

Appendix 13.1

Aviation

Issue	Date	Revision Details
1245923A	22/02/2021	Released

Appendix A to Chapter 13 – Aviation

1. This briefing note has been produced to explain the rationale behind the aviation lighting requirements and lighting layout for the Proposed Development and to report on the lighting arrangements as approved by the CAA and MOD. It has been written by Squadron Leader Mike Hale RAF (Ret) and takes into account the latest thinking from both the CAA and the MOD.

Lighting Layout Starting Point and Assumptions

2. The following factors were taken into account when considering a suitable lighting layout for the Daer Wind Farm. These factors include:
 - The proposed Daer wind farm is located towards the north of the Borders Region;
 - The site is effectively surrounded by Edinburgh, Glasgow, Carlisle and Prestwick Airports. However, the site is outside the Control Zones (CTZ) of all four airfields;
 - Daer is in MOD Low Flying Area (LFA) 16. This is a training area where military aircraft operate down to 250ft (figure 1);
 - Daer is in the part of LFA 16 that doubles as Tactical Training Area (TTA) 20. This is where military aircraft operate down to 100ft and helicopters to ground level (Figure 1);
 - The Daer site straddles the boundary of an area that is designated by the MOD as 'preferred for wind turbines' as opposed to 'preferred for low flying' (Figure 2);
 - Because of its location in a TTA the MOD will require that the site is adequately lit by Infra Red (IR) lights and;
 - The Daer turbines will exceed 150m to tip and will therefore require ANO visible lighting.

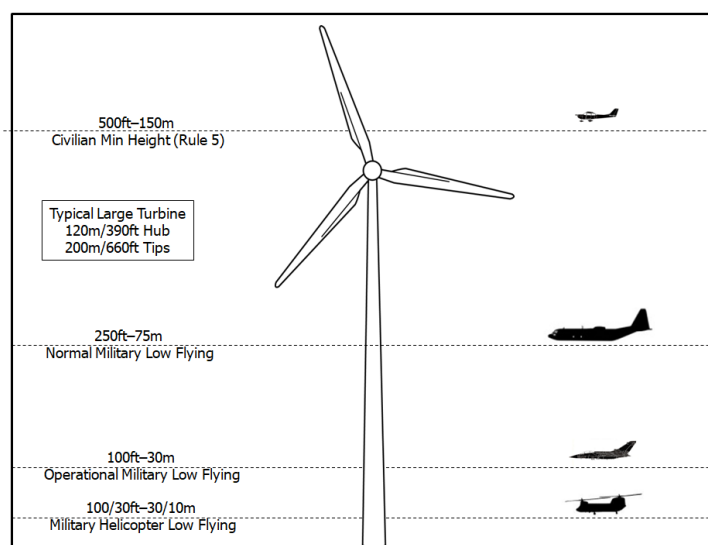


Figure 1

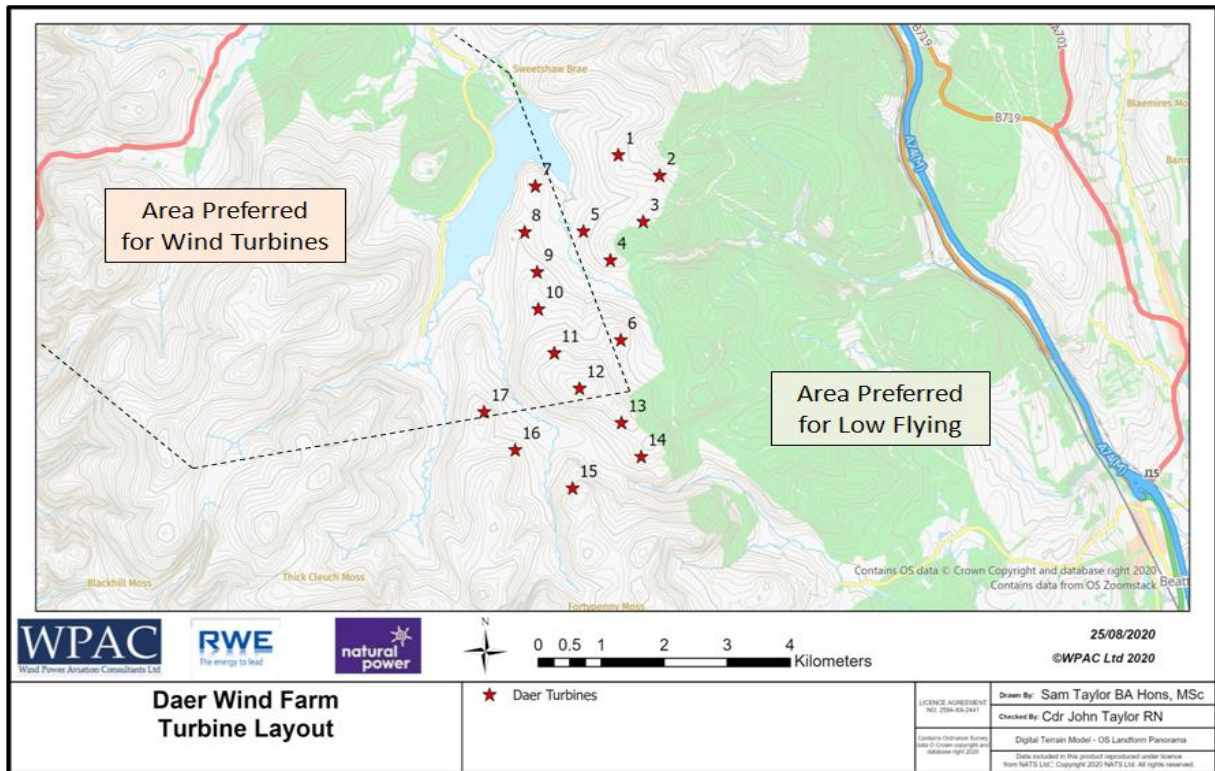


Figure 2

3. The Proposed Development is just to the south of the Scottish Central Belt. This is an area that is popular with the General Aviation (GA) community that operates from the many small airfields around Glasgow and Edinburgh (Figure 3). For that reason it is unlikely that the Civil Aviation Authority (CAA) would consider a dispensation (reduced) lighting scheme in this area. The site will require lighting compliant with the Air Navigation Order 2016 and CAA Policy Statement: *'Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level dated 01/06/17'*, hereafter referred to as 'ANO lighting'. ANO lighting requires fixed red lights at 2000 candela located at the highest practical point which in the case of wind turbines is the hub. The lights must be lit from dusk until dawn and can be reduced to not less than 10% brilliance when the visibility in all directions exceeds 5 km. The numbers of turbines carrying the ANO lighting will be defined by the recent release of the draft CAP 764 which is due to be published as CAP 764 Version 7 in October 2020. In addition, the MOD operates fast jet, tactical transport and helicopter formations and singletons in this area at night and will specify Infra Red lights on sufficient turbines for Night Vision Device/Goggles (NVD/G) users to identify the turbine site quickly at night. Note: The MOD will often rely on the CAA ANO lighting assuming that it is NVG/D compatible. Such lighting is no longer manufactured so separate IR lighting will be required.

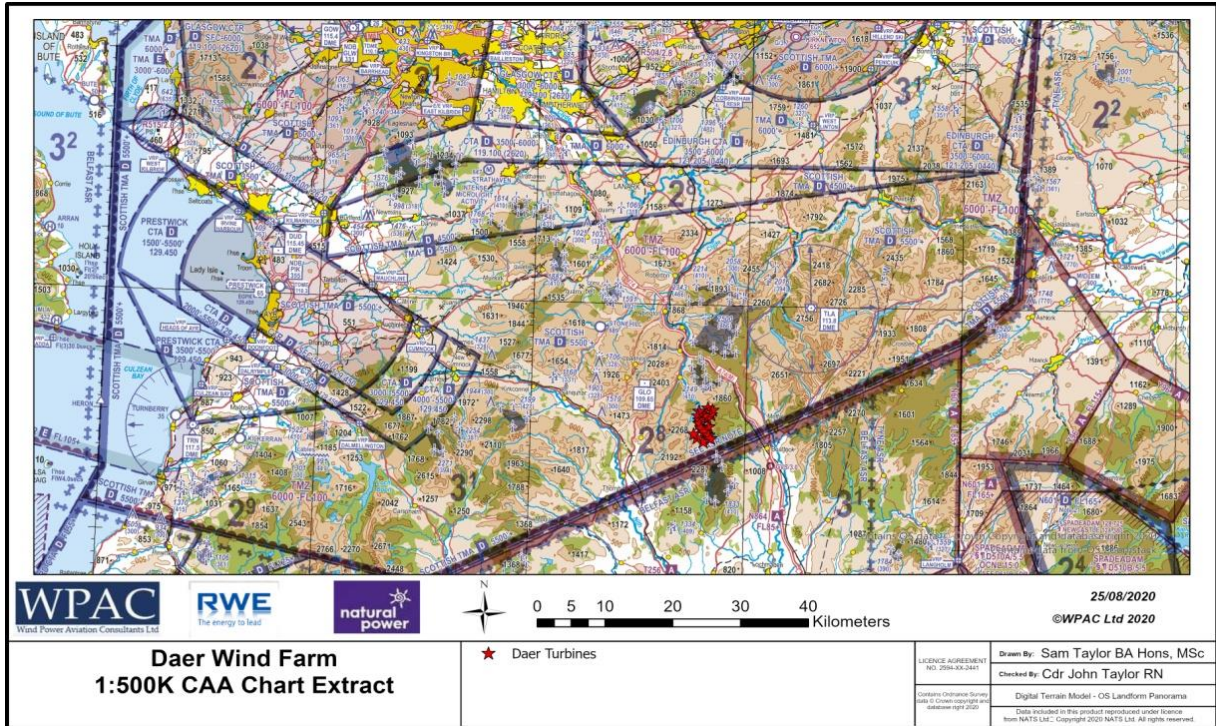


Figure 3

Visible Lighting Scheme – ANO Visible Red Lights

4. The Draft CAP 764 lighting requirements for wind turbine sites is quite complex to apply. Fortunately, the Proposed Development is a relatively straight forward site with an simple perimeter and only the '900m perimeter spacing' and '200m perimeter displacement' rules will be applicable to the lighting layout. The rule requires all perimeter turbines to be lit with ANO lighting unless removing a light from a turbine leaves a lighting gap of 900m or less, then the light can be removed. Equally, any central turbine within 200m of the perimeter must be lit unless the bordering turbines are less than 900m apart.

5. Figure 4 shows a lighting scheme that is compliant with the latest draft CAP 764 release. Eight of the seventeen turbines have ANO visible lights. However, the distance between T8 and T17 is close to 3km and the distance between T2 and T14 is around 4km. Accordingly, the CAA may specify lighting over and above the CAP 764 and require lighting on turbines T6 and T10 and possibly T3. Figure 5 shows this lighting arrangement. However the layout at Figure 4 is technically compliant and has been submitted to the CAA for approval.

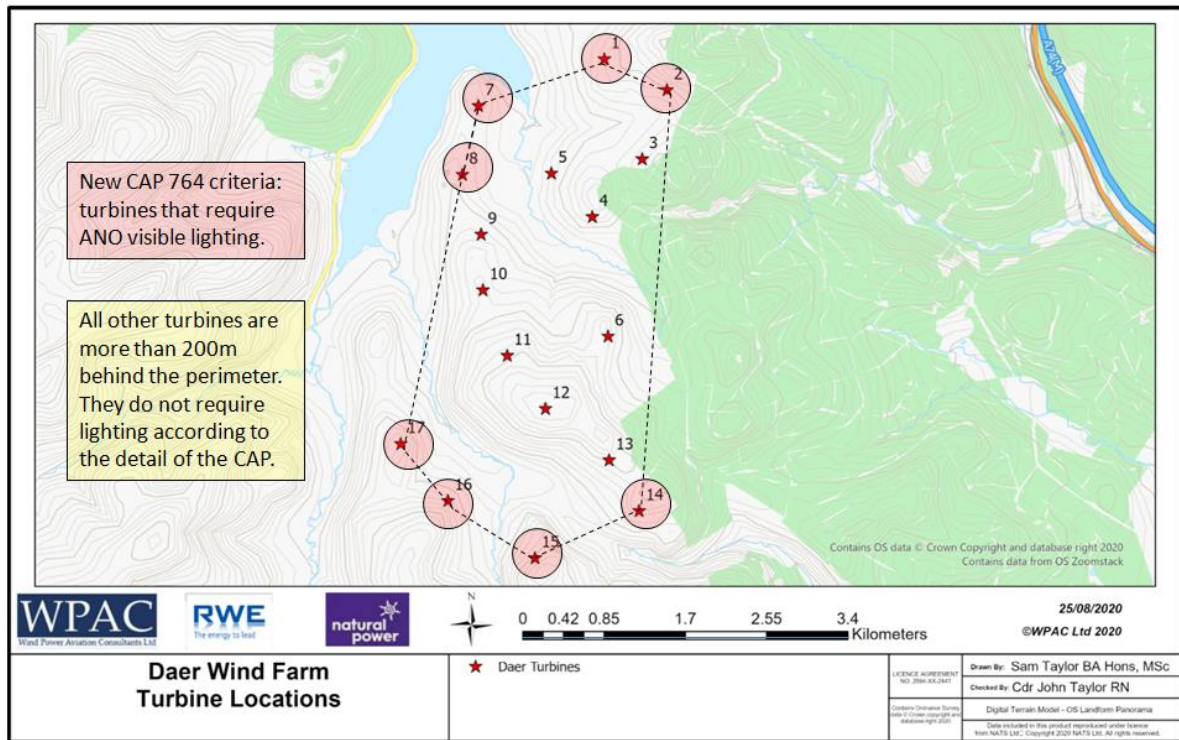


Figure 4

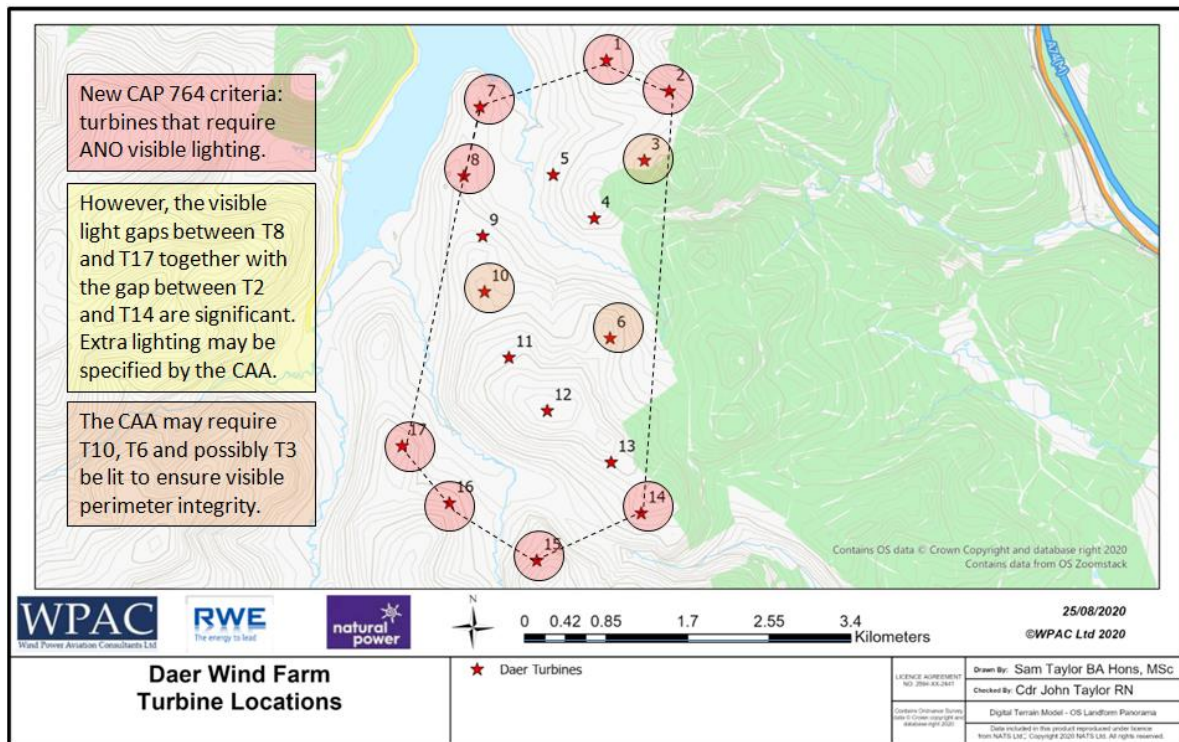


Figure 5

6. The CAA responded to the proposal under Reference CAA/Windfarms/DaerWF letter dated 17 November 2020 agreeing a variation to the lighting requirements specified in the ANO Article stating the following requirements:
- medium intensity steady red (2000 candela) lights on the nacelles of Turbines 1, 2, 6, 7, 10, 14, 15, and 17;
 - a second 2000 candela light on the nacelles of these turbines to act as alternates in the event of failure of the main light;
 - the lights on these turbines will be capable of being dimmed to 10% of peak intensity when the visibility as measured at the wind farm exceeds 5km;
 - infra-red lights to MoD specification installed on the nacelles of perimeter turbines, which consists of turbines 1, 2, 4, 6, 7, 8, 10, 12, 14, 15, 16 and 17.
7. The finalised CAA approved ANO lighting layout is shown in Figure 6 and the MOD IR lighting layout in Figure 7.

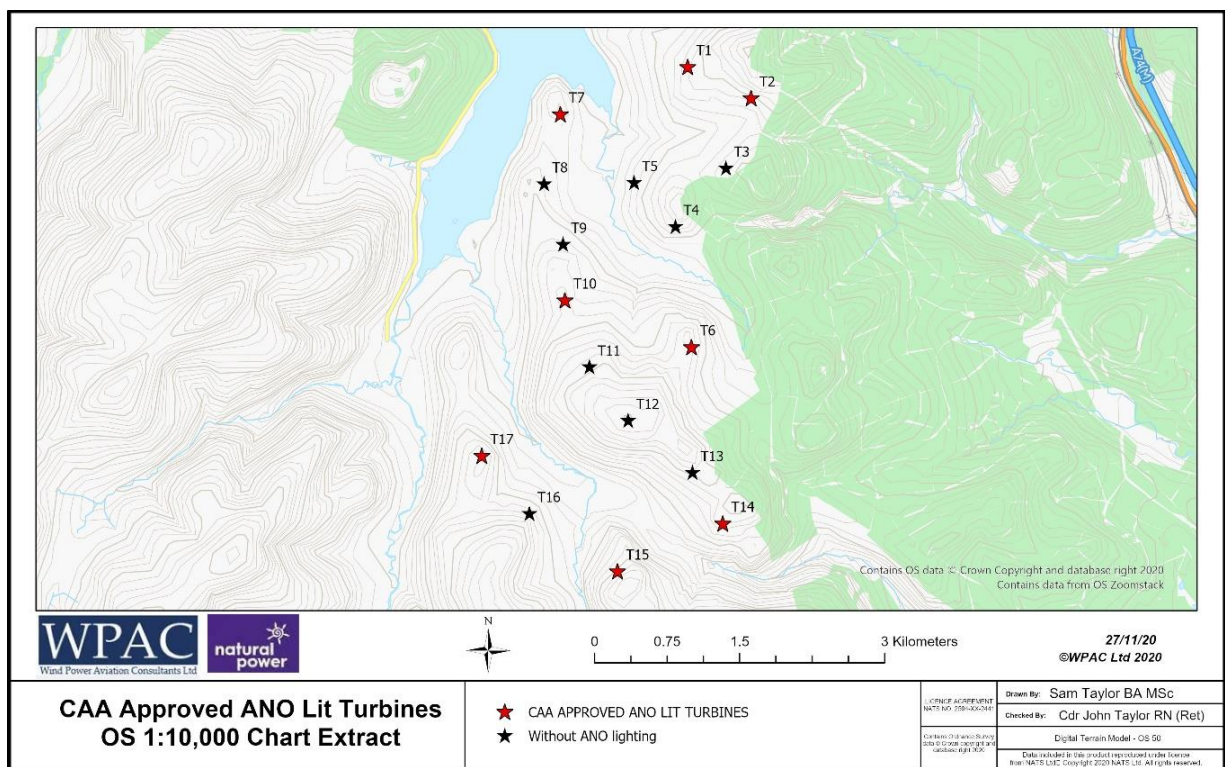


Figure 6

Intermediate Visible Red Lights on the Turbine Towers

8. The analysis so far has considered hub mounted 2000cd lights that are carefully focused to shine the main beam level and up when compared to the horizon. Downward spill of light is carefully controlled to keep the environmental effect to a minimum.

9. The new draft CAP 764 Version 7 also specifies less powerful 32cd lights to be fitted midway between the turbine hub and the ground. These lights are intended to provide pilots with improved awareness of the turbine site. The specification requires that the 32cd light has a level and up beam with no downward beam.
10. These lights have been used off-shore for many decades and have remained over-powered (up to 70cd) and unfocused with a significant downward light spill at full strength. The CAA has recognised that these lights represent an environmental problem and, until properly focused lights are available at the correct power, is offering a dispensation as follows: *'Intermediate level 32 candela lights are required to be fitted on the turbine towers, listed in the first bullet of paragraph 2, in accordance with the light distribution table given in Table 6-2 of ICAO Annex 14, Aerodromes. This requirement is given on the understanding that lights of this specific intensity and vertical beam profile would be available in the future; if the wind farm was constructed prior to these becoming available, the CAA would accept a temporary arrangement whereby lights of a higher intensity (e.g. 70cd) and unfocused (vertical beam profile) were included to fulfil the intermediate level lighting requirement'*.

Infra-Red Lighting Scheme – NVG/D Compatible Lighting

11. The MOD Guidance for turbine obstruction lighting requires the fitting of Infra Red lights that can be seen by military pilots operating on NVD/Gs. The MOD will require Infra Red lights on sufficient turbines for NVD/G users to identify the turbine site quickly and easily at night.
12. The Daer site has 17 turbines and a footprint of more than one square nautical mile (four square kilometres). Accordingly, it is defined as a medium site by the MOD and should be limited to a maximum of 10 IR lights to avoid NVG gain-down. However, in the Tactical Training Areas, where fast jet aircraft operate at high speed and low level at night, lighting all perimeter turbines will take priority.
13. The MOD will require perimeter turbines to be lit and a number of central turbines to provide 'depth perception' for approaching pilots and to fill any obvious gaps in the outer perimeter.
14. Figure 7 shows a lighting scheme that is compliant with the MOD Lighting Guidance in terms of perimeter turbines. Eight perimeter turbines are lit with IR lighting. However, as the perimeter lights are concentrated to the north and south of the site, extra central/gap fill lights are fitted to central turbines as shown in the Figure.
15. The MOD (DIO) confirmed by email on 20th November that the IR lighting scheme had been approved, stating: *Daer Reservoir (DIO 10045032) - This has been reassessed both technically and operationally as the layout has been updated since we were last consulted, I can confirm that the MOD is content with the lighting proposal you have provided. '*

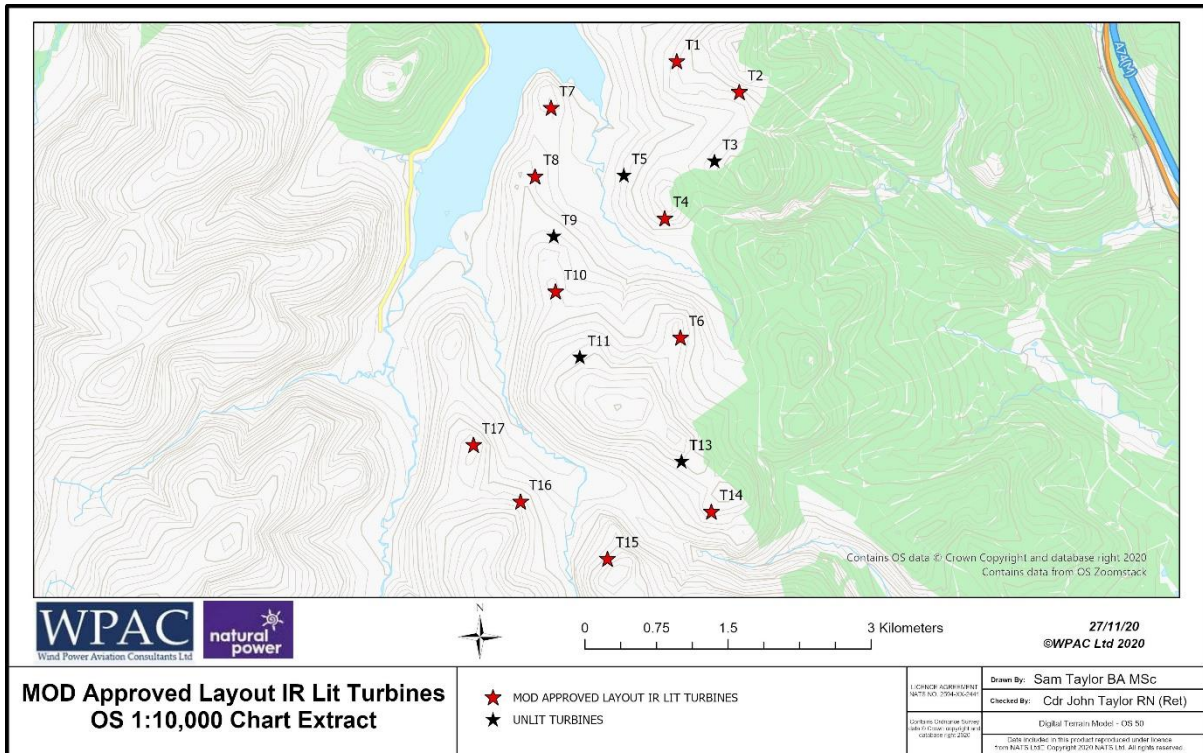


Figure 7