midwinter to midsummer, and anticlockwise from midsummer to midwinter.

Winter solstice (21 Dec in 2019) reflection arc boundaries
Vernal & autumnal equinox (20 Mar & 23 Sep in 2019) reflection arc boundaries
Summer solstice (21 Jun in 2019) reflection arc boundaries
East-facing roof boundary

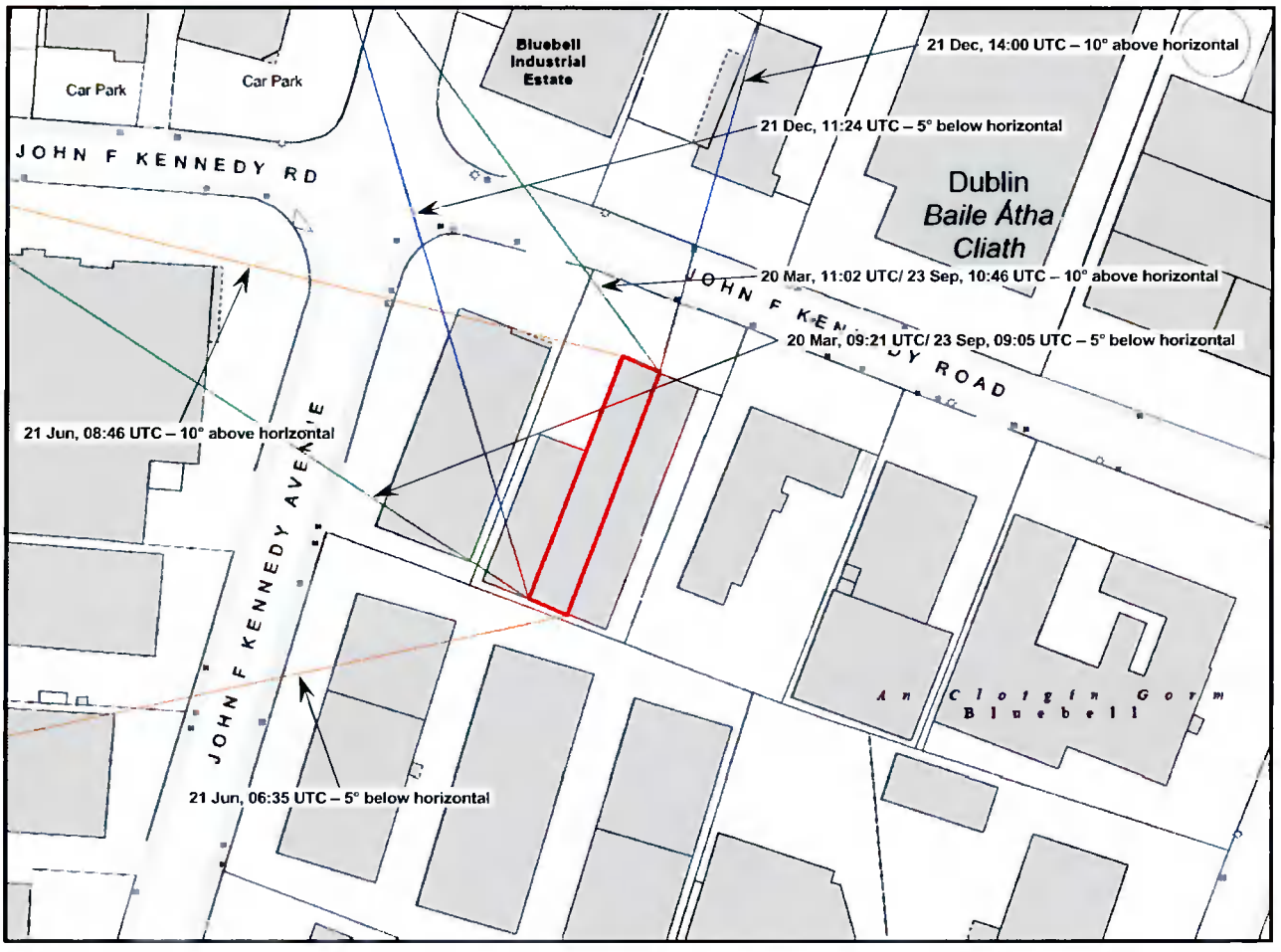


3.2 West Facing Roof Panels

Near-horizontal reflections can occur for limited times on any day of the year. The east-facing roof is outlined in red on the following chart, and the arc boundaries for near-horizontal reflections are shown, colour coded for significant days of the year. Throughout the year, the dates shown encompass the arcs of all near-horizontal solar reflections from these panels.

Such reflections from the west-facing main roof are low to begin with, and tend to get higher through the day as the sun sweeps through the sky; they tend to move clockwise (as viewed from above) through the day. The reflection arcs also tend to sweep anticlockwise through the year from midwinter to midsummer, and clockwise from midsummer to midwinter.

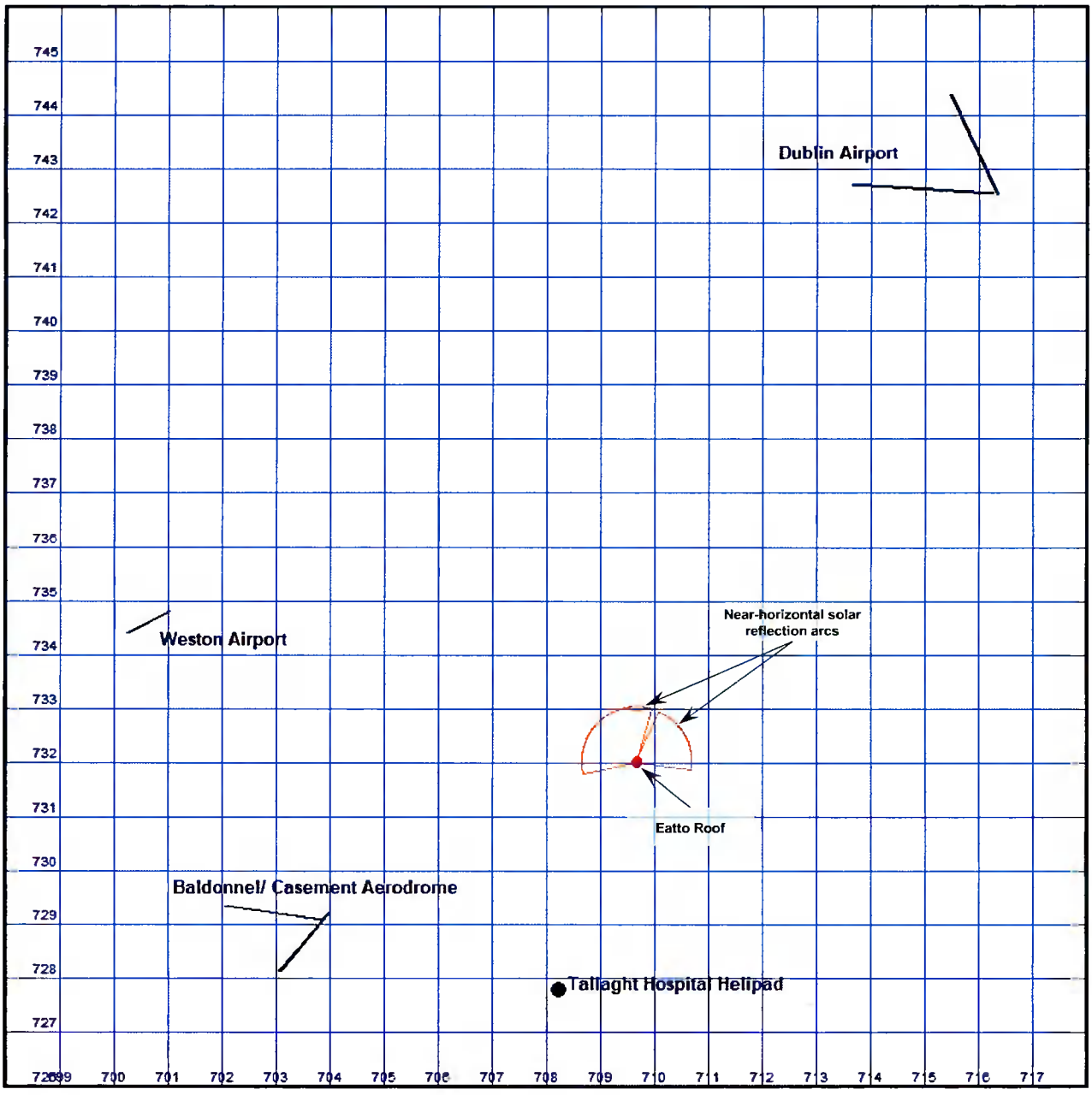
Winter solstice (21 Dec in 2019) reflection arc boundaries
Vernal & autumnal equinox (20 Mar & 23 Sep in 2019) reflection arc boundaries
Summer solstice (21 Jun in 2019) reflection arc boundaries
West-facing roof boundary



3.3 All Solar Reflections and Aviation Interests

The following chart (without a background map for clarity) shows the east- and west-facing solar panels' location with respect to the nearby airfields and Tallaght Hospital helicopter landing site. It also summarises all the near-horizontal reflections identified above. The Eatto building is marked as the red dot, the orange arc represents the direction of all possible near-horizontal solar reflections. The chart is overlaid on the IRENET 95 grid (grid squares are 1km x 1km) with Eastings and Northings marked in kilometres east and north of the datum point. Runways at Dublin, and Weston Airports, and at Baldonnel/ Casement Aerodrome are marked to scale. The location of the helicopter landing site at Tallaght Hospital is also shown (this is not shown to scale).

Whilst the size of the solar reflections arc is not intended to be necessarily indicative of anything, it seems unlikely that solar reflections much beyond it could be a significant nuisance to an observer.



4 Discussion

4.1 Eatto Glint and Glare Effects

From the chart is Section 3.3 above, it is clear that all near-horizontal reflections are directed effectively to the north of the Eatto rooftop (notably, away from Tallaght Hospital).

It is clear from the runway orientations that aircraft on final approach to, or departing from, any of the runways or the hospital will not be flying towards possible solar reflections from the proposed rooftop solar cells.

Although only 'near-horizontal reflections' have been considered in this report, it is possible that at certain dates and times, solar reflections could be directed more steeply upwards than the near-horizontal angles considered. However, aircraft operating to the various aviation sites will be flying relatively low when close to those sites and such reflections will pass well above them, given the distances from the solar panels.

Any aircraft – whether flying to or from any of these sites or another airfield – that encounters solar reflections from the Eatto roof may reasonably be considered to be in the 'en-route' phase of flight. There is no reason for them to be flying directly towards the roof top (this includes descending towards it) for any continuous period (unless perhaps to deliberately investigate the solar reflections). At aircraft speeds, if any reflections were encountered, they would fly through them within 1 or 2 seconds (due to the small area of solar panels) so the brief flash (which could only occur in bright daylight with the pilot's eyes well attuned to the brightness) would be insignificant and lost amongst other everyday sources of solar reflections, e.g., windows of buildings and vehicles, bodies of water, reflections from wet roads and runways. It is highly improbable that a glint and glare assessment has been made on any of these other commonplace sources of solar reflections.

The effect on aviation interests from the Eatto rooftop solar panels is therefore assessed as negligible.

4.2 Cumulative Glint and Glare Effects

Since the effects from the solar panels in isolation is negligible, the cumulative effect will also be negligible. It is doubtful that any adverse effects from the existing solar panels considered at Annex A have been noticed.

5 Conclusions

Aircraft on final approach to, or departing from, any of the runways or the hospital will not be flying towards possible solar reflections from the proposed rooftop solar cells.

Any that encounters solar reflections from the Eatto roof may reasonably be considered to be in the 'en-route' phase of flight. It will pass through any reflections within 1 or 2 seconds and the source would be indistinguishable from other everyday sources of solar reflections.

The effect on aviation interests, both in isolation and cumulative, will be negligible.

ANNEX A

to

Aviation Glint & Glare Analysis

for the proposed Solar Array at

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AARDVaRC Ltd

Aviation **A**nalysis, **R**enewables **D**evelopment &
Visualisation, **a**nd **R**adio **C**ommunications

Aviation Glint & Glare Analysis

for the proposed Solar Array at

Artizan Catering,

County Dublin

Prepared for KRA Renewables
by Charles Morelli BEng

19 May 2020

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1 Executive Summary

AARDVaRC Ltd has been retained to conduct its own aviation glint and glare effects from the proposed rooftop solar cells at Artizan Catering, County Dublin. The analysis uses predicted sun positions on a minute-by-minute basis for a whole year (2019), and predicted the directions, dates and times (and other pertinent factors) of solar reflections from the proposed solar panels.

This analysis considered effects on nearby aviation interests, including flight operations at Dublin and Weston airports, Baldonnel/Casement Aerodrome and a helicopter landing site at Tallaght Hospital.

It was concluded that effects on the above aviation interests will be negligible.

2 Introduction

The proposed Artizan Catering solar cells are to is mounted on either side of a roof whose ridge is aligned on a grid (IRENET 95) bearing of 18°, i.e., facing just north of due west, and just south of due east, respectively. The inclination of the roof on either side of its ridge is 15° to the horizontal. Sun position data for the report has been predicted for the year 2019 on a minute-by-minute basis.

Reflections of sunlight from the solar cells are assumed to come from the whole roof area and are considered significant when close to horizontal (taken for this report as 10° above, to 5° below, horizontal) – these are described as 'near-horizontal reflections'. Flight profiles are almost invariably close to horizontal over built-up areas and in proximity to airfields (typical glideslopes on approach to land are 3°). Although aircraft may encounter solar reflections from steeper angles, they will fly through them almost instantly and so such reflections are not significant.

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AARDVaRC Ltd

AARDVaRC Ltd was founded in April 2010 to provide expert aviation, defence and other technical consultancy services to the renewable energy and other industries. Although these services are particularly focussed on renewable technologies, this expertise is equally applied to other industries, e.g., *AARDVaRC* provided its expert aviation and defence services for the consented Cherry Orchard tower development in south London.

AARDVaRC's technical expertise lends itself to a wide range of technical issues relating to renewable energy development. Hence, the company has developed an analytical model to assess solar reflections from large-scale solar farm developments, particularly – but not solely – for aviation impact assessment.

The Author

After graduating from Bath University as a Bachelor of Engineering in Aeronautical Engineering, Charles was commissioned into the Royal Regiment of Artillery where he served as a Forward Observation Officer managing battlefield indirect fire and

electronic warfare (perhaps better described as 'electromagnetic warfare') assets for the local commander.

He later undertook flying duties in the Army Air Corps as second-in-command of an anti-tank helicopter squadron and electronic warfare expert. He was seconded as the Army Aviation subject matter expert and project manager compiling flying regulations for the newly formed Joint Helicopter Command (JHC), harmonising flying regulations for the Royal Navy, Army Air Corps and RAF assets under the JHC. Charles is also a glider pilot and holds a Private Pilot's Licence (PPL) for light single-engined aeroplanes.

After leaving the Army in 2004, Charles was employed as a consultant in a renewable energy firm where he conducted technical analyses whilst developing the company's military and aviation expertise in relation to wind energy developments. He later moved to become an Aviation Analyst at a specialist aviation and telecoms company serving the renewable energy industry. He was instrumental in the growth of this company from just 2 to 10 employees until moving on to found AARDVaRC Ltd in April 2010.

Charles has an in-depth knowledge of the aviation industry, electromagnetic propagation (including reflections of light/ glint/ glare), wave theory, and of communications, navigation and surveillance (CNS) equipment. He is also an Association of Project Managers (APM) Professional, holds the PRINCE 2 project management qualification and a Microsoft Office Master certificate.

He has conducted detailed assessments of aviation and electromagnetic issues on a number of sites, identifying constraints and resolving aviation, radar and other issues. Sites include: Kirkharle, Fallago Rigg, New Albion, Isle of Grain, Clochnahill, Clyde, Bransford Bridge, Stoke Heights wind farms and many others; in addition, his work has enabled developers to avoid costly issues in the early stages of development at many more sites.

He has also developed specialist analytical tools, e.g., to support glint/ glare assessments conducted by AARDVaRC for the operational Westmill (near Swindon), Parkhouse (near Salisbury), Strete Farm (near Exeter Airport), Ermine Street (near RAF Cranwell airfield), Membury M4 Services (adjacent to multiple runways at Membury airfield) and Cuckoo Grove (Pembrokeshire) sites, as well as many other consented sites. Issues included effects on adjacent main roads, railways and nearby airfields – from international airports to glider sites.

Other work includes aviation and defence assessments and stakeholder consultation for: a residential development at Winchburgh near Edinburgh Airport, an industrial development near Kingsnorth on the Medway Estuary in Kent, as well as for a 170m-tall tower development on the Cherry Orchard Road in Croydon, south London.

Charles is also a glider pilot and holds a Private Pilot's Licence (PPL) for light single-engined aeroplanes. Other interests and hobbies include amateur astronomy, renewable energy technology and cycling.

3 Solar Reflections Analysis

Solar reflections were considered separately for the east- and west-facing sides of the roof, and then combined. These are summarised through the year in the following charts, overlaid on the 1:1,000-scale Planning Pack Map. Maps shown are copyright © Ordnance Survey Ireland, 2020.

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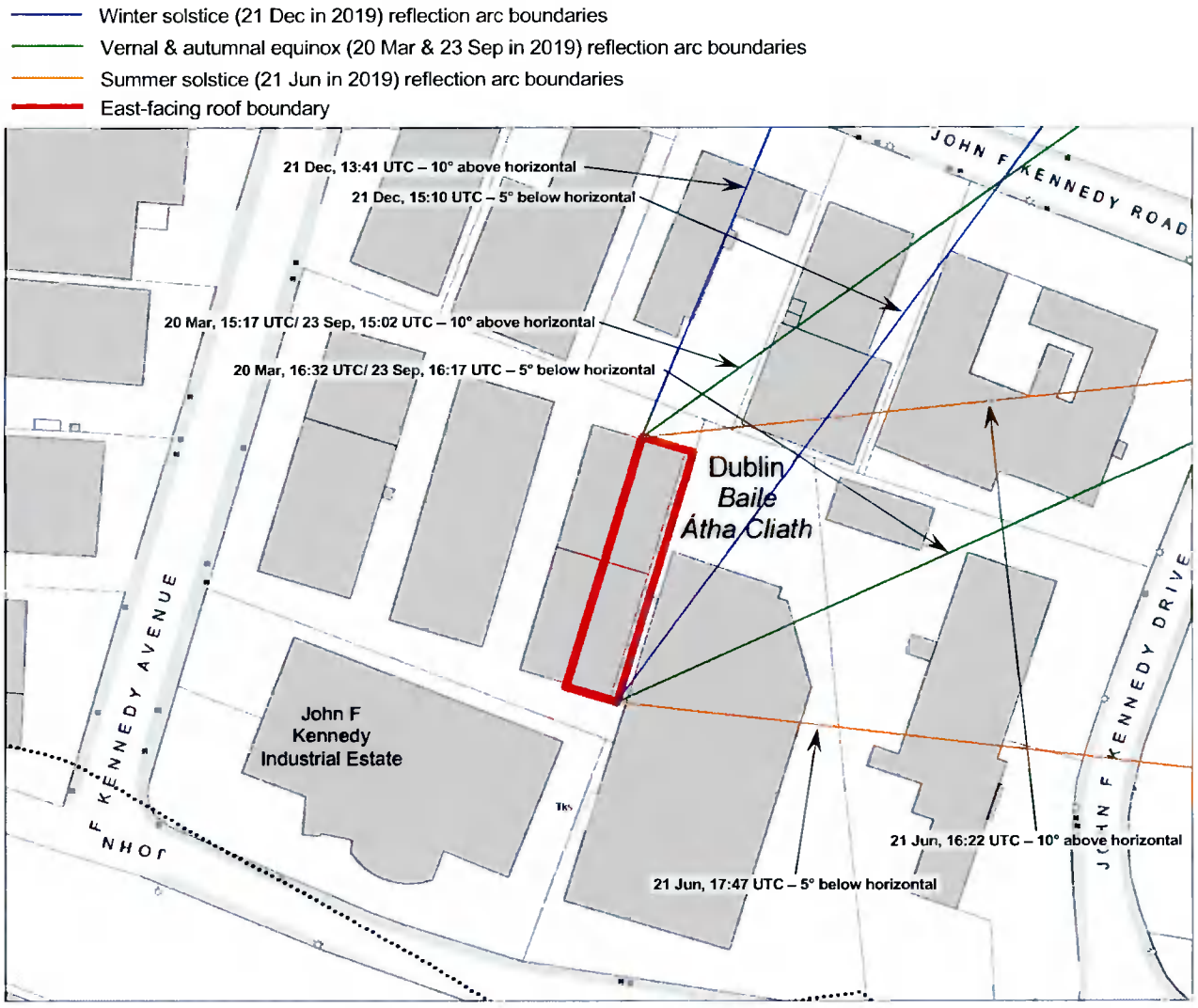

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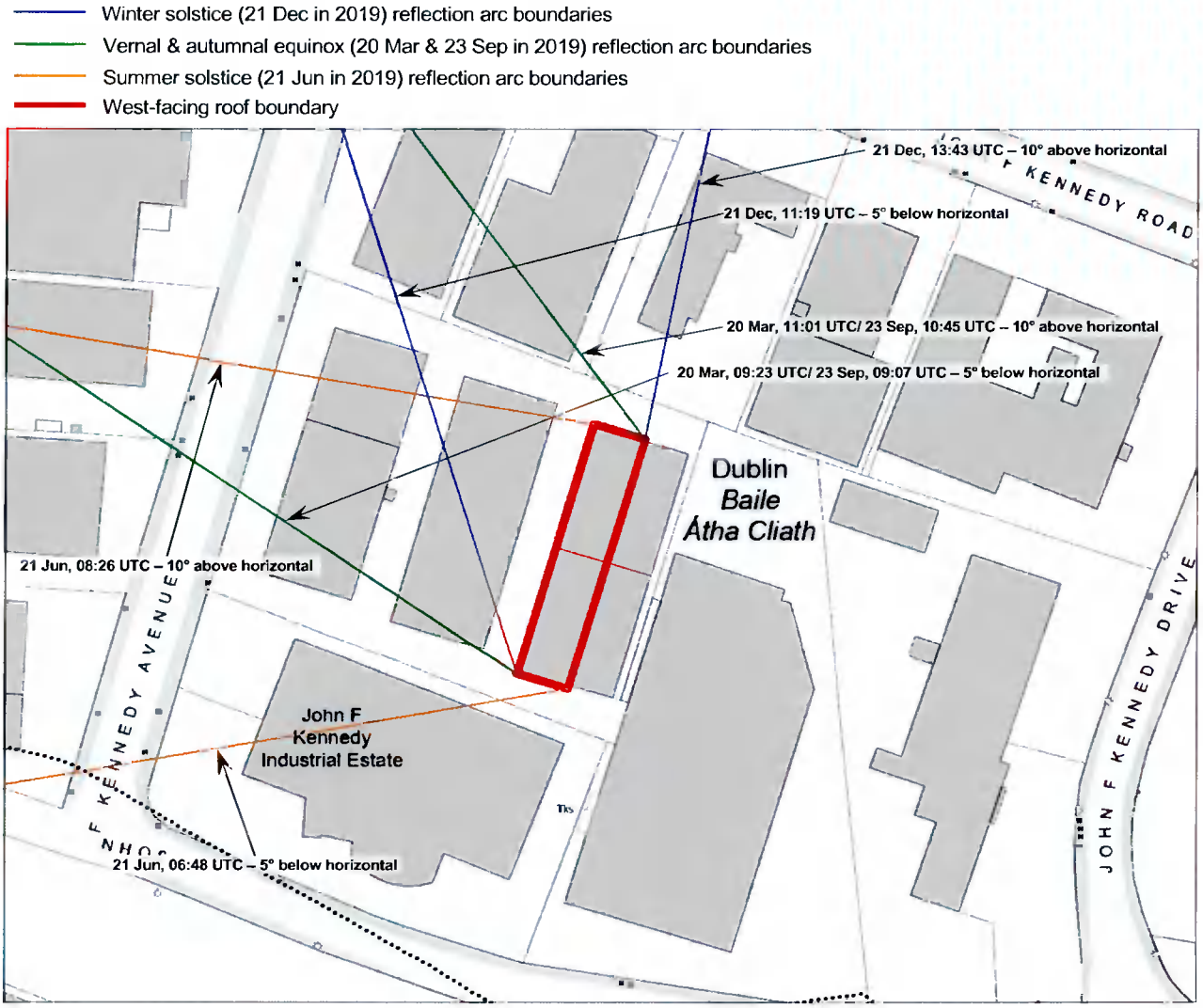

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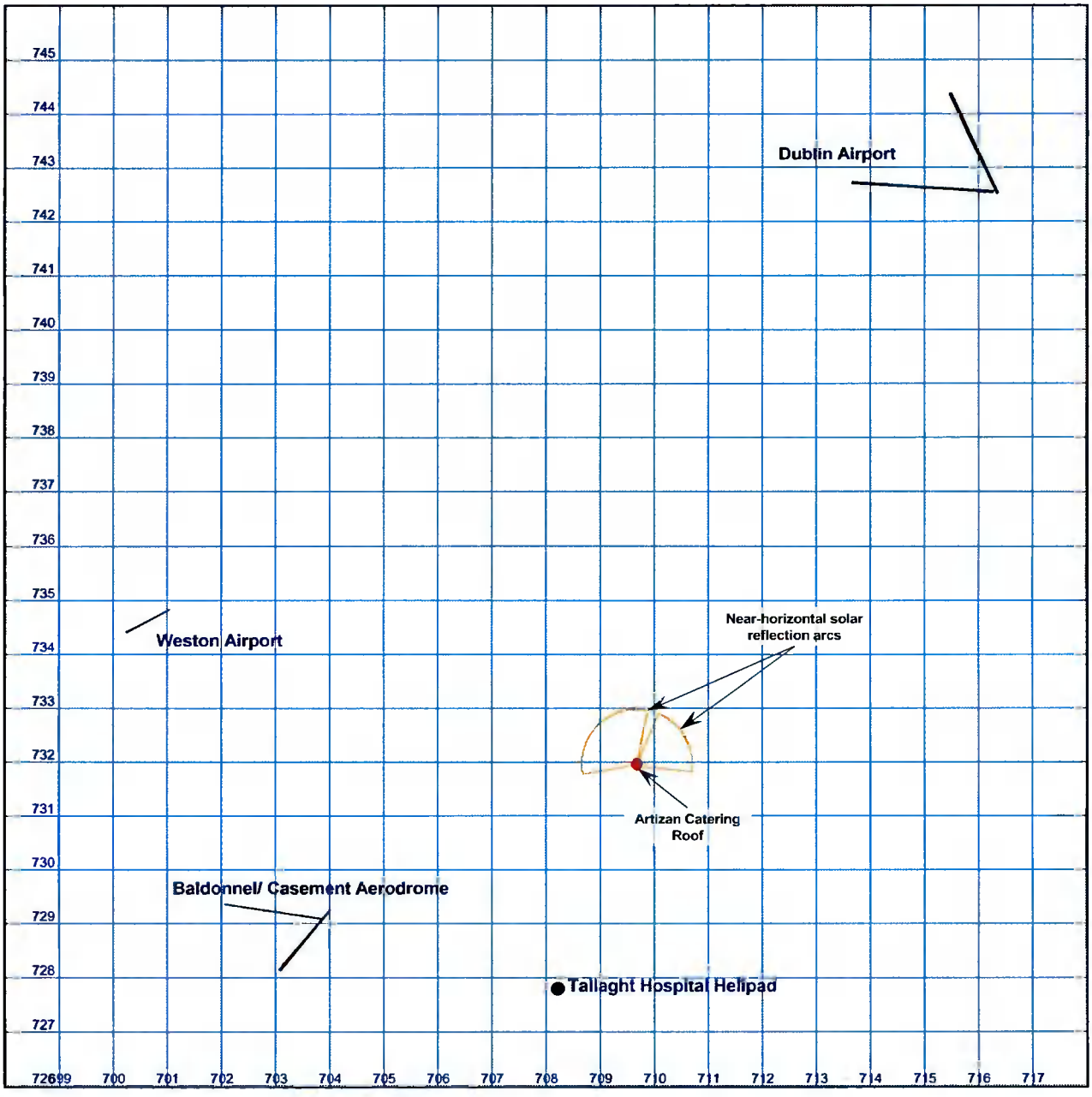

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