Pennant Walters Ltd

Trecelyn Wind Farm

Draft Environmental Statement

14A: Aviation Report

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Wind Farm Aviation Safeguarding Ltd

Aviation Baseline Assessment

Trecelyn

For

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Reference Documents

A. Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines.
B. CAP 774 UK Flight Information Services.
C. CAP 168 Licensing of Aerodromes
D. CAP 493 Manual of Air Traffic Services Part 1.
E. CAP 670 Air Traffic Services Safety Requirements.
F. CAP 774 UK Flight Information Services
G. CAP 738 Safeguarding of Aerodromes
H. CAP 793 Safe Operating Practices at Unlicensed Aerodromes
I. CAA Policy Statement of Lighting of Onshore Wind Turbine Generators
J. Military Aviation Authority Traffic Management (3000 series) Instructions.
K. Military Aviation Authority Regulatory Article 2330 (Low Flying)
L. UK Military Aeronautical Information Publication (MIL AIP).
M. UK Aeronautical Information Publications (AIP).
N. CAA 1:250,000 and 1:500,000 VFR Charts.

Figures

Tables

Issue

WFAS Ltd been tasked with conducting an assessment of the aviation baseline and any associated radar issues/constraints relating to the construction and operation of a wind turbine generator (WTG) development at Trecelyn to inform the EIA report and in accordance with the consultation criteria specified within this report.

It is a condition of this report that WFAS Ltd cannot, and will not, be held liable for any loss or damage resulting from any use of the information contained herein. Whilst all reasonable endeavours have been made to ensure the accuracy of the content of this report its accuracy is not warranted. The commissioning party agrees to indemnify and hold the author and associates harmless against any losses arising from any use or misuse of the information contained within the document.

Introduction

The development of wind turbines has the potential to cause a variety of adverse effects on aviation during turbine operation. These include (but are not limited to): physical obstructions, the generation of unwanted returns on Primary Surveillance Radar (PSR) and adverse effects on the overall performance of Communications, Navigation and Surveillance (CNS) equipment. A full aviation assessment of the Proposed Development will be undertaken to identify and assess the likely aviation issues associated with the Norfolk Farm wind turbine development.

Since there are many issues that need to be considered when assessing the potential impact of proposed developments, the local Air Navigation and Air Traffic Services Providers are best placed to provide expert interpretation of what those impacts might be and how they might affect safety, efficiency and flexibility of their operations. There is a well-established regulatory and policy framework that has been in force for a number of years, but which has been the subject of constant amendment and updating and there are a number of regulatory and guidance documents that have been taken into account and complied with in the preparation of this assessment.

Where there is line of sight between turbines and air traffic control radars it is possible that the turbines may be detected by the radar, dependant on atmospheric conditions, and appear as clutter on the controllers' screens; such clutter can have a direct operational impact on air traffic control operations. Similarly, turbines when constructed can act as a physical obstruction either to aviation operations at aerodromes in the vicinity of the development or aircraft transiting the area.

Taken collectively the reference and guidance sources establish that:

- Officially safeguarded aerodromes and aerodromes with a surveillance radar facility need to be consulted if the proposed wind turbines are within 30km;
- Within airspace coincidental with any published Instrument Flight Procedure (IFP) to take into account the aerodrome's requirement to protect its IFPs;
- Consultation with the operators of officially safeguarded technical sites is required if the proposed wind turbines are within 10km;
- Further assessment and/or consultation will be required if turbines are planned within:
  - 17km of a licensed aerodrome within a runway of 1100m or more;
  - 5km of a licensed aerodrome with a runway of less than 1100m;
  - 4km of an unlicensed aerodrome with a runway of more than 800m; and/or
  - 3km of an unlicensed aerodrome with a runway of less than 800m.

CAP 764 goes on to state that these distances are for guidance purposes only and do not represent the radar/safeguarding range beyond which all wind turbine developments will be approved or within which they will always be objected to. These quoted ranges are intended as a prompt for further discussion between developers and aviation stakeholders.

Ministry of Defence

Furthermore, it is necessary to take into account the aviation and air defence activities of the Ministry of Defence (MoD). The types of issues that will be addressed include:

- Ministry of Defence Airfields
- Ministry of Defence Air Defence Radars
- Ministry of Defence Meteorological Radars

The Ministry of Defence does not stipulate consultation distances for their radars.

National Air Traffic Services Facilities

It will also be necessary to take into account the possible effects of wind turbines upon the National Air Traffic Services (NATS) radar systems – a network of primary and secondary radars and navigation facilities around the country.

The Aviation Environment

The aviation environment in which the proposed site is located as shown in Figures 1 to 3. The site is located underneath some very complex airspace structure and at the confluence of six different control areas (CTAs) relating to the airspace in the area, namely the Cardiff, Bristol, Berry Head, Strumble, Niton and the Cotswold CTAs. In Figure 1 these areas are marked by the thicker blue and purple lines, with Cardiff immediately to the south of the proposed location and adjoining the CTA for Bristol airport. The Cotswold and Strumble CTAs route predominantly east – west whilst the Berry head and Niton sectors route north-south.

To the north and west of Trecelyn there are a series of military Danger Areas (marked with red hashed lines) and training areas associated primarily with RAF Valley in Anglesey (marked with blue diamond lines). There are further military Danger Areas along the south Welsh coast.

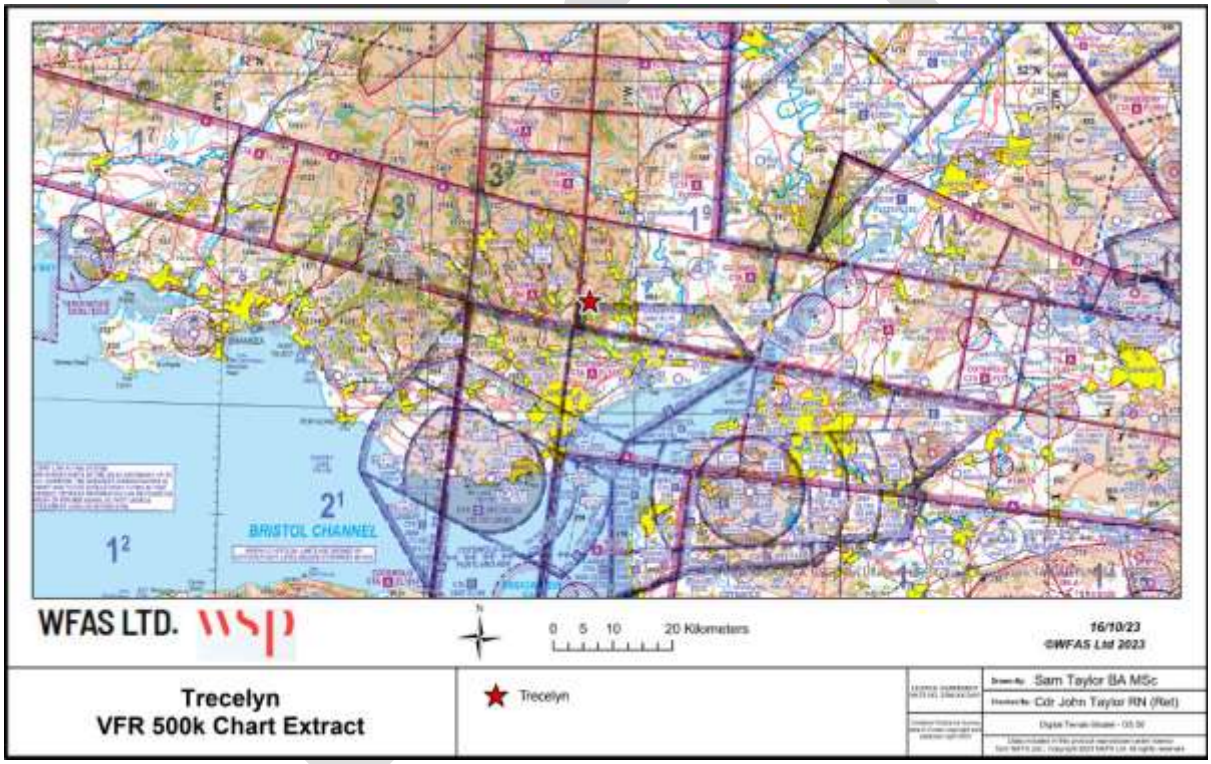

Figure 1 – CAA VFR 1:500,000 Chart extract

To the northwest of Trecelyn a navigational beacon is shown as a grey-blue compass and with arrows pointing to the cardinal points; this is the Brecon VOR/DME navigational beacon and is the navigation point overhead which the CTAs meet. Figure 2 shows this in more detail whilst Figure 3 shows the site position within the wider aviation environment.

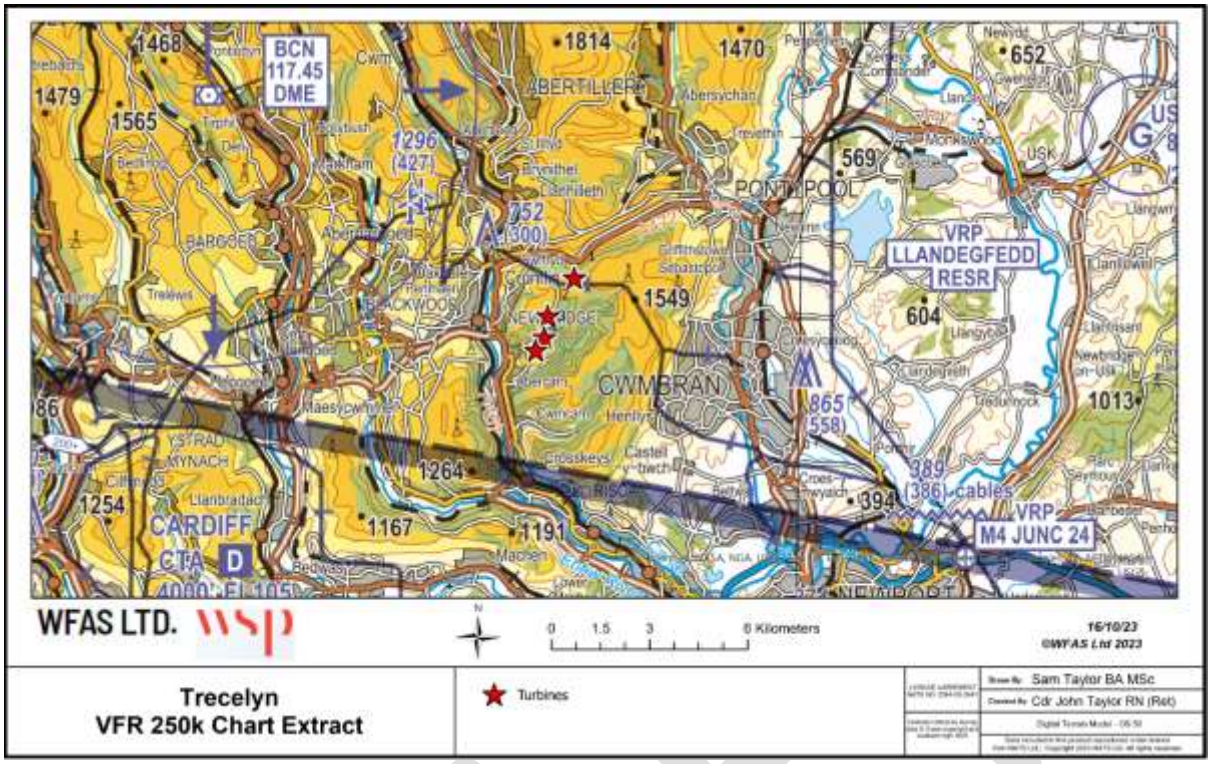

Figure 2 – CAA VFR 1:250,000 Chart extract

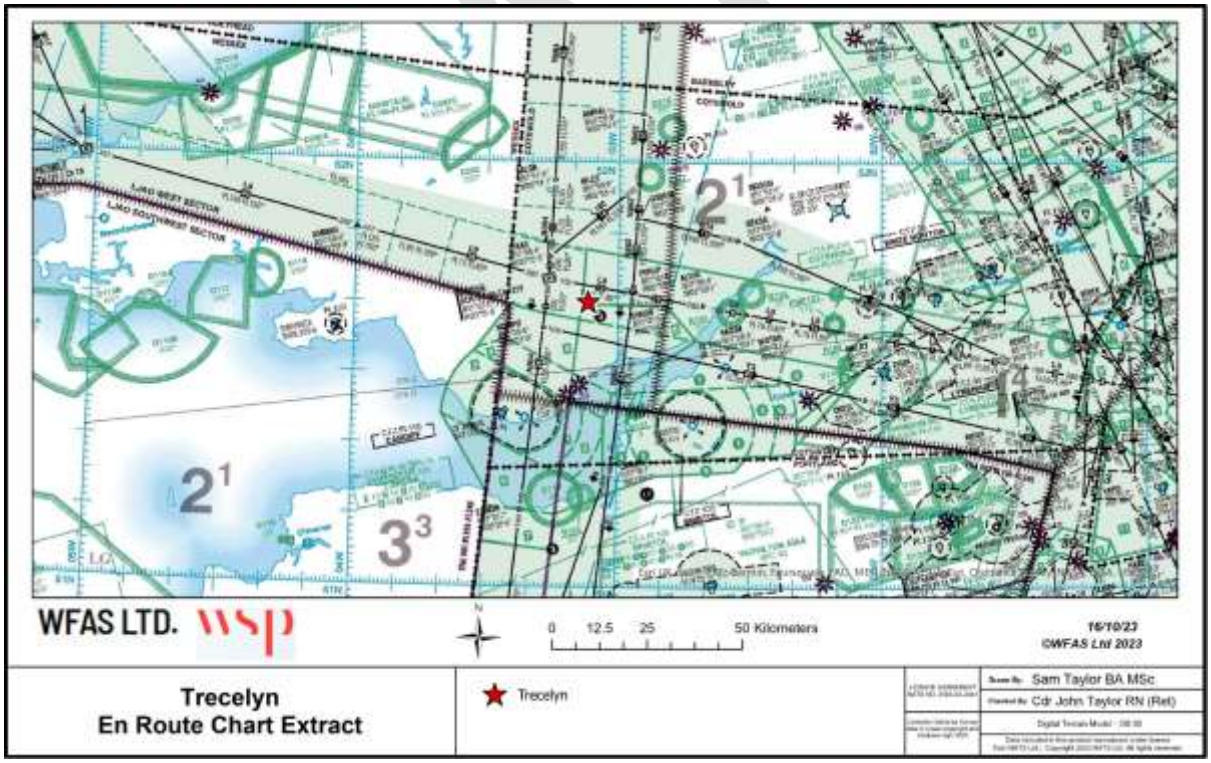

Figure 3 – En Route Chart extract showing airspace over South Wales and the West Midlands

There are no military airfields within the immediate vicinity of the proposed development, the nearest being in Somerset and Shropshire.

Smaller civilian airfields (and there are many) are denoted differently. To the west the airfileds at Pembury and Swansea are shown as very light pink circles edged with purple

dots signifiying the Air Traffic Zone (ATZ) associated with the facility; neither is equipped with radar. To the northeast of Trecelyn is the Glider site at Usk denoted by the letter "G" surrounded by a blue circle; another is shown at Talgarth, to the north.

This about as complicated airspace as it is possible to experience in the UK and all of the military activities and civil airports ensure that this area is extremely busy for a mix of aviation activity.

The Illustrative Turbine Locations

Figure 4 shows the illustrative turbine positions and Table 1 indicates the provided positions used for radar modelling purposes and with the turbines having a suggested tip height of 143m above ground level (agl).

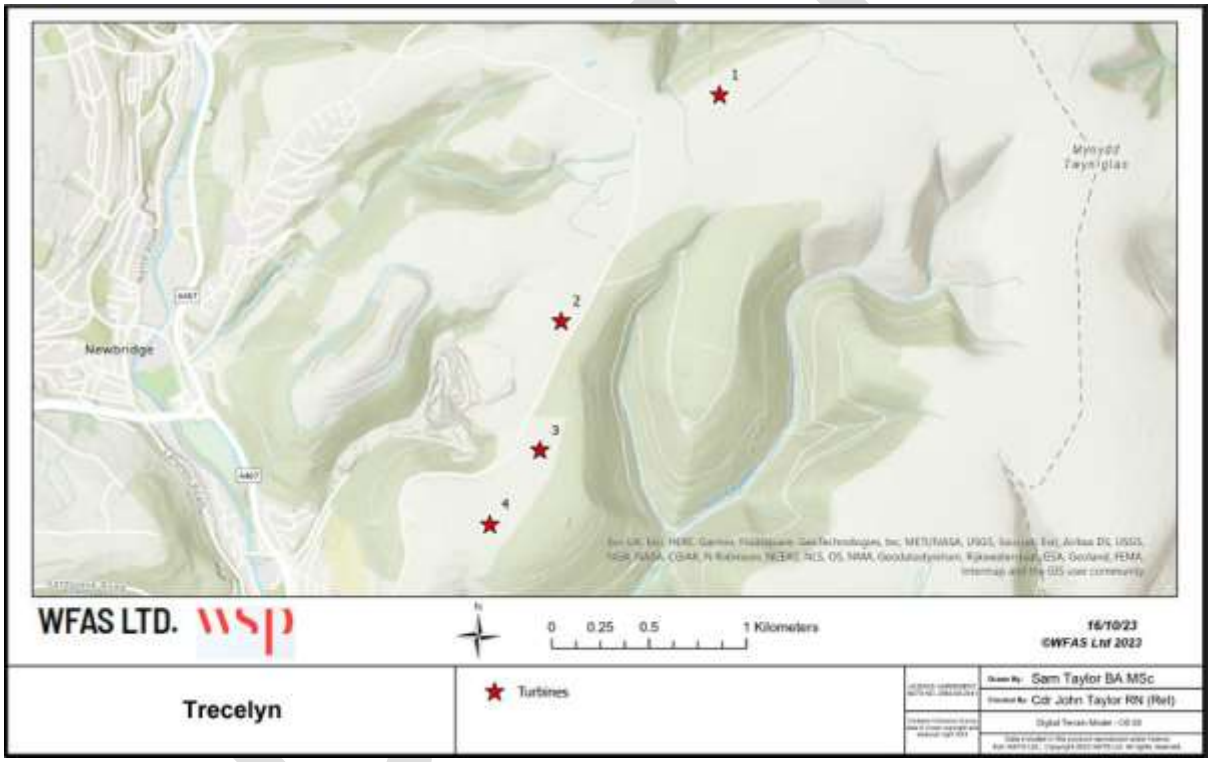

Figure 4 – Ordnance Survey map showing the turbine positions

Turbine	Easting	Northing
T1	324041.801	198159.320
T2	323229.472	196996.926
T3	323120.211	196333.450
T4	322862.602	195952.349

Table 1 – Provided turbine positions

Radar Projection Information

The radar projections shown in this report have been produced using specialist propagation prediction software (RView) which has been designed and refined specifically for the task. RView uses a comprehensive systems database which incorporates the safeguarding criteria for a wide range of radar and radio navigation systems and models terrain using the Ordnance Survey (OS) Landform Panorama digital terrain model, which has a post spacing of 50 metres and has a root mean square (RMS) error of 3 metres. The results are verified using the Shuttle Radar Topography Mission (SRTM) dataset, a separate smoothed digital terrain model with data spacing of 3 arc seconds. By using two separate and independently generated digital terrain models, anomalies are identified and consistent results assured. RView models the refractive effects of the atmosphere on radio waves and the First Fresnel Zone. RView can perform calculations using the true Earth Radius at the midpoint between the radar and the wind turbine or the simplified 4/3 Earth Radius model. If needed, RView is also capable of modelling a range of atmospheric refractive conditions and models the trajectory of radar signals at different elevations permitting the modelling of both volume surveillance and pencil beam radars as well as the effects of angular sterilisation as applied, for example, in Met Office radars.

The radar line of sight illustrations used in this report show the radar on the left and the turbine location on the right. The purple line illustrates radar line of sight (the lowest point at which there will be any radar coverage), the green line shows the terrain. Under some specific circumstances turbines can be located slightly above radar line of sight and still not be visible to the radar due to increased attenuation of the radar signal close to the ground or the shape of the terrain within the first Fresnel Zone for the radar, but as an initial assessment tool, radar line of sight is a very good indicator.

It should also be noted, however, that with some high-powered radars such as those used for air defence, it is also possible for diffraction effects to occur particularly where the 'terrain blocking point' is close to the radar, which can in some circumstances lead to a radar being able to detect a turbine that is just below radar line of sight. Although every care is taken during the line-of-sight modelling and analysis process, modelling limitations and assumptions obviously lead the conclusions in this report to be based on theoretical results. The results are therefore indicative, and actual radar performance may differ from this analysis. Similarly, different Air Navigation Service Providers may use differing terrain data models which might produce slightly different results. Once a site layout has been designed, if radar visibility in marginal situations becomes a key issue, detailed and extensive modelling can be undertaken, usually in cooperation with the aviation consultee to determine the extent of any technical impact on a radar.

For the purposes of radar modelling 143m tip heights were used for the illustration, which in all projections is for Turbine 1, but this height parameter makes no difference to the Line of Sight (LoS) results but is just a value for modelling and for the diagrams of projections.

It should be noted that the radar modelling software used to compile this report does not model against a fixed point in space, namely it does not measure against a fixed tip height. In our opinion modelling on such a basis is misleading in that, for example, such models will show if a 143m tip height is visible to any, each and all of the radars with the operational range over the turbine position but will not indicate if a 142m tip would not be visible. RView measures against a geographical point on the earth's surface and determines the lowest level that any, each and all of the radars with the operational range over that position can detect contacts at both the theoretical base of radar cover and the lowest level of solid radar cover.

Radar LoS varies significantly from position to position depending on the topography between the position and the radar head. In the radar projections below the purple line represents the radar line of sight and originates on the left-hand side at the radar antenna height and radiates towards the right hand side position of the turbine; the green line represents the terrain. Furthermore, when the bottom of the lowest radar beam (Hf0.6magl Fresnel line – the light blue line) is plotted, the base of solid radar cover above the turbine position can be determined; the base of solid radar coverage can be assumed to be where the Fresnel Zone (the bottom radar lobe) intercepts the Free Space line above the turbine.

For assessment purposes assume that the respective radar operators will look at their value for the radar Line of Sight (HLos) which will be below the base of solid radar cover (Hf06) as the basis for any objection. In any subsequent discussion on specific locations the Hf06 figure could be introduced in determining the radar's ability to detect and present the turbine return on the radar screen. Simplistically, it can be viewed as the height when the radar might see it (HLos) and the height when it can be considered that the radar will, in all probability, detect the turbine (Hf06).

The values are measured in metres (m) above ground level (agl); for the turbines not to be visible to the radar the values have to be greater than the turbine tip heights (143m).

Civil Aviation

Cardiff Airport

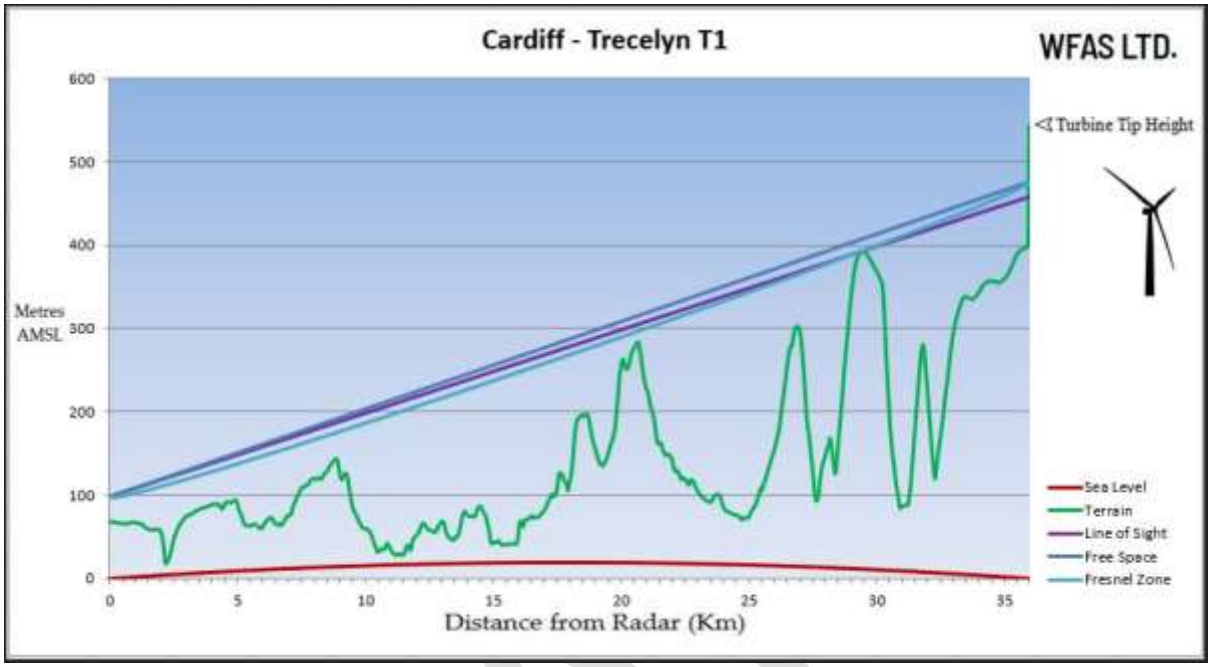

Figure 5 – Line-of-Sight to Cardiff Airport Radar

Technically, and according to stipulated guidance, it could be considered that Cardiff is outside the required consultation distance. However, given the complexity of the airspace above the location, and the number of airport flight profiles/procedures that will use that Breacon VOR/DME, you should expect that Cardiff will be consulted either through their own airport operating authority or through NATS who provide the ATC services. Cardiff Airport is routinely consulted by planning officers and they usually adopt a stance of objecting if the turbines show on their radar.

Radar modelling has been undertaken with the following results:

Turbine	Tdkm	Hf06magl	Hlosmagl
1	36.009	75.8	58.3
2	34.596	105.7	90.5
3	33.967	104.5	90.2
4	33.508	103.3	89.8

Table 2 – Cardiff Airport Radar Line-of-Sight values

All of the turbines will show on the Cardiff Airport Radar.

Under some circumstances the rotating blades of a wind turbine can mimic the radar signature which the radar is designed to detect and the resultant returns appear on the radar screen as areas of radar returns or “clutter”. Where turbines create radar ‘clutter’, controllers cannot always distinguish turbine returns from aircraft.

Bristol International Airport

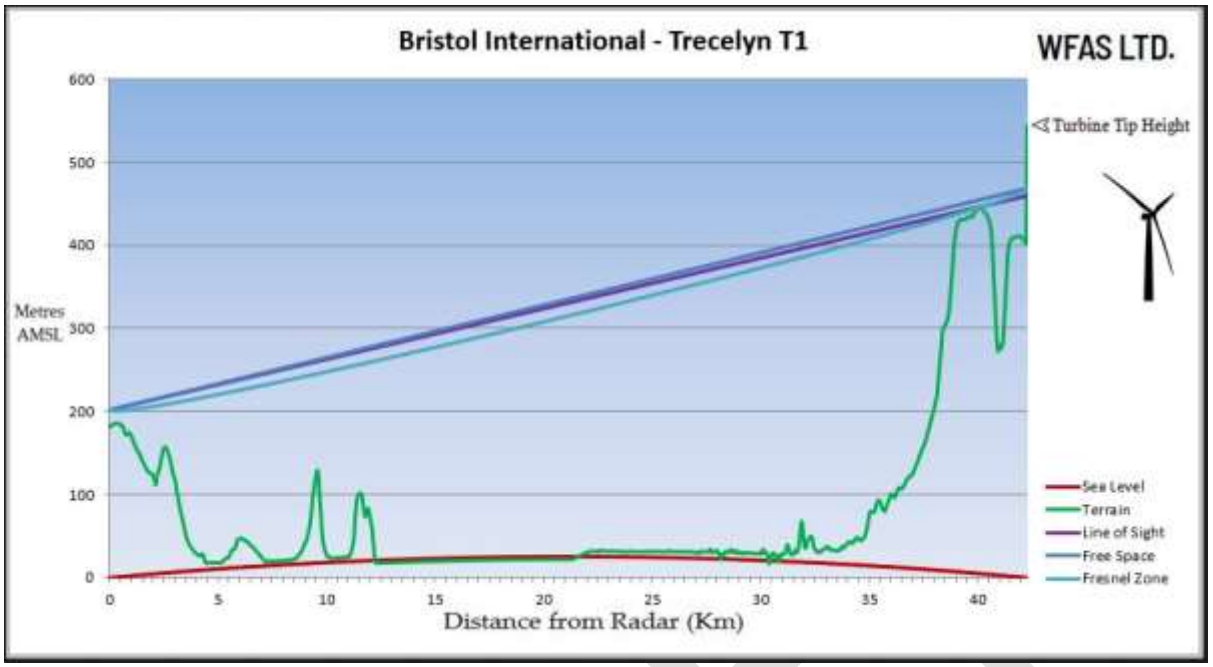

Figure 6 – Line-of-Sight to Bristol International Airport Radar

Just as with Cardiff, technically it could be considered that Bristol is outside the required consultation distance. However, the same conditions will apply given the complexity of the airspace above the location and the traffic routing through that. NATS also provide the ATC services to Bristol and, as NATS will know about this proposal, you should expect that Bristol international Airport will be consulted. As at Cardiff, the airport authorities are routinely consulted by planning officers and they usually adopt a stance of objecting if the turbines show on their radar.

Radar modelling has been undertaken with the following results:

Turbine	Tdkm	Hf06magl	Hlosmagl
1	42.315	68.7	59.1
2	41.923	83	74
3	41.487	82.2	73.6
4	41.367	74.3	65.4

Table 3 – Bristol International Airport Radar Line-of-Sight values

All of the turbines will show on the Bristol International Airport Radar.

NATS – Clee Hill

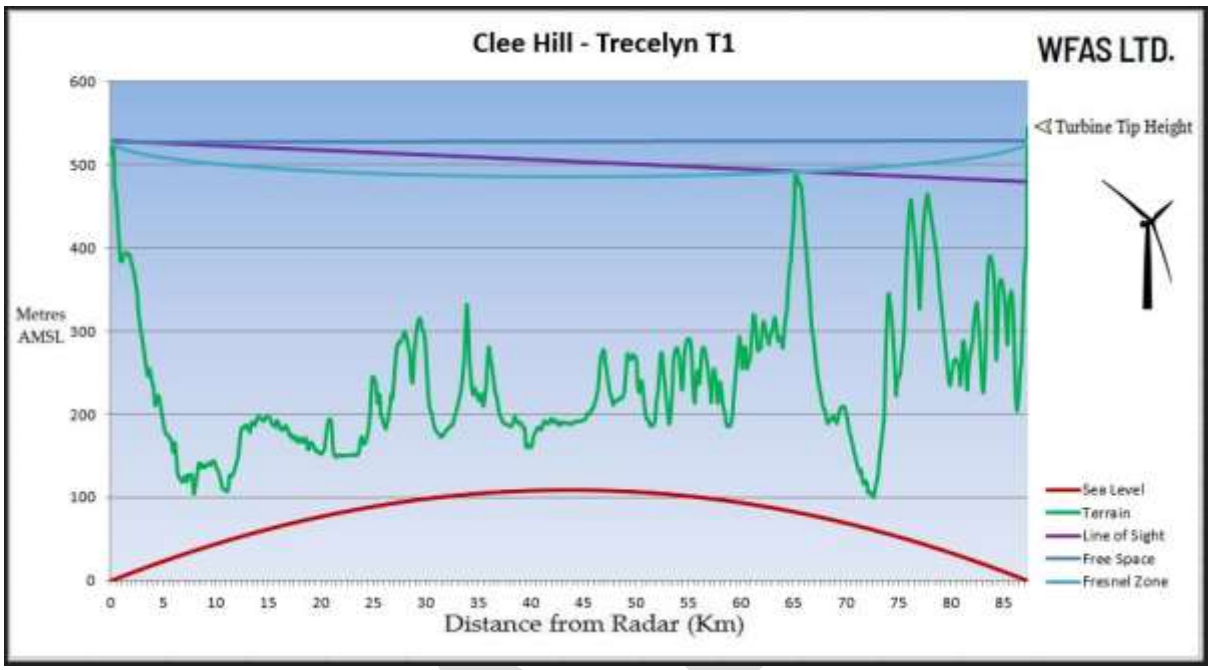

Figure 7 – Line-of-Sight to NATS Clee Hill Radar

Radar modelling has been undertaken with the following results:

Turbine	Tdkm	Hf06magl	Hlosmagl
1	87.318	128.4	78.2
2	88.71	168.2	132.9
3	89.361	166.9	130.6
4	89.814	181.0	144.0

Table 4 – Clee Hill Radar Line-of-Sight values

NATS is a Statutory Consultee and will consider these results (along with those from Cardiff and Bristol) and you should expect a further objection.

Furthermore, the position within Wales in respect of NATS approach to turbine applications has been subject to a recent change. Sites that would previously not have received an objection have been assessed differently and resulting in an unexpected NATS stance of objection. Based on results for other proposed developments we consider that they are adding in a further assessment now taking into account the fact that the Clee radar is actually about 200 metres to the east of the summit of Titterstone Clee Hill and that the summit is the only blocking point for the radar. To account for the amount of energy that could be flowing round the summit and may be reaching the radar head we model an additional point, Clee Hill West.

NATS – Clee Hill West

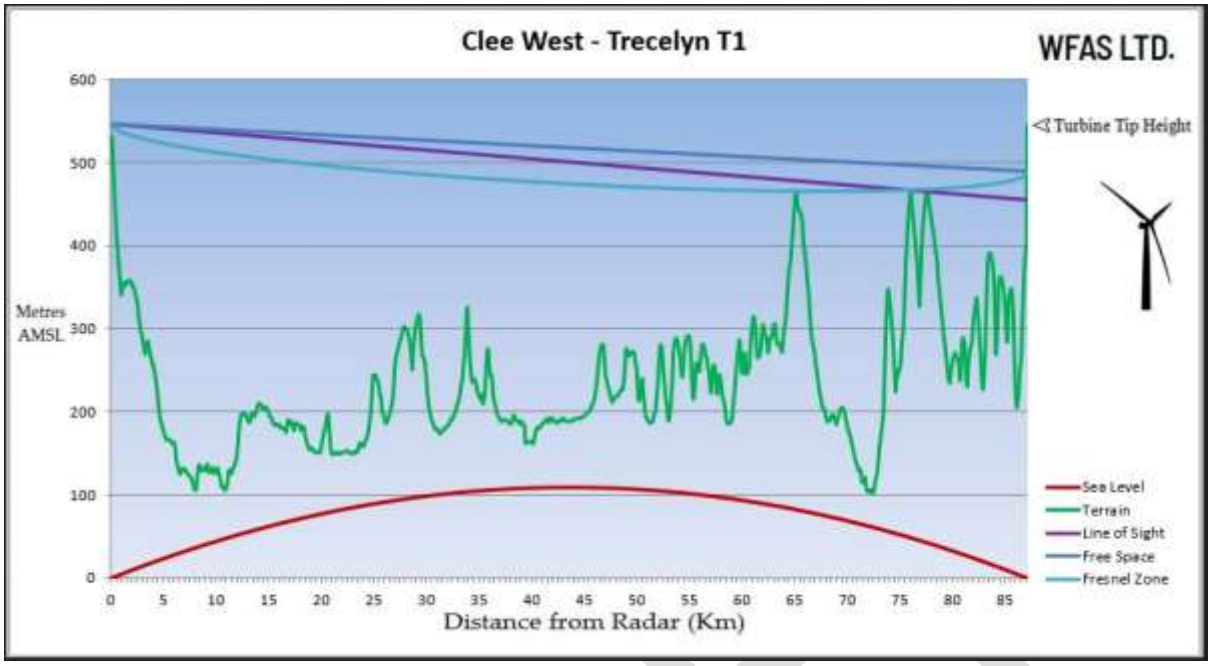

Figure 8 – Line-of-Sight to NATS Clee Hill West Radar

Radar modelling has been undertaken with the following results:

Turbine	Tdkm	Hf06magl	Hlosmagl
1	87.173	88.6	54
2	88.565	166.5	131.1
3	89.216	167.2	130.9
4	89.668	179.6	142.6

Table 5 – Clee Hill Radar (alternate) Line-of-Sight values

These results are very similar to the previous Clee Hill results and it can be assumed that NATS will assess that the turbines will be visible to the radar regardless of what parameters and algorithms they apply. The resultant clutter on the controllers screens is, in most cases, unacceptable to air navigation service providers and we have no reason to believe that NATS will view this any differently. This will need to be confirmed with NATS and through their Technical Assessment (TOPA) and this is the priority for the project with regard to aviation, although probably to be conducted coherently with approaches to Cardiff and Bristol.

As stated previously, it should be assumed that the aviation stakeholders have considered their responses based on HLos as the "worst case" scenario and, whilst the Hf06 values might suggest more leeway for development of turbines, we would not advise this as a basis for consultation/negotiation. Clearly, the Clee Hill radar will be the crucial issue for the future development of Trecelyn Wind Farm in its current, suggested layout.

In terms of mitigation, the adoption of an operational radar in-fill mitigation solution might be the best solution. These have been deployed into an operational environment where additional conventional radars have been located in such a position that turbines are screened by terrain from this additional radar. However, this is a technically complex, time-consuming and expensive option which relies on the capacity of the existing radar infrastructure to accommodate another radar input or feed and available mitigation options will not be known until consultation is initiated with NATS.

Military Aviation

There are no military airfields within the vicinity but the Ministry of Defence do not apply any limitations on distance from radars and will assess to the maximum possible operational range of such facilities. For completeness, and to eliminate those from further consideration, we have conducted radar modelling against military radars in the area.

RNAS Yeovilton

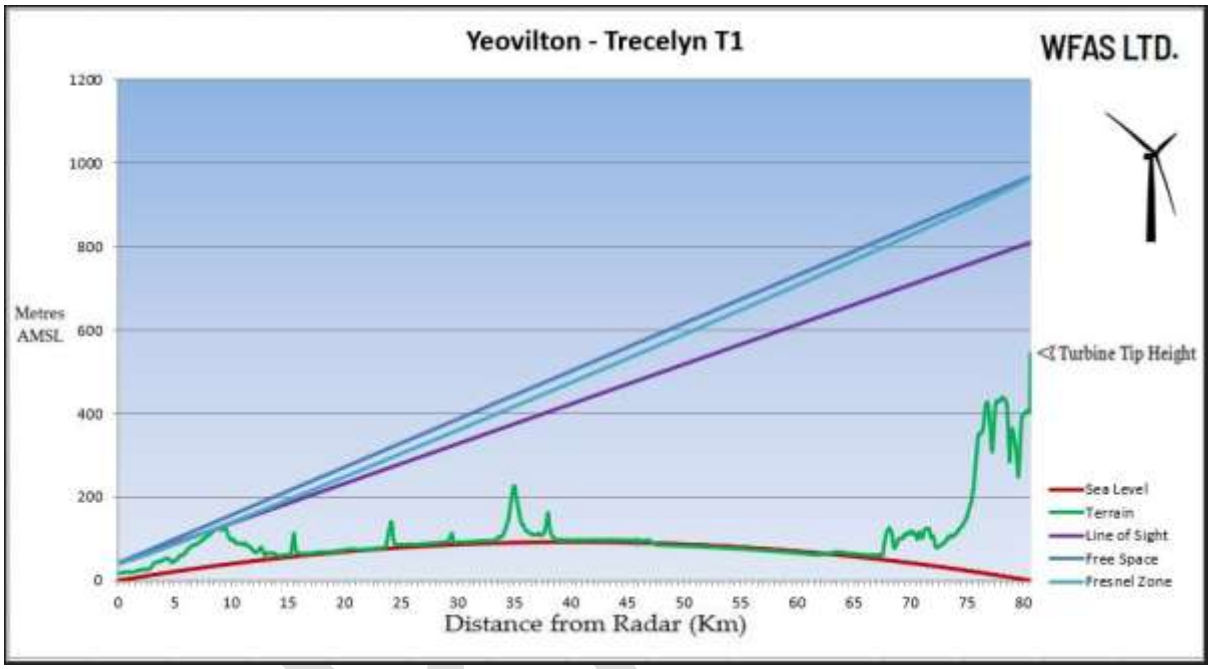

Figure 9 – Line-of-Sight to RNAS Yeovilton Radar

Turbine	Tdkm	Hf06magl	Hlosmagl
1	80.654	567.7	408.4
2	79.904	630.5	473.3
3	79.339	631.5	479.9
4	79.095	642.5	493.5

Table 6 – RNAS Yeovilton Line-of-Sight values

RAF Brize Norton - Watchman Radar

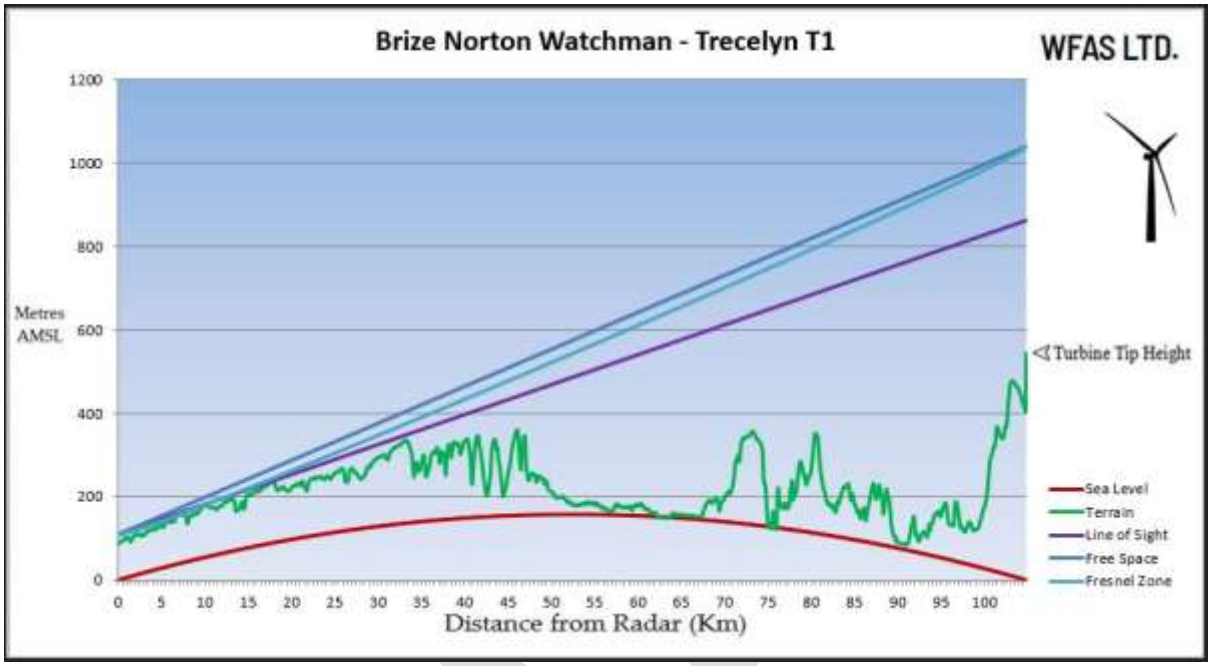

Figure 10 – Line-of-Sight to RAF Brize Norton Watchman Radar

Turbine	Tdkm	Hf06magl	Hlosmagl
1	104.885	638.9	461.6
2	105.79	693.6	509.7
3	105.958	697.2	511.9
4	106.249	704.3	513.2

Table 7 – RAF Brize Norton Line-of-Sight values (Watchman)

RAF Brize Norton – Star 4P Radar

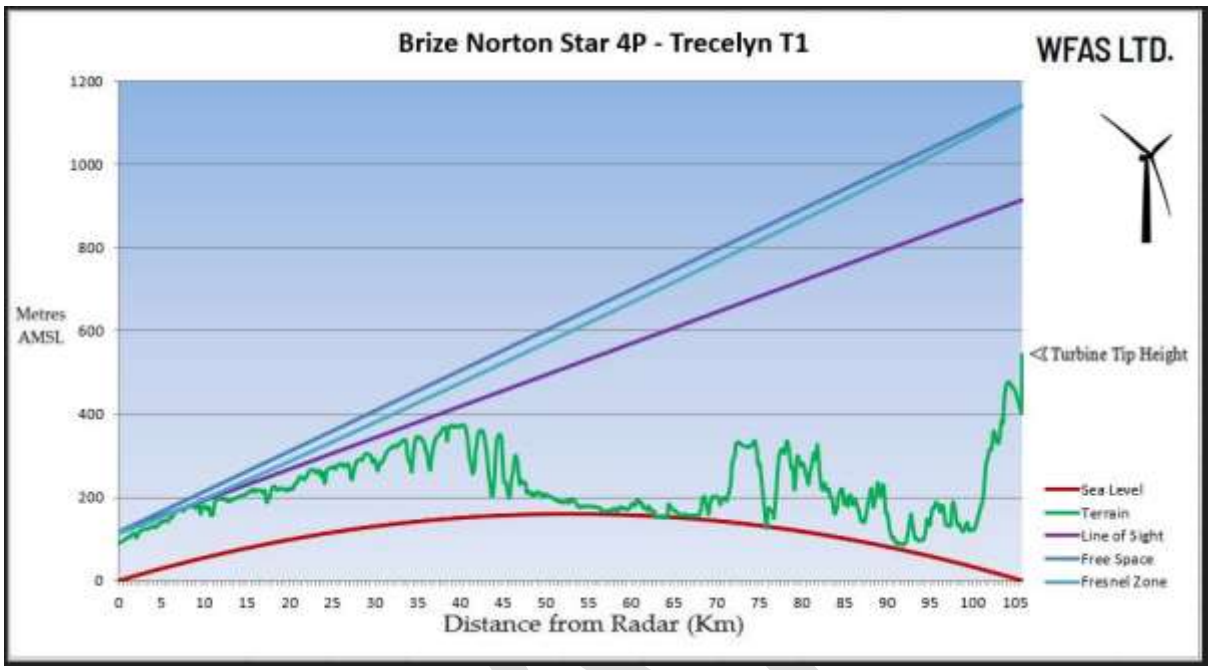

Figure 11 – Line-of-Sight to RAF Brize Norton Star 4P Radar

Turbine	Tdkm	Hf06magl	Hlosmagl
1	105.883	741.7	514.2
2	106.806	814.3	581.1
3	106.985	820.1	587.4
4	107.282	829.6	596.3

Table 8 – RAF Brize Norton Line-of-Sight values (Star 4P)

Air Defence

Radar modelling has shown that there are no air defence radars that will be affected by the proposed turbines.

Met Office

There are no Met Office radars that will be affected by the proposed development.

Low Flying

The United Kingdom Low Flying System (UKLFS) covers the open airspace of the whole UK below 2,000 ft agl. Low Flying by military aircraft is permitted within established Low Flying Areas (LFAs) which exclude locations where such flying is restricted or not permitted such as large urban areas. WFAS have considered the proposed development in relation to military operations. The site is within an area designated as 'Green' in relation to low flying operations. This is defined as "an area with no military low flying concerns" and an MoD objection on low flying grounds is not anticipated. You should, however, expect that the MoD will require the installation of infra-red lights to the MoD specification and, should this occur, we can conduct a lighting assessment and subsequent report.

Other facilities

An extensive search of available documentation has not revealed any further aviation facilities within the stipulated consultation distances. However, it should be noted that not all private airstrips are listed in documents or on charts and these can be established without planning permission or notification.

Conclusions

In respect of aviation feasibility, the proposed development has some significant issues and which will need to be addressed. The turbines will be visible to the Clee Hill radar and to those at Cardiff and Bristol and it should be assumed that NATS initial position will be to object on all three. However, it might prove that the potential interference is acceptable to some of the operators or that mitigation might be possible but it should be noted that, if mitigation is possible, it could prove difficult and/or expensive to implement both in financial terms and in time to achieve. We consider that additional and urgent consultation be undertaken with NATS Safeguarding (including Cardiff and Bristol) to determine what might be possible with the proposal in either the extant configuration or with an altered development.

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