Addendum to the Environmental Impact Assessment Report

NISA

North Irish Sea Array

Volume 9 - Offshore Appendices

Appendix A19.1

Airspace Analysis and Radar Modelling

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Appendix A19.1 Airspace Analysis and Radar Modelling

North Irish Sea Array Offshore Wind Farm

25 February 2026

CL-5721-RPT-005 DA

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Document Information

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Document reference and Version	CL-5721-RPT-005 DA
Date of release	25 February 2026

Change History Record

Issue	Date	Details
DA	25 February 2026	Final draft

Abbreviations

The new Sections 4, 5, 6 and 7 include the following abbreviations in addition to those listed in Appendix 19.1 of the 2024 EIAR:

DVOR	Doppler VHF Omni-directional Range
ILS	Instrument Landing System
PIC	Pilot in Command
RCS	Radar Cross Section
SERA	Standardised European Rules of the Air
SVFR	Special VFR
VMC	Visual Meteorological Conditions
VPD	Vertical Polar Diagram
VRP	Visual Reporting Point

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Appendix A19.1 Airspace Analysis and Radar Modelling

North Irish Sea Array Windfarm Ltd (NISA, hereafter referred to as 'the Developer') has been considering the Request for Further Information (RFI) issued by An Bord Pleanála (now An Coimisiún Pleanála) as well as the third-party submissions received following public consultation. At An Coimisiún Pleanála's behest, the Developer has also continued to consult with stakeholders in respect of the 2024 planning application throughout 2024-2026. The Developer has refined elements of the design to respond to the third-party submissions, the continued public and stakeholder consultation and the RFI. Amendments are therefore required to Appendix 19.1 Airspace Analysis and Radar Modelling of the 2024 Environmental Assessment Report (EIAR). Full details of consultation undertaken can be found in Appendix A1.2: Consultation Report.

For the purposes of clarity, this document shall be read in conjunction with the Appendix 19.1 Airspace Analysis and Radar Modelling submitted as part of the 2024 EIAR.

Any cross reference to a chapter, section, table, image, figure or appendix within this document is to another location within the Addendum to the EIAR unless explicitly stated otherwise. Any cross reference to anything included in the 2024 EIAR will be clearly labelled as such.

Text in bold is only used throughout this document to indicate where changes are required, and why they are required. Text in italics is text from a section of the 2024 EIAR which is deleted, or quotations from other documents (as explicitly stated). Replacement text is in normal font.

Only tables and figures which have been updated from the 2024 EIAR, or entirely new tables and figures, have been included in the Addendum to the EIAR. These can be identified by the "A" prefix in the caption. Any changes within an updated table, in comparison to tables within the 2024 EIAR, are indicated by grey shading in the relevant cell, column or row, as necessary.

The sections relevant to Appendix A19.1 in the RFI are included below.

RFI Section	RFI	Relevance to Chapter
1 (b)	The scientific information provided as part of the planning application documentation should be based on up-to-date survey reports and data. Accordingly, the applicant is requested to confirm/provide justification/verification that the information submitted in support of the planning application remains relevant and appropriate at the point of submitting further information or to update same as required.	The timeframes associated with the RFI have necessitated a review of the datasets previously used in the 2024 EIAR to ensure any necessary updates to the baseline environment are captured. Therefore, a review of the airspace and radar baseline resources has been undertaken to comply with RFI 1 (b).

RFI Section	RFI	Relevance to Chapter
17 (b)	The applicant is requested to confirm through consultation with Dublin Airport Authority and Air Nav Ireland (the national Air Navigation Service Provider (ANSP)) that the layout and reduced height of 311m above LAT applied to a number of turbines for layout Option 2 is satisfactory, having regard to the location of the area within the 3nm buffer areas of Dublin Airport's ATCSMAC sectors 1 and 2.	A meeting with the DAA (formerly Dublin Airport Authority) and AirNav Ireland was held in May 2025 during which details of a newly commissioned radar facility were shared. AirNav also raised concerns regarding the range between the NISA array area and their secondary surveillance radars, the potential impact of construction of the NISA onshore cable route on navigation aids, and the potential airspace conflicts if low-level aircraft are required to fly higher to avoid wind turbine obstacles. Supplementary assessments to model the new radar and to address AirNav concerns were undertaken and in December 2025, AirNav confirmed that all AirNav, daa and Weston Airport concerns have been addressed. The supplementary assessments are now detailed in Appendix A19.1, with minor updates to reflect the latest wind turbine layouts. The updated layout does not materially alter the outcomes of the supplementary assessments.

1. Introduction

1.1. Overview

In response to Section 17 (b) of the RFI, where the applicant is requested to confirm through consultation with AirNav and daa that the layout and reduced height applied to a number of turbines for the Project Option 2 layout is satisfactory, the following Section 1.1.1 shall be added:

1.1.1. Meeting with AirNav Ireland and daa

1.1.2. During a meeting with AirNav Ireland and daa (formerly Dublin Airport Authority) on 27 May 2025 it was noted that a new co-located Primary and Mode S Secondary Surveillance Radar (PSR/SSR) facility to the north of Dublin Airport, known as Tooman PSR/SSR, was undergoing commissioning. The intention is for this radar to replace the existing Dublin Head 2 PSR/SSR.

1.1.3. Regarding SSR facilities, AirNav advised that although the proposed developments array area is more than the Eurocontrol recommended safeguarded range of 16km from the nearest SSR site, the range is based on a maximum wind turbine tip height of 200m.

1.1.4. The proposed developments onshore cable route passes to the east of Dublin Airport and concerns were raised that infrastructure associated with the route and its construction could have an impact on airfield and en route navigation aids in the vicinity.

1.1.5. A potential issue was raised regarding Visual Flight Rules (VFR) traffic following the VFR transit route to the east of Dublin Airport and the possibility of such traffic being required to fly higher to avoid wind turbine obstacles, and thus potentially conflicting with Instrument Flight Rules (IFR) traffic flying Instrument Flight Procedures (IFPs).

1.1.6. At the meeting it was agreed that Cyrrus would undertake supplementary aviation assessments in addition to those detailed in Appendix 19.1 of the 2024 EIAR. The supplementary assessments are detailed in the following new sections:

1. Radar Line of Sight – Tooman PSR/SSR;
2. SSR Assessment;
3. Onshore Cable Route Assessment; and
4. VFR Transit Assessment.

1.1.7. There are two project options under consideration for the proposed developments offshore infrastructure: Project Option 1 comprises 49 wind turbines with a 250m rotor diameter and Project Option 2 comprises 35 wind turbines with a 276m rotor diameter. Project Option 2 has been selected for the RLoS, SSR and VFR transit route assessments as taller wind turbines have a greater potential for radar and obstacle impacts.

1.2. Effects of Wind Turbine Generators on Aviation

There are no changes to this section. Refer to Section 1.2 of Appendix 19.1 in the 2024 EIAR.

1.3. Technical Data

There are no changes to this section. Refer to Section 1.3 of Appendix 19.1 in the 2024 EIAR.

1.3.1. Radar Data

There are no changes to this section. Refer to Section 1.3.1 of Appendix 19.1 in the 2024 EIAR.

1.3.2. Assessment Area

There are no changes to this section. Refer to Sections 1.3.2 of Appendix 19.1 in the 2024 EIAR.

1.3.3. WTGs

There are no changes to the text within this section, but the latest Project Option 2 WTG layout results in a reduced number of WTGs within the aviation restricted zone. Further information on the design refinements made in response to the RFI, third-party submissions and the continued public and stakeholder consultation is found within Appendix A5.1 Design Refinements. This change has been added to Table A1, as indicated by the grey shading. Table A1 replaces Table 1 of Appendix 19.1 in the 2024 EIAR.

Table A1: WTG design parameters (replaces Table 1 of Appendix 19.1 in the 2024 EIAR)

Parameter	Project Option 1	Project Option 2	
Maximum blade tip height above LAT	290m	311m Within the aviation restricted zone	316m Outside of the aviation restricted zone
Maximum rotor diameter	250m	276m	276m
Maximum hub height above LAT	165m	173m	178m
Total number of turbines	49	8	27

To depict the latest Project Option 1 and Project Option 2 WTG layouts, Figure 1 and Figure 2 of Appendix 19.1 in the 2024 EIAR shall be deleted and replaced with the figures below.

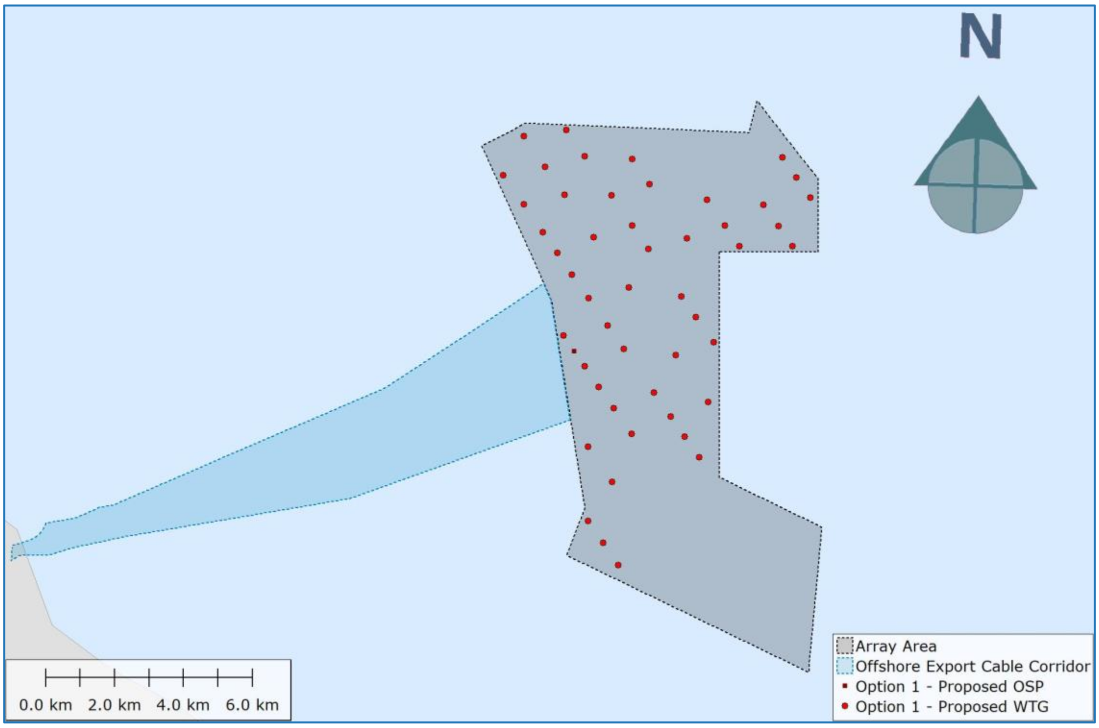


Figure A1: Project Option 1 WTG layout (replaces Figure 1 of Appendix 19.1 in the 2024 EIAR)

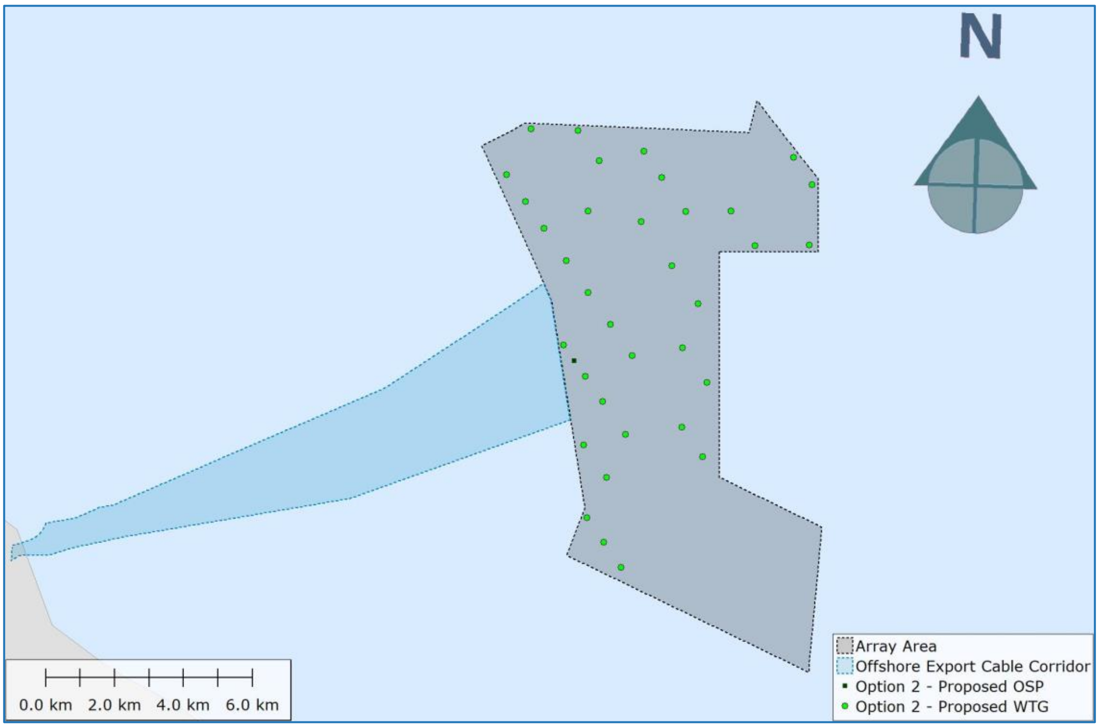


Figure A2: Project Option 2 WTG layout (replaces Figure 2 of Appendix 19.1 in the 2024 EIAR)

1.3.4. Terrain Data

There are no changes to this section. Refer to Section 1.3.4 of Appendix 19.1 in the 2024 EIAR.

1.3.5. Analysis Tools

There are no changes to this section. Refer to Section 1.3.5 of Appendix 19.1 in the 2024 EIAR.

1.3.6. Mapping Datum

There are no changes to this section. Refer to Section 1.3.6 of Appendix 19.1 in the 2024 EIAR.

2. Airspace Analysis

2.1. Introduction

There are no changes to this section. Refer to Sections 2.1 of Appendix 19.1 in the 2024 EIAR.

2.2. Scope

There are no changes to this section. Refer to Sections 1.3.6 of Appendix 19.1 in the 2024 EIAR.

2.3. Airspace Classification

There are no changes to this section. Refer to Sections 2.3 of Appendix 19.1 in the 2024 EIAR.

2.4. Aircraft Vertical Reference

There are no changes to this section. Refer to Section 2.4 of Appendix 19.1 in the 2024 EIAR.

2.5. Current Civil Aviation Baseline

The Standard (Instrument) Arrival (STAR) chart for runways 28L and 28R at Dublin Airport, as published in the Ireland Integrated Aeronautical Information Package (IAIP), has been updated since submission of the 2024 EIAR. In response to RFI 1 (b), where it was requested that scientific information provided with the application should be based on up-to-date survey reports and data, Figure 5 of Appendix 19.1 in the 2024 EIAR shall be deleted and replaced with Figure A3 below to depict an extract from the updated chart.

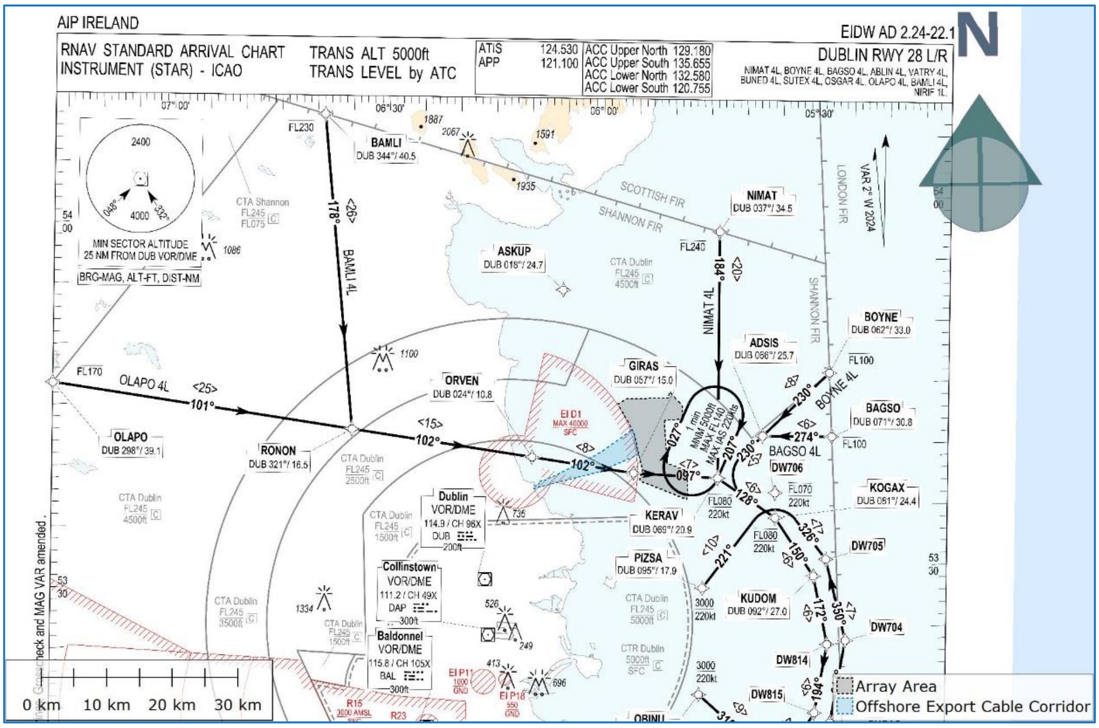


Figure A3: Dublin runway 28L/R STAR chart extract

Changes to the Project Option 2 WTG layout mean that the following text from paragraph 2.5.20 of Section 2.5 of Appendix 19.1 in the 2024 EIAR shall be deleted:

"Figure 9 shows that 10 WTGs are within the aviation restricted area and 3 are on the border (the Limit of Deviation of 500m overlaps). Therefore potentially 13 WTGs within the Project Option 2 proposed WTG layout will be within the restricted tip height area. As part of the proposed development design, WTGs within this area will have a lowered tip height of 311m above LAT, or 308.15m amsl, so that the minimum required obstacle clearance for sectors 1 and 2 is not infringed."

And replaced with:

Figure A4 shows that 7 WTGs are within the aviation restricted area and 1 is on the border (the Limit of Deviation of 500m overlaps). Therefore potentially 8 WTGs within the Project Option 2 WTG layout will be within the restricted tip height area. As part of the proposed development design, WTGs within this area will have a lowered tip height of 311m above LAT, or 308.15m amsl, so that the minimum required obstacle clearance for sectors 1 and 2 is not infringed.

To depict the latest Project Option 2 WTG layouts, Figure 9 of Appendix 19.1 in the 2024 EIAR shall be deleted and replaced with Figure A4 below.

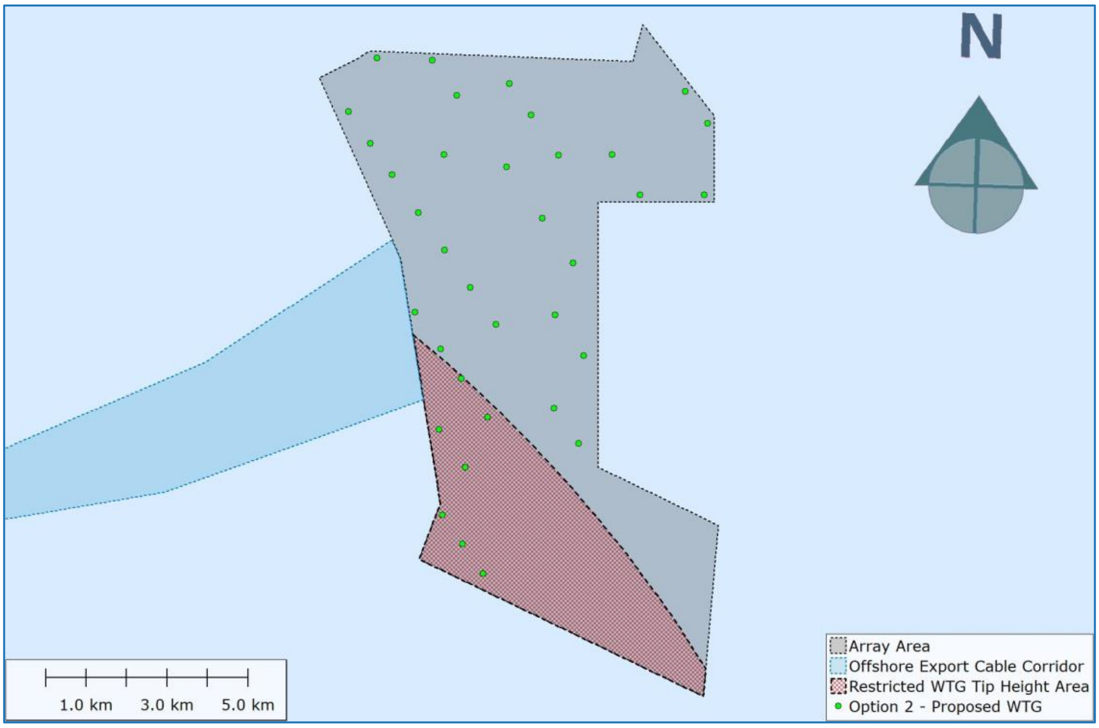


Figure A4: Project Option 2 WTG layout (replaces Figure 9 of Appendix 19.1 in the 2024 EIAR)

There are no further changes required to this section. Refer to Section 2.5 of Appendix 19.1 in the 2024 EIAR.

2.6. Current Military Aviation Baseline

The published Instrument Approach Procedure (IAP) chart for runway 22 at Casement Aerodrome has been updated since submission of the 2024 EIAR. In response to RFI 1 (b), where it was requested that scientific information provided with the application should be based on up-to-date survey reports and data, Figure 14 of Appendix 19.1 in the 2024 EIAR shall be deleted and replaced with Figure A5 below to depict an extract from the updated chart.

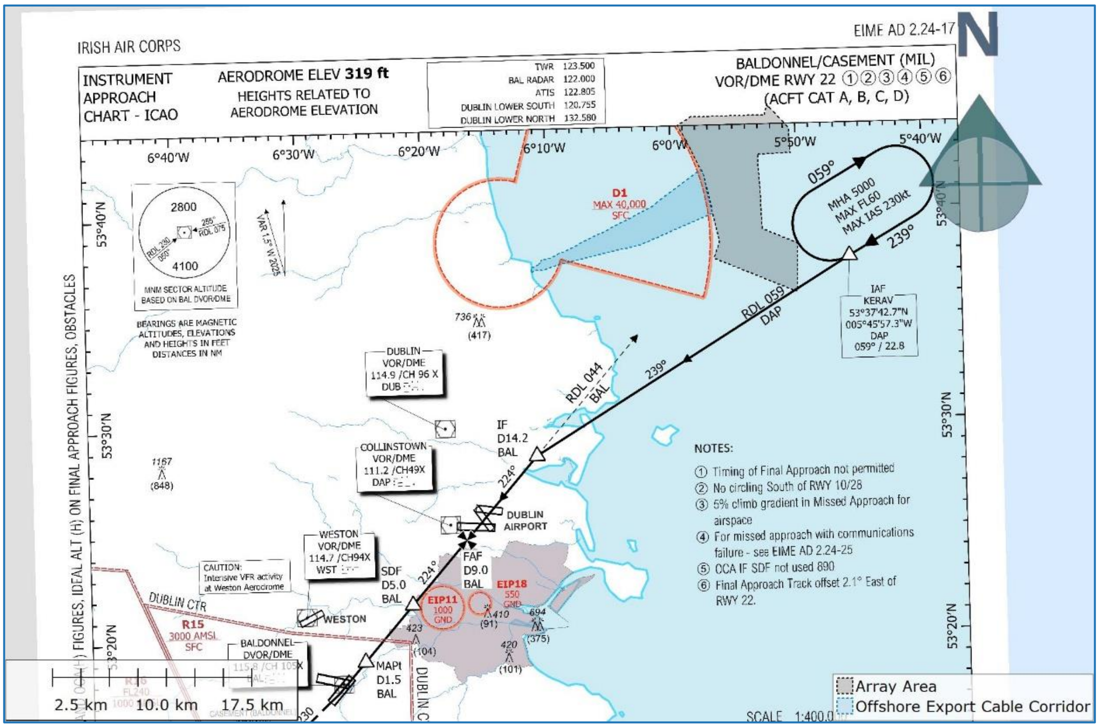


Figure A5: Casement runway 22 IAP chart extract

There are no further changes to this section. Refer to Section 2.6 of Appendix 19.1 in the 2024 EIAR.

3. Radar Line of Sight Assessment

The published Casement Aerodrome radar vectoring chart has been updated since submission of the 2024 EIAR. In response to RFI 1 (b), where it was requested that scientific information provided with the application should be based on up-to-date survey reports and data, Figure 22 of Appendix 19.1 in the 2024 EIAR shall be deleted and replaced with Figure A6 below to depict an extract from the updated chart.

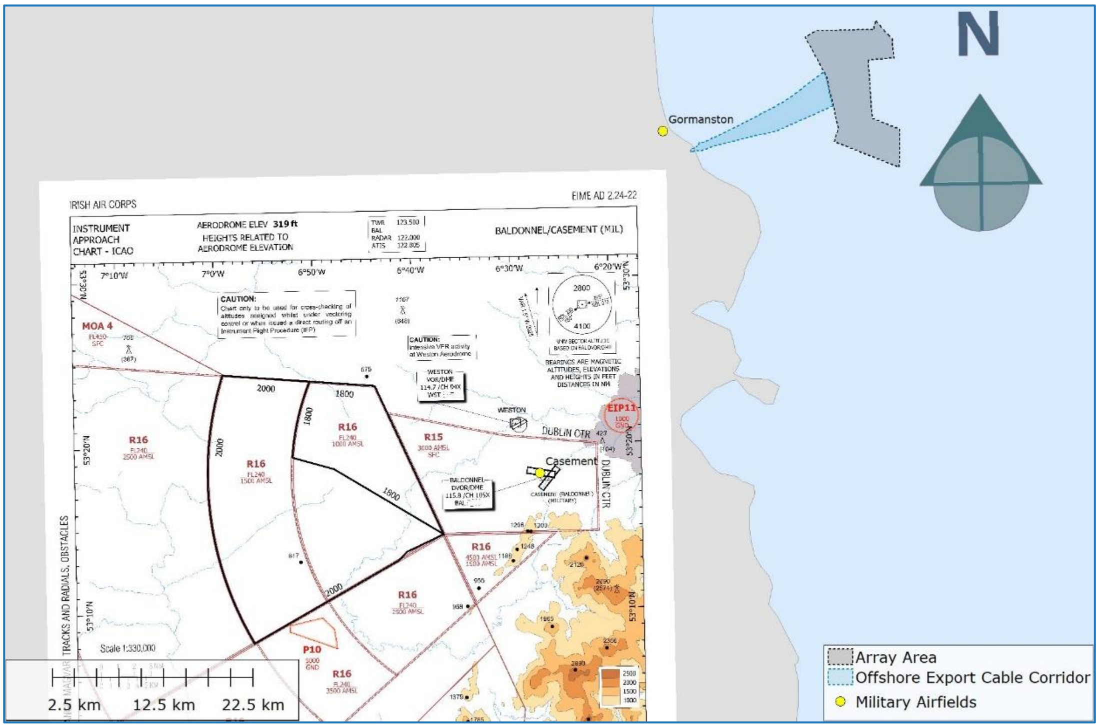


Figure A6: Casement radar vectoring chart extract

There are no further changes to this section. Refer to Section 3 of Appendix 19.1 in the 2024 EIAR.

In response to Section 17 (b) of the RFI, where the applicant is requested to confirm through consultation with AirNav and daa that the layout and reduced height applied to a number of turbines for the Project Option 2 layout is satisfactory, the following Section 4 details the radar line of sight modelling of the new Tooman radar that was requested through the consultation process. This section shall be added to Appendix 19.1 of the 2024 EIAR following Section 3.

4. Radar Line of Sight – Tooman PSR/SSR

4.1. Overview

4.1.1. A new radar facility, Tooman PSR/SSR, has been installed at a site at Hollywood Great, Naul, County Dublin, approximately 14km north of Dublin Airport. Tooman PSR/SSR was commissioned in May 2025 and replaces the existing Dublin Head 2 PSR/SSR.

4.1.2. Tooman PSR/SSR lies 21.8km west south-west of the proposed developments' array area at its closest point, as shown in Figure A7.

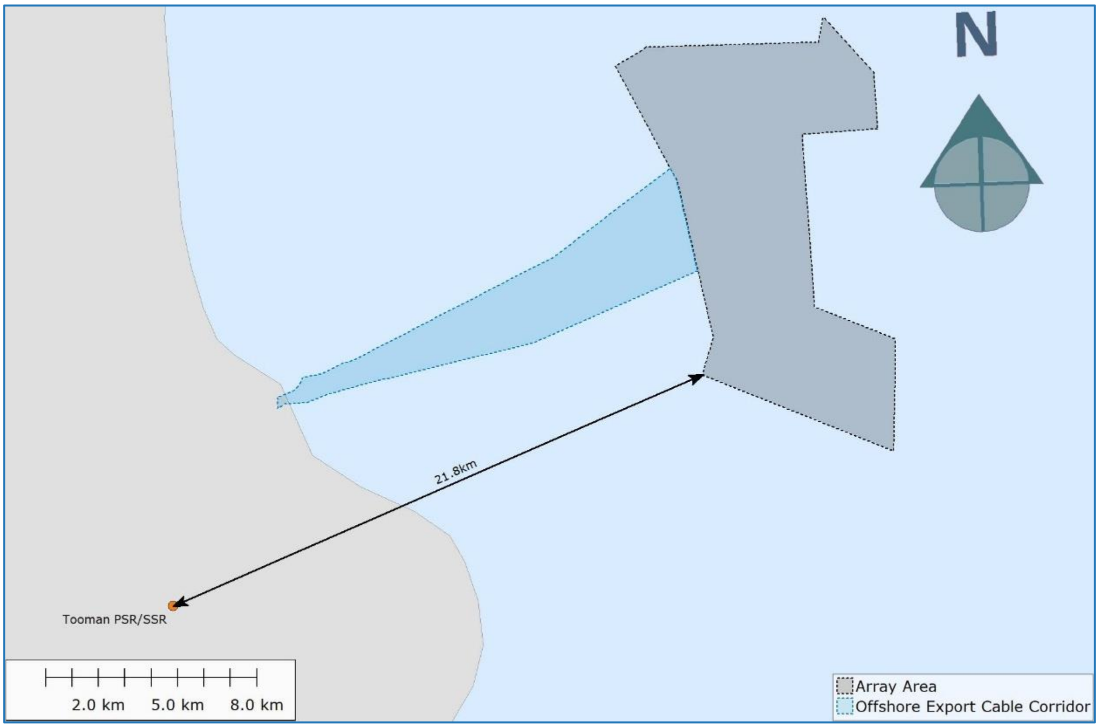


Figure A7: Tooman PSR/SSR and proposed developments' array area

4.2. Radar Line of Sight

4.2.1. For PSR the principal source of adverse wind farm effects are the wind turbine blades, so RLoS is calculated for the maximum proposed blade tip heights of the wind turbines, that is 290m (Project Option 1) and 316m (Project Option 2).

4.2.2. Tooman RLoS coverages for blade tip heights of 290m and 316m are shown in Figure A8.

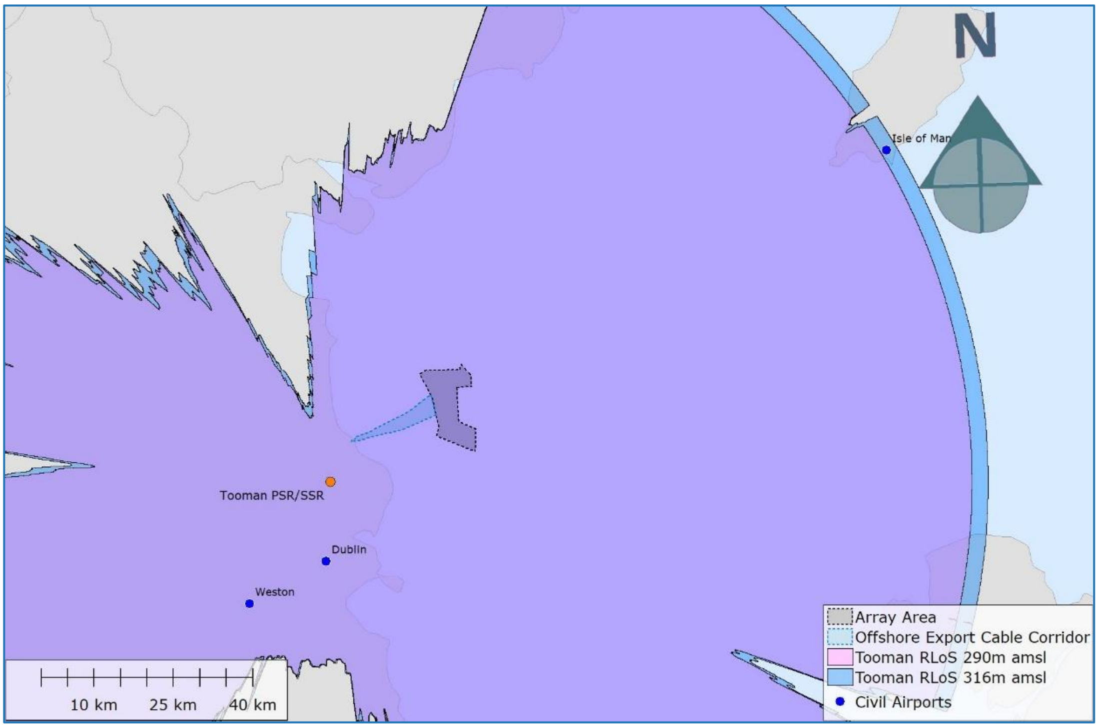


Figure A8: Tooman 290m/316m RLoS coverages

4.2.3. In the case of SSR, adverse effects are predominantly generated by the turbine towers, so RLoS is also calculated for the maximum proposed hub heights of the wind turbines, that is 165m (Project Option 1) and 178m (Project Option 2).

4.2.4. Tooman RLoS coverages for hub heights of 165m and 178m are shown in Figure A9.

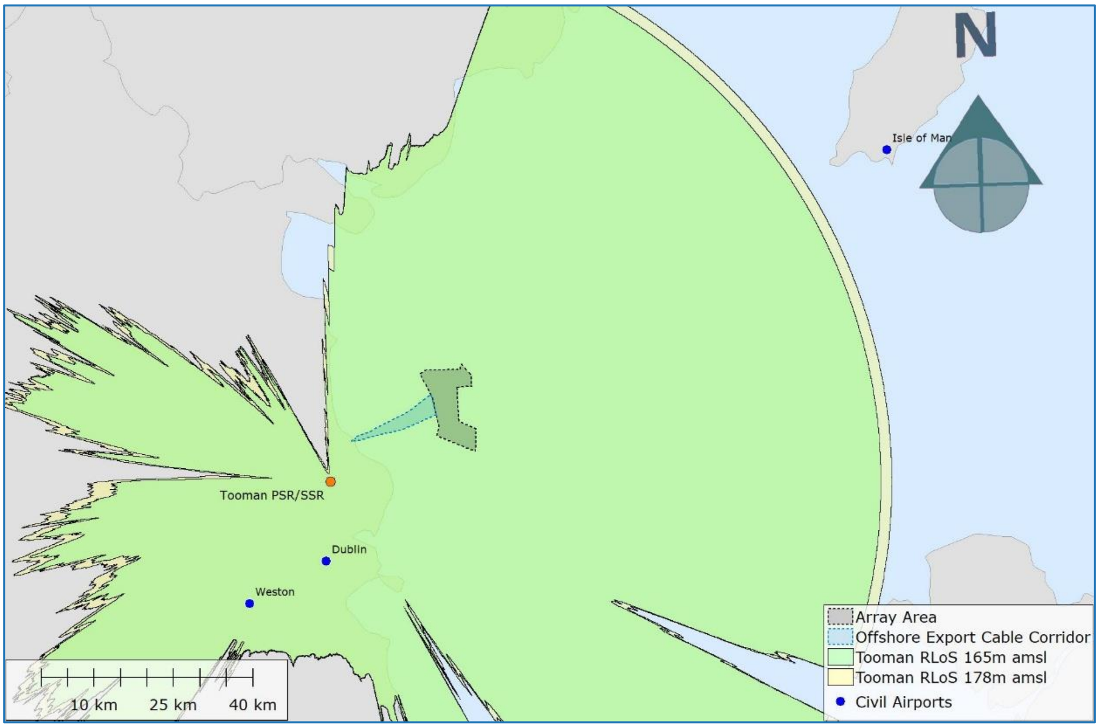


Figure A9: Tooman 165m/178m RLoS coverages

4.2.5. All wind turbines within the array area will be in RLoS of the Tooman PSR/SSR and highly likely to be detected, irrespective of blade tip or hub height.

In response to Section 17 (b) of the RFI, where the applicant is requested to confirm through consultation with AirNav and daa that the layout and reduced height applied to a number of turbines for the Project Option 2 layout is satisfactory, the following Section 5 details the modelling of the new Tooman Secondary Surveillance Radar facility that was requested through the consultation process. This section shall be added to Appendix 19.1 of the 2024 EIAR.

5. SSR Assessment

5.1. Potential impact of wind turbines on SSR

5.1.1. Unlike PSR, SSR is an 'active' system. It operates by the radar transmitting a coded pulse sequence which is received and decoded by suitably equipped aircraft. The aircraft responds with a coded pulse sequence on a different frequency which is received by the SSR. Range and azimuth information is derived in the same way as PSR, but additional information in the coded reply allows the identification of a particular aircraft and its height. Other data may also be made available dependant on the mode of operation.

5.1.2. SSR is immune to direct reflections (monostatic back scatter) from large objects such as wind turbines because the transmitted and received frequencies differ and the message structure is different for transmit and receive paths.

5.1.3. Bistatic reflection is where the signal transmitted by the radar is 'forward' reflected to an aircraft, and the aircraft reply is also reflected back to the radar. The effect of this is best understood by considering the following diagrams.

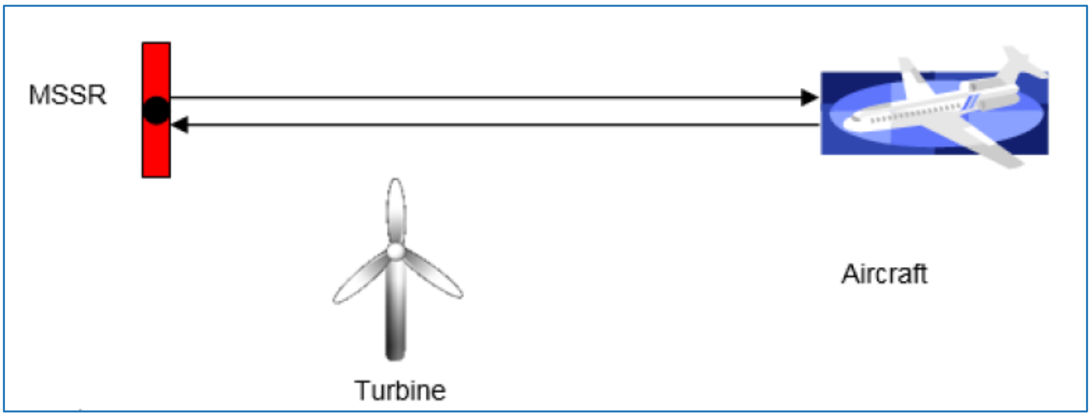


Figure A10: Direct interrogation and reply pulses

5.1.4. In Figure A10, the SSR transmits an interrogation pulse sequence and the aircraft, on receiving the interrogation sequence, replies with a coded pulse sequence. The time delay between interrogation and receipt of reply is proportional to the distance of the aircraft from the radar. The bearing of the aircraft is the physical bearing of the radar antenna.

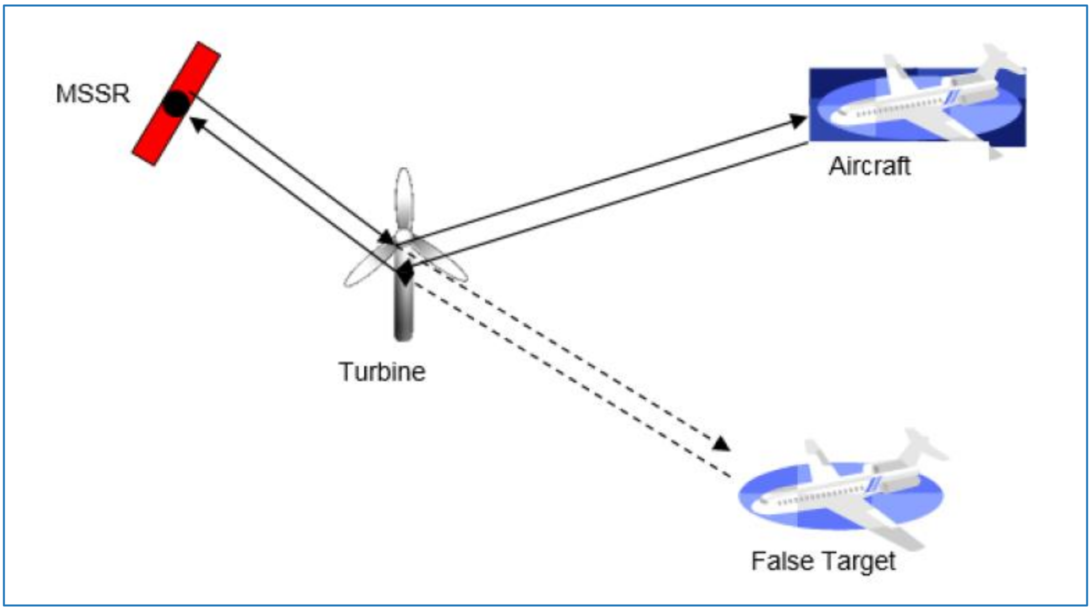


Figure A11: Reflected interrogation and reply pulse

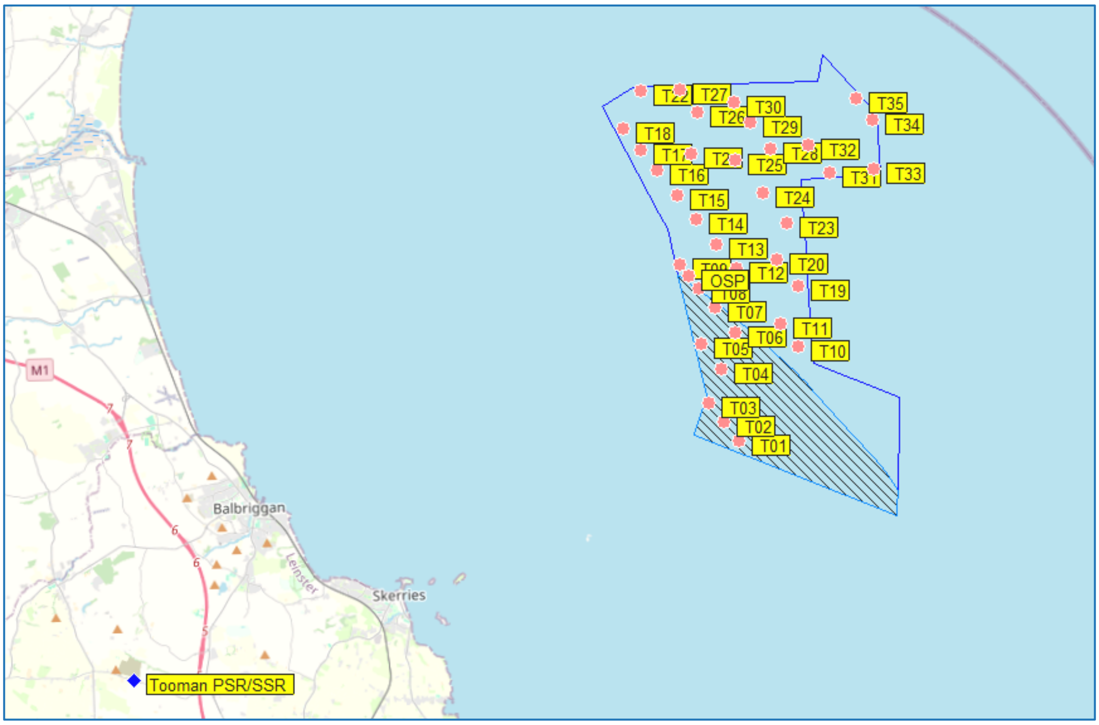
5.1.5. In Figure A11, the SSR beam illuminates a wind turbine which reflects the interrogation to an aircraft on a different bearing. The aircraft transponder replies, and this is received by the radar via the turbine. The radar processes this as a false target on the bearing of the wind turbine and at a distance proportional to the path length, which is slightly longer than the direct path length.

5.1.6. Objects can produce a radar shadow in the area behind the object. As a wind turbine is narrow compared to the radar beam width, assuming the turbine is >2km from the radar, the shadow will be relatively small and will reduce with increasing distance behind the turbine. Shadowing effects are likely to be insignificant but, due to diffraction of the beam around the turbine tower, small azimuth angular errors may be introduced. Aircraft targets in this area can potentially be subject to track jitter causing the returns to meander from side to side. This can only occur where the turbine is in the direct RLoS between the radar and the aircraft target.

5.1.7. At a range of 21.8km from the array area, Tooman SSR will be considerably closer to the proposed dvelopments' wind turbines than the Dublin Head 3 SSR (29.7km) and Forrest Little SSR (29.4km) facilities at Dublin Airport. The SSR assessment is therefore focussed on Tooman SSR as the most likely facility to be potentially impacted by the proposed developments' wind turbines.

5.2. Tooman SSR path loss and reflections

5.2.1. The proposed wind turbine layout for Project Option 2 is illustrated in Figure A12. Note that the shaded area depicts the aviation restricted zone. There are 8 wind turbines within and immediately adjacent to this zone that have reduced hub and blade tip heights of 173m and 311m respectively. All other wind turbines have a hub height of 178m and a blade tip height of 316m.



© OpenStreetMap contributors

Figure A12: Project Option 2 wind turbine layout

5.2.2. Using the radar propagation model the path loss between Tooman SSR and the hub of the closest proposed wind turbine, T03, in the Project Option 2 layout can be determined.

5.2.3. The path loss profile between Tooman SSR and turbine T03 is shown in Figure A13. As with all the turbines within the array area, Tooman SSR has uninterrupted RLoS to the hub of the turbine tower.

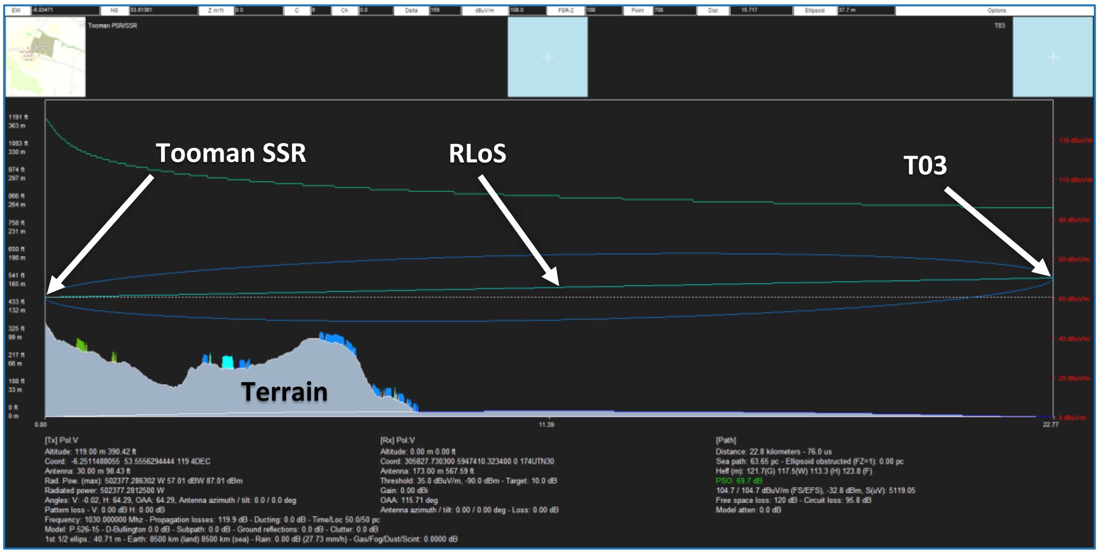


Figure A13: Path loss profile between Tooman SSR and hub of turbine T03

5.2.4. As explained in Section 5.1, multipath, or bistatic, reflections from turbine towers can potentially cause ‘ghost’ targets on SSR. This occurs when an aircraft replies through a signal reflected from an obstruction; the radar attributes the response to the original signal and outputs a false target in the direction of the obstruction, which can lead to air traffic controllers deconflicting real traffic from targets that do not physically exist.

5.2.5. The likelihood of bistatic reflections can be determined by knowing the SSR transmitter power, antenna gain, path loss to the turbine tower, Radar Cross Section (RCS) gain and aircraft receiver sensitivity.

5.2.6. The amount of signal reflected by a turbine tower is a function of the tower's RCS. A typical RCS value for a 100m steel tower of 8m diameter is 3,000,000m^2. However, a 0.5° taper of the tower can reduce this figure from millions to hundreds of square metres.

5.2.7. EUROCONTROL Guidelines[1] recommend an RCS value of $10^{3.5}$m^2 or 35dBm^2 for a wind turbine which equates to an RCS gain of 57dB at the SSR uplink frequency of 1030MHz. However, this is only applicable for a wind turbine of up to 200m in blade tip height.

5.2.8. A cylindrical scaling method for calculating a wind turbine RCS from a generic wind turbine RCS value is described in the QinetiQ document "Assessment of wind turbine effects for DCSA"[2], where the ratio of RCS for two cylinders scales as:

$$RCS_2/_{RCS_1} = \left(H_2/_{H_1}\right)^3 \text{ (where H = cylinder height)}$$

5.2.9. This equation can be used to scale the RCS for a 200m wind turbine to calculate the RCS for a 316m wind turbine:

$$RCS = 10^{3.5} \times \left(316/_{200}\right)^3$$

5.2.10. This results in an RCS value of $10^{4.1}$m^2 or 41dBm^2 for a 316m wind turbine which equates to an RCS gain of 63dB at the SSR uplink frequency of 1030MHz.

5.2.11. The following calculation can be used to determine the power of a radar signal reflected by a wind turbine tower:

	Transmitted Power	dBm
+	Antenna Gain	dB
-	Path Loss	dB
+	RCS Gain	dB (41dBm^2 ~ +63dB)
=	Reflected Power	dBm

5.2.12. Free Space Path Loss can be used to calculate the maximum distance from the reflecting obstacle an aircraft can be in order for the reflected signal to trigger a response from the aircraft transponder.

5.2.13. The maximum range at which a reflection can trigger a response is proportional to the reflected power of the signal. From the above calculation it can be seen that reflected power

[1] EUROCONTROL (2014) 'Guidelines for Assessing the Potential Impact of Wind Turbines on Surveillance Sensors', EUROCONTROL-GUID-0130 Edition Number 1.2
[2] QinetiQ (2007) 'Assessment of wind turbine effects for DCSA', QINETIQ/D&TS/SEA/TA0705054/1.0

is greatest when the path loss between the SSR and a turbine is the least. Path loss increases with range; therefore, the least path loss will be between the SSR and the closest turbine within the array area, T03.

5.2.14. The path loss between Tooman SSR and turbine T03 is 119.9dB.

5.2.15. An SSR transmitted power of 2.0kW or 63dBm is assumed (EUROCONTROL Guidelines).

5.2.16. SSR antenna gain varies with the elevation angle, with typical peak gain of 27dB at an elevation of approximately 9° above the horizontal. If the mechanical tilt of the antenna is altered, then the angle of maximum gain will change by a corresponding amount. The mechanical tilt of the antenna is set at the commissioning of the radar to achieve the best compromise between suppressing ground reflections and interrogating low altitude aircraft targets. Antenna gain reduces rapidly at lower elevation angles as a function of the antenna Vertical Polar Diagram (VPD). Radar VPD data can be plotted as a smoothed line of elevation versus gain to enable intermediate values of antenna gain to be determined.

5.2.17. The VPD for a Thales AS 909 SSR antenna is shown in Figure A14.

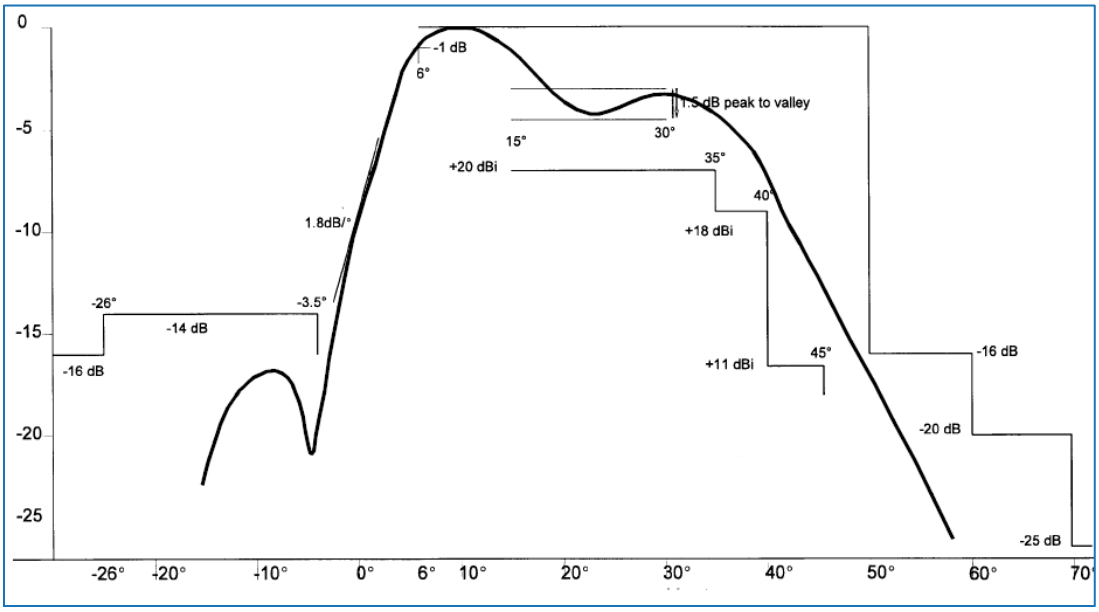


Figure A14: Thales AS 909 antenna VPD

5.2.18. The vertical angle from Tooman SSR to the hub of turbine T03 is -0.02°. If a mechanical tilt of 0° is assumed, this means a reduction in gain of -9dB at this elevation.

5.2.19. The various values can be entered into the reflected power calculation as follows:

	Transmitted Power	63dBm
+	Antenna Gain	18dB (27dB – 9dB = 18dB)
-	Path Loss (T03)	119.9dB
+	RCS Gain	63dB (41dBm^2 ~ +63dB)
=	Reflected Power (T03)	24.1dBm

5.2.20. If an aircraft SSR transponder sensitivity of -77dBm is assumed (EUROCONTROL Guidelines), the reflected signal will not trigger a response if the Free Space Path Loss from turbine T03 to the aircraft is more than 77 + 24.1 = 101.1dB.

5.2.21. The Free Space Path Length for an SSR frequency of 1030MHz and path loss of 101.1dB is 2.6km. This means that aircraft beyond this distance from turbine T03 will not detect a reflected signal. Reflected signals from other turbines within the array area will only be detected at ranges less than 2.6km.

5.2.22. Annex D of the EUROCONTROL Guidelines states that an airborne transponder will be insensitive for 35µs following reception of a radar interrogation. Thus, an aircraft closer than 5.25km (half of the distance corresponding to 35µs) to the source of a reflected interrogation will not reply to reflected interrogations because the path length between the direct and reflected signals will always be smaller than 35µs.

5.2.23. Aircraft will not respond to reflected Tooman SSR interrogations as they will only be detected when the aircraft is within 5.25km of the turbines within the proposed developemnts' array area.

5.3. Tooman SSR shadow region

5.3.1. An array of turbines can create a radar shadow in the space beyond it from the radar. The EUROCONTROL Guidelines provides a means of calculating the dimensions of this shadow region.

$$Dwr = Dtw/[\lambda.\frac{Dtw}{S^2}\left(1-\sqrt{PL}\right)^2 - 1]$$

- *Dwr* = depth of the shadow region.
- *Dtw* = distance of turbines (22.8km (turbine T03) to 33.1km (turbine T34))
- λ = wavelength (0.29m)
- S = diameter of support structures (10m)
- PL = acceptable power loss (0.5/3dB as per guidelines)

5.3.2. The depth of the shadow region beyond each of the proposed developments' turbines will vary between 4.5km and 4.9km for Tooman SSR.

5.3.3. The EUROCONTROL Guidelines also provide equations for calculating the width and height of the shadow regions at depths between 4.5km and 4.9km. For Tooman SSR the shadow regions beyond the proposed developments' turbines will vary in width from 73m to 75m and will vary in height from 350m to 360m (1,150ft to 1,180ft) above mean sea level (amsl).

5.3.4. In summary, the greatest magnitude of impact in relation to the volume of the SSR shadow regions behind each proposed developments' turbine will be length 4.9km x width 75m x height 360m. The overall shadow zone for multiple wind turbines located in a radar beamwidth will be somewhat larger, however this should be operationally tolerable.

5.4. Tooman SSR azimuth accuracy

5.4.1. As explained in the EUROCONTROL Guidelines, azimuth errors may occur when an aircraft is located behind a wind turbine and there is a small path difference (less than 0.25µs or 75m) between the direct and the reflected signals. This will have an impact on the azimuth measurement if the ratio between the direct signal (C or Carriage) and the reflected signal (I or Interference) is smaller than a given threshold.

5.4.2. The following equation for calculating the C/I ratio is derived in the EUROCONTROL Guidelines:

$$\frac{C}{I} \leq \frac{4\pi}{\sigma} \cdot D_{wr}^{2}$$

- D_{wr} = distance of wind turbine to radar
- σ = bi-static RCS of the wind turbine ($41dBm^2$)

5.4.3. Given that a C/I ratio of 50dB is largely sufficient to ensure a good discrimination between the direct and reflected signals, a minimum D_{wr} that ensures good discrimination can be determined for a given maximum bi-static wind turbine RCS (calculated as $41dBm^2$ for the proposed dvelopments' wind turbines).

5.4.4. Minimum D_{wr} = 10.01km to ensure a good discrimination between the direct and reflected signals.

5.4.5. Therefore, at a minimum distance of 22.8km from Tooman SSR, the impact of wind turbines within the proposed developments' array area on azimuth accuracy will be tolerable irrespective of the path difference between the direct and the reflected signals.

5.4.6. Note that the above calculation is applicable for a single wind turbine. Multiple wind turbines within a radar beamwidth at ranges beyond 10km could still result in significant SSR azimuth errors.

In response to Section 17 (b) of the RFI, where the applicant is requested to confirm through consultation with AirNav and daa that the layout and reduced height applied to a number of turbines for the Project Option 2 layout is satisfactory, the following Section 6 details the assessment of potential impacts on navigation aids during the construction of the onshore cable route facility that was requested through the consultation process. This section shall be added to Appendix 19.1 of the 2024 EIAR.

6. Onshore Cable Route Assessment

6.1. Onshore infrastructure

6.1.1. The onshore infrastructure is located within the proposed development boundary landward of the high water mark. Landfall is at a site north of Balbriggan, County Dublin and comprises offshore export cables to transition joint bays and onshore export cables from the transition joint bays to a grid facility. The grid facility comprises a compensation substation and the Bremore substation and will be predominantly above ground. Both substation compounds will include a Gas Insulated Switchgear building of approximately 17m in height (plus 3m lightning rods). All other infrastructure will be below this height.

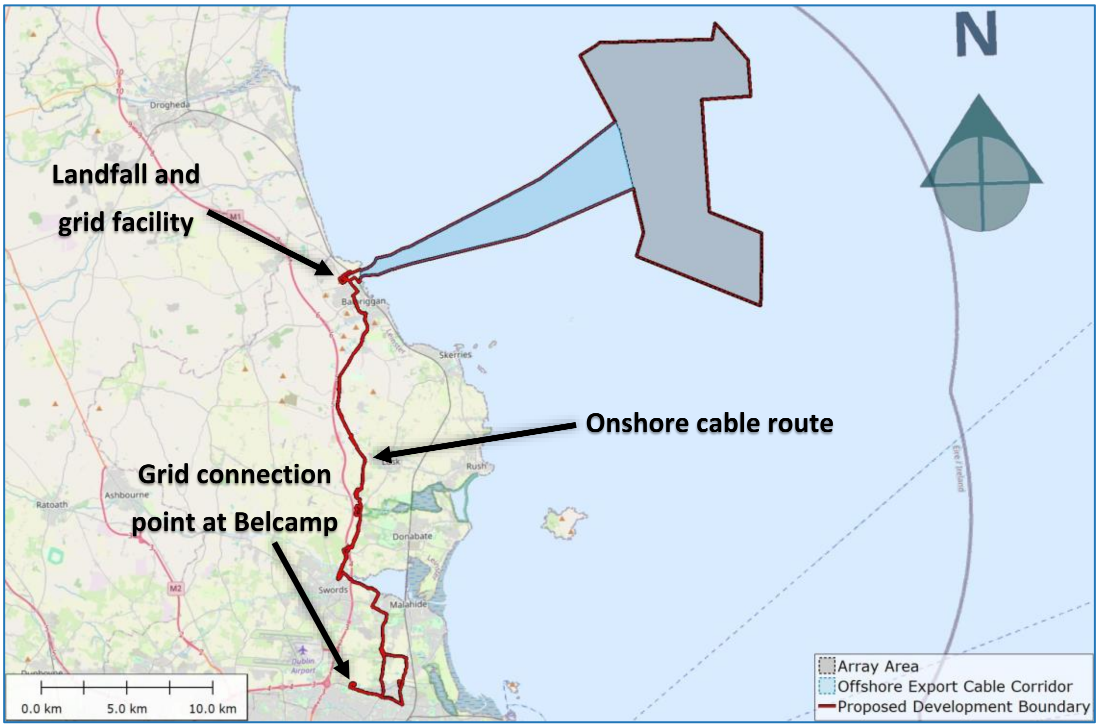
6.1.2. The onshore cable route runs for approximately 33 to 35km and will be laid underground from the grid facility to the grid connection point at the existing substation at Belcamp on the northern outskirts of Dublin. The majority of the route, approximately 29km out of 33km, is contained within the footprint of existing roads. Two cable circuits will be laid along the cable route, in either a single trench or a twin-trench arrangement.

6.1.3. Typical plant used for cable route trenching along public roads will be:

- Road saw(s);
- Excavator;
- 4-axle lorry;
- Small dumper(s); and
- 4-axle grab loader lorry.

6.1.4. All works along the onshore cable route are expected to be at heights of 10m or less.

6.1.5. The landfall site and the onshore cable route is depicted in Figure A15. The highest terrain elevation within the proposed development boundary is approximately 46m amsl.



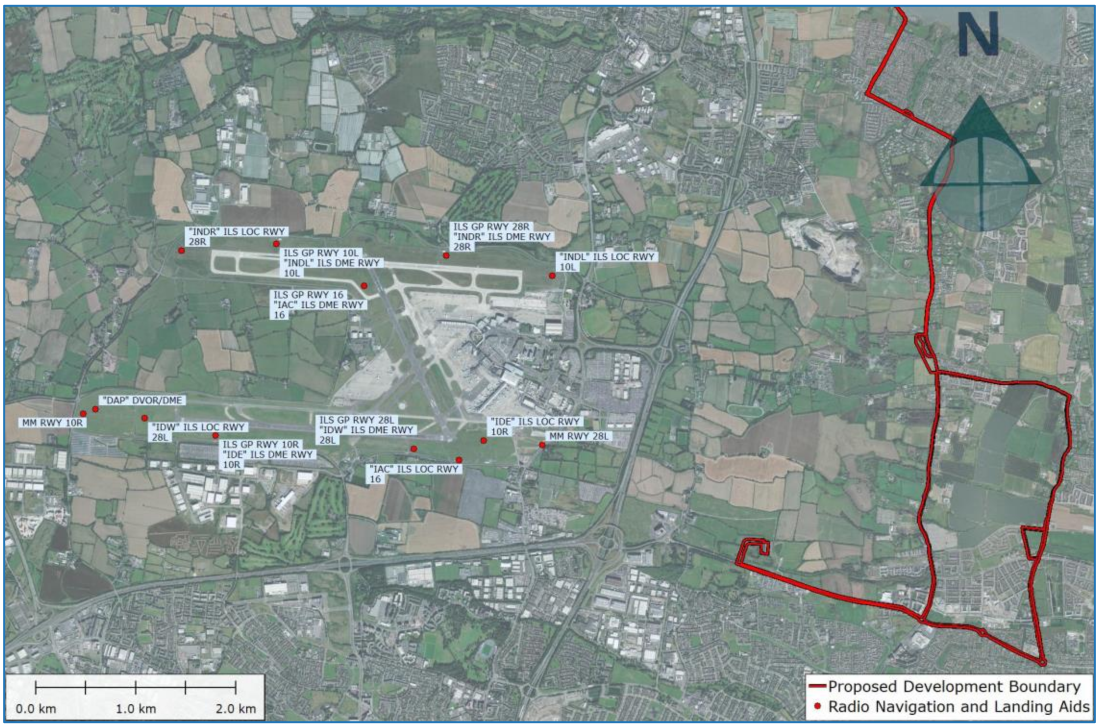
© OpenStreetMap contributors

Figure A15: Proposed development boundary

6.2. Navigation aids under consideration

6.2.1. The navigation aids under consideration at Dublin Airport consist of an Instrument Landing System (ILS) Localiser, Glidepath and DME at runways 10L/28R, 10R/28L and 16, and a co-located Doppler VHF Omni-directional Range (DVOR) and DME. Marker beacons and Locators are additional navigation aids supporting aircraft landing on runways 10R and 28L.

6.2.2. The Dublin Airport navigation aids are shown in Figure A16.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A16: Dublin Airport navigation aids

6.2.3. Beyond Dublin Airport there are further navigation aid facilities in the vicinity of the onshore cable route and landfall site, including an NDB and DME at the IAC's Gormanston Aerodrome, and the 'DUB' and 'BAL' en route DVOR/DME facilities.

6.2.4. These navigation aid sites, together with Dublin Airport's Outer Marker and Locator facilities, are shown in Figure A17.

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A17: Navigation aids beyond Dublin Airport

6.3. Safeguarding of navigation aids

6.3.1. As explained in Section 2.6, the safeguarded areas for these technical facilities are defined by ICAO in the document ICAO EUR DOC 015[3]. The document defines BRA shapes for both directional and omni-directional navigation aid facilities.

6.3.2. Figure 11 in Appendix 19.1 of the 2024 EIAR shows an example of the BRA shape for an omni-directional facility, and applicable dimensions to be applied for various omni-directional navigation aids are reproduced in Figure 12 in Appendix 19.1 of the 2024 EIAR.

6.3.3. Figure A18 shows an example of the BRA shape for directional facilities such as ILS Localisers and Glidepaths, as depicted in ICAO EUR DOC 015 Figures 3.1, 3.2, 3.3 and 3.4.

[3] ICAO EUR DOC 015 European Guidance Material on Managing Building Restricted Areas, Third Edition 2015

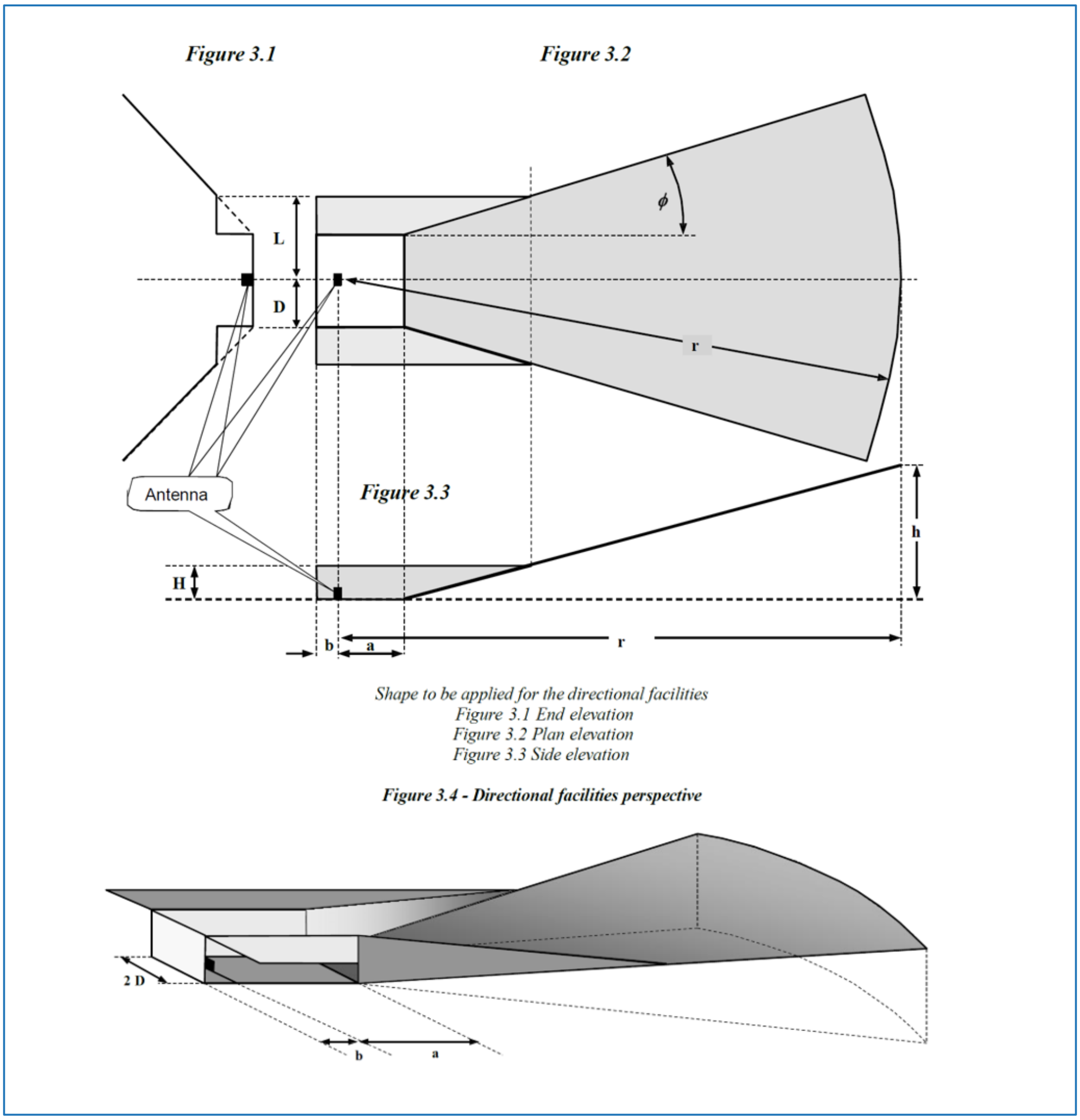


Figure A18: ICAO EUR DOC 015 Figures 3.1-3.4 – BRA shape for directional facilities

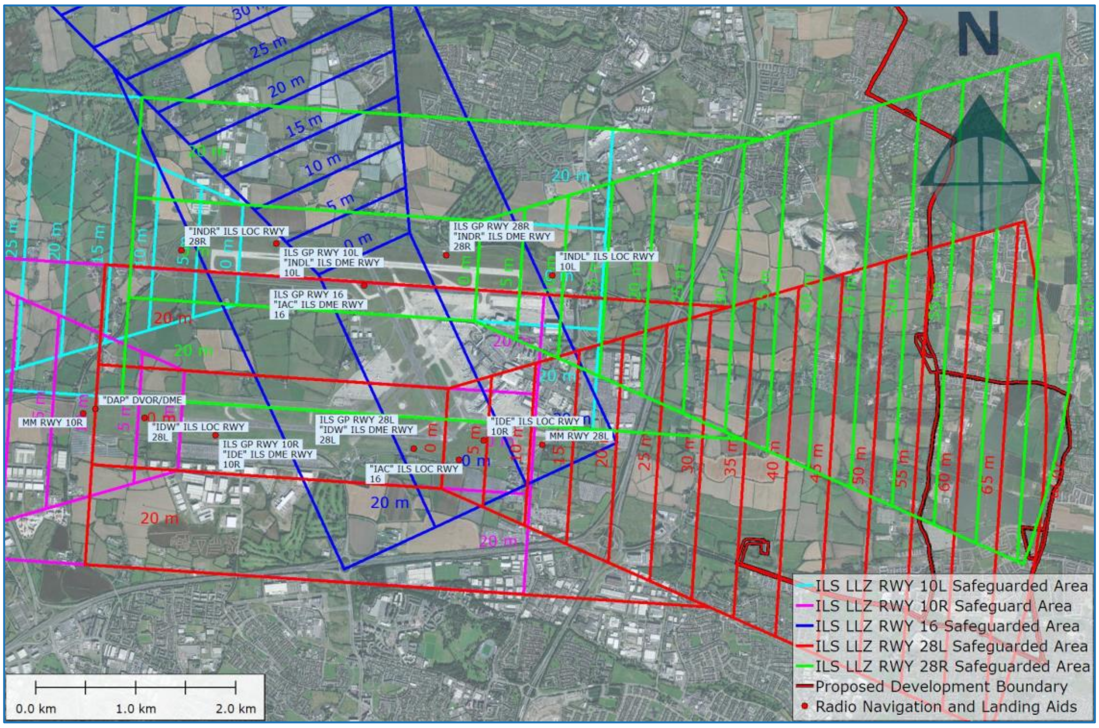
6.3.4. Applicable dimensions to be applied for various directional navigation aids are reproduced from EUR DOC 015 in Figure A19.

Type of navigation facilities	*A (m)*	*b (m)*	*h(m)*	*r (m)*	*D (m)*	*H (m)*	*L (m)*	*ϕ (°)*
ILS LLZ (medium aperture single frequency)	Distance to threshold	500	70	a+6000	500	10	2300	30
ILS LLZ (medium aperture dual frequency)	Distance to threshold	500	70	a+6000	500	20	1500	20
ILS GP M–Type (dual frequency)	800	50	70	6000	250	5	325	10
MLS AZ	Distance to threshold	20	70	a+6000	600	20	1500	40
MLS EL	300	20	70	6000	200	20	1500	40
DME (directional antennas)	Distance to threshold	20	70	a+6000	600	20	1500	40

Figure A19: EUR DOC 015 Table 2 – Harmonised guidance figures for directional facilities

6.4. Assessment

6.4.1. The Dublin Airport Localiser safeguarded areas are illustrated in Figure A20.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A20: Localiser safeguarded areas

6.4.2. Onshore infrastructure and construction plant equipment will not infringe the Localiser 10L (cyan), Localiser 10R (magenta) or Localiser 16 (blue) safeguarded areas and will have no impact on the performance of these facilities.

6.4.3. The zoomed view in Figure A21 shows that the onshore cable route lies below the safeguarded areas of Localiser 28R (green) and Localiser 28L (red).

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A21: Localiser safeguarded areas – zoomed

6.4.4. The onshore cable route lies below sloped safeguarded surfaces where the heights indicated are referenced to the base of the navigation aid antenna at ground level.

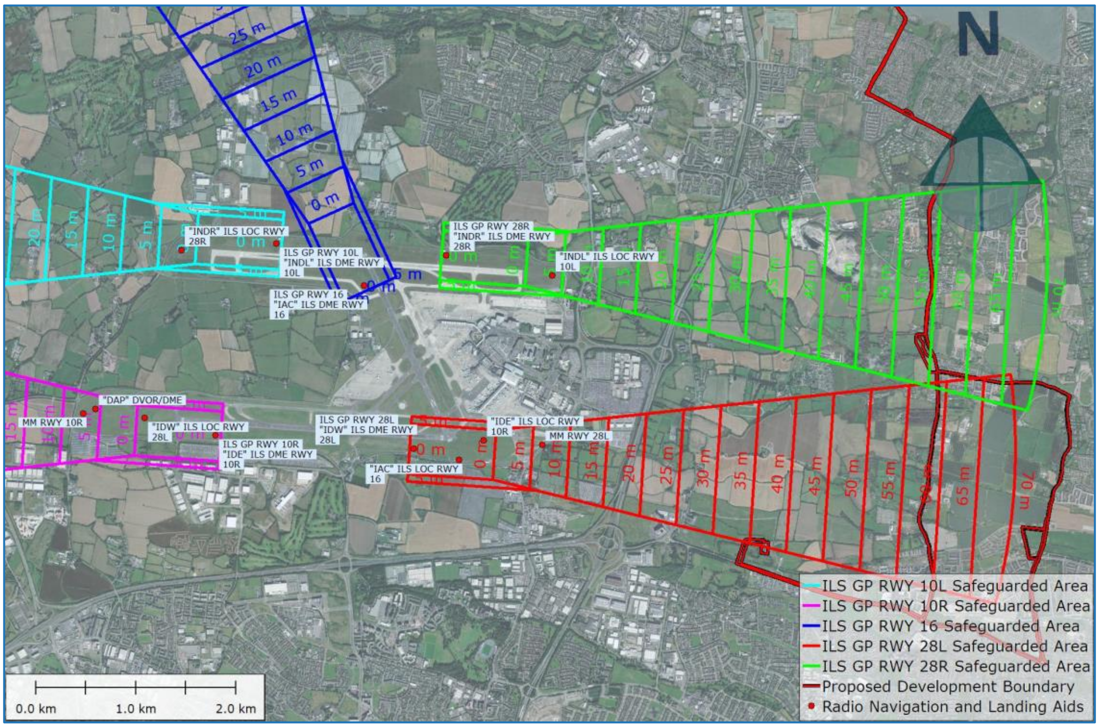
6.4.5. The minimum height of the Localiser 28R safeguarded slope over the onshore cable route is between 45m and 50m (circled green in Figure A21). Ground level at the site of the Localiser 28R antenna is 71.4m amsl. Assuming the worst-case safeguarded height (minimum of 45m) and worst-case onshore cable route terrain elevation (maximum of 46m amsl), then an obstacle would need to be 71.4 + 45 – 46 = 70.4m or more in height to infringe the Localiser 28R safeguarded area.

6.4.6. Onshore infrastructure and construction plant equipment will not infringe the Localiser 28R safeguarded area and will have no impact on the performance of this facility.

6.4.7. The minimum height of the Localiser 28L safeguarded slope over the onshore cable route is between 35m and 40m (circled red in Figure A21). Ground level at the site of the Localiser 28L antenna is 76.7m amsl. Assuming the worst-case safeguarded height (minimum of 35m) and worst-case onshore cable route terrain elevation (maximum of 46m amsl), then an obstacle would need to be 76.7 + 35 – 46 = 65.7m or more in height to infringe the Localiser 28L safeguarded area.

6.4.8. Onshore infrastructure and construction plant equipment will not infringe the Localiser 28L safeguarded area and will have no impact on the performance of this facility.

6.4.9. The Dublin Airport Glidepath safeguarded areas are illustrated in Figure A22.

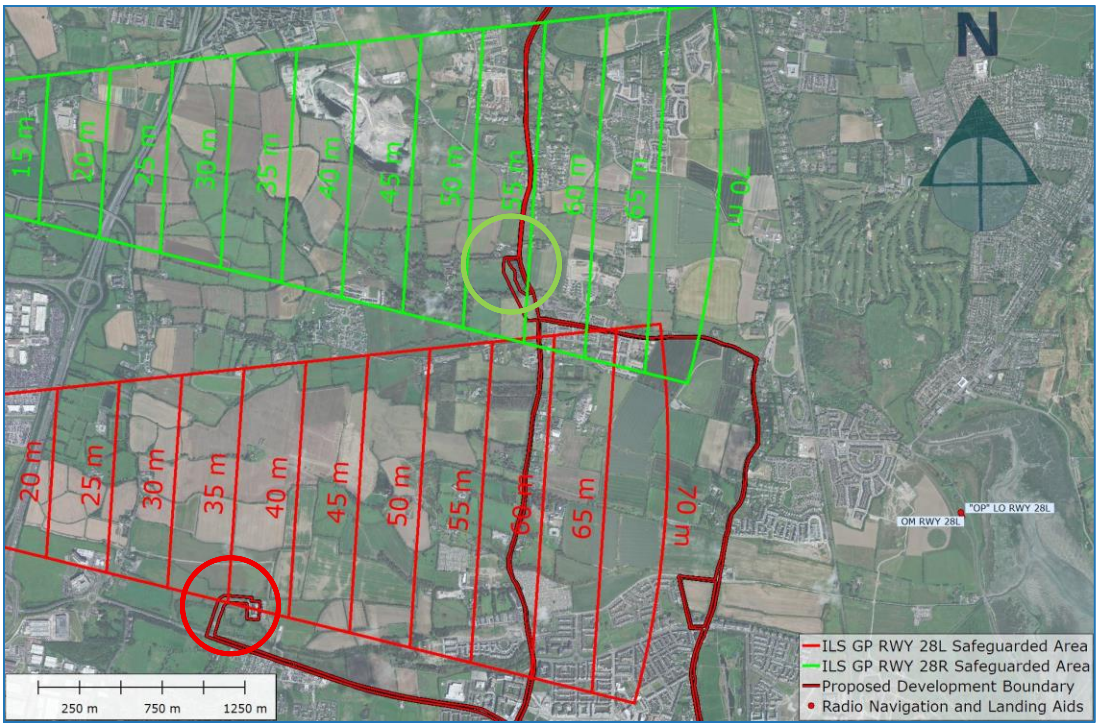


Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A22: Glidepath safeguarded areas

6.4.10. Onshore infrastructure and construction plant equipment will not infringe the Glidepath 10L (cyan), Glidepath 10R (magenta) or Glidepath 16 (blue) safeguarded areas and will have no impact on the performance of these facilities.

6.4.11. The zoomed view in Figure A23 shows that the onshore cable route lies below the safeguarded areas of Glidepath 28R (green) and Glidepath 28L (red).



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A23: Glidepath safeguarded areas – zoomed

6.4.12. The onshore cable route lies below sloped safeguarded surfaces where the heights indicated are referenced to the base of the navigation aid antenna at ground level.

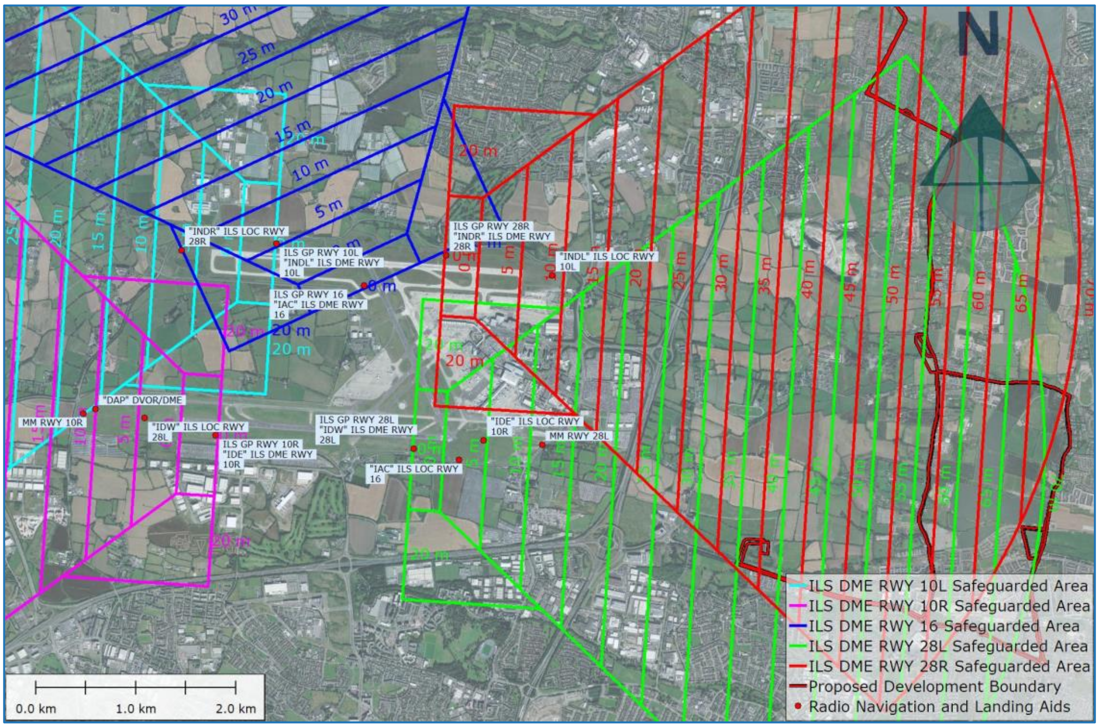
6.4.13. The minimum height of the Glidepath 28R safeguarded slope over the onshore cable route is between 50m and 55m (circled green in Figure A23). Ground level at the site of the Glidepath 28R antenna is 63.4m amsl. Assuming the worst-case safeguarded height (minimum of 50m) and worst-case onshore cable route terrain elevation (maximum of 46m amsl), then an obstacle would need to be 63.4 + 50 – 46 = 67.4m or more in height to infringe the Glidepath 28R safeguarded area.

6.4.14. Onshore infrastructure and construction plant equipment will not infringe the Glidepath 28R safeguarded area and will have no impact on the performance of this facility.

6.4.15. The minimum height of the Glidepath 28L safeguarded slope over the onshore cable route is between 30m and 35m (circled red in Figure A23). Ground level at the site of the Glidepath 28L antenna is 63.0m amsl. Assuming the worst-case safeguarded height (minimum of 30m) and worst-case onshore cable route terrain elevation (maximum of 46m amsl), then an obstacle would need to be 63.0 + 30 – 46 = 47.0m or more in height to infringe the Glidepath 28L safeguarded area.

6.4.16. Onshore infrastructure and construction plant equipment will not infringe the Glidepath 28L safeguarded area and will have no impact on the performance of this facility.

6.4.17. The Dublin Airport DME safeguarded areas are illustrated in Figure A24.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A24: DME safeguarded areas

6.4.18. Onshore infrastructure and construction plant equipment will not infringe the DME 10L (cyan), DME 10R (magenta) or DME 16 (blue) safeguarded areas and will have no impact on the performance of these facilities.

6.4.19. The zoomed view in Figure A25 shows that the onshore cable route lies below the safeguarded areas of DME 28R (red) and DME 28L (green).

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A25: DME safeguarded areas – zoomed

6.4.20. The onshore cable route lies below sloped safeguarded surfaces where the heights indicated are referenced to the base of the navigation aid antenna at ground level.

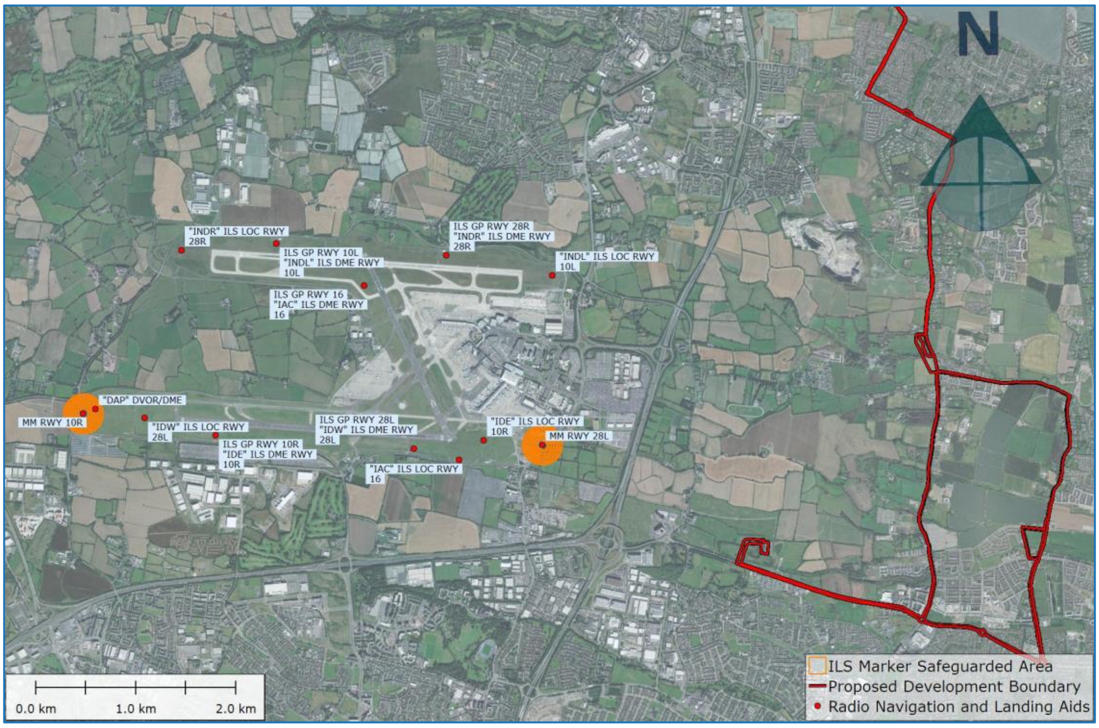
6.4.21. The minimum height of the DME 28R safeguarded slope over the onshore cable route is between 30m and 35m (circled white in Figure A25). Ground level at the site of the DME 28R antenna is 63.4m amsl. Assuming the worst-case safeguarded height (minimum of 30m) and worst-case onshore cable route terrain elevation (maximum of 46m amsl), then an obstacle would need to be 63.4 + 30 – 46 = 47.4m or more in height to infringe the DME 28R safeguarded area.

6.4.22. Onshore infrastructure and construction plant equipment will not infringe the DME 28R safeguarded area and will have no impact on the performance of this facility.

6.4.23. The minimum height of the DME 28L safeguarded slope over the onshore cable route is between 35m and 40m (circled white in Figure A25). Ground level at the site of the DME 28L antenna is 63.0m amsl. Assuming the worst-case safeguarded height (minimum of 35m) and worst-case onshore cable route terrain elevation (maximum of 46m amsl), then an obstacle would need to be 63.0 + 35 – 46 = 52.0m or more in height to infringe the DME 28L safeguarded area.

6.4.24. Onshore infrastructure and construction plant equipment will not infringe the DME 28L safeguarded area and will have no impact on the performance of this facility.

6.4.25. The Dublin Airport Middle Marker safeguarded areas are illustrated in Figure A26.

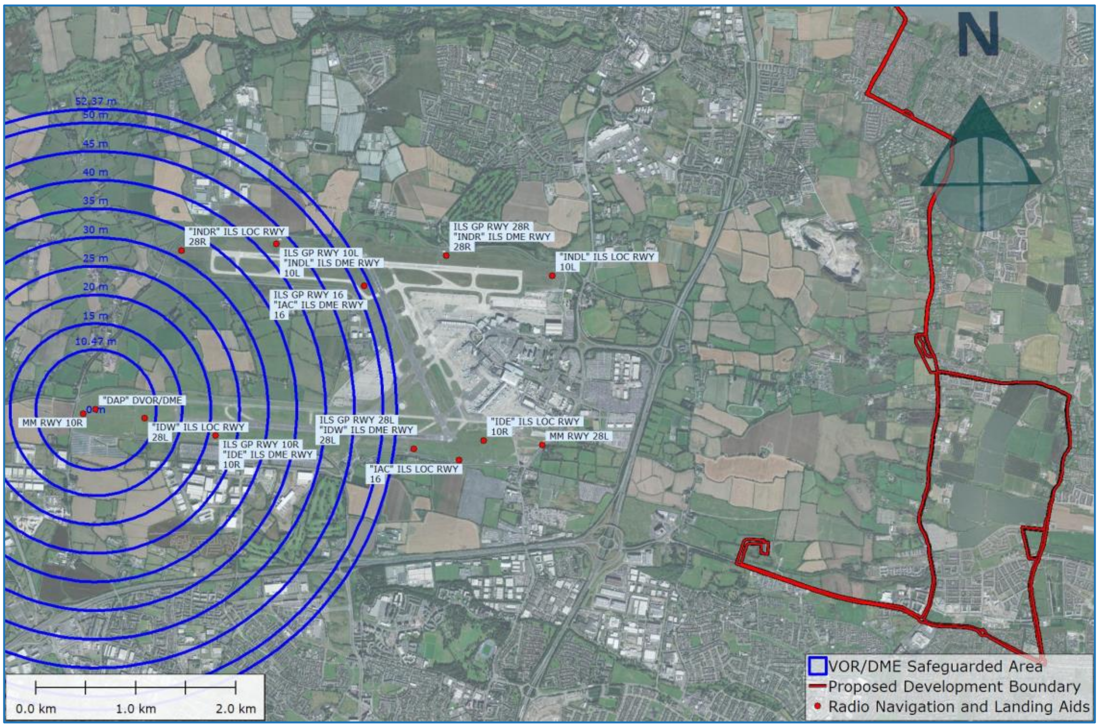


Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A26: Middle Marker safeguarded areas

6.4.26. Onshore infrastructure and construction plant equipment will not infringe the Middle Marker 10R or Middle Marker 28L safeguarded areas and will have no impact on the performance of these facilities.

6.4.27. The 'DAP' DVOR/DME safeguarded area is illustrated in Figure A27

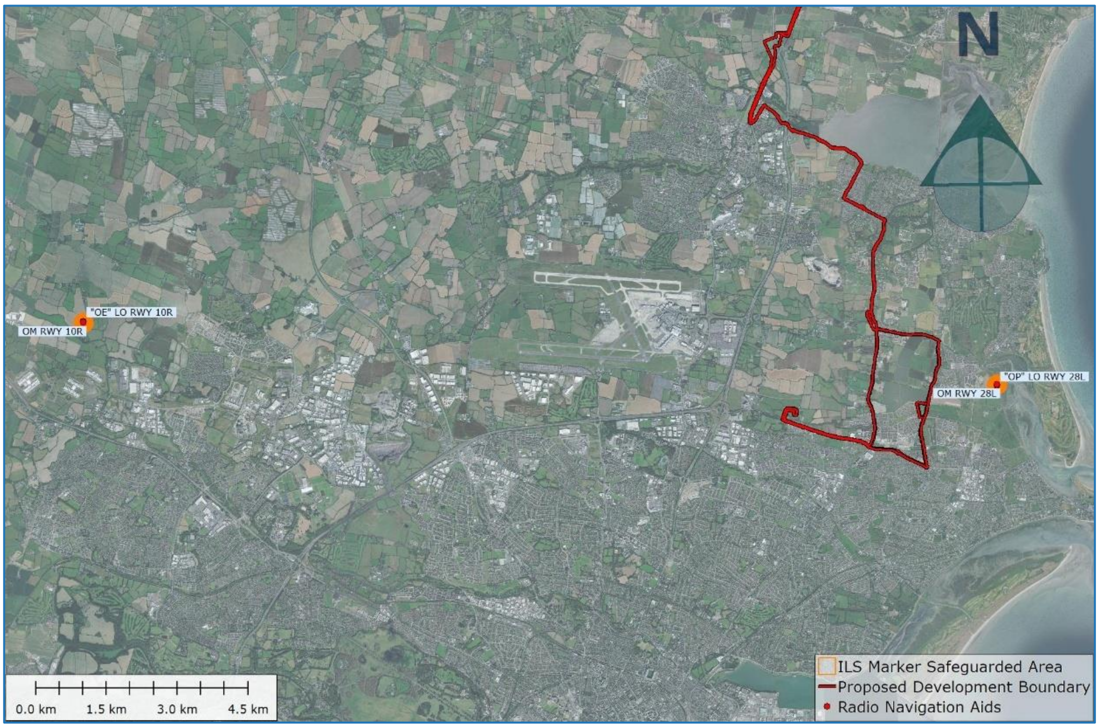


Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A27: 'DAP' DVOR/DME safeguarded area

6.4.28. Onshore infrastructure and construction plant equipment will not infringe the 'DAP' DVOR/DME safeguarded area and will have no impact on the performance of this facility.

6.4.29. The Dublin Airport Outer Marker safeguarded areas are illustrated in Figure A28.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A28: Outer Marker safeguarded areas

6.4.30. Onshore infrastructure and construction plant equipment will not infringe the Outer Marker 10R or Outer Marker 28L safeguarded areas and will have no impact on the performance of these facilities.

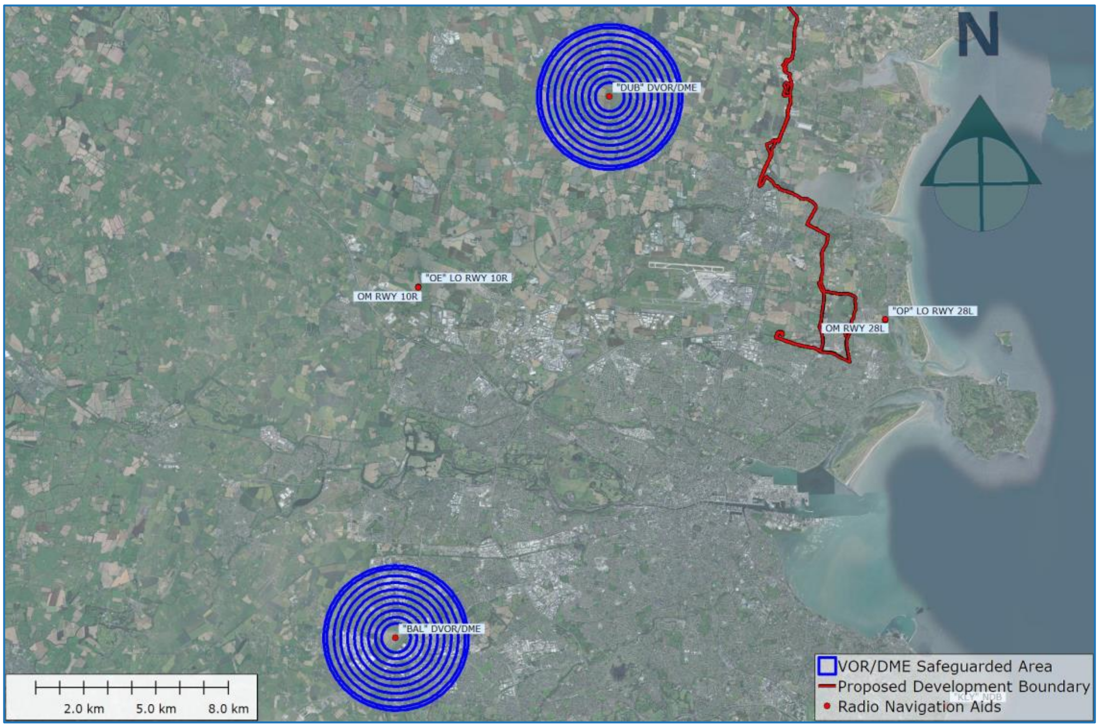
6.4.31. The Dublin Airport Locators and Gormanston Aerodrome NDB safeguarded areas are illustrated in Figure A29.

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A29: Locator and NDB safeguarded areas

6.4.32. Onshore infrastructure and construction plant equipment will not infringe the Locator 10R, Locator 28L or ‘GMN’ NDB safeguarded areas and will have no impact on the performance of these facilities.

6.4.33. The ‘DUB’ and ‘BAL’ en route DVOR/DME safeguarded areas are illustrated in Figure A30.



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A30: En route DVOR/DME safeguarded areas

6.4.34. Onshore infrastructure and construction plant equipment will not infringe the 'DUB' or 'BAL' DVOR/DME safeguarded areas and will have no impact on facility performance.

6.4.35. The 'GMN' DME safeguarded area is illustrated in Figure A31.

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Figure A31: 'GMN' DME safeguarded area

6.4.36. Onshore infrastructure and construction plant equipment will not infringe the 'GMN' DME safeguarded area and will have no impact on the performance of this facility.

In response to Section 17 (b) of the RFI, where the applicant is requested to confirm through consultation with AirNav and daa that the layout and reduced height applied to a number of turbines for the Project Option 2 layout is satisfactory, the following Section 7 details the assessment of the potential for airspace conflicts if low-level aircraft are required to fly higher to avoid WTG obstacles that was requested through the consultation process. This section shall be added to Appendix 19.1 of the 2024 EIAR.

7. VFR Transit Assessment

7.1. Airspace overview

7.1.1. Airspace is classified according to several factors, but primarily that of the type of flight rules applicable, what service ATC provide within that class of airspace and what separation is applied between the aircraft. Classes of airspace worldwide are A through G with the first six of those being controlled airspace and only Class G being uncontrolled airspace.

7.1.2. Ireland uses only three classes of airspace, namely A, C and G.

7.1.3. Controlled Airspace is airspace in which an aircraft is being 'controlled' – it is being flown adhering to instructions from the ATC unit responsible for that particular area of airspace. Instructions may range from direction of flight, altitude and even speed control. Compliance with ATC instructions is mandatory. This type of airspace within Ireland is represented by Classes A and C.

7.1.4. Uncontrolled Airspace is airspace in which an aircraft is not instructed by ATC. Indeed, the flight may not be monitored by ATC at all, although ATC will always try and maintain an operational watch over uncontrolled airspace subject to workload of the controllers. However, in most areas of uncontrolled airspace, various degrees of ATC service are available. This ranges from simple flight monitoring to services providing advice to pilots in terms of routing and separation from other aircraft in that airspace. Aircraft within uncontrolled airspace fly in accordance with the Rules of the Air, but do not have to interact with ATC. Many pilots choose to interact with ATC by at least 'checking in' with the unit which brings about an arguably safer flight experience providing a pilot with more situational awareness within the uncontrolled environment in which they are flying.

7.1.5. Aircraft are flown in accordance with one of two flight rules – VFR or IFR.

7.1.6. As a general explanation, aircraft flying in accordance with IFR are being flown with sole reference to the flight instrumentation in the aircraft. IFR flight is, within reason, not concerned with the weather as whether the pilot has a view outside of the aircraft is immaterial. Generally, aircraft flown in classes A and C airspace are flown in accordance with IFR. Such flight would be that associated with airlines (passengers and cargo) as well as charter and corporate travel.

7.1.7. Aircraft flying according to VFR are generally small, private aircraft associated with pleasure and sightseeing flights, flight training and those engaged in sport flying, i.e. parachuting, aerobatics etc. A fundamental principle of VFR flight is that the aircraft is flown with reference to the natural horizon, i.e. the pilot looks out of the window. VFR flight is responsible for avoidance of terrain, obstacles and other aircraft and adherence to minimum heights rules is mandatory.

7.2. Dublin airspace

7.2.1. Dublin Airport has a CTA established around the Dublin area to a distance of approximately 40nm (74km). This provides airspace in which ATC can sequence aircraft for their arrival into Dublin Airport as well as to other airports in the vicinity such as Casement (aka Baldonnel) military airfield and Weston Airport. It also provides a protected environment for aircraft to climb to a relatively high altitude and begin positioning towards one of many 'exit gateways' which generally mark the beginning of the en route airway structure.

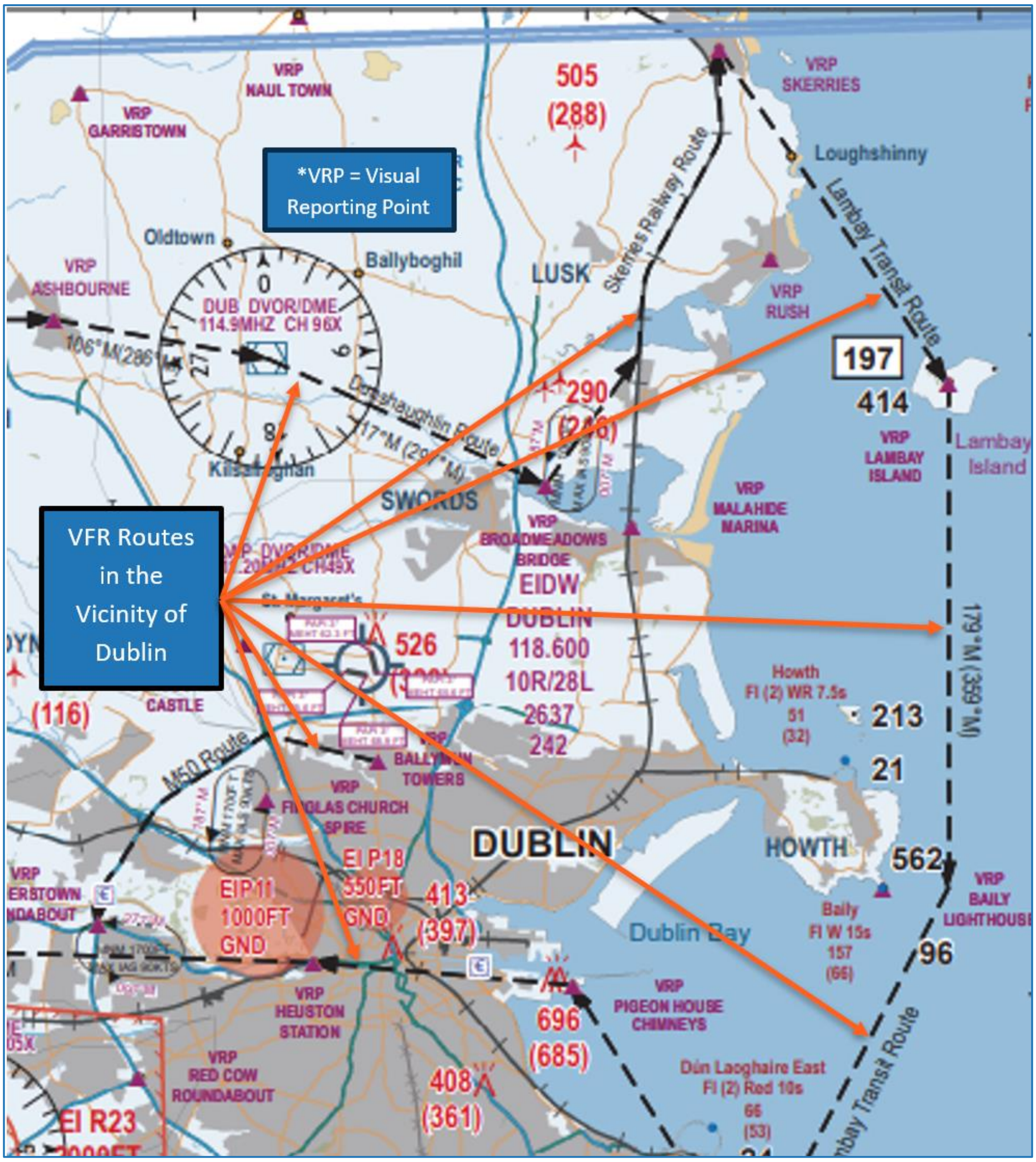
7.2.2. Dublin Airport also has a CTR established around the airport which is an airspace established essentially for the protection of aircraft descending into and climbing out of the airport. This provides a protected space for the air traffic controller to vector (provide heading instructions to) aircraft onto the ILS at five of the six runway directions available using radar information and provides a protected space for aircraft to begin their initial climbs onto the standard departure routes when leaving the airport.

7.2.3. The CTR is Class C airspace and is therefore a controlled airspace. This allows ATC to exercise complete control over the area. Whilst the majority of aircraft would be flying in accordance with IFR, it is permissible, contrary to popular belief, for VFR aircraft to transit this airspace.

7.2.4. Should such a clearance be granted it is known as *Special* VFR (SVFR). Essentially, a VFR aircraft granted this clearance must comply with a precise clearance issued to it by ATC when being granted this routing through the CTR. ATC can only control its IFR aircraft when it is certain that any VFR aircraft wishing to transit the CTR will comply with a precise set of instructions. The VFR aircraft in this case cannot simply do as it pleases as it would when in Class G, uncontrolled airspace.

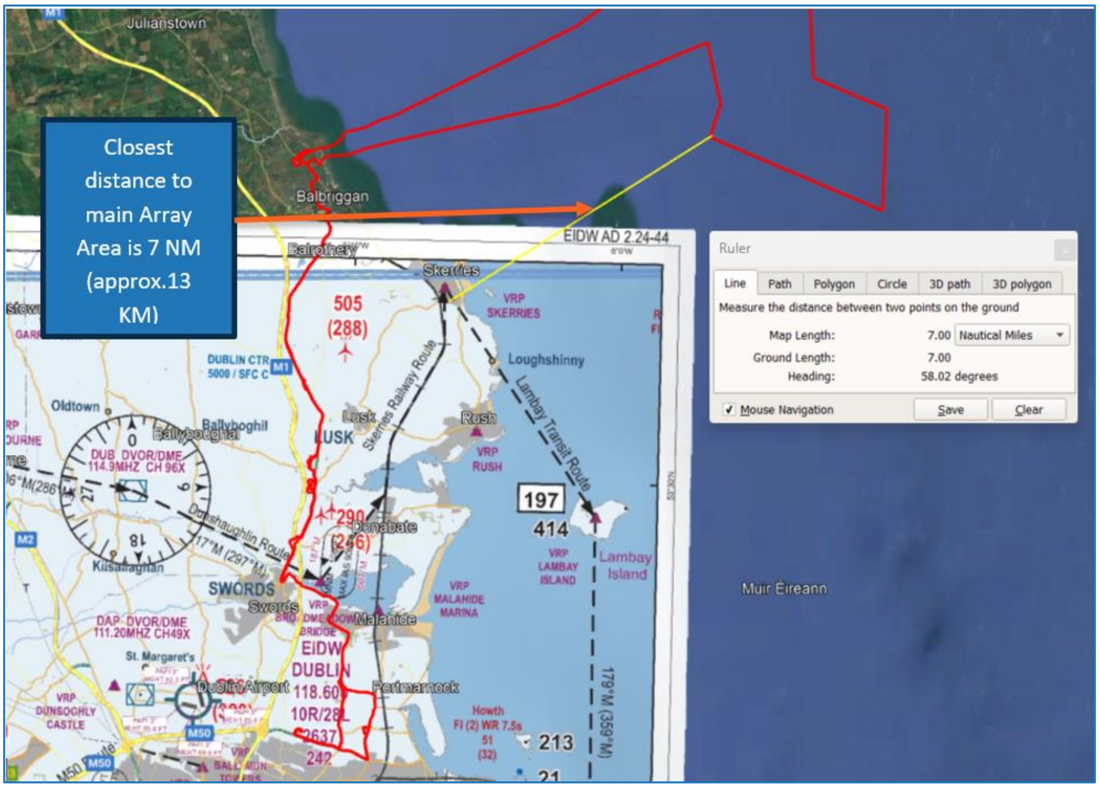
7.2.5. However, SVFR is viewed as a privilege within the ATC/flying sector and cannot be taken for granted by a VFR flight wishing to transit the area. Requests for SVFR transits of this airspace will be evaluated, in the first instance, against the workload of the air traffic controller. High workloads generally indicate the airspace is very busy with aircraft arriving and departing the airport and the controller, under such conditions, may very well refuse a CTR transit request by a VFR aircraft.

7.2.6. In order for VFR aircraft to fly around a major airport, or several major airports, in a particular area, specific routes are often established for this purpose. This also provides a more formal route for VFR aircraft intending to land at Dublin Airport or one of the other airports in the vicinity – the premise being that more structured VFR routes in the immediate area of a large, busy airport ensures VFR aircraft are seen and can be monitored (on radar) whilst flying in the vicinity. VFR aircraft conducting flight training manoeuvres etc would ensure they remain clear of such routes and would operate in the general, Class G uncontrolled airspace away from these routes. Figure A32 shows the visual routes established in the vicinity of Dublin Airport with Figure A33 showing the same chart but overlaid on Google Earth with the proposed developments' boundary also shown.



© AirNav Ireland/Google Earth

Figure A32: Chart showing VFR routes in the vicinity of Dublin Airport



© AirNav Ireland/Google Earth

Figure A33: Chart showing VFR routes on Google Earth with the proposed developments' boundary depicted

7.3. The VFR flight environment

7.3.1. VFR flight as noted in paragraph 7.1.7 is based on a pilot using the natural horizon to orientate the aircraft, as well as avoiding obstacles visually.

7.3.2. In order to comply with this visual environment a pilot operating an aircraft in accordance with VFR must ensure the aircraft is in weather conditions that *allow* for such flying to be based on visibility outside of the aircraft. A table of Visibility Minima will determine whether an aircraft is in Visual Meteorological Conditions (VMC) or not. This is a mandatory requirement for flying in accordance with VFR. Table A2, Standardised European Rules of the Air (SERA) *SERA.5001 VMC visibility and distance from cloud minima*, shows the VMC minima that *must* be determined by the Pilot-in-Command (PIC) to ensure the aircraft can actually be flown in accordance with VFR.

Table A2: VMC visibility and distance from cloud minima

Altitude Band	Airspace Class	Flight Visibility	Distance from Cloud
At and above 3,050m (10,000ft) amsl	**A thru G**	**8km**	**1,500m horizontally and 300m (1,000ft) vertically**

Altitude Band	Airspace Class	Flight Visibility	Distance from Cloud
Below 3,050m (10,000ft) amsl and above 900m (3,000ft) amsl, or above 300m (1,000ft) above terrain, whichever is higher	**A thru G**	**5km**	**1,500m horizontally and 300m (1,000ft) vertically**
At and below 900m (3,000ft) amsl, or 300m (1,000ft) above terrain, whichever is higher	**A thru E**	**5km**	**1,500m horizontally and 300m (1,000ft) vertically**
	F and G	**5km**	**Clear of cloud and in sight of the surface**

7.3.3. In addition to the PIC determining whether flight in accordance with VFR is possible the PIC must ensure that specified vertical distance from terrain, obstacles etc are complied with.

7.3.4. Rules surrounding Minimum Heights are also published as part of the SERA and are mandatory.

7.3.5. *SERA .3105 Minimum heights* states:

'Except when necessary for take-off or landing, or except by permission from the competent authority, aircraft shall not be flown over the congested areas of cities, towns or settlements or over an open-air assembly of persons, unless at such a height as will permit, in the event of an emergency arising, a landing to be made without undue hazard to persons or property on the surface. The minimum heights for VFR flights shall be those specified in SERA.5005(f) and minimum levels for IFR flights shall be those specified in SERA.5015(b)'.

7.3.6. This simply means that, in the first instance, any flight must be at such an altitude or Flight Level that will enable it to land clear of any persons or property. Put another way, it means that any aircraft must fly high enough so as to be able to glide or otherwise, away from people or property on the ground if it suffers some kind of emergency.

7.3.7. *1.6.2. SERA.5005(f) – (Minimum heights for) Visual flight rules* states*:*

f) Except when necessary for take-off or landing, or except by permission from the competent authority, a VFR flight shall not be flown:

(1) over the congested areas of cities, towns, or settlements or over an open-air assembly of persons at a height less than 300m (1 000ft) above the highest obstacle within a radius of 600 m from the aircraft;

(2) elsewhere than as specified in (1), at a height less than 150m (500ft) above the ground or water, or 150m (500ft) above the highest obstacle within a radius of 150m (500ft) from the aircraft.

7.3.8. Therefore, any aircraft flying in accordance with VFR must ensure that the aircraft is at least 500ft above the highest object within 500ft laterally of the aircraft.

7.3.9. Given that the proposed developments' array area wind turbines are expected to have a height of approximately 314m amsl, then a VFR flight crossing the array would be required to fly at an altitude of approximately 1,530ft amsl. This is made up of the height of the wind turbines (1,030ft [314m x 3.2808] + 500ft vertical clearance). Good airmanship would dictate though that a pilot would fly at an altitude which would allow the aircraft to glide beyond the wind farm should it experience a technical failure that prevented the aircraft from maintaining altitude. Most pilots, however, would choose to fly around the perimeter of a wind farm.

7.3.10. The airspace beneath which the proposed developments' boundary is located is the Dublin CTA and has vertical limits of 2,500ft amsl up to Flight Level (FL) 245 – approximately 24,500ft amsl. Should an aircraft fly at an altitude of 1,530ft above the proposed wind farm (in order to comply with minimum heights rules) it would leave 970ft of vertical airspace above the aircraft which would allow the aircraft to operate in uncontrolled, Class G airspace. Thus, flight over the wind farm would not force an aircraft complying with minimum heights rules to infringe on Class C, controlled airspace. The over-lying airspace would allow the aircraft to transit the array area at 2,400ft amsl should it wish. Should the aircraft choose to climb above that altitude then it would require a clearance from ATC to enter controlled airspace. This would be the case regardless of the presence of the proposed wind farm.

7.3.11. Figure A34, below shows elements of controlled airspace associated with Dublin Airport and the vicinity. This shows that aircraft operating along the Lambay VFR route (marked in yellow) from Skerries Visual Reporting Point (VRP) to Lambay Island VRP are clear of the proposed developments' boundary.

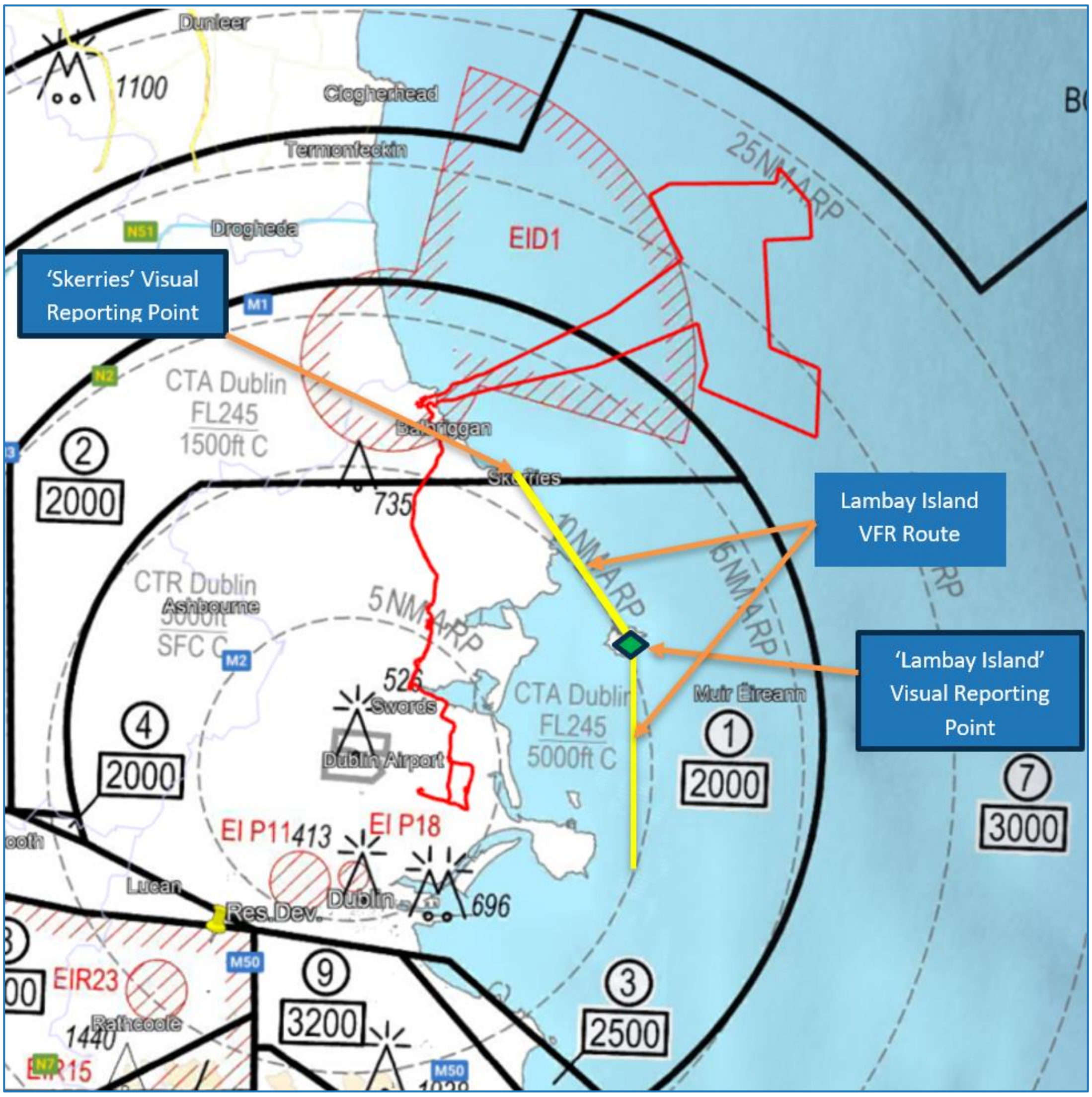


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Figure A34: Controlled Airspace around Dublin with Lambay Island VFR route in yellow

7.4. Conclusion

7.4.1. The proposed development's array area is located beneath Class C, controlled airspace which begins at 2,500ft amsl. The airspace *within* which the array area is actually located is Class G, uncontrolled airspace. This airspace is, *in general*, used by VFR aircraft.

7.4.2. VFR flights are responsible for maintaining their own separation from obstacles, terrain and other aircraft. Additionally, whilst operation in Class G airspace provides choice of whether or not to interact with ATC, the PIC must nevertheless comply with minimum heights regulation.

7.4.3. This entails ensuring the flight is conducted at least 500ft above the highest obstacle located within 500ft laterally of the aircraft. This would require an aircraft transiting the array area to be flown at a minimum altitude of approximately 1,530ft amsl (paragraph 7.3.9). Considering controlled airspace begins at a height of 2,500ft amsl over the site, this allows adequate airspace above the aircraft for use to increase altitude should it wish to and prevents the aircraft from having to enter controlled airspace so as to transit the array area.

7.4.4. However, good airmanship would dictate that a single-engined aircraft, especially, be flown around the perimeter of the array area which would mitigate risk from engine failure if over the middle of the site. With the array area adjacent to the EID Danger Area at Gormanston this may prevent an aircraft from routing around the array area to the west although transit around the perimeter to the east would be possible. Should the aircraft's PIC wish to transit across the array area, however, then an altitude of up to 2,400ft amsl is available to them. This altitude limitation would be in place regardless of the presence of the wind farm.

7.4.5. VFR routes are sometimes formalised (as in this case) in the vicinity of large, busy airports to facilitate the routing of VFR air traffic that wish to pass in close proximity to the airport or wish to land at that airport. These routings provide the air traffic controller with a means of exercising a degree of control over the VFR flight and allowing the controller to provide separation from other flights.

7.4.6. These VFR routes are a minimum distance of 7nm (13km) from the proposed developments' array area and would not be impacted by the site.

There are no further changes required to Appendix 19.1 of the 2024 EIAR.

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