Aviation Response Statement

Response to the Request for Further Information from An Bord Pleanála on the Ballycar Green Energy Ltd Strategic Infrastructure Development Application

Case Reference ABP-318943-24 / Ballycar Green Energy Limited

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Author:	Ai Bridges Ltd.			
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Abbreviations

AGL	Above Ground Level
AMSL	Above Mean Sea Level
ANSP	Air Navigation Service Provider
ARP	Airport Reference Point
ATC	Air Traffic Control
ATCSMAC	Air Traffic Control Surveillance Minimum Altitude Chart
BRA	Building Restricted Area
DME	Distance Measuring Equipment
DoD	Department of Defense
EAS	Emergency Aeromedical Service
GASU	Garda Air Support Unit
GP	Glide Path
HLS	Helicopter Landing Site
IAA	Irish Aviation Authority
ICAO	International Civil Aviation Organization
IFP	Instrument flight Procedure
ILS	Instrument Landing System
MSSR	Monopulse Secondary Surveillance Radar
NAVAIDS	Navigational Aids
NATS	National Air Traffic Services (UK)
NM	Nautical Miles
OLS	Obstacle Limitation Surface
PSR	Primary Surveillance Radar
RWY	Runway
SID	Standard Instrument Departure
STAR	Standard Arrival Route
SSR	Secondary Surveillance Radar
VOR	VHF Omni-directional Range Station

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1. An Bord Pleánala – Request for Further Information

- This Response Statement relates to a Request for Further Information (RFI) received from An Bord Pleanála regarding the aviation concerns raised by AirNav Ireland and Shannon Airport Authority DAC in relation to the proximity of the proposed development to the Woodcock Hill Radar. The RFI was dated 26th July 2024.

- An Bord Pleanála acknowledges that Ballycar Green Energy Limited (the "Applicant") have responded to the observations to-date.

- An Bord Pleanála request that the Applicant review the submissions to-date and respond accordingly by means of a technical report.

- The Applicant is also advised that they should demonstrate, in their response, that sufficient consultation with AirNav Ireland and Shannon Airport Authority has been undertaken and all aviation concerns have been addressed.

2. Response Statement Overview

This Response Statement has been prepared in support of a Request for Further Information by An Bord Pleanála in relation to the planning application for Ballycar Wind Farm and responds to the request to review all submissions to-date and also demonstrate that sufficient consultation has been undertaken with AirNav Ireland and Shannon Airport Authority to ensure all aviation concerns have been addressed.

At the feasibility stage in 2021, the EIAR Consultants for the project, Malachy Walsh & Partners (MWP), appointed Cyrrus Limited to conduct an Aviation Technical Assessment. In addition, MWP also engaged with IAA-approved aviation specialists (FCSL Limited) to conduct detailed technical Navigation Aids assessments on behalf of the applicant.

During the consultation process with the Irish Aviation Authority (IAA)/AirNav Ireland (commenced in January 2022) summarized in Section 2.3 below, specific concerns were raised in relation to aviation and requests were made for more detailed assessments. Ai Bridges have prepared this Response Statement in reply to the Request for Further Information to demonstrate the extensive consultation undertaken in relation to aviation concerns, raised by the IAA/AirNav Ireland and to further demonstrate that the proposed Ballycar Wind Farm will not result in an impact on aviation. The full detailed technical assessments conducted since 2021 to 2024 are included as appendices to this report.

The submission from AirNav Ireland contained the following concerns:

- Potential impact of radar beam deflections on the Woodcock Hill Radar;

- Potential impact of radar beam reflections on the Woodcock Hill Radar;
- Potential impact of shadowing on the Woodcock Hill Radar;
- Woodcock Hill compliance with EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in En-Route Irish airspace and 3 Nautical Mile horizontal separation of aircraft in Dublin airspace.

During the extensive engagement process as part of pre-application consultation in 2022 – 2023, potential impacts to En-route traffic was not raised by IAA/AirNav Ireland.

The submission from Shannon Airport Authority DAC highlighted that the proposed development will have no impact on the aerodrome obstacle limitation surfaces (OLS) and that the development is not within the protection areas as per their safeguarding maps. It highlights that there will be no impacts to the Annex 14 OLS surfaces due to the proposed wind farm. Therefore, no impact on the operations of Shannon Airport are envisaged. The submission notes that Shannon Airport shares the concerns of AirNav Ireland in relation to the potential impacts on the En-route Radar Facilities at Woodcock Hill.

The *Ballycar Wind Farm Aviation Impact Assessment & Mitigation Report* and the *Mitigation Options Study* (as shown in Appendices 4 and 5 respectively) and associated Technical Assessments (as shown in Appendices 1, 2 and 3) submitted to An Bord Pleanála as part of the planning application highlighted the following:

- Ballycar Wind Farm will not result in radar beam deflections on the Woodcock Hill Radar, as stated in the Mitigation Options Study (shown in Appendix 4, Table 1) as the Woodcock Hill Radar already has inbuilt radar processing to eliminate deflections.
- Ballycar Wind Farm will not result in radar beam reflections on the Woodcock Hill Radar (with minor optimisation as part of scheduled maintenance), as stated in the Mitigation Options Study (shown in Appendix 4, Table 1) as the Woodcock Hill Radar has inbuilt radar processing to eliminate reflections.
- Ballycar Wind Farm will not result in shadowing impacts on the Woodcock Hill Radar as any shadowing caused will be below the published Air Traffic Control allowable altitudes for surveillance and are operationally tolerable.

This Response Statement further confirms the above and also confirms:

- Ballycar Wind Farm will not result in any impacts to en-route aircraft and will not impact Woodcock Hill Radar compliance with EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in En-Route Irish airspace and 3 Nautical Mile horizontal separation of aircraft in Dublin airspace.

2.1 Statement Of Authority

Ai Bridges Limited:

Ai Bridges Limited has been engaged by Ballycar Green Energy Limited to manage the aviation assessments and conduct aviation statement reviews and Response Statement submissions in respect of the proposed Ballycar Wind Farm.

Ai Bridges has been supplying telecommunications and aviation assessment solutions to the wind farm industry throughout the Republic of Ireland, Northern Ireland and the UK since 2007. The Ai Bridges Engineering Department has more than 170-man years of experience in the delivery of Aviation, Telecommunications, Broadcast & EMI\EMC Impact Assessments for the Wind Farm industry.

The Engineering Team at Ai Bridges takes the role of Project Manager responsible for overseeing project progress and deliverables for the Telecommunications and Aviation Impact Assessments. This role takes responsibility, along with other team members, for day-to-day running of the projects including co-ordination of project team, sub-contractors and achieving agreed milestones.

The team responsible has extensive experience in the areas of software modelling of telecommunications and aeronautical communications networks. This includes extensive working knowledge of software modelling and of telecommunications and aviation networks and systems. This role also includes the ongoing development of 3D modelling software techniques used to predict wind farm impacts on aviation safeguarding surfaces and infrastructure.

Cyrrus Limited:

Cyrrus Limited is an Irish Aviation Authority Approved Procedure Designer Organisation.

Cyrrus Limited were contracted, as requested by Ballycar Green Energy Limited, by Ai Bridges on behalf of the applicant to address the IAA request for detailed technical IFP and Radar Assessments. Cyrrus provides specialized Radar Engineering & Consultancy Services, IFP Assessments and IFP Procedure Design Services.

Cyrrus is a leading international consultancy providing a range of specialist aviation support services to help airports and developers manage and overcome the varied and often complex technical requirements associated with the running of airports or delivering development projects on or adjacent to airports.

Cyrrus is an accredited Instrument Flight Procedure design organization approved by the United Kingdom Civil Aviation Authority and the Irish Aviation Authority. Cyrrus uses modelling and computer simulation to determine the effects of development and, if required, how these effects can be mitigated.

Cyrrus have significant relevant experience in the areas of UK Civil Aviation and MoD (Ministry of Defense) Radar Assessments and provide Radar Engineering & Consultancy Services and IFP Procedure Design Services. Kevin Sissons, a principal consultant engineer, conducted the Radar Assessment Studies and has significant Radar Systems Engineer experience with NATS UK (National Air Traffic Services).

2.2 Regulatory Context

The International Civil Aviation Organization (ICAO) published their Global Air Navigation Plan 2013 – 2028 which sets out the introduction of Performance Based Navigation (PBN) in order to achieve a transition to a more modern navigation system from the traditional navigation infrastructure. It will move today's ground-based air traffic control system (such as Woodcock Hill Monopulse Secondary Surveillance Radar (MSSR)) to a more efficient one that relies on satellite navigation and on-board aircraft avionics. In response to this, EU Regulation 2018 / 1048[1] was brought into force and lays down airspace usage requirements concerning Performance Based Navigation (PBN IR). This dictates that air navigation services will transition from ground-based radar systems such as the Woodcock Hill MSSR to satellite navigation systems. Such satellite systems will negate current issues with ground based radar systems (topography, built environment, etc.).

In turn, the IAA has developed the PBN Transition plan[2] applicable to all airspace users as required under EU regulations. This is to ensure a transition and rationalization of the ground-based navigation infrastructure so that there is a smooth and safe transition to the provision of the Air Traffic Management and Air Navigation services using performance-based navigation and the eventual rationalization of the ground-based navigation infrastructure.

In the en-route phase, navigation is conducted under the State PBN plan – primarily realised through Global Navigation Satellite Systems (GNSS) positioning. In this phase of flight, the PBN specification should be such to ensure that aircraft can navigate from point to point in a structured manner. This includes a Plan to develop Direct/Free route airspace throughout the Shannon FIR/UIR (Flying Information Region/Upper Information Region). Surveillance will be provided by the existing Mode–S capable MSSR network. This will be supplemented by the existing PSR systems at Dublin, Cork and Shannon. The IAA's ATM system capability has been updated with the introduction of the COOPANS system at the Shannon and Dublin ATCCs since 2011.

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018R1048

[2] https://www.iaa.ie/commercial-aviation/airspace/airspace---pbn-ta-acp-fua#:~:text=Performance%20Based%20Navigation&text=Volume%20II%20contains%20a%20number,based%20to%20performance%2Dbased%20navigation.

The movement to satellite based navigation systems in Irish airspace is due to take place by June 6th, 2030. Satellite based aircraft navigation systems will negate any potential impacts associated with wind farms on aircraft navigation.

2.3 IAA/AirNav Ireland Consultations

Extensive consultations, engagements, meetings and detailed email and letter correspondences with the IAA/AirNav Ireland commenced in January 2022 up to submission of the planning application.

Following submission and prior to the receipt of a Request for Further Information, additional significant consultation (meetings and email correspondence) has been undertaken with AirNav Ireland.

A summary of these engagements has been included below and demonstrates the extended consultation process that has taken place with the IAA and AirNav Ireland since 2022.

2.3.1 Malachy Walsh & Partners (EIAR Consultants) – January 2022 - May 2022:

In January 2022, Malachy Walsh and Partners (MWP) engaged and submitted a scoping report to the IAA with a request for comments in relation to the proposed wind farm on lands at and near Ballycar, Co. Clare.

There were further rounds of consultations in January 2022 with the Airspace and Navigation Team at the IAA where it was highlighted that there are a number of aviation surfaces under the responsibility of the IAA Air Navigation Service Provider (ANSP) regarding safeguarding around Shannon Airport. These were referred internally within the IAA and the Shannon Airport Operator for further response on potential impacts to the following:

- Navigational Aids
- Surveillance Radar
- Instrument Flight Procedures (IFPs)

The consultation between with the IAA from January 2022 to May 2022 served to:

- Identify the main concerns of the IAA in relation to the potential impacts on aviation surfaces.

- Present the findings of the detailed Aviation Technical Assessments to the IAA in relation to Instrument Flight Procedures, showing a “No Impact” condition.

- Present the findings of the detailed Aviation Technical Assessments to the IAA in relation to Navigational/Flight Calibration Impact Assessments, demonstrating a “No Impact” condition.

- Present the findings of the detailed Aviation Technical Assessments to the IAA in relation to Radar Surveillance including the Primary Surveillance Radar (PSR) at Shannon Airport and the Monopulse Secondary Surveillance Radar (MSSR) at Woodcock Hill, showing a "Potential Impact" condition which can be appropriately mitigated.

2.3.2 IAA Consultation Responses – February 2022:

The IAA has welcomed and accepted the findings presented within the detailed Aviation Technical Assessments and in a consultation response to MWP on February 28th, 2022, responded as follows:

1. *In relation to the IFP Opinion (Attachment 1) I'm happy to accept that the proposed turbines will not affect the Shannon Airport Instrument Flight Procedures and nothing further is required from this perspective.*

   Note: If planning is granted and the construction goes ahead, these turbines will need to be notified to the IAA Aviation Safety Regulator, each being higher than 100m elevation.
2. *Technical Assessment Report:*
   - *Building Restricted Areas: SAA's Paul Hennessy copied for information.*
   - *NAVAIDs: The report confirms no issues for Airport NAVAIDs: Fergal Doyle copied to confirm this.*
   - *Surveillance: The report notes that mitigations are required for the Shannon PSR and the Woodcock Hill MSSR most particularly to prevent false targets and ghost signals respectively. While the report outlines how these mitigations could be applied, this must be assessed by our surveillance team*

2.3.3 IAA/AirNav Ireland Correspondence – November 2022:

A further consultation response was received from the IAA on 29 November 2022 from the Management Surveillance ME Systems Team. This response is shown in Appendix 4 (shown in section Appendix A – IAA Consultations). In this response the IAA raise ten concerns relating specifically to deflections, reflections and shadowing impacts of the proposed development on the Woodcock Hill MSSR and conclude that the proposed development would degrade the performance of the Woodcock Hill Radar.

Ai Bridges Limited was commissioned by MWP, the EIAR consultants acting on behalf of Ballycar Green Energy Limited, to review the IAA consultation response. Ai Bridges then recommended that a detailed technical assessment be carried out that would include a Mitigation Options Report to address the concerns raised by the IAA and engaged with Cyrrus Limited to conduct this study. This Mitigation Options Study is included Appendix 5.

2.3.4 AirNav Ireland Correspondence - December 2023:

Following the submission of the Mitigations Option Study and further consultation, a letter was received from AirNav Ireland (specifically from the AirNav Manager Airspace and Navigation) in December 2023 acknowledging the proactive engagement by the applicant. The letter states:

> *"Based on the interactions with you and your Consultants, I'm satisfied that there is adequate time to consider how to mitigate issues related to the Woodcock Hill Radar site that at this point do not present a reason for us to object to the proposed development going to Planning application stage."*
>
> *"Noting the comparator development supplied through our ongoing correspondence, I support this application in principle, on behalf of AirNav Ireland, subject to our ongoing interaction with you and your consultants in developing appropriate mitigations for the potential surveillance impacts, as outlined above. I also note the willingness of the developer to bear costs associated with these mitigations".*

This correspondence is included in the planning application for Ballycar Wind Farm in Appendix 1B Stakeholder Consultation and Responses.

2.3.5 Radar Workshop – Dublin - February 2024:

Following the submission of the planning application for the Ballycar Wind Farm further additional consultation was undertaken and continued with AirNav Ireland. A radar workshop was held in Dublin with representatives of the Irish Aviation Authority, AirNav Ireland, Shannon Airport Authority and Ballycar Green Energy in February 2024. The purpose of this was to facilitate discussion between radar manufacturers and the representatives present from the IAA, AirNav Ireland and Shannon Airport. The workshop did not specifically relate to the proposed Ballycar Wind Farm development. Over the course of the workshop, a representative from AirNav Ireland introduced the topic of the Proposed Development and potential impacts on the Woodcock Hill radar. The information presented was in relation to the potential impacts to "En-route" airspace and had not been referenced in any previous consultation with the IAA/AirNav between dates of January 2022 to January 2024. The IAA/AirNav representative stated that the information presented on potential shadowing impacts of the Proposed Development was "not quantified". It was also stated that they are in the process of upgrading all Thales radar equipment in the State within the next 2 – 5 years which would allow for optimisations and implementation of the Thales Windfarm Mitigation Filters.

2.3.6 AirNav Ireland Correspondence - February 2024:

Following the workshop, a further letter was received in February 2024 from the AirNav Manager Airspace and Navigation, rescinding the letter of support in principle supplied.

No technical aviation reason was included in relation to the rescinding.

2.3.7 AirNav Ireland Observation – March 2024:

In March 2024 an observation was submitted by IAA/AirNAV Ireland and they highlight their concerns and restate that the proposed development would degrade the performance of the Woodcock Hill Radar. There is no reference to the Mitigations Options study that was prepared by Cyrrus Limited and which shows that there are viable upgrades that can be implemented on the radar equipment.

> The AirNav Ireland Surveillance Domain has analyzed the potential impact on our Surveillance infrastructure of the proposed Ballycar Wind Farm development. Our conclusion is that this proposed Ballycar Wind Farm development would degrade the performance of the Woodcock Hill Radar.
>
> Due to the proximity and scale of the proposed development, there are no credible and implementable mitigations on the Woodcock Hill Radar itself to eliminate the Radar beam deflections, reflections, and shadowing from the proposed turbines. This development would compromise the Woodcock Hill radars compliance with EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in Irish En-Route airspace and 3 Nautical Mile horizontal separation of aircraft in Dublin controlled airspace.
>
> I have engaged in meetings and in a workshop in Dublin on 22 February to explain and illustrate the potential impact of the proposed development on our Woodcock hill radar. As previously presented, the Woodcock Radar region impacted is a sector over 30 degrees wide extending over Ireland and the Irish sea. Much of our En-Route air traffic from Europe and the UK to North America fly through this sector, and much of the Dublin Airport arrivals and departures fly through this sector.
>
> In summary, the AirNav Ireland Surveillance Domain, as part of AirNav Ireland's Technical Services CNS (Communications, Navaids, Surveillance) safeguarding processes will be recommending that AirNav Ireland object to the development of the proposed Windfarm at Ballycar proceeding.

Figure 1: Extract from AirNav Ireland Correspondence, March 2024

2.3.8 IAA/AirNav Meeting, Shannon Airport Head Offices – May 2024:

A meeting was convened with representatives of the IAA Management Surveillance M&E Systems Team and Ballycar Green Energy Limited, as well as from Cyrrus Limited and Ai Bridges Limited. At this meeting a presentation was given by Cyrrus on the shadowing impacts of the Proposed Development on Woodcock Hill Radar. The presentation contained material based on the Response Statement prepared by Cyrrus (shown in Appendix 6 – "AIRNAV Response Statement Ballycar Windfarm")

The IAA/AirNAV confirmed that they had upgraded all of the monopulse secondary surveillance radar equipment in the State to Mode S technology. It was noted that the current air traffic control system was experiencing some tracking issues. Minor optimisation to the Woodcock Hill MSSR to ensure no reflections from the Proposed Development would present an opportunity to analyse and resolve such issues.

It was suggested at this meeting that the issue of aircraft tracking in the vicinity of Dublin Airport was a known issue (Standard Deviation Error) due to a limitation of the radar when max-ranging the radar capabilities. The manufacturer of the Woodcock Hill Radar notes that beyond a certain distance that a standard deviation error applies. This is also stated in the EUROCONTROL Guidelines. This a common issue that is reported by ANSP's whereby if the radar system goes out of alignment, when the radar is max-ranged i.e. beyond a distance of 90NM, the standard deviation error (sometimes up to 10's of meters) can be fed into the multi radar tracking (MRT) system. This would give rise to "error" areas which could cause an issue in the MRT system. Radar systems can be tuned to allow for this known issue of standard deviation error i.e. in the event of certain permanent echoes, the bearings of these echoes will be known and the ATC operators would know if the system goes out of alignment.

At this meeting representatives from Ballycar Green Energy proposed a planning condition whereby the wind farm could not commence until all aviation concerns were fully addressed to the satisfaction of AirNav Ireland.

2.3.9 Email Correspondence between Ballycar Green Energy Ltd and AirNav Ireland – May 2024:

Following the meeting with AirNav representatives in May 2024, email correspondence was issued from Ballycar Green Energy to AirNav Ireland in relation to a planning condition being placed on the project (should planning permission be received) whereby the wind farm could not commence until all aviation concerns were fully addressed to the satisfaction of AirNav Ireland.

An acknowledgment of the request was received from AirNav Ireland who outlined that the request was to be assessed by senior management and the legal team. At the time of writing this Response Statement, a reply in relation this request is outstanding from AirNav Ireland.

2.4 Aviation Assessment Methodology

The methodologies used for the Aviation Assessments are outlined in Appendix 7.

The methodology approach to address the scope of aviation assessments has been supplemented with additional detailed technical assessments and references to demonstrate evidence-based support of the assessment and mitigations measure proposals.

3. Technical Reports

A number of technical reports have been prepared since 2021 that assess risks to aviation safeguarding by the Proposed Development at Ballycar. These include specialist detailed technical assessments of the flight procedures and the communications, navigation and surveillance infrastructure at Shannon International Airport and at Woodcock Hill Radar.

A review of these detailed technical assessments was carried out by Ai Bridges in December 2023 and the findings of these assessments were summarized including reference to mitigation measure required, if any, as well as noting residual impacts where mitigation measures are required. All of these assessments are reviewed in the sections below.

3.1 Instrument Flight Procedures & Air Traffic Control Surveillance Minimum Altitude Charts

In November 2021 Malachy Walsh & Partners engaged Cyrrus Limited to conduct a review of the Instrument Flight Procedure Safeguarding Assessment.

The findings presented by Cyrrus in their IFP Opinion (shown in Appendix 2) in November 2021 concludes that the proposed development would have no impact to the Instrument procedures for Shannon Airport.

As noted in Section 2.3 above, there were extensive engagements with the IAA between January 2022 to May 2022 in relation to the 12-turbine design layout. During the consultation process, the IAA highlighted that there would be no impacts to Instrument Flight Procedures or on the Air Traffic Control Surveillance Minimum Altitude Charts (ATCSMAC).

The Ballycar Wind Farm IFP Opinion Report, in Appendix 2, identifies that the proposed wind farm does not impact the current published procedures at Shannon airport. This is however limited to the ATC Surveillance Minimum Altitude Chart (ATC SMAC). Although a full IFP assessment is normally required to identify an impact, it is normally recommended to submit the opinion report to the IAA Air Service Navigation Provider for consideration as to whether a full assessment is required. Following a review of the IFP Opinion, the IAA deemed that a full IFP Assessment is not required and that there would be a “No Impact” condition on IFP surfaces and therefore, no mitigation is required.

3.1.1 Mitigation Options:

In their IFP Opinion Cyrrus identify that there will be no impact to the existing ATCSMAC Charts for Shannon Airport.

No Mitigations are required.

Aviation Impact Assessment	Mitigation Measure Action	Residual Impact
Instrument Flight Procedures surfaces	No action	None

3.2 NAVAIDS – Flight Inspection Procedures

The Ballycar Wind Farm Impact on ILS Inspection Report, in Appendix 3 shows that there is no impact on the Airport Navigational Aids at Shannon Airport. The IAA requested that an assessment be performed to establish any adverse effect the proposed wind farm may have on flight inspection procedures and profiles associated with the Shannon Airport Runway 24 Instrument Landing System (ILS). This report provides an assessment of the impact of terrain and obstacles on ILS flight inspection procedures. The assessment presented within the report outlines that the flight inspection aircraft flying centreline, part orbit and bottom edge flight profiles associated with the Shannon Airport Runway 24 ILS will remain sufficiently clear of the proposed Ballycar Wind Farm site and therefore there would be no impacts.

3.2.1 Mitigation Options:

The review of the bi-annual calibration flights conducted in 2021 shows no impact to NAVAID Flight Inspection Services.

No Mitigations are required.

Aviation Impact Assessment	Mitigation Measure Action	Residual Impact
Runway 24 ILS Flight Inspection Procedures	No action	None

3.3 IAA Radar Surveillance

The Radar Surveillance Domain at the IAA is responsible for the provision of Surveillance Sensors and Surveillance Data Processing Systems to deliver a current and accurate picture of the air traffic and airport surface traffic to IAA Air Traffic Controllers. The Surveillance Domain is responsible for the provision of Surveillance Sensors and Surveillance Data Processing Systems to deliver a current and accurate picture of the air traffic and airport surface traffic to IAA Air Traffic Controllers, enabling them to safely and efficiently maintain separation. The IAA has nine radar sites strategically placed throughout the country. These sites have new Mode-S radars and three new Solid State Primary Radars at the three state airports.

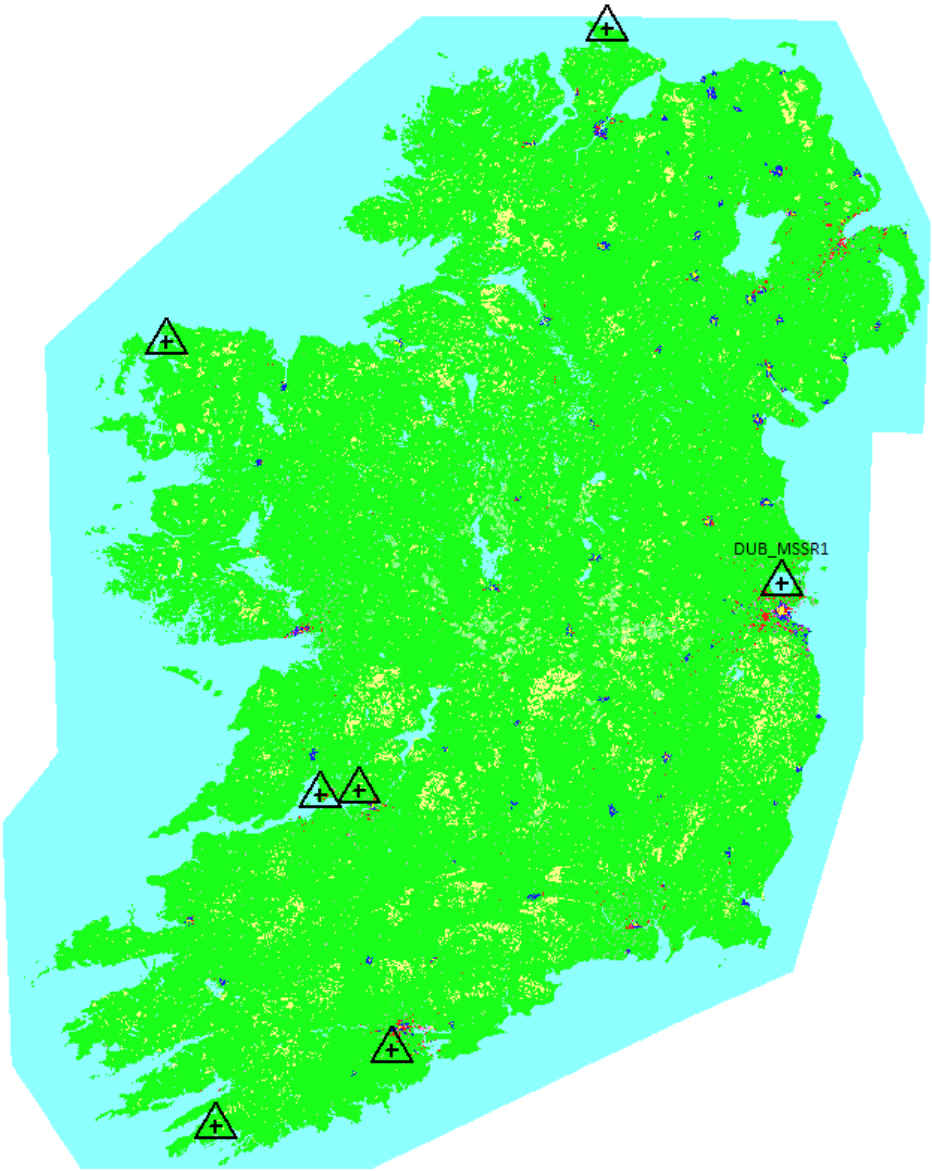

Figure 2: Location of Radars

Figure 3 below outlines the coverage of the radar systems in Ireland and the overlapping coverage. As is evident, there is overlapping radar coverage from multiple radar systems over the location of the proposed Ballycar Wind Farm.

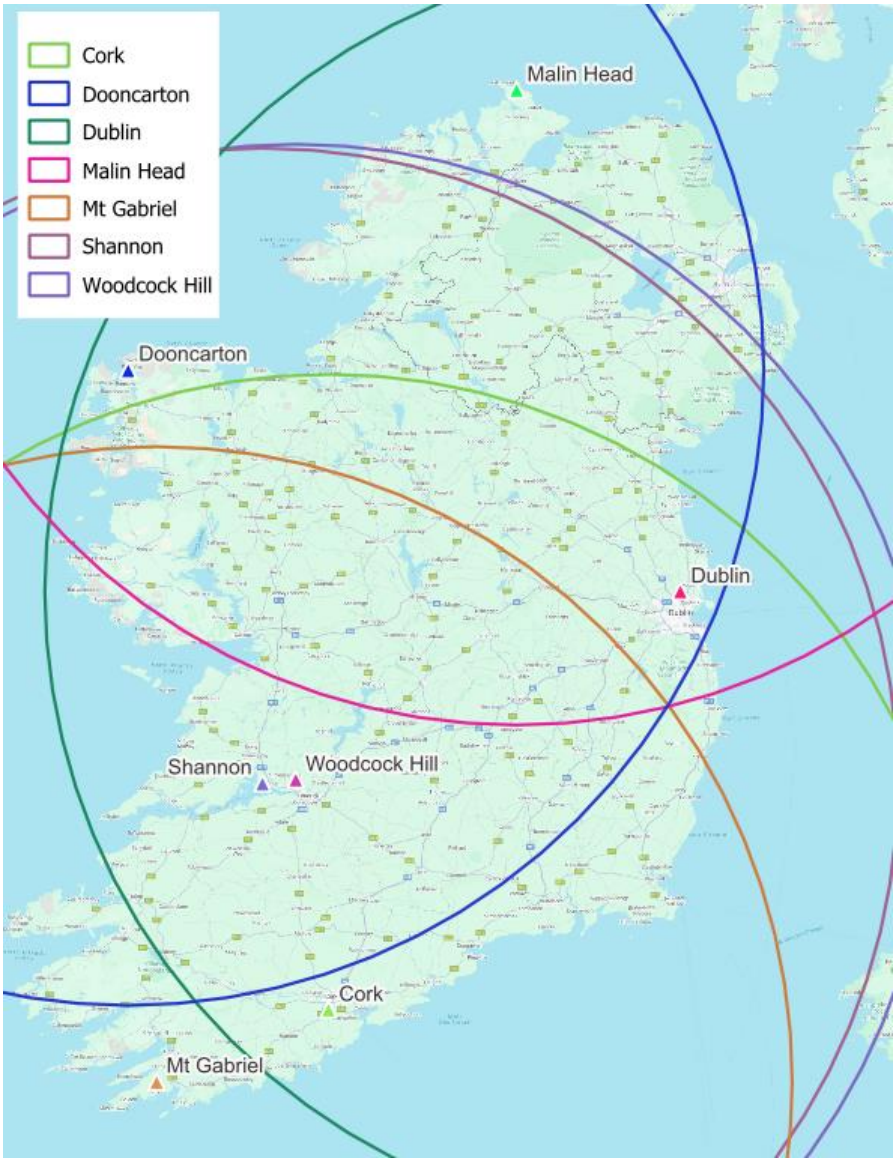

Figure 3: Radar Overlapping Coverage

At these radar sites, there are new Mode-S radars and three new Solid State Primary Radars at the three state airports. Radar coverage of the airspace, for which the Irish Aviation Authority is responsible, is provided from Monopulse Secondary Surveillance Radar (MSSR) Sensors and Primary Surveillance Radar (PSR) Sensors, located at Dublin Airport (two co-located MSSR/PSR), Cork Airport (PSR), Mount Gabriel (two MSSRs), Co. Cork, Shannon Airport (co-located MSSR/PSR), Woodcock Hill (MSSR) Co. Clare, and Dooncarton (MSSR) Co. Mayo. Each MSSR sensor is equipped with a rotating radar antenna, and dual interrogators, receivers, extractors and trackers. Having received aircraft replies, to interrogations from the

radar sensor, the extractors and trackers process the received replies and generate tracks, which are transmitted over data lines to the Air Traffic Control Centres (Shannon, Dublin, Cork). The Shannon En-route ATC receives tracks from the selected Mt. Gabriel MSSR Sensor, Woodcock Hill, Shannon, Dooncarton and the selected Dublin MSSR/PSR Sensor, which are then processed by the Radar Data Processing System (RDPS). The RDPS Multi Radar Tracking (MRT) process generates a single system track output from the combined track inputs. The MRT system track is then sent to the controller's radar display. If an aircraft is transmitting, it is assigned a code and a flight plan exists in the Flight Data Processing System (FDPS) associated with that particular a Code. Then a correlated track containing the aircraft flight identification will be sent to the controller's radar display.

A system area, in nautical miles, is defined in the RDPS. The system area is divided into nautical mile cells with up to three radars, on a priority basis, defined in each cell. The MRT calculates the position of an aircraft based on the input data from each mono radar track.

Radar coverage in the extreme southwest and extreme northwest of Ireland is mostly single radar coverage, while the southwest and northwest has double radar coverage, rising to triple and quadruple coverage to the west and overland. Providing more than single radar coverage, by locating radar sensors with diverse geographic locations, helps to overcome problems of poor single radar coverage, such as screening by hills or mountains, reflections, garbling etc. Garbling ('ghost' aircraft/plots/tracks) is a limitation on the radar system which can occur when data arriving at the SSR sensor from one aircraft overlaps with data from another. This may not be a problem if the overlapping transponder replies can be deconflicted, but when simultaneously arriving data cannot be separated, the SSR data from either or all of the aircraft can be corrupted. Modern monopulse SSR sensors, such as the Woodcock Hill Radar include techniques to minimise the effects of garbling.

The radars deliver full duplicated coverage of AirNav Ireland's airspace to the advanced ARTAS Surveillance Data Processing systems located in Shannon and Dublin Air Traffic Control centres. The ARTAS system is one of the most advanced and successful surveillance data processing systems in the world. The IAA use the ARTAS system for Air Traffic Management Surveillance in Irish Airspace. The system merges the radar data and distributes the appropriate air situation picture to the controllers. In the event of a lack of coverage from one radar, the system automatically uses data from another radar providing overlapping coverage, thereby ensuring an accurate picture to air traffic controllers.

The integration of data in the ARTAS system allows for the application of the 5 NM separation throughout the area covered by the system, 3 NM separation may also be applied. In their submission to the Board, AirNav Ireland reference maintaining these separation distances which the ARTAS system allows for. The IAA operate to the legislative standards set by the European Union Aviation Safety Agency (EASA) and EUROCONTROL. EASA acts as the European regulator of the EU aviation systems, while EUROCONTROL is the pan-European civil

aviation organisation playing a central coordination role. Over the last 25 years, EUROCONTROL has been committed to tackling the fragmentation of the European surveillance systems and has developed a distributed and interoperable surveillance tracker and server. All aviation technical assessments and reviews were carried out against EUROCONTROL GUIDELINES as requested by the IAA/AirNav Ireland.

3.4 Woodcock Hill Monopulse Secondary Surveillance Radar (MSSR)

MSSR 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 MSSR. Range and azimuth information is derived along with additional information to allow the identification of a particular aircraft and its height.

The Woodcock Hill MSSR is a Thales RSM970 which has inbuilt two stage reflection processing to eliminate reflections. The Surveillance Data Processor will mitigate against any reflections, also known as “sporadic” or “dynamic” reflections for buildings, terrain and man-made objects such as wind turbines. The radar is also able to process out deflections which give rise to the common issue of “false returns” i.e. a phenomenon which is experienced by most aviation radars which can be caused by terrain, buildings as well as by wind turbines etc. The correct terminology for these deflections/false returns is False Returns Uncorrelated in Time (FRUIT). The Surveillance Data Processer within the RSM970 at Woodcock Hill is equipped with De-FRUITER to remove these false targets.

3.4.1 Reflections

MSSR radars are 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. 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.

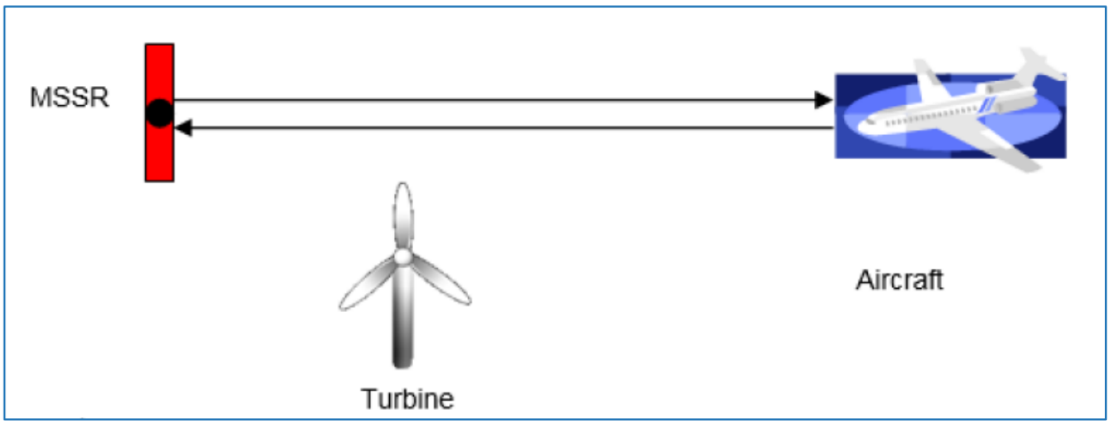

Figure 4: Direct Interrogation and Reply Pulses

In Figure 4, the MSSR 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.

In Figure 5 below, the MSSR 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 and potentially causes 'ghost' targets on MSSR.

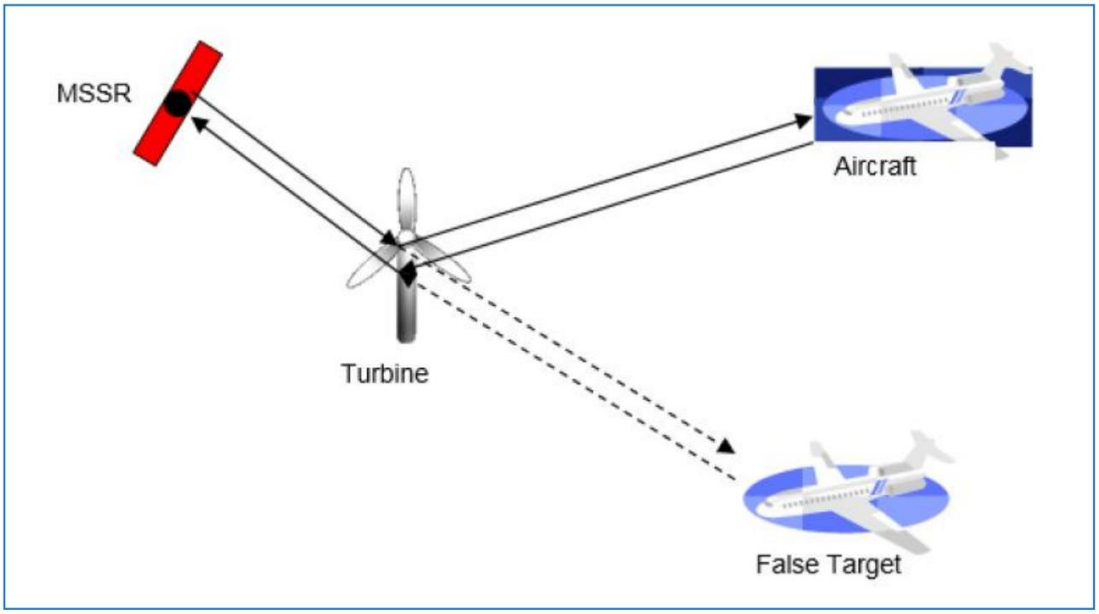

Figure 5: Reflected Interrogation and Reply Pulse

The Thales RSM970 MSSR at Woodcock Hill is sited 2.4km from the nearest wind turbine proposed in the Ballycar wind farm.

As detailed in the Ballycar Wind Farm Aviation Technical Assessment (shown in Appendix 1), the likelihood of bistatic reflections can be determined. The assessment for the Ballycar wind farm, outlines that aircraft between 5,250m and 10,536m from the proposed turbines may respond to reflected MSSR interrogations from Woodcock Hill, potentially resulting in MSSR 'ghost' targets. As outlined in the technical assessment carried out by Cyrrus, aircraft closer than 5,250m will not reply to reflected interrogations and aircraft beyond 10,536m will not detect a reflected signal.

The Woodcock Hill MSSR is a Thales RSM970 which has inbuilt two stage reflection processing to eliminate reflections. The Surveillance Data Processor will mitigate against any reflections, also known as "sporadic" or "dynamic" reflections for buildings, terrain and man-made objects such as wind turbines.

This is referenced in the Thales RSM970 MSSR Technical Description Document (Appendix 8). To prevent possible reflection issues, some minor optimisation of the radar may be required. This is usually carried out as part of the scheduled maintenance of the equipment.

With the implementation of this optimisation, the radar at Woodcock Hill will not experience reflections due to the Ballycar Wind Farm.

3.4.2 Deflections

Deflections occur when a radar interrogation signal is deflected by a structure such as terrain, vegetation, buildings and man-made obstacles such as wind turbines i.e. which introduce an error in the measured bearing of an aircraft. It can generate dual aircraft tracks.

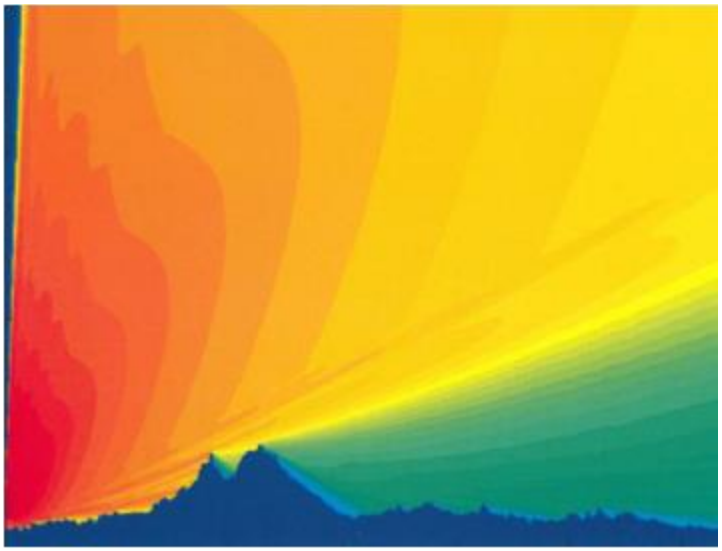

Figure 6: Visualisation of Deflections by Hill/Mountain Range.

The Thales RSM970 MSSR installed at Woodcock Hill uses a well-established processing system to remove deflected targets which are known as False Replies Uncorrelated In Time (FRUIT). The MSSR operated at Woodcock Hill can use one of its own specific inbuilt processing techniques within its Surveillance Data Processor (SDP) to remove these false targets. This process removes the issue of deflections from the system. This is referenced in the Thales RSM970 MSSR Technical Description Document (Appendix 8). No additional optimisation is required as a DEFRUITER is part of the standard MSSR processing on the Thales system.

Therefore, the radar at Woodcock Hill will not experience deflections due to the Ballycar Wind Farm.

3.4.3 Shadowing

Objects can produce a radar shadow in the airspace behind the object. As a wind turbine is narrow compared to the radar beam width, shadows are 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 radar line of sight (RLoS) between the radar and the aircraft target.

EUROCONTROL Guidelines provide equations for calculating the depth, width and height of shadow regions. Table 7 of the Ballycar Wind Farm Aviation Technical Assessment (Appendix 1) outlines the calculated depth, width and height of predicted shadow regions due to the proposed wind farm. The depth of the shadow regions beyond the Ballycar turbines will vary between 2.3km and 3.6km for Woodcock Hill MSSR, with widths of up to 65m and with a maximum height of 352m or 1,155 feet AMSL.

Figure 7: Maximum Shadow Region (2D) Due to Ballycar Wind Farm

In Figure 8 below it is shown that shadowing of radar signals can be caused by terrain (hills/mountains) beyond the wind farm. This is later shown to be the case where there is shadowing caused by the Slieve Bloom range on the radar signal from the Woodcock Hill Radar.

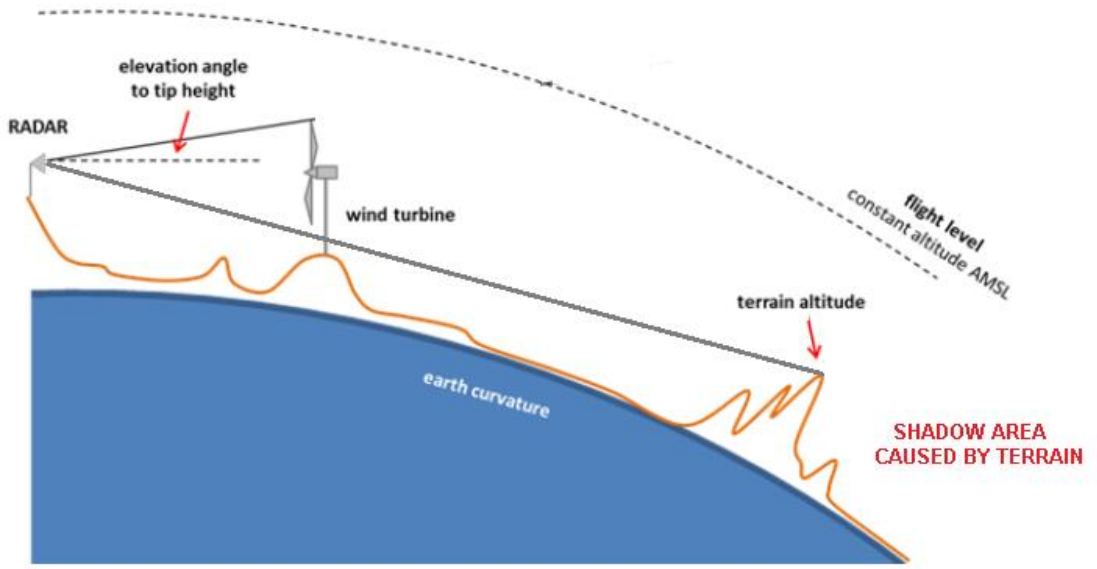

Figure 8: Shadow Region Caused by Terrain beyond Wind Farm

Based on Shannon Airport's ATC Surveillance Minimum Altitude Chart, as published by the Irish Aviation Authority, turbines T1 to T10 of the Ballycar wind farm are within Sector 1 where the minimum flying altitude is 2,300 feet AMSL. Turbines T11 and T12 are in Sector 2 where the minimum altitude is 3,000 feet AMSL. Aircraft at these minimum altitudes will not be low enough for the shadow regions to have any impact, as the calculated worst case shadow will extend to 1,115 feet AMSL.

Therefore, the shadow regions that may be generated beyond the proposed turbines will not extend into airspace where aircraft are flying (see Figure 9 below).

3.4.4 En-route Radar Facilities

As part of the submission by AirNav Ireland to An Bord Pleánala in relation to the Ballycar wind farm, a concern was raised regarding impacts to en-route traffic within Irish airspace due to the degraded performance of the Woodcock Hill radar equipment, as a result of the presence of the Ballycar wind farm.

As detailed in Sections 3.5.1 and 3.5.2 above, the Woodcock Hill MSSR will not experience reflections (with minor optimisation) or deflections due to the Ballycar wind farm and therefore, the performance of the radar equipment will not be degraded. As a result, there will be no impact to en-route traffic within Irish airspace from reflections and deflections or

compromise to the Woodcock Hill MSSR EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in en-route Irish airspace.

As concluded in Section 3.5.3 above, any potential shadows generated from the Ballycar wind farm will be limited to a height of 1,115 feet AMSL. The minimum flying height for en-route traffic through controlled Irish airspace is 7,500 feet. Therefore, there is no possibility for any shadowing impacts from the Ballycar wind farm on En-route traffic, which will not result in any compromise to the Woodcock Hill MSSR EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in En-route airspace. Figure 9 graphically represents this.

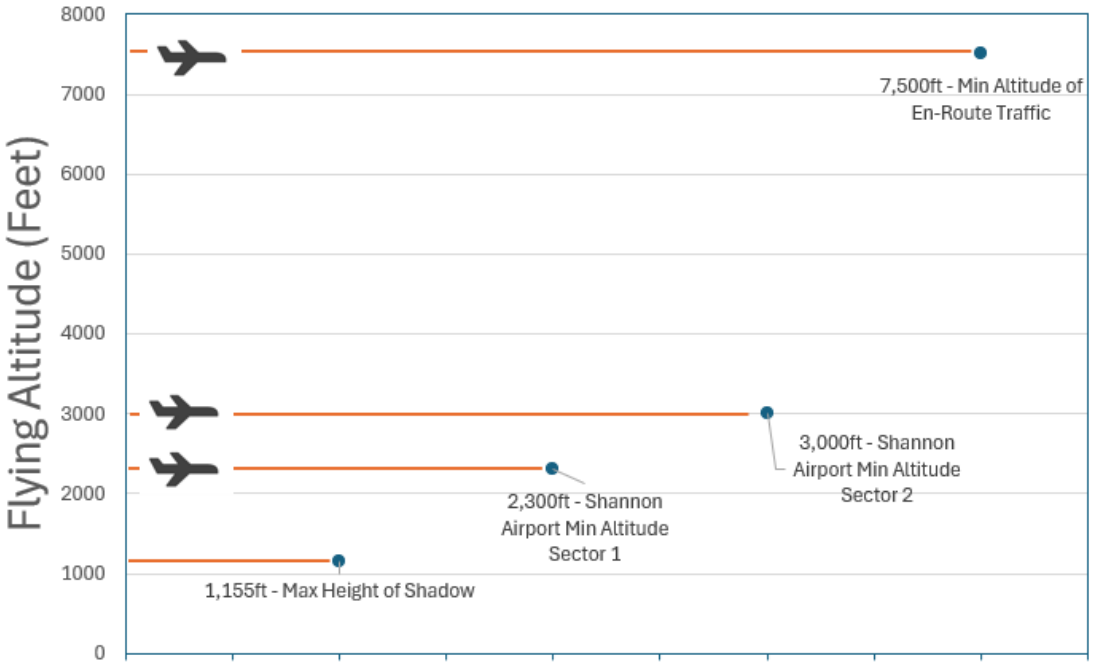

Figure 9: Altitude of Shadow Region and Minimum Flying Altitudes

The Irish Airspace Structure is shown below in Figure 10.

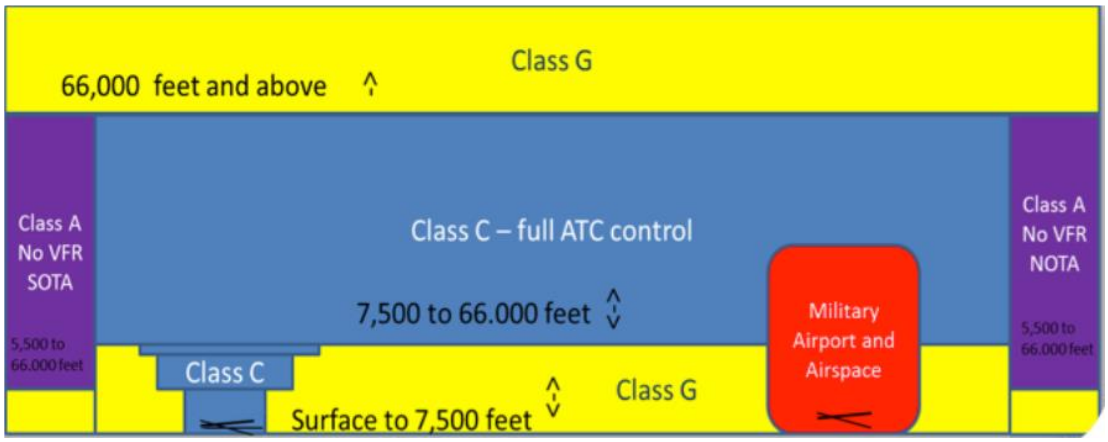

Figure 10: Irish Airspace Structure

At the Radar Workshop Meeting in February 2024, the IAA Surveillance M&E Team presented on the shadowing impact of the proposed development and identified an un-quantified impact area by drawing lines from the Woodcock Hill Radar location bounded by the most northerly and southerly wind turbine locations of the proposed development and separated by an angle of 30 degrees and arbitrarily extending these lines out to the Irish Sea and connecting then with a vertical line. This area cannot be relied upon as an accurate service coverage from the Woodcock Hill radar as there is no consideration given to terrain blocking by the Slieve Bloom mountain range in the midlands and is a manual sketch that should be used for demonstrative purposes only. This conceptual sketch presented by the IAA is shown in Figure 11 below.

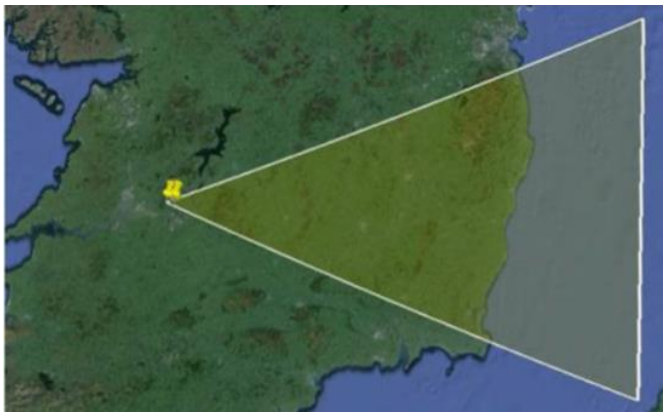

Figure 11: Arbitrary shadowing zone presented by IAA

As previously outlined in Section 3.5.3, the maximum calculated shadow region due to the presence of the Ballycar turbines is 3.6km. Therefore, any shadow region will not extend as demonstrated in Figure 11 and will not impact on Dublin airspace.

Additional analysis from Cyrrus in relation to shadow regions identifies that while there may be some limited shadowing behind the Ballycar wind farm, there will be no shadowing impact to Woodcock Hill Radar Surveillance of En-route aircraft at heights of 7,500 to 35,000ft. Radar Service coverage plots are shown in Figures 12 and 13 below at En-route flight levels of 35,000 ft (FL350) showing no impact.

Figure 12: Woodcock Hill radar service coverage at 35,000ft – without turbines

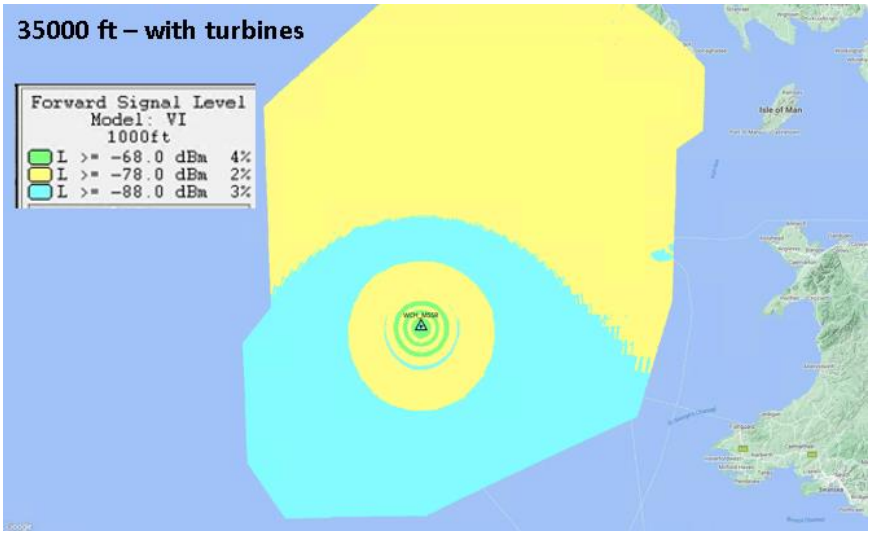

Figure 13: Woodcock Hill radar service coverage at 35,000ft – with turbines

To support this assessment, a reference has been included to field trials that have taken place in the UK to address the minimal shadow region impacts on En-route Radar facilities. This is supported by reference to the UK Civil Aviation Authority (CAA) Safety Policy (shown in

Appendix 6 in section) which addresses the precedent of shadowing and low-level coverage impacts caused by the physical obstruction of wind turbines.

> *"SUR13A.68 Trials have indicated that wind turbines also create a shadow beyond the wind farm so that low flying aircraft flying within this shadow go undetected. The magnified shadows of the turbine blades and the moving rotors are visible on the radar screens of weather and ATC radars. However recent trial measurements have indicated that the shadow region behind the wind turbines would last only a few hundred meters and would hide only very small objects*. "
>
> *"SUR13A.85 Existence of a shadow region means the radar's ability to detect targets directly behind the wind turbines can be affected. Since a shadow region is thought to exist only a few kilometers behind a wind farm and the size is believed to be defined by a straightforward geometric relationship between the radar and the wind turbine farm, only the low level coverage is affected."*

These trials demonstrate and further prove that shadowing is limited and does not extend for significant distances past the wind farm. At the meeting in May 2024 at AirNav Ireland Offices in Shannon, Co. Clare reference to these flight trials conducted by the UK CAA was made to AirNav Ireland.

Also, it should be noted that in Appendix 9 there is a reference by Thales, the manufacturer of the Woodcock Hill Radar, to dedicated flight trials that they have conducted of their Wind Farm Filter in difficult terrain circumstances such as low Radar Cross Section targets, ground targets and low altitudes.

At the meeting with AirNav officials in May 2024, there were a number of points made in relation to the Woodcock Hill radar range and which have been documented and shown in Appendix 6. One of the points made was in relation the cone of silence of the radar. There is an area above ground based radar system that does not track En-route traffic and this is also the case for the Woodcock Hill MSSR. In essence, the radar cannot see above itself and therefore, cannot track aircraft through this area. This is referred to as the conical zone of silence. All radar in the state will have these "non-coverage" areas and this is demonstrated in the graphic below in Figure 14 (for demonstrative purposes only).

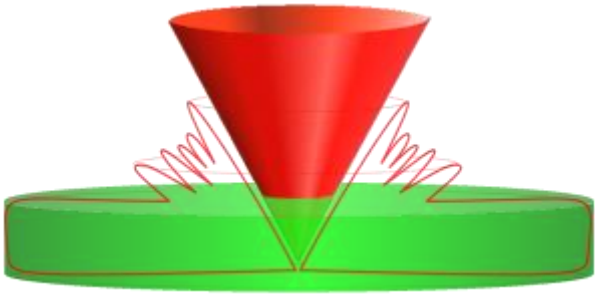

Figure 14: Graphic showing the conical zone of silence over Woodcock Hill Radar

Due to this cone of silence, overlapping radar coverage from multiple radar systems is required to ensure surveillance and tracking of aircraft through this zone. In the event of a failure of a radar in any part of the state there is overlapping coverage from another alternate radar providing identical radar surveillance which all feed into the air traffic control systems. Figure 15 below illustrates the coverage area over Woodcock Hill from various other radars.

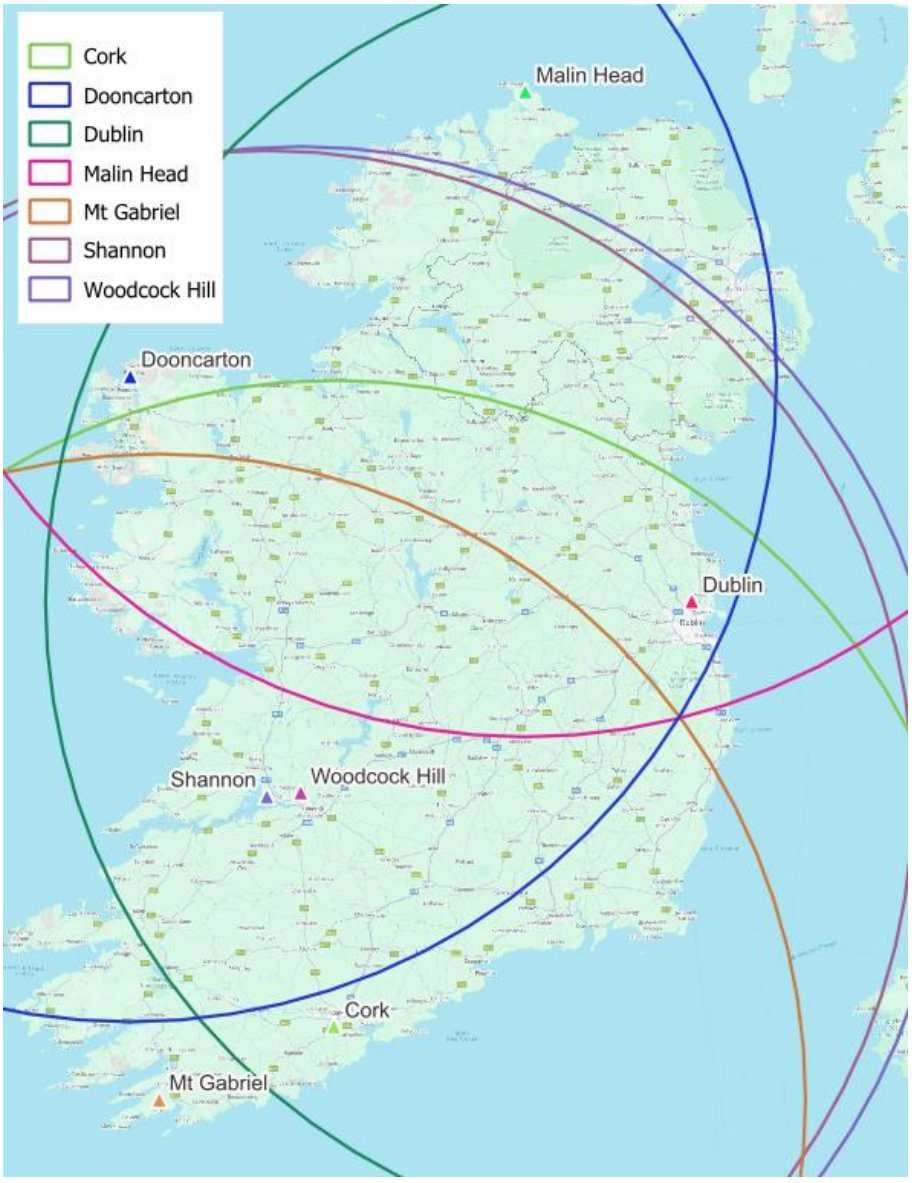

Figure 15: Overlapping Coverage Map shows that there is multi radar tracking capability of the AirNav Radar equipment i.e. if Woodcock Hill MSSR were to fail/undergo maintenance there is overlapping coverage from Dooncarton, Cork Airport, Mt Gabriel

As previously discussed, the ARTAS system used by AirNav Ireland merges the radar data and distributes the appropriate air situation picture to the controllers. Therefore, it has the ability to incorporate data from other radar systems to provide coverage over the cone of silence

over the Woodcock Hill radar. Therefore, using data from other radar systems, the shadow area caused by the Ballycar turbines will have duplicated radar service coverage using the ARTAS multi-radar tracking system.

Due to the curvature of the earth, Air Traffic Controllers usually calculate that for every 10NM from the radar, they would lose approximately 1000ft of cover. As Woodcock Hill is >90NM from Dublin Airport, it is estimated that aircraft below 9000ft would not be detected or controlled in the Dublin CTA using the Woodcock Hill MSSR radar. Therefore, there will be no compromise to compliance with EU mandated surveillance performance criteria required to support 3 nautical mile horizontal separation of aircraft in Dublin airspace.

Figure 16 below outlines the radar signal path from Woodcock Hill to the Dublin Airport Terminal area. As referenced earlier in section 3.4.3 there is terrain blocking due to the Slieve Bloom Mountain range which screens any potentials impacts from the Ballycar wind farm from projecting aircraft tracking issues into the En-route airspace in the vicinity of Dublin Airport.

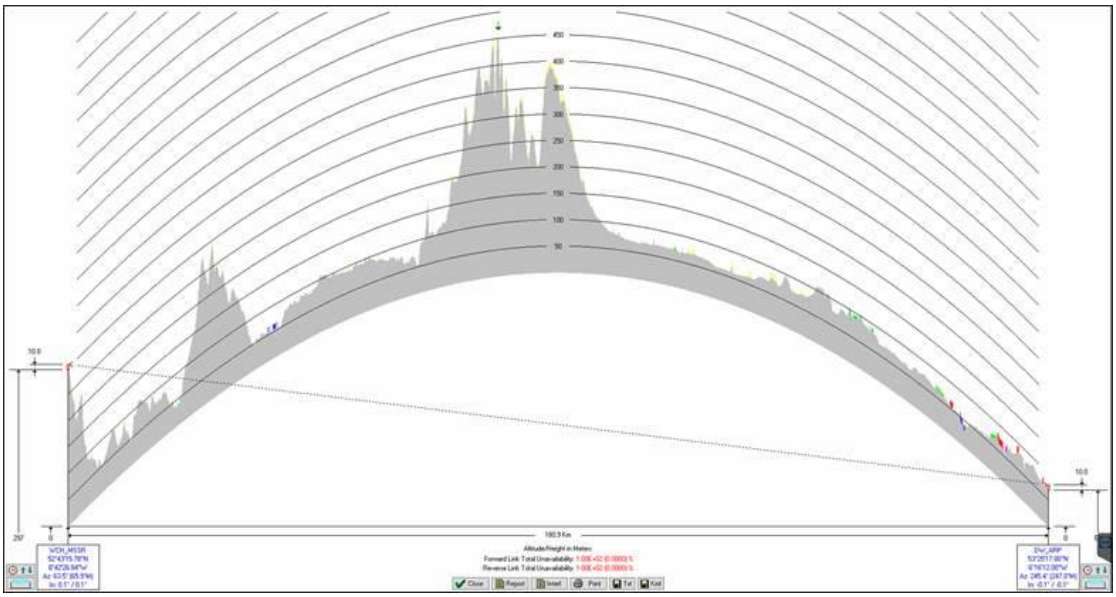

Figure 16: Radar Signal Path from Woodcock Hill – Dublin Airport Terminal Area

4. Mitigation Measures

Cyrrus have conducted their assessment in accordance with the EUROCONTROL Guidelines as requested by the IAA. Based on the detailed technical assessments, the only potential mitigation required to address any concerns in relation to radar facilities relates to the Woodcock Hill Secondary Surveillance Radar. To prevent possible reflection issues, some minor optimisation of the existing radar system may be required. Should the Woodcock Hill Radar require optimisation, this would be completed one channel at a time and allow the system to remain operational throughout. If upgrades or optimisation are required to the Woodcock Hill Radar system, transitional arrangements can be managed to ensure minimal operational disruption occurs. As outlined in this report, there is overlapping radar coverage over the Woodcock Hill radar area, therefore in the event that the radar system was offline for a short period, sufficient coverage can be provided by other radar systems.

4.1 International & National Precedence

The Cyrrus Radar Mitigation Options Study Report, carried out in May 2023, refers to the rationale behind the EUROCONTROL assessment to show:

- that any operational impact caused by the proposed development would be operationally acceptable.
- that a suitable mitigation, if required, can be put in place to ensure continued compliance.

Newcastle Airport: Based on these EUROCONTROL Guidelines the Mitigation Scheme in operational use at Newcastle Airport would demonstrate that wind farm mitigations can be implemented on the current facility at Woodcock Hill. By reference to the published Aeronautical Informational Procedure (AIP) for Newcastle Airport (Appendix 12), it can be seen that there are several wind farms located within the radar's operating volume. The radar is operational and is used to control aircraft within the control airspace.

Project Marshall: The reference to the Project Marshall Radar Upgrade in the UK is a reference to an FOI Request by the UK Wind Industry in relation to the MOD Radar Upgrade Program for Air Traffic Control. The UK Military of Defense (MOD) deployed an upgrade program that incorporated Windfarm Mitigation Filters to their existing radars some of which were the same model and age of the Woodcock Hill Radar. The upgrade list can be seen in Appendix 13. This list shows that a number of radars upgraded were the Thales RSM970S which is the same model as the Woodcock Hill Secondary Radar.

These references demonstrate that the Woodcock Hill Secondary Radar can be upgraded, if required, subject to a conditions survey by the manufacturer of the radar. Cyrrus state in their Radar Mitigations Options Study in Appendix 5 that:

> *" An asset condition survey of the Shannon Airport and Woodcock Hill radar systems should be undertaken by Thales. This will include the current build state.*
>
> *As the manufacturer and Design Authority of both radar systems, Thales will be able to assess the type of mitigation package required (if any). They will confirm costs and timescales based on their scope of work.*

Dutch Government Radar Modelling: The Dutch Government have commissioned detailed radar modelling using Computer Aided Radar Performance Evaluation Tools which involved use of a comprehensive computer program which alleviates the difficult task of designing and evaluating surface based radar systems. The modelling tools considers the entire radar system and its environment, emitter and receiver characteristics, clutter and propagation phenomena. The program produces diagrams which are particularly useful in assessing the detection performance of a radar system.

These radar modelling tools were also used on UK onshore and offshore wind farm projects. The radar impact assessments conducted in relation to the wind farm south of Manchester Airport were able to demonstrate that the shadowing impacts of the wind farm where blocked/screened by the mountain range further south of the wind farm i.e. all shadowing impacts were blocked.

4.2 UK Aviation Plan – Wind Turbines and Aviation Radar

The Newcastle Airport reference site (as attached in Appendix 12) demonstrates how the Radar facilities, same model as is used at Woodcock Hill, was upgraded as part of the implementation of a viable wind farm mitigation solution. Newcastle Airport has a Thales STAR2000 with a co-mounted Thales RSM970 Secondary Radar, the same Secondary Surveillance Radar model that is used at Woodcock Hill.

The Project Marshall reference (as attached in Appendix 13), undertaken by the Military of Defense (MOD) is an example of a Radar Facilities project that included an upgrade and deployment to the Thales RSM970S radars, the same model of the Radar at Woodcock Hill. The Marshall Project consists of over forty Military of Defense (MOD) Radar installations.

From 2005 until 2011 Newcastle airport received over 250 consultations for on and off-shore wind farm developments from across the UK North-East region, all aiming to meet government-set targets for renewable energy. Many of the developments had the potential to affect the daily operations of Newcastle Airport's Air Traffic Control since wind turbines in operation can appear on the airport radar with similar markings to a moving aircraft.

In the absence of a solution, in the past, Newcastle Airport stated that they had no alternative but to object to proposed wind farm developments where an unacceptable impact was predicted. However, following a detailed engagement process with all stakeholders Newcastle Airport were satisfied a technological solution was found in the form of radar optimisation, which involved updating the airport's radar software system. The software upgrade mitigated the potential impact of the wind farm sites, thereby preventing turbines appearing, so they could not be mistaken for moving aircraft. The Thales Windfarm filter incorporates this feature.

In the UK, Renewable UK has been working with the Ministry of Defense, Department for Transport, Department for Business, Energy and Industrial Strategy (BEIS), the Scottish Government, the Civil Aviation Authority, NATS, the Airport Operators Association, the General Aviation Awareness Council, and The Crown Estate for many years.

In 2008 in the UK, the DECC, the Dept for Transport, Military Of Deference, Renewable UK, Civil Aviation Authority and National Air Traffic Services signed a Memo Of Understanding which committed them to work together to identify mitigation solutions and drive forward progress on projects as part of an "Aviation Plan". This Plan was endorsed by representatives from the relevant stakeholders within the Aviation Sector.

5. Other Wind Farm Developments in the Area

There are a number of wind farms in East Clare/Limerick at various stages in the planning process, some of which have been consented and single turbine projects which are operational. All of these wind farms are within the EURCONROL 16km Safeguarding Assessment Area for Secondary Surveillance Radar for Woodcock Hill Radar.

An overview of the consented wind farms and wind farms in the planning process in East Clare/Limerick have also been included.

5.1 Consented/Operational Wind Farms Developments in East Clare/Limerick

The Planning References for the Wind Farm(s) in the vicinity of the proposed Ballycar Project are shown in Table 2 below. These wind farms are depicted in Figure 17 which shows the wind farm developments in relation to the Monopulse Secondary Surveillance Radar (MSSR) facilities at Shannon Airport and Woodcock Hill that are in the vicinity of the proposed Ballycar wind farm.

Wind Farm	Planning Status	Planning Reference	Wind Farm Description
Carrownagowan	Consented	https://www.pleanala.ie/en-ie/case/308799	Permitted 19-Turbine Wind Farm (No Impacts on Instrument Flight Procedures or Radar Surveillance Facilities)
Fahy Beg	Consented	https://www.pleanala.ie/en-ie/case/317227	Permitted 8-turbine Wind Farm (No Impacts on Instrument Flight Procedures or Radar Surveillance Facilities)
Lackareagh	Submitted for Planning	https://www.eplanning.ie/ClareCC/AppFileRefDetails/2360219/0	Proposed 7-Turbine Wind Farm (No Impacts on Instrument Flight Procedures or Radar Surveillance Facilities)
Oatfield	Submitted for Planning	https://www.pleanala.ie/en-ie/case/318782	Proposed 11-Turbine Wind Farm In Planning
Knockshanvo	Submitted for Planning	https://www.pleanala.ie/en-ie/case/320705	Proposed 9-Turbine Wind Farm In Planning
Johnson & Johnson	Operational	https://www.eplanning.ie/LimerickCCC/AppFileRefDetails/13746/0	1-Turbine Wind Farm
Limerick Blow Mounding	Operational	https://www.eplanning.ie/ClareCC/AppFileRefDetails/22254/0	1-Turbine Wind Farm

Table 2: East Clare/Limerick Wind Farm Planning Reference

Both the **Carrownagowan** and **Fahybeg** wind farms have been permitted. Both wind farm developments are within 16km of the Woodcock Hill Secondary Surveillance Radar at Woodcock Hill. The IAA, in their consultation response state that all Radar Assessment should be completed to EUROCONTROL Guidelines i.e. any significant obstacle within 16km of the Woodcock Hill Radar may have an impact. The IAA/AirNAV Ireland deemed there to be no impact from both wind farm developments on En-route Radar.

No adverse impacts to En-route Secondary Surveillance Radar facilities at Woodcock Hill were noted by the IAA/AirNav Ireland for either the Carrownagowan or Fahybeg wind farms even though both were inside the 16km exclusion zone. The Radar Safeguarding Assessments for both projects were conducted according to EURCONTROL guidelines and the IAA deemed there to be no adverse impact to the Woodcock Hill Radar.

The **Lackareagh** wind farm development has been submitted for planning and no adverse impacts to En-route Secondary Surveillance Radar facilities at Woodcock Hill have been identified by AirNav Ireland. The Lackareagh wind farm development is also inside the 16km assessment zone. The Radar Safeguarding Assessments was conducted according to EURCONTROL guidelines and the IAA deemed there to be no adverse impact to the Woodcock Hill Radar.

It should also be noted that there are single wind turbine developments at **Johnson & Jonshson** and **Limerick Blow Moulding**, both of which are operational and within the EUROCONTROL 16km zone with no operational impacts on the Woodcock Hill Radar En-route Facilities.

The **Oatfield** and **Knockshanvo** wind farms are currently in the planning process. In the concern raised by the IAA/AirNav Ireland regarding Radar Surveillance Systems Safeguarding, the developers state that there are suitable mitigations and optimisations available to mitigate out any impacts. These are included the respective Aviation Review Statements, available online for review. Both developers of the Oatfield and Knockshanvo Wind Farms have commissioned specialist detailed Technical Aviation Assessments that show that there will be no impacts to the Woodcock Hill Radar En-route Facilities.

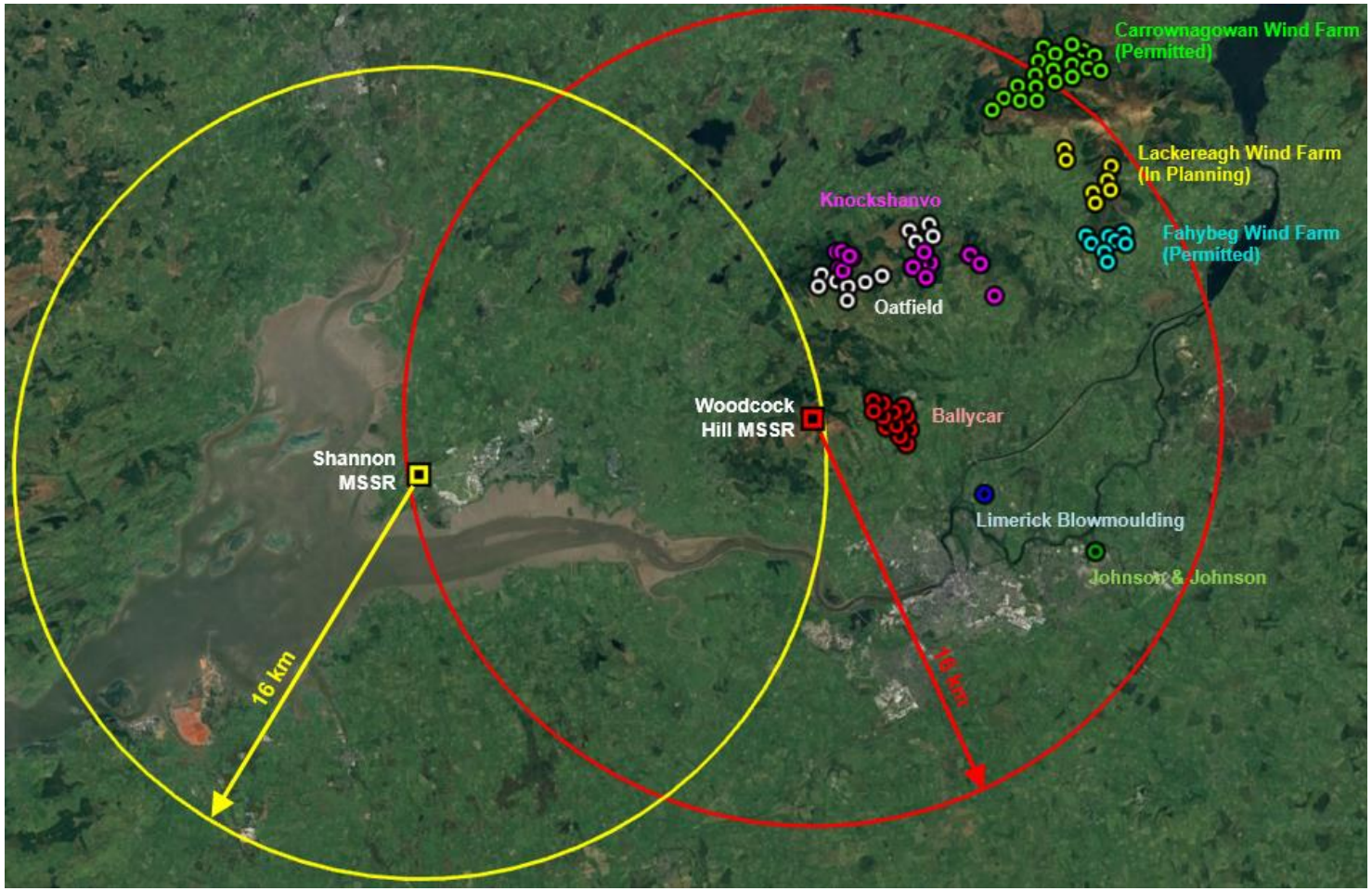

Figure 18: East Clare/Limerick Wind Farm Developments

6. Residual Impacts

During the engagements with the IAA in 2022, they state that Instrument Flight Procedures will not be impacted. It has been identified that there will be no impact to the existing ATCSMAC Charts for Shannon Airport.

The assessment completed by FCSL (Appendix 3) showed that there would be no adverse effect from the proposed wind farm on the flight inspection procedures on the Shannon Airport Instrument Landing Systems.

The Radar Mitigations Options Study carried out by Cyrrus shows that some shadowing will occur. It was considered any shadowing would be minimal, would be below minimum flying altitudes and would not have an impact on flights in En-route airspace. Once the wind farm is built, the radar systems may require optimisation by the Radar manufacturer (Thales) and a flight check may be required to confirm the systems performance according to the industry standard Eurocontrol Guidelines adopted by the IAA, thus ensuring that the radar performance is to the satisfaction of AirNav Ireland and no residual impacts remain.

The technical reports submitted as part of the planning application and this response statement determine that:

- Reflections – No residual impacts following optimisation if required of the Woodcock Hill MSSR.
- Deflections – No residual impacts on the Woodcock Hill MSSR as a result of the in-built DEFRUITER.
- Shadowing – Minimal and operationally tolerable shadow region which is below the minimal flying altitude.
- En-route traffic – No residual impacts.

7. Conclusions

The IAA/AirNav have not raised any concerns in relation to Instrument Flight Procedures against the Ballycar wind farm. It is not considered that any cumulative aviation impacts occur from the Ballycar wind farm and the other proposed/operational wind farms in the area on the Woodcock Hill MSSR because:

- Ballycar Wind Farm will not result in radar beam deflections on the Woodcock Hill Radar.
- Ballycar Wind Farm will not result in radar beam reflections (following optimisation if required) on the Woodcock Hill Radar.
- Shadowing from the Ballycar Wind Farm will extend for a maximum of 3.6km beyond the wind farm, with the height of the shadow region below minimum flying altitudes.
- Ballycar Wind Farm will not result in any impacts to en-route aircraft and will not impact Woodcock Hill Radar compliance with EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in En-Route Irish airspace and 3 Nautical Mile horizontal separation of aircraft in Dublin airspace.

A concluding statement for each of the issues identified by the IAA/AirNav as areas for further analysis including Assessment Outcomes and Mitigations is provided below.

- Instrument Flight Procedures and ATCSMAC at Shannon Airport.
- Navigational Aids at Shannon Airport.
- Secondary Surveillance Radar (MSSR) at Woodcock Hill.

Issues	Areas for Further Analysis	Assessment Outcomes \ Mitigations	Residual Impact
IFP's \ ATCSMAC Charts Shannon Airport	IFP's	No issue reported by IAA\AirNav Ireland.	None
	ATCSMAC Chart	No issue reported by IAA\AirNav Ireland.	
NAVAIDS at Shannon Airport.	Flight Inspection Procedures	The assessment completed by FCSL showed that there would be no adverse effect from the proposed wind farm on the flight inspection procedures on the Shannon Airport Instrument Landing Systems. No issue reported by IAA\AirNav Ireland or Shannon Airport.	None
MSSR at Woodcock Hill	Reflections	The Thales RSM970 MSSR sited at Woodcock Hill is 2.4 km from the nearest wind turbine. The Thales radar utilizes a two-stage system to prevent both temporary (Dynamic) and permanent (Static) reflections being displayed. It also has inbuilt adaptive reflection processing. This is referenced in The Thales RSM970 MSSR Technical Description Document (Appendix 8). To prevent possible reflection issues, some minor optimisations may be required. The IAA/AirNav have scheduled an upgrade in the next two to five years of all the radar surveillance equipment in the state.	None

		Upgrades can be carried out to include updates to the two-stage system within MSSR to prevent reflections being displayed. This would be confirmed as part of an asset conductions survey by the Radar Manufacturer (Thales).	
	Deflections	The Thales RSM970 MSSR at Woodcock Hill uses a well-established processing system to remove any False Replies Uncorrelated In Time (FRUIT). This process removes the issue of deflections from the system. No additional optimisation is required as a DEFRUITER is part of the standard MSSR processing on the Thales system.	
	Shadowing	Due to the proximity of the turbines to the Woodcock Hill radar, some shadowing will occur. It was considered any shadowing would be minimal as outlined (section 3.4.3), will be below the minimum flying altitude and would not have an impact on flights in En-route airspace.	
	En-Route	The Woodcock Hill MSSR will not experience reflections or deflections due to the Ballycar wind farm and therefore, the performance of the radar equipment will not be degraded. As a result, there will be no impact to en-route traffic within Irish airspace from reflections and deflections or compromise to the Woodcock Hill MSSR EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in en-route Irish airspace. Any potential shadows generated from the Ballycar wind farm will be limited to a height of 1,115 feet AMSL. The minimum flying height for en-route traffic through Irish airspace is 7,500 feet. Therefore, there is no possibility for any shadowing impacts from the Ballycar wind farm on en-route traffic, which will not result in any compromise to the Woodcock Hill MSSR EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in en-route Irish airspace.	

It should also be noted that as previously discussed, the ARTAS system used by AirNav Ireland merges the radar data and distributes the appropriate air situation picture to the air traffic controllers. Therefore, there is duplication of radar tracking over the Woodcock Hill radar using coverage from other radar systems to provide a picture to air traffic controllers. Therefore, using data from other radar systems, the shadow area caused by the Ballycar turbines will have duplicated radar service coverage using the ARTAS multi-radar tracking system.

Following submission of the planning application for the Ballycar wind farm to An Bord Pleanála, further additional consultation was undertaken/continued with AirNav Ireland. As part of this continued consultation, a planning condition was proposed whereby the wind farm could not commence (should planning permission be received) until all aviation concerns were fully addressed to the satisfaction of AirNav Ireland.

An acknowledgment of the request was received from AirNav Ireland who outlined that the request was to be assessed by senior management and the legal team. At the time of writing this Response Statement, a reply in relation this request is outstanding from AirNav Ireland.

As such, the Applicant is amenable to the Board inserting a planning condition regarding agreement with AirNav Ireland upon the optimisation of Woodcock Hill radar equipment to be undertaken and its financing prior to commencement of the Proposed Development. For example:

> *"Prior to the commencement of development, and following consultations with AirNav Ireland, a detailed aviation mitigation plan which incorporates the commitments set out in the aviation technical report submitted as further information, including details of any required minor optimisations of the Woodcock Hill Radar and the developer's financial contribution for same, shall be submitted to, and agreed in writing with, the relevant planning authority."*

The applicant also notes that in certain circumstances due to the issues involved with the proposed development, that An Bord Pleanála can also decide to convene a limited agenda oral hearing.

At the meeting in May 2024 with AirNav Ireland, reference was made in relation to the flight trials that were conducted by the CAA UK in relation to wind turbine shadowing area (section 3.4.4) (as stated in the CAP 670 documentation). Cyrrus has submitted written requests to the CAA UK to obtain additional information in relation to the flight trials so that this information can be provided to the IAA/AirNav Ireland. A response from the CAA UK has not yet been received at the time of writing of this Response Statement.

Additional contact, through the offices of Cyrrus has been made directly to technical representatives from NATS and the UK CAA, both of whom have extensive knowledge of radar operations in the vicinity of wind farms. The nominated representatives from NATS and the UK CAA have confirmed that they would be available to engage directly with the IAA/AirNav Ireland. This would bring to bear the extensive working knowledge of Radar Surveillance Management and Policy adopted by the UK CAA in addressing operating radar systems in proximity to wind farms in the UK.

This Aviation Response Statement and associated appendices confirms that:

- Ballycar Wind Farm will not result in radar beam deflections on the Woodcock Hill Radar.
- Ballycar Wind Farm will not result in radar beam reflections (following optimisation if required) on the Woodcock Hill Radar.
- Shadowing from the Ballycar Wind Farm will extend for a maximum of 3.6km beyond the wind farm, with the height of the shadow region below minimum flying altitudes.

- Ballycar Wind Farm will not result in any impacts to en-route aircraft and will not impact Woodcock Hill Radar compliance with EU mandated surveillance performance criteria required to support 5 Nautical Mile horizontal separation of aircraft in En-Route Irish airspace and 3 Nautical Mile horizontal separation of aircraft in Dublin airspace.