

**From:** [Redacted]  
**Sent:** 06 May 2015 08:33  
**To:** [Redacted]  
**Subject:** 20150506-DIO 22325 High Moor Farm URG Wind Farm  
**Attachments:** WFS\_ProForma\_22325.xls; 20150506-DIO22325 Concerns High Moor Farm-RSP1b-O.doc

[Redacted text]

**From:** [Redacted]  
**Sent:** 06 May 2015 08:22  
**To:** [Redacted]  
**Subject:** FW: 20150505-DIO22325-High-Moor-Farm-Urg-O

**From:** [Redacted]  
**Sent:** 05 May 2015 11:45  
**To:** [Redacted]  
**Subject:** 20150505-DIO22325-High-Moor-Farm-Urg-O

Good Morning,

Please see attached details for the above planning consultation.

A response is required by 8<sup>th</sup> May 2015

Kind Regards

[Redacted text]

**Defence  
 Infrastructure  
 Organisation**

[Redacted text]

[Redacted text]

[Redacted text]

Please note that my email address will change in mid May 2015

23/06/2015

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[DE REF]

[WINDFARM NAME] TURBINE LOCATIONS

Wind Farm Name  
Developers Ref  
DE Reference  
Addr1  
Addr2  
Addr3  
County  
Postcode  
Country  
Offshore?  
Related Apps

High Moor Farm  
15/01718/FUL  
22325  
High Moor Farm  
Beckwithshaw  
Harrogate  
North Harrogate  
HG3 1QY  
England  
FALSE

1	0 SE	25637	50605	N	53	57	2.56	W	1	36	33.53
2	0 SE	25905	50296	N	53	56	52.51	W	1	36	18.92

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Ministry  
of Defence

**AIR DEFENCE & ELECTRONIC WARFARE SYSTEMS**

**RADIO SITE PROTECTION**

**TECHNICAL REPORT**

**Issue:** 1  
**Date:** 06 May 2015

**Title:** WR80026/01  
DIO 22325 – AIR TRAFFIC CONTROL (ATC)  
RADARS – ASSESSMENT OF THE DEVELOPERS  
PROPOSAL TO ESTABLISH A WINDFARM AT  
HIGH MOOR FARM, NEAR BECKWITHSHAW,  
YORKSHIRE

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**FOI FORMAT AND SUMMARY**

20150506-DIO22325 Concerns High Moor Farm-RSP1b-O

Radar Field Strength and/or Radar Line-of-Sight analysis indicates that the proposed windfarm at High Moor Farm shows a high degree of probability that it will be detected by one or more MoD radars to a degree that will affect their function.

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AIR-1GP-BM Cap Safeguarding Windfarms  
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**Internal:**

DES ADEWS Task Management-Windfarms (Multiuser)

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Figure 1 – Local area map for High Moor Farm windfarm

Figure 2 – Coverage prediction plot for Leeming Watchman

Figure 3 – Coverage prediction plot for Linton-on-Ouse Watchman

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**REFERENCES**

- A. E-mail from Defence Infrastructure Organisation, DIO 22325 dated 05 May 15
- B. JSP 604 Leaflet 3032 (formerly JSP846)
- C. QINETIQ/D&TS/SEA/TA0705054/1.0 – Assessment of Wind Turbine Effects for DCSA
- D. AWC/WAD/72/655/TRIALS dated 10 May 05 – The effect of wind turbine farms on ATC radar (Qixotic Zephyr trial)
- E. AWC/WAD/72/655/TRIALS dated 06 Jan 05 – The effects of wind turbine farms on Air Defence radars (Swift Crofter trial)
- F. Further evidence of the effects of wind turbine farms on AD radar dated 12 Aug 05 (Mistral Crop trial)
- G. Trial report Weave Elbow (Stage 3) dated 21 May 2014 – Further testing of wind turbine effects on the TPS-77 radar.



## Standard Assumptions and Terms

RLOS - Radio Line of Sight. This is a linear path estimation of line-of-sight at radar wavelengths that compensates for refractive effects by assuming a reduced earth curvature (4/3 earth radius).

Clutter is taken into consideration as part of the propagation model that generates coverage plots and can significantly reduce the probability of detection by the radar.

Stated accuracy for the Ordnance Survey ground height data is  $\pm 3\text{m}$  to 1RMS. DES ADEWS maintains mapping data at far greater accuracy for the radar positions. The radar aperture heights used in calculation reflect this increase in accuracy.

All heights AMSL are referenced to the National Grid geoid. All angles are referenced to Grid north unless specifically stated.

Areas of the coverage plots shaded in blue indicate where a turbine of the dimensions given is predicted to be detected by the radar.

**Level 1 Assessment:** Considers RLOS only and is used for radars where no parameters other than physical location are available. This method is not considered to be particularly accurate.

**Level 2 Assessment:** Calculated probability of detection from available radar parameters, turbine parameters and terrain data. The total RCS of the turbine is used in all instances. This report constitutes a Level 2 Assessment except for NATS Great Dun Fell and MAA Yeovil. Coverage plots are not relevant for Secondary Surveillance Radars which are more concerned with short-range reflections.

**Level 3 Assessment:** A more extensive Probability of Detection calculation, utilising sectioned RCS. This method is considered to give more accurate answers when RLOS is not present and diffraction is the sole method of detection.

**Turbine RCS:** A measure of the radar reflectivity of the complete turbine structure.

**Turbine Visibility:** The amount of the turbine visible over terrain, considering RLOS only. In general, a large positive value is a strong indicator that the turbine will be detected. A Level 3 assessment is generally requested in the report where this value is zero and detection is still indicated.

**Max height for no visibility:** A sample cut-off height below which all of the turbine would be obscured by terrain. Note that this figure will vary between turbines with different ground heights in the same proposal.

**Visibility over clutter:** The amount of the turbine which is un-obscured from the radar by building clutter and terrain (where this is the same as the Turbine Visibility, no clutter exists in the beam path). Where this value is zero or very small, the turbine is completely obscured by clutter and the detection probability will be greatly reduced. Note that clutter is represented by average values for a type in an area (forest, sub-urban, urban, etc) and not to the individual building level.

## **1 Scope**

1.1 The purpose of this report is to ascertain the likely effects of the proposed wind turbines at High Moor Farm on the performance of Radar Systems at MoD-related sites.

## **2 Introduction**

2.1 Reference A is a proposal to establish a wind farm of 1 turbine at High Moor Farm, near Beckwithshaw, Yorkshire. National Grid References were provided (SE 25637 50605). The highest point of the turbine blades will be 48 metres above ground level. A local map of the proposed area is shown at Figure 1.

2.2 Siting restrictions for radars are defined in Reference B. Reference C details methods of determining Radar Cross-Section (RCS) values from a generic turbine model. Reference D defines specific restrictions for siting wind turbines, which apply when there is Line of Sight (RLoS) between radar and turbine. References E, F and G define additional restrictions applicable only to Air Defence (AD) radars.

## **3 Effects of Wind Turbines on Radar Performance**

3.1 It has been shown that where RLOS exists and/or Radar Field Strength detection occurs, the wind turbines will appear as genuine aircraft targets. This effect has been shown to mask aircraft responses, even when the aircraft is in a high elevation beam and the turbine is in a lower sidelobe. The radar may also be desensitised by its clutter processing within the sector containing wind turbines.

3.2 Additionally, shadowing of aircraft at similar radar to target elevation angles at the wind turbines may occur, degrading radar performance. However, this is only expected to occur over short distances from wind turbines.

3.3 In close proximity, turbines can cause spurious reflections of returns. This is particularly a problem for Secondary Surveillance Radars.

#### **4 Assessment of the Proposed Wind Farm**

##### **4.1 RAF Leeming Watchman Radar Field Strength Coverage summary**

4.1.1	Range to Windfarm:	38.6km
	Angle to Windfarm:	186.1°
	RLOS Visibility	10m (#1 only)
	Turbine RCS:	20.5m <sup>2</sup>
	Aux Beam:	Outside

4.1.2 A Field Strength Coverage plot was generated for the radar using these parameters (Figure 2), indicating that turbine #1 will be detected by the radar. Turbine #2 is obscured by terrain.

4.1.3 All other radars at this site have been checked.

##### **4.2 RAF Linton-on-Ouse Watchman Radar Field Strength Coverage summary:**

4.2.1	Range to Windfarm:	26.2km
	Angle to Windfarm:	243.1°
	RLOS Visibility	43m
	Turbine RCS:	20.5m <sup>2</sup>
	Aux Beam:	Inside

4.2.2 A Field Strength Coverage plot was generated for the radar using these parameters (Figure 3), indicating that all of the turbines will be detected by the radar.

4.2.3 All other radars at this site have been checked. The turbines are outside the arc of concern for the RPAR.

##### **4.3 There are no concerns regarding the following radars, which have been checked:**

4.3.1 RAF Topcliffe (no arc), Brizlee Wood, Staxton Wold

4.3.2 MAA Warton

4.3.3 NATS Great Dun Fell

4.4 The proposed wind farm is beyond the protected range and/or outside the protective arcs of all other radars.

#### **5 Conclusion and Recommendations**

It is recommended that the Operations Staff check whether the proposed wind farm at High Moor Farm is in an area of vital air traffic operations controlled by the radars at RAF Leeming and RAF Linton-on-Ouse. If so a decision to object to the proposal should be considered on the grounds referred to in paragraph 3.1 and paragraph 3.2.

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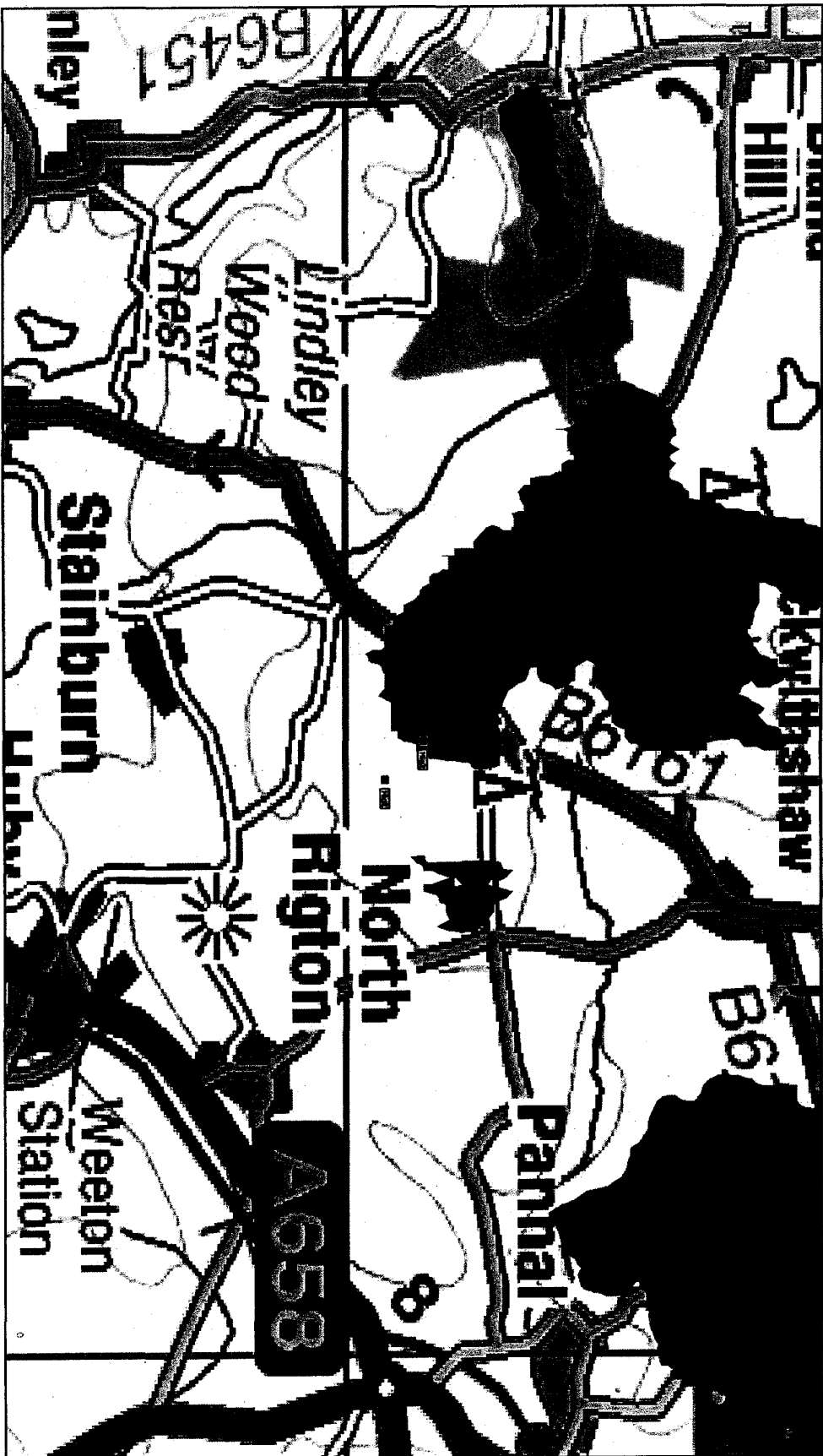
Local area map for DIO 22325 High Moor Farm windfarm (SE 25637 50605)

Figure 1

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DIO 22325 coverage estimate plot for Learning Watchman (48m, 20.5m<sup>2</sup> RCS, 175° - 195°)

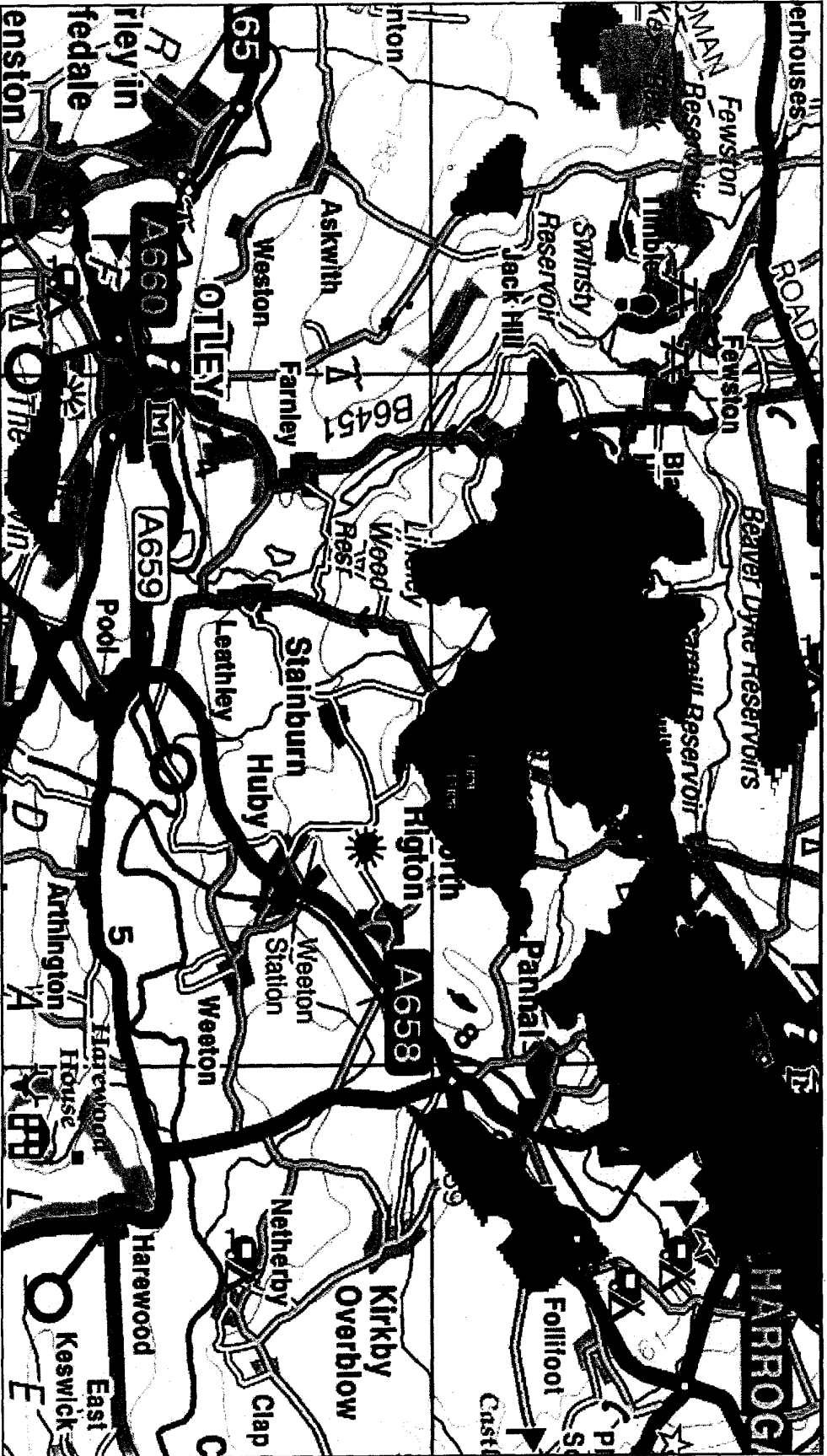
0

Figure 2

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DIO 22325 coverage estimate plot for Linton-on-Ouse Watchman (48m, 20.5m² RCS, 235° - 255°, Aux Beam)

Figure 3

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