

Appendix 15A

Aviation Assessment



Wind Power Aviation Consultants Ltd

Eredine Wind Farm Aviation Technical Appendix for RWE Renewables UK Limited

Our Reference: WPAC/008/24
Your Reference: PO4300006262-S1-U21

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Contents

Reference Documents.....	2
Scope.....	2
Consultation Criteria.....	3
Civil Aerodromes.....	3
Ministry of Defence	3
National Air Traffic Services Facilities.....	4
The Proposed Site	4
The Local Area.....	5
Ministry of Defence Considerations.....	7
Military Airfields.....	7
Air Defence Radars	7
Meteorological Radars.....	7
Ministry of Defence Low Flying Areas	7
MOD Scoping Response.....	8
Civil Aerodromes	8
Radar Equipped Licensed Aerodromes.....	8
Glasgow Prestwick Airport (GPA).....	9
Glasgow International Airport (GIA)	10
Non-Radar Equipped Licensed Aerodromes.....	11
Unlicensed Aerodromes, Gliding, Hang Gliding and Parachuting Sites	11
En Route Airspace and NATS En Route Radars	11
NATS Scoping Response	13
Conclusions and Recommendations	13
Actions	14

Reference Documents

- A. Purchase order No. 4300006262-S1-U21
- B. Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines Version 6, Feb 2016
- C. CAP 168 Licensing of Aerodromes, Edition 12 Jan 2022
- D. CAP 670 ATS Safety Requirements Version 3 July 2019
- E. CAP 774 UK Flight Information Services, Version 4 Dec 2021
- F. CAP 738 Safeguarding of Aerodromes Version 3 Oct 2020
- G. CAP 793 Safe Operating Practices at Unlicensed Aerodromes Ed 1 July 2010
- H. CAP 493 Manual of Air Traffic Services Part 1 Ed 10 March 2022
- I. CAP 660 Parachuting Ed 5 March 2020
- J. Military Aviation Authority Traffic Management (3000 series) Regulatory Articles
- 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

Scope

1. Wind Power Aviation Consultants Ltd have been tasked at Reference A with writing an aviation technical appendix for the Environmental Impact Assessment (EIA) Report on the aviation issues relating to the construction and operation of a wind farm at Eredine, 7km to the west of Inver-aray, in accordance with the consultation criteria specified within this report.

Consultation Criteria

Civil Aerodromes

2. Civil Aviation Publication (CAP) 764 states the distances from various types of airfields where consultation should take place. These distances include:
 - Airfield with a surveillance radar – 30 kilometres (km)
 - Non radar licensed aerodrome with a runway of more than 1,100 metres – 17km
 - Non radar licensed aerodrome with a runway of less than 1,100 metres – 5km
 - Licensed aerodromes where the turbines would lie within airspace coincidental with any published Instrument Flight Procedure (IFP)
 - Unlicensed aerodromes with runways of more than 800 metres – 4km
 - Unlicensed aerodromes with runways of less than 800 metres – 3km
 - Gliding sites – 10km
 - Other aviation activity such as parachute sites and microlight sites within 3km – in such instances developers are referred to appropriate organisations
3. CAP 764 goes on to state that these distances are for guidance purposes only and do not represent ranges beyond which all wind turbine developments will be approved or within which they will always be objected to. These ranges are intended as a prompt for further discussion between developers and aviation stakeholders.
4. As well as examining the technical impact of wind turbines on Air Traffic Control (ATC) facilities, it is also necessary to consider the physical safeguarding of ATC operations using the criteria laid down in CAP 168 to determine whether a proposed development will breach obstacle clearance criteria.

Ministry of Defence

5. 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, both radar and non-radar equipped
 - Ministry of Defence Air Defence Radars
 - UK Met Office Meteorological Radars

National Air Traffic Services Facilities

6. It is 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.

Radar Projection Information

7. The radar projections shown in this report have been produced using our own specialist propagation prediction software (RView Version 5). Developed over a number of years, it has been designed and refined specifically for the task. RView uses our comprehensive systems database which incorporates the safeguarding criteria for a wide range of radar and radio navigation systems. RView models terrain using the latest Ordnance Survey (OS) Terrain 50 digital terrain model, (currently 2023 V2.0) which has a post spacing of 50 metres and has a root mean square (RMS) error of 4 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. A feature of RView is that as well as performing calculations in the manner we believe to be most appropriate it also allows us to compare our own results with results from simpler models. For example, 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. RView models the trajectory of radar signals at different elevations allowing us to model both volume surveillance and pencil beam radars as well as the effects of angular sterilisation as applied, for example, in Met Office radars.
8. 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 normally 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. 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 technical impact on a radar.

The Proposed Site

9. This is a 22 turbine proposal with a tip height of up to 200m at the locations in Table 1 and as shown in Figure 1.

Wind Power Aviation Consultants Ltd

Eredine Wind Farm Aviation Technical Appendix for RWE Renewables UK Limited

Our Ref: WPAC/008/24

Date: 23/01/24

Turbine	Easting	Northing	Turbine	Easting	Northing
1	201508	706114	12	198805	704370
2	201129	707055	13	198850	706418
3	200888	705148	14	198423	706930
4	200779	706459	15	198350	705077
5	200222	704727	16	198155	703498
6	200175	705910	17	198092	705579
7	199614	704277	18	198064	706123
8	199236	705150	19	197887	702987
9	199178	707191	20	197534	702434
10	199172	705898	21	197030	704927
11	199000	703779	22	196547	704575

Table 1 Turbine Locations

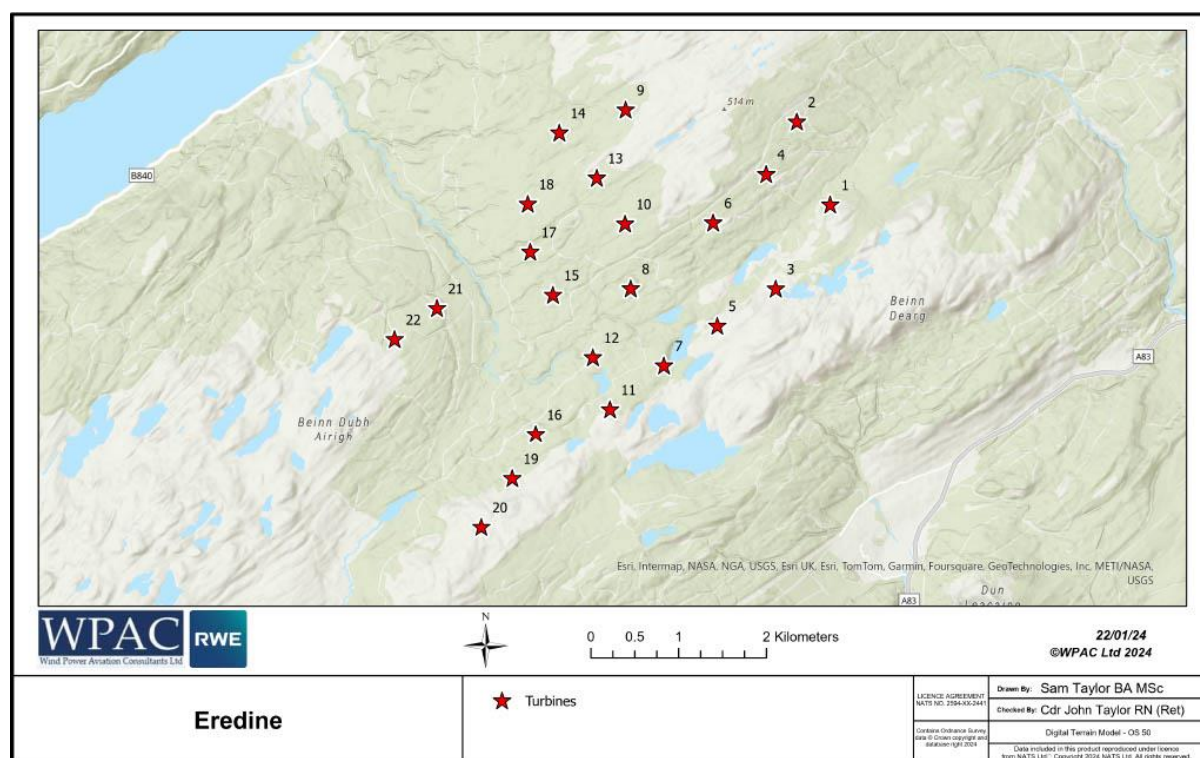


Figure 1 - Map Extract showing turbine locations

The Local Area

10. The site is located in an area that is relatively remote from significant aviation facilities. It is 60km to the north-west of Glasgow International Airport, 86km north of Glasgow Prestwick Airport and 30km to the south of the small aerodrome at Oban. In military terms there are no military airfields or other facilities in the region. Figure 3 shows that the site is located under Class G unregulated airspace although it is adjacent to the northern boundary of Class E Regulated Airspace called the Argyll CTA which is used to take air traffic from Glasgow to Tiree and beyond.

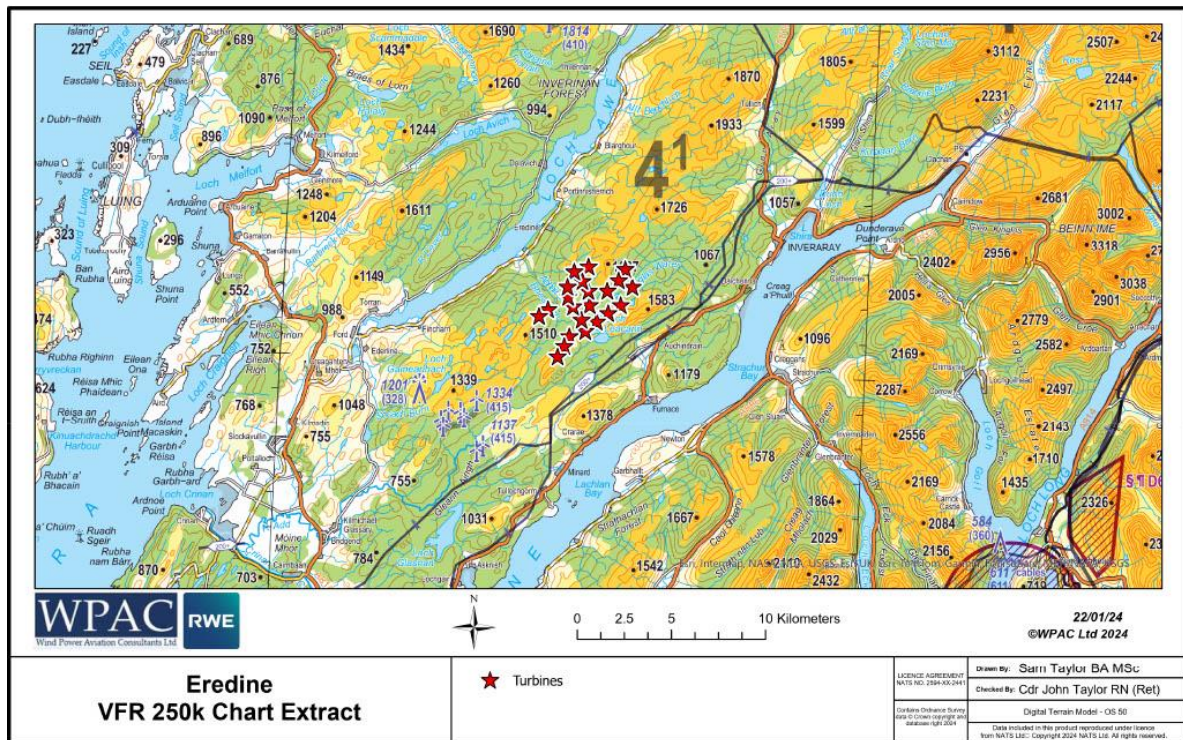


Figure 2 CAA 1:250K VFR Chart Extract showing aviation details close to the site up to 5000ft

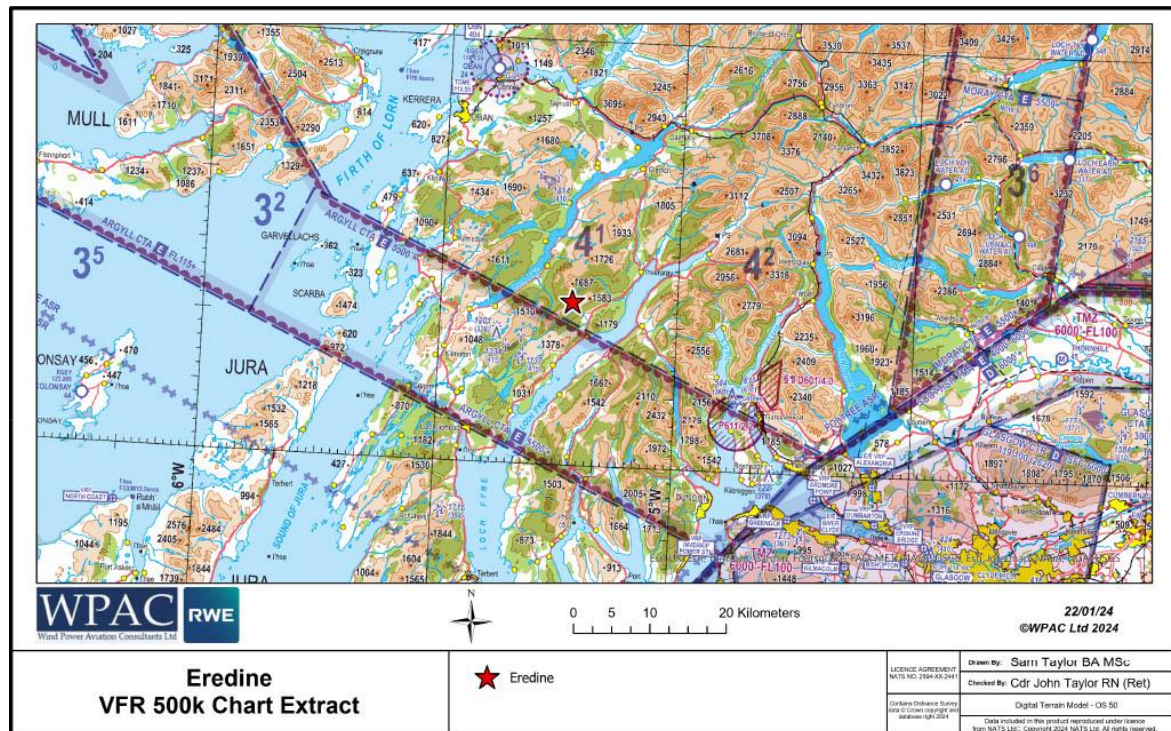


Figure 3 CAA 1:500K VFR Chart Extract showing the area up to 10,000ft

Ministry of Defence Considerations

Military Airfields

11. There are no military airfields or ATC facilities in this area. Radar modelling confirms that the turbines will not be visible to any military ATC radars.

Air Defence Radars

12. The UK maintains a network of radars around the country to provide a policing and security service for the airspace for which it is responsible under international agreements and for National security. The nearest Air Defence radar is located at Benbecula in the Outer Hebrides. Radar line of sight is in excess of 1000 metres AGL and the radar will be unaffected by the Proposed Development. There will be no MOD Air Defence Radar objection in this case.

Meteorological Radars

13. The Met Office safeguards its network of radars using a European methodology known as OPERA. In general they will object to any turbine within 5km in line of sight and will examine the impact of any turbines within 20km. Where a site is within 20km, the Met Office will undertake an operational assessment based on three main criteria, having determined that there is a technical impact on the radar. The factors they will consider include the following:

- Proximity to Airports
- River catchment response times
- Population density

14. In this case the closest Met Office radar is at Holehead over 60km to the south-east. There will be no Met Office radar objection to this proposal.

Ministry of Defence Low Flying Areas

15. Eredine is located 30km south of Oban and within Low Flying Area 14 which encompasses the vast majority of Northern and Central Scotland as shown on the UK Low Flying Consultation Areas map at Figure 4 below. It is within an area designated as 'Blue' by the MOD.

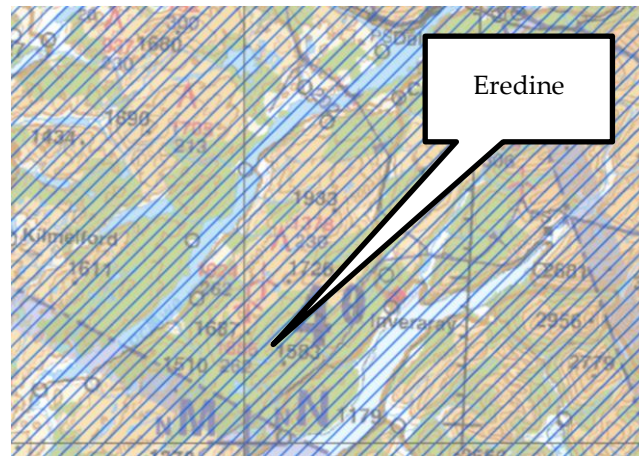


Figure 4

16. A blue area is defined as a 'low priority military low flying area less likely to raise concerns'. The MOD will require infra-red (IR) obstruction lighting. However, as the turbines are planned to exceed 150 metres to tip, the IR lighting requirement will be in addition to the aviation lighting required by the CAA. Lighting requirements will be addressed in more detail in the Aviation Lighting and Mitigation technical appendix also written by WPAC.

MOD Scoping Response

17. The MOD, through DIO responded to the scoping layout under reference DIO10048403 dated 06 July 2022. Their response confirms there are no radar objections but does state a 'concern' relating to low flying. In order to alleviate the concern, they require 'the development be fitted with MOD accredited aviation lighting in accordance with the Air Navigation Order 2016'. The Aviation Lighting Mitigation Report demonstrates that it is intended to install ANO 2016 compliant visible medium intensity red lights, however, these are not visible to military pilots flying on Night Vision Goggles (NVG). MOD compliant IR lighting will also be installed which is invisible to the human eye but highly visible to pilots using NVG. Again this will be explained in the Aviation Lighting Mitigation Report technical appendix.

Civil Aerodromes

Radar Equipped Licensed Aerodromes

18. There are no radar equipped licensed aerodromes within the 40km consultation zones claimed by any of the main Scottish Airports, however, planning authorities will often consult far more widely than this to ensure that all aviation issues are captured. For completeness and to determine if there will be any technical effects on the radars in the region, radar line of sight modelling has been conducted for sites beyond 40km.

Glasgow Prestwick Airport (GPA)

19. Radar modelling has been conducted against the primary surveillance radar (PSR) at Prestwick. Eredine is 87km to the north. Radar results for the PSR are at Table 2 with an example projection at Figure 5. The results show that there is no possibility of the PSR being affected.

Turbine	Distance (Km)	RLOS (m AGL)	Turbine	Distance (Km)	RLOS (m AGL)
1	87.5	994.4	12	87.1	790.1
2	88.5	955.7	13	88.9	820.4
3	86.9	940.3	14	89.5	836.8
4	88.1	939.5	15	87.9	824.2
5	86.8	907.1	16	86.6	753.5
6	87.9	901.2	17	88.5	819.1
7	86.6	795.3	18	89.0	818.7
8	87.6	820.6	19	86.2	818.7
9	89.4	904.4	20	85.9	862.0
10	88.3	844.3	21	88.3	868.1
11	86.4	741.1	22	88.3	941.7

Table 2 GPA Results

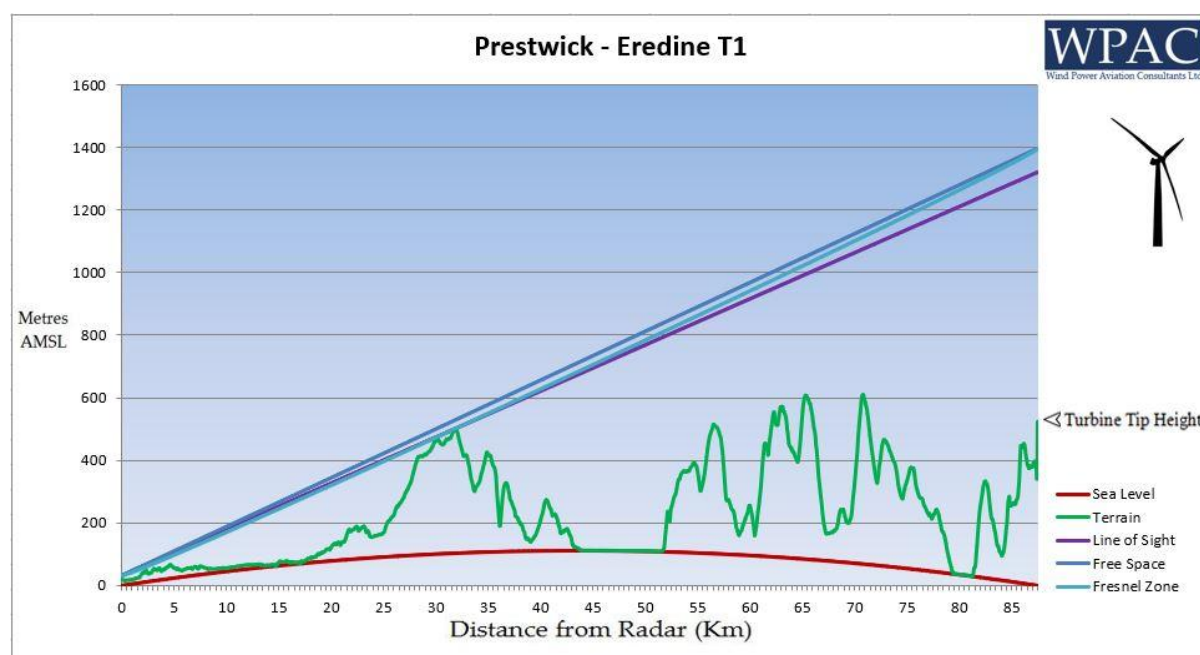


Figure 5

GPA commented at scoping: 'On behalf of Glasgow Prestwick Airport (GPA) – the proposed development lies out with the Airport's safeguarding area and as such GPA have no comment to make on the scoping consultation and would have no aviation grounds to object to this proposal should it come to a full Section 36 Planning Application.'

20. The Proposed Development is also beyond the distance within which Instrument Approach Procedures need to be assessed. There is no requirement for further consultation with GPA in relation to the Proposed Development.

Glasgow International Airport (GIA)

21. GIA did not provide comment at scoping as the Proposed Development is over 60km to the north-west of the airport. Radar modelling has been undertaken to confirm there is no impact with the results at Table 3 and an example projection at Figure 6. There is no requirement to consult with GIA.

Turbine	Distance (Km)	RLOS (m AGL)	Turbine	Distance (Km)	RLOS (m AGL)
1	60.4	739.4	12	61.38	368
2	61.2	621.8	13	62.60	395.8
3	60.2	539.2	14	63.25	512.9
4	61.1	710.3	15	62.17	396.4
5	60.5	339.3	16	61.38	562.7
6	61.2	569.6	17	62.68	433.6
7	60.7	358.4	18	63.03	474.4
8	61.5	438.1	19	61.29	546.8
9	62.8	692.5	20	61.26	452.4
10	62.0	307.7	21	63.13	580.3
11	60.9	425.2	22	63.31	553.8

Table 3 Glasgow Airport Radar Line of Sight Results (metres AGL)

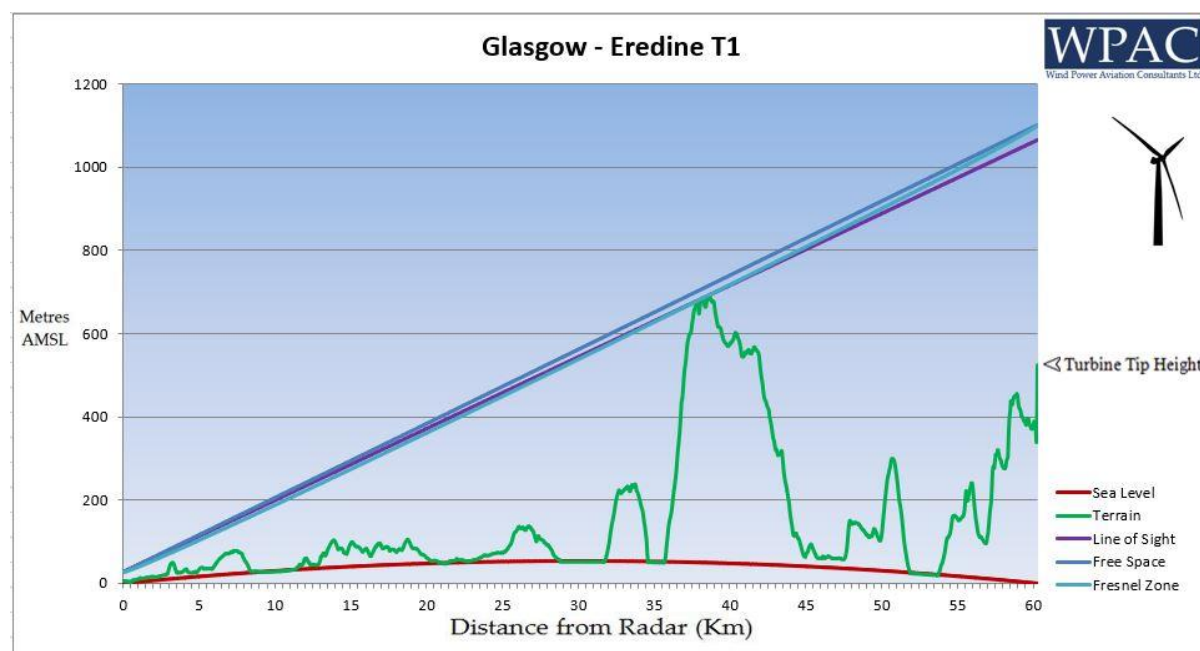


Figure 6

Non-Radar Equipped Licensed Aerodromes

22. None within consultation distance. The closest is at Oban but at 30km consultation is not required.

Unlicensed Aerodromes, Gliding, Hang Gliding and Parachuting Sites

23. None within consultation distance. **Caution** – not all microlight sites or unofficial landing strips are marked on charts or promulgated in any publications, it is possible that in spite of thorough research, the first indication of an existing strip may be when an objection is received during the planning process.

En Route Airspace and NATS En Route Radars

24. NATS En Route Ltd (NERL) operates a network of long range ATC radars throughout the country in addition to other communications, navigation and surveillance systems. Whether or not they would object to any turbine development depends upon whether the turbines show on a radar and what type of airspace is above the site or if the turbines will be likely to infringe upon the technical safeguarding criteria for other systems.

25. The site lies underneath Class G unregulated airspace but also close to the northern boundary of Class E regulated airspace designated as the Argyll Control Area (CTA). It is also designated as a Transponder Mandatory Zone (TMZ) which can reduce the reliance upon primary radar for separation purposes in this class of airspace. The two closest long range ‘en route’ radars within the network are located at Lowther Hill and Tiree. Radar modelling has been undertaken for both radars with the results in Tables 4 and 5 below and example projections at Figures 7 and 8.

Turbine	Distance (Km)	RLOS (m AGL)	Turbine	Distance (Km)	RLOS (m AGL)
1	129.5	198.2	12	130.0	398.8
2	130.4	265.7	13	131.5	370.9
3	129.2	299.9	14	132.2	394.3
4	130.2	236	15	130.9	439.5
5	129.3	426.9	16	129.9	537
6	130.2	266.3	17	131.4	446.4
7	129.4	383	18	131.8	417.4
8	130.3	411	19	129.7	401.6
9	131.8	284.7	20	129.6	336.8
10	130.9	408.5	21	131.7	590.8
11	129.5	426.4	22	131.8	434

Table 4 Lowther Hill Radar



Figure 7

26. The results for Lowther Hill show that a single turbine (T1) has a very small exposure to the radar (less than 2 metres) at a distance of almost 130km. This is within the error allowance for the digital terrain model. One turbine with marginal visibility is unlikely to require an objection from NATS but they will need to be reconsulted.

Turbine	Distance (Km)	RLOS (m AGL)	Turbine	Distance (Km)	RLOS (m AGL)
1	110.1	517.1	12	108.1	329
2	109.4	334.6	13	107.5	448.6
3	109.8	535.3	14	106.9	451.6
4	109.3	411.2	15	107.4	328.5
5	109.3	417.3	16	107.8	304
6	108.9	483.3	17	107.0	448.5
7	108.9	279.0	18	106.8	518.5
8	108.2	424.8	19	107.7	331
9	107.5	337.1	20	107.5	391.7
10	107.9	474.6	21	106.2	335.4
11	108.5	275.0	22	105.9	265.7

Table 5 Tیره Radar

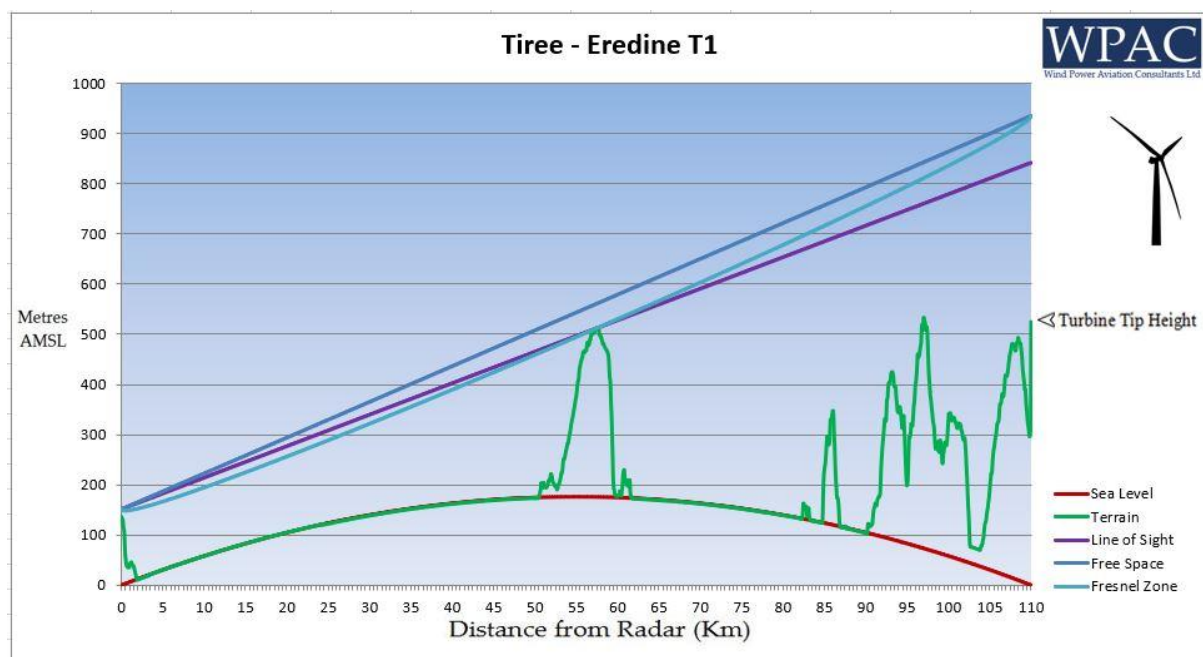


Figure 8

27. The results for Tiree show that all of the turbines will be screened by terrain from the radar and will have no effect on the performance of the Tiree radar.

NATS Scoping Response

28. NATS responded at scoping under reference SG29875 dated 18 July 2022 stating that there would be 'an unacceptable impact from Turbine 8 on its radar'. However, the site layout has changed since then and the results at Table 4 show that there is only a very small marginal effect from T1 on the Lowther Hill radar with the application layout. NATS will need to be re-consulted but in the worst case if they assume that T1 will affect the radar and that the effect would be operationally unacceptable, a simple 'single cell blank' mitigation should be available in order to enable a planning condition to be agreed.

Conclusions and Recommendations

MOD ATC Radar – none affected

MOD AD Radar – none affected

MOD Met Office Radar – none affected

MOD Low Flying – the site is in a Blue area. MOD specification I-R lighting will be required

Civil Radar Equipped Airports – none affected

Other civil aerodromes, helicopter landing sites, microlight sites etc – none affected

NATS En Route - one turbine is marginally visible to the Lowther Hill radar and may require a single cell blank mitigation

Aviation Lighting – a CAA compliant lighting scheme will be required

Actions

- Reconsult with the MOD providing the finalised layout and provide the IR lighting layout
- Re-consult with NERL using the finalised layout.

A handwritten signature in blue ink that reads "John Taylor". The signature is written in a cursive style and is enclosed within a hand-drawn rectangular box.

Cdr John Taylor RN (Ret)
Managing Director
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