Technical Appendix 14.3: Edinburgh Airport IFP Assessment

Windburn Wind Farm

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Edinburgh Airport – Safeguarding Report – Windburn Windfarm

Assessment of Instrument Flight Procedures

Date: 02/10/23
Author: Daniel Figueras under supervision of Chris Latus
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Executive Summary

Osprey CSL has been commissioned by Edinburgh Airport to assess the impact of Windburn Windfarm, located approximately 20 NM to the north-west of the airport, with Wind Turbines of maximum tip height of 149.9m AGL (Above Ground Level).

This report assesses the windfarm in relation to the Instrument Flight Procedures (IFPs) serving Edinburgh Airport.

Impact on the IFPs

The windfarm will have no impact on the IFPs serving Edinburgh Airport.

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1 Introduction

1.1 Background

Osprey CSL has been commissioned by Edinburgh Airport to assess the impact of Windburn Windfarm, located approximately 20 NM to the north-west of the airport, with Wind Turbines of maximum tip height of 149.9m AGL (Above Ground Level).

1.2 Scope of the Assessment

This report assesses the development boundary location and height in relation to Instrument Flight Procedures (IFPs) and has been completed with the use of the Airport's 2021 CAP 1732 aerodrome survey data (EGPH-2021).

1.3 Data Provided by Client

Email dated 07/09/2023 provided the boundary for the windfarm site and confirmed a maximum Tip Height AGL of 149.9m.

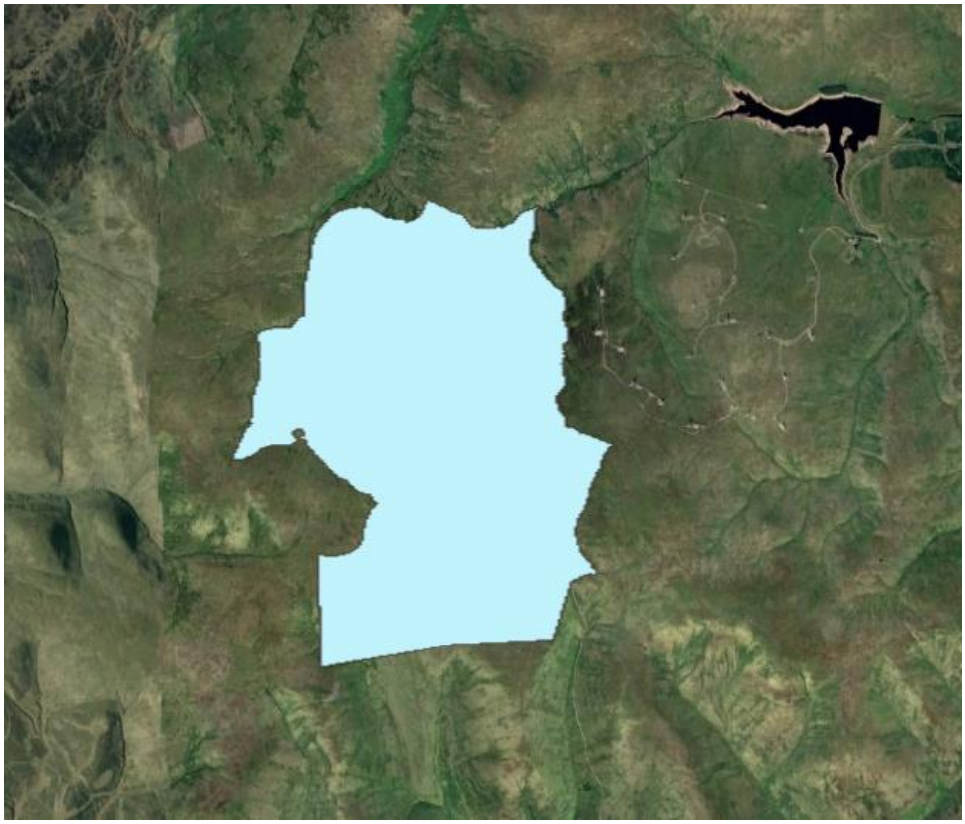

Figure 1 – Turbine Development Area © Unknown – Provided by client (Background Imagery from Google Earth © 2023 Maxar Technologies).

1.4 Assumptions and Transformations made to Data

The above data format was changed from KMZ and Shapefiles to DWG using Global Mapper software to be used in AutoCAD and with PDToolkit software.

In order to assess the windfarm against the IFPs, an Elevation Value Above Mean Sea Level (AMSL) needs to be established. To derive the Elevation AMSL at the position of the obstacles we need to source the maximum terrain elevation AMSL within the given development boundary.

Email dated 25/09/2023 confirmed (via the developer) the maximum ground elevation within the site is 570m AMSL.

Therefore, the maximum possible turbine elevation within the site is 570m + 149.9m = 719.9m. This maximum value will be used for assessment.

1.5 Final Obstacles and Orientation

The windfarm boundary was added to the AutoCAD Model, with an extra lateral buffer (tolerance) of 150m.

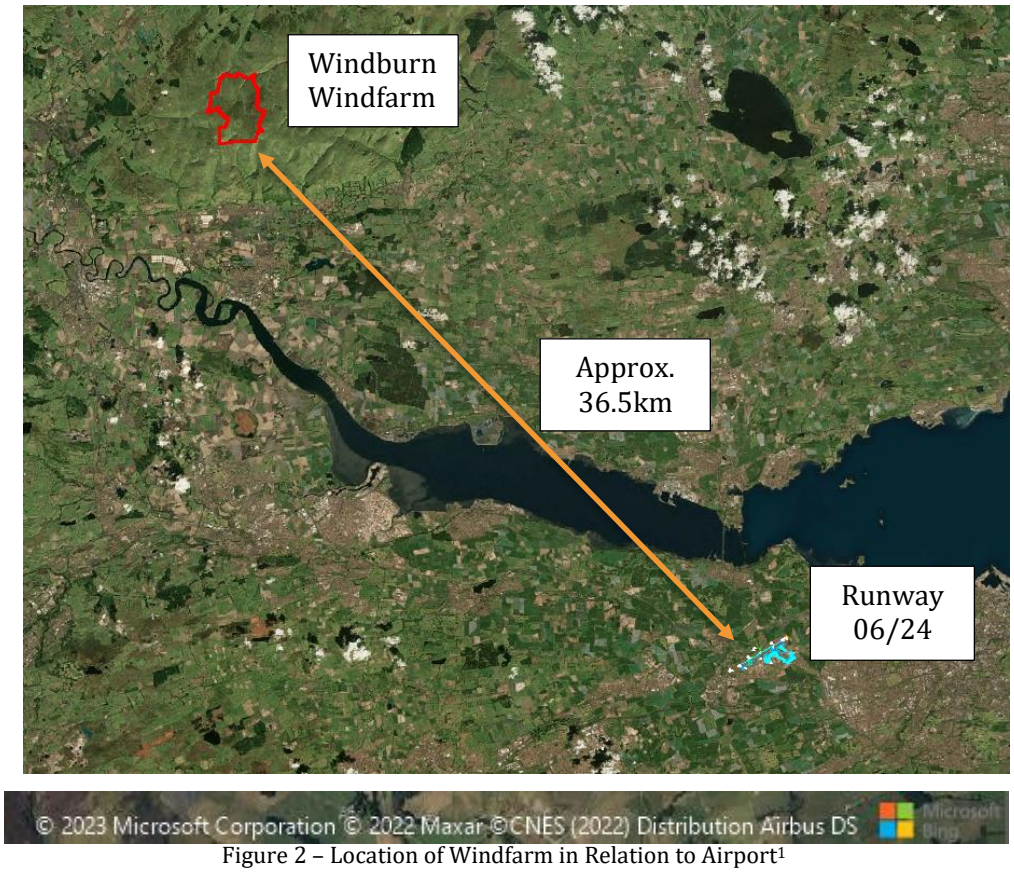

Figure 2 – Location of Windfarm in Relation to Airport[1]

[1] All Figures shown in this report (from this page onwards) that contain an Aerial Map Background, are from Autodesk AutoCAD 2019 embedded Online Maps Data – unless specified otherwise.
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2 IFP Safeguarding

2.1 General

The IFPs assessed are as follows:

AIRAC Effective 09/2023 (07 SEP 2023)

- AD 2.EGPH-5-1 ATCSMAC (25 Apr 2019);
- AD 2.EGPH-6-1 SID GOSAM (13 Jul 2023);
- AD 2.EGPH-6-2 SID TALLA (13 Jul 2023);
- AD 2.EGPH-6-3 SID GRICE (13 Jul 2023);
- AD 2.EGPH-7-1 STAR PTH 1G (06 Oct 2022);
- AD 2.EGPH-7-2 STAR INPIP 1E (06 Oct 2022);
- AD 2.EGPH-7-3 STAR AGPED 1E (06 Oct 2022);
- AD 2.EGPH-7-4 STAR GIRVA 1E (06 Oct 2022);
- AD 2.EGPH-7-5 STAR TUNSO 1E (06 Oct 2022);
- AD 2.EGPH-8-1 ILS/DME/NDB(L) RWY 06 (13 Jul 2023);
- AD 2.EGPH-8-2 LOC/DME/NDB(L) RWY 06 (13 Jul 2023);
- AD 2.EGPH-8-3 NDB/DME RWY 06 (13 Jul 2023);
- AD 2.EGPH-8-4 ILS/DME/NDB(L) RWY 24 (13 Jul 2023);
- AD 2.EGPH-8-5 LOC/DME/NDB(L) RWY 24 (13 Jul 2023);
- AD 2.EGPH-8-6 NDB(L)/DME RWY 24 (13 Jul 2023).

Additionally, the following were checked:

- Visual Circling
- Holding
- Visual Segment Surface
- Minimum Sector Altitudes

2.2 Assessment

2.2.1 Air Traffic Control Surveillance Minimum Altitude Chart (ATCSMAC)

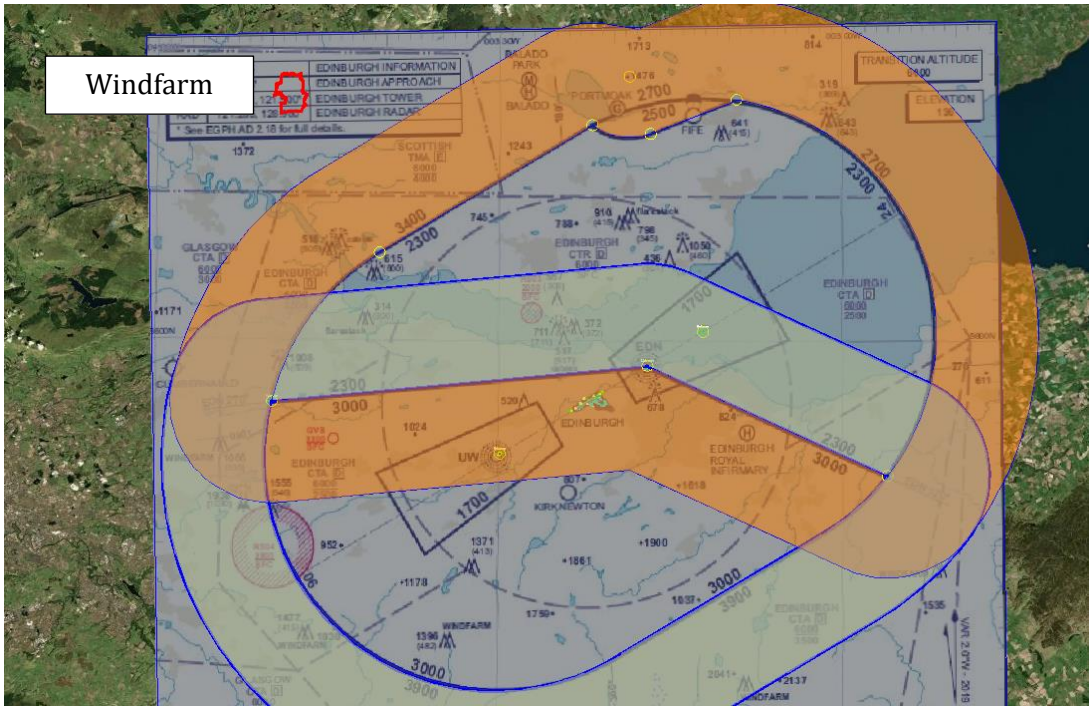

Figure 3 – ATCSMAC

The proposed windfarm lies outside the lateral confines of the Surveillance Minimum Altitude Areas (SMAA) and their associated buffers.

Beyond the SMAAs, the windfarm is within the Aerodrome Reference Point (ARP) Minimum Sector Altitude (MSA) areas – See Section 2.2.14 for this assessment (no impact).

The windfarm would have no impact on the ATCSMAC.

2.2.2 RWY 06 GOSAM 1D / TALLA 6D / GRICE 4D

Straight Departure Areas

The windfarm is outside the Straight Protection Areas for the SIDs departing RWY 06.

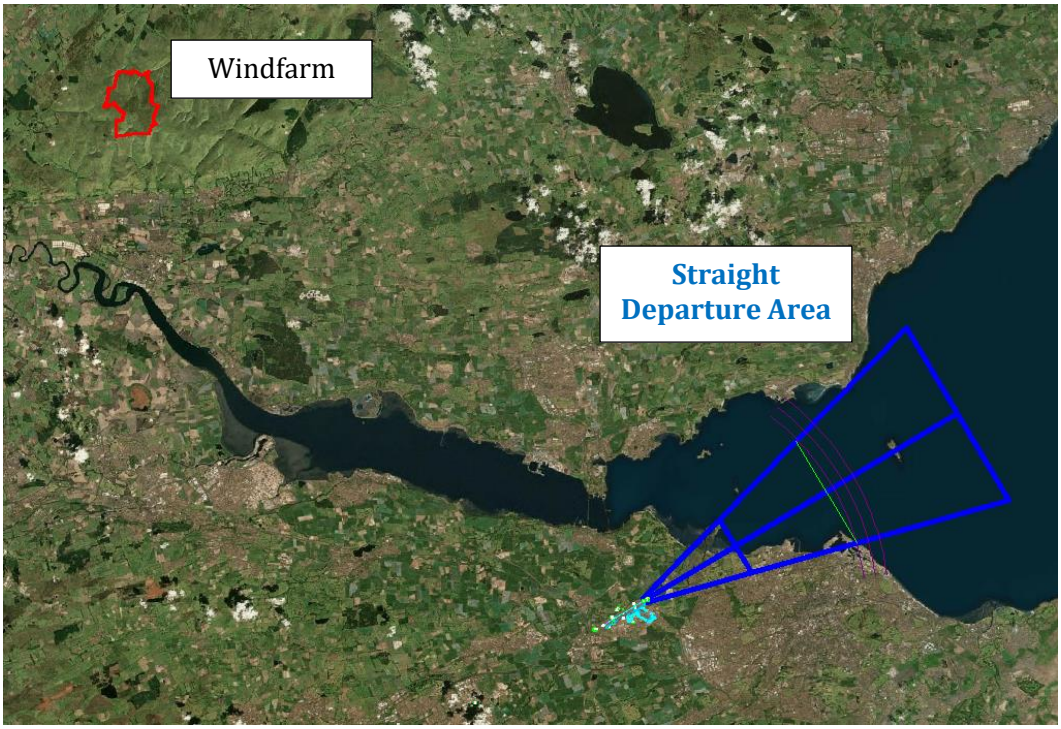

Figure 4 – RWY 06 Straight Departure Area

Turn Areas

The GOSAM 1D and GRICE 4D procedures turn LEFT towards the windfarm and might be impacted.

The TALLA 6D procedure turns RIGHT away from the windfarm and would be unaffected.

Further calculations have been made to consider the potential height of protection surfaces at the closest windfarm location:

Minimum ALT of Aircraft Required to Start Turn = 635ft / 193.548m.

Distance from KK/TIA to closest obstacle = 37067.08m.

Elevation of Aircraft at OBS = 193.548m + (37067.08m x 0.033) = 1416.76m / 4648ft.

The altitude aircraft would have reached at the closest windfarm location is 1416.76m / 4648ft.

The required elevation to clear the highest turbine tip height of 149.9m (719.9m AMSL) with maximum MOC for SIDs (300m) would be = 719.9m + 300m MOC = 1019.9m / 3347ft.

The proposed windfarm would have no impact on the RWY 06 GOSAM 1D/ TALLA 6D / GRICE 4D SIDs.

2.2.3 RWY 24 GOSAM 1C / TALLA 6C / GRICE 3C

Straight Departure Areas

The windfarm is outside the Straight Protection Areas for the SIDs departing RWY 24.

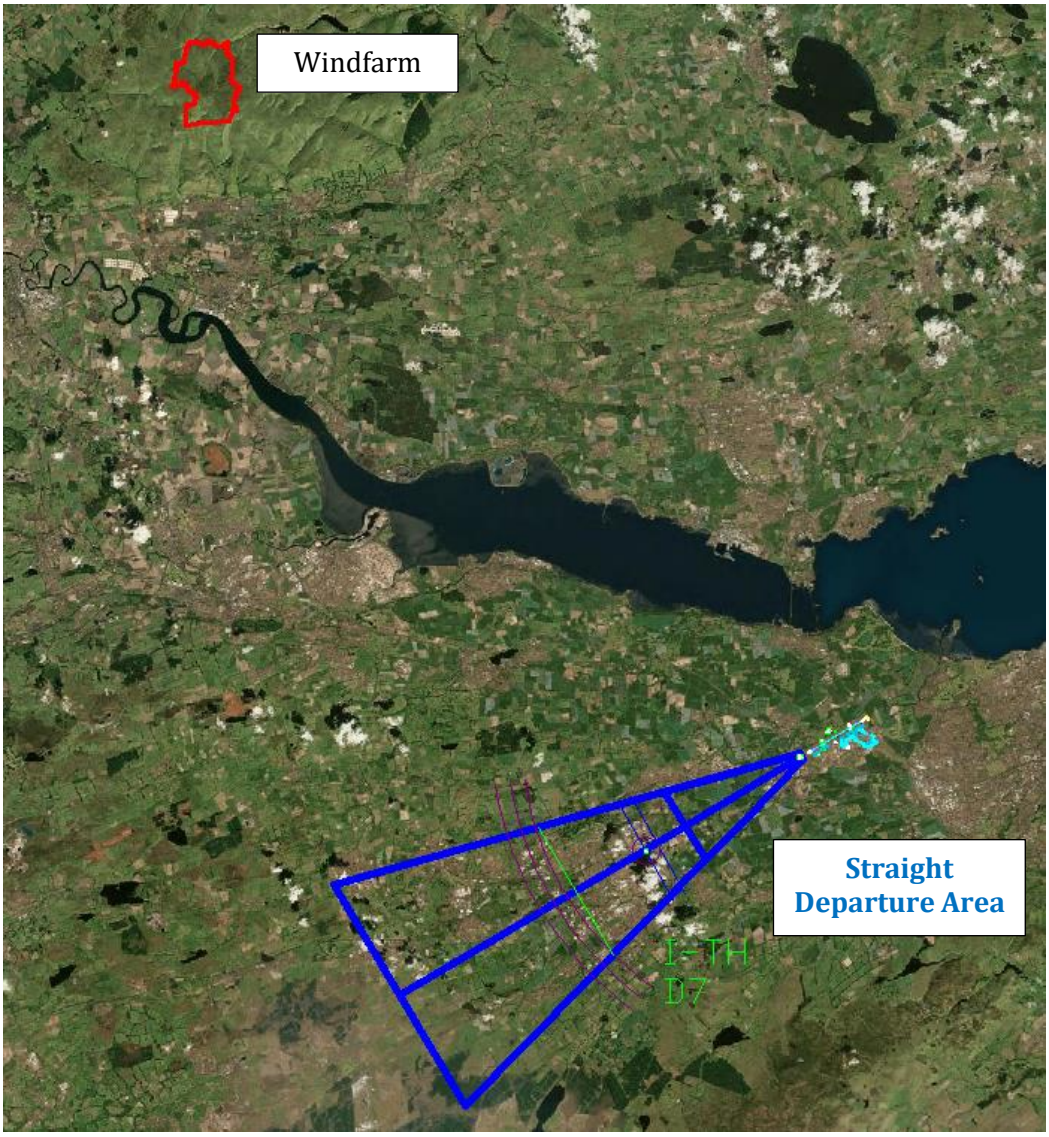

Figure 5 – RWY 24 Straight Departure Area

Turn Areas

The GOSAM 1C and GRICE 3C procedures turn RIGHT towards the windfarm and might be impacted.

The TALLA 6C procedure turns LEFT away from the windfarm and would be unaffected.

Further calculations have been made to consider the potential height of protection surfaces at the closest windfarm location:

Elevation of Aircraft at Early Turn Point (ETP) = 34.2m (TODA elev.) + 5m (height above TODA) + (7208.31m x 0.033) = 277.07m / 909ft.

Distance from ETP at NDB(L) UW to closest windfarm location = 33725.66m

Elevation of Aircraft at OBS = 277.07m + (33725.66m x 0.033) = 1390.01m / 4560ft.

The altitude aircraft would have reached at the closest windfarm location is 1390.01m / 4560ft.

The required elevation to clear the highest turbine tip height of 149.9m (719.9m AMSL) with maximum MOC for SIDs (300m) would be = 719.9m + 300m MOC = 1019.9m / 3347ft.

The proposed windfarm would have no impact on the RWY 24 GOSAM 1C / TALLA 6C / GRICE 3C SIDs.

2.2.4 AD 2.EGPH-7-1 STAR PTH 1G

AD 2.EGPH-7-2 STAR INPIP 1E

AD 2.EGPH-7-3 STAR AGPED 1E

AD 2.EGPH-7-4 STAR GIRVA 1E

AD 2.EGPH-7-5 STAR TUNSO 1E

All STARS (Standard Instrument Arrivals) terminate at FL70.

Maximum windfarm elevation plus the maximum MOC of 300m is:

719.9m + 300m MOC = 1019.9m / 3347ft.

This is below the termination altitude of the STARs.

The windfarm would have no impact on the published STARs.

2.2.5 ILS/DME/NDB(L) RWY 06 CAT I / CAT II

The proposed windfarm is outside the CAT I (yellow) and CAT II (green) Obstacle Assessment Surfaces (OAS) for the ILS.

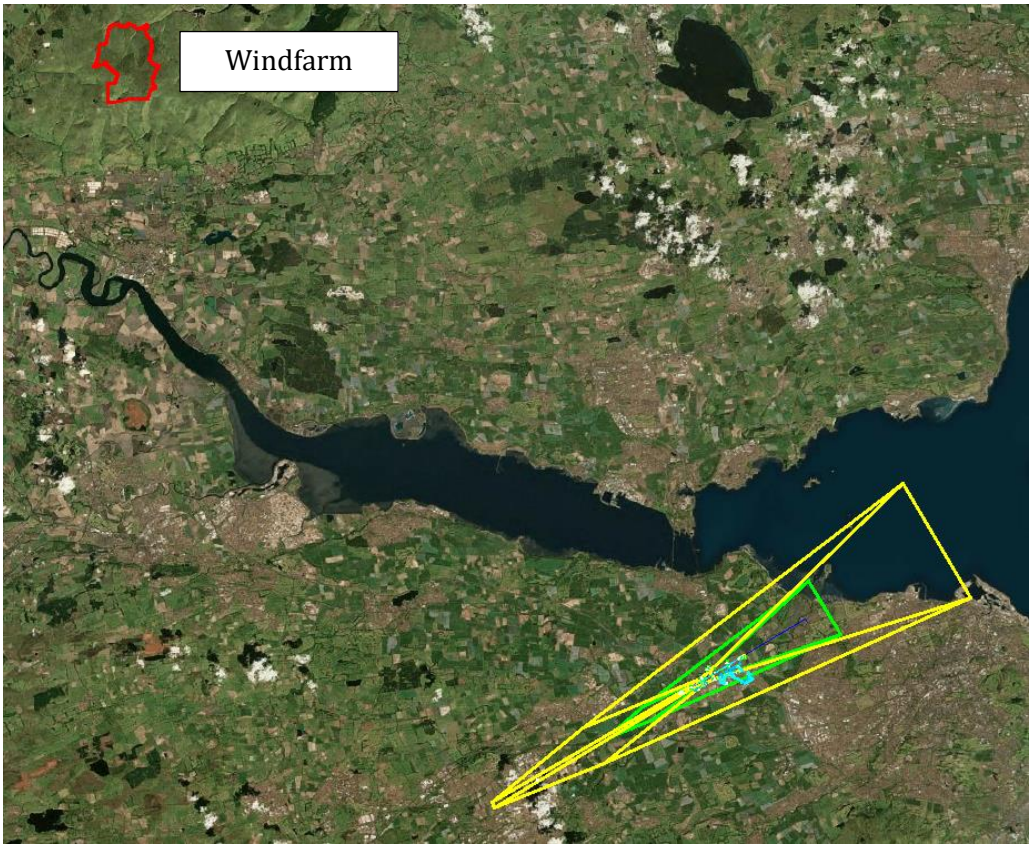

Figure 6 – ILS/DME/NDB(L) RWY 06 CAT I & CAT II

As the windfarm is outside the OAS Surfaces, it does not need to be taken into consideration for determination of the procedure OCA.

The windfarm would have a maximum arrival / initial MOCA of 3347ft (MOC 300m). This is below the FAF/FAP and reversal altitude of 4000ft, which would be unaffected.

The RCF (Radio Communication Failure) missed approach turns left after reaching 3000ft. The required final Missed Approach MOC to clear the turbines is 50m, which enforces a minimum turning altitude of 719.9m + 50m = 769.9m / 2526ft. This is below the actual RCF turning altitude and therefore the missed approach is unaffected.

The windfarm would have no impact on the published ILS CAT I & CAT II RWY 06.

2.2.6 LOC/DME/NDB(L) RWY 06

See Section 2.2.5 (common protection areas and FAF/FAP and reversal minima).

The windfarm is outside the intermediate approach areas and would not affect the intermediate segment MOCA of 2500ft.

The proposed windfarm would have no impact on the published LOC/DME/NDB(L) RWY 06 procedure.

2.2.7 NDB/DME RWY 06

The proposed windfarm is outside the Final and Missed approach protection area of the NDB(L) UW Navigation Splay, therefore it would not impact the procedure OCA.

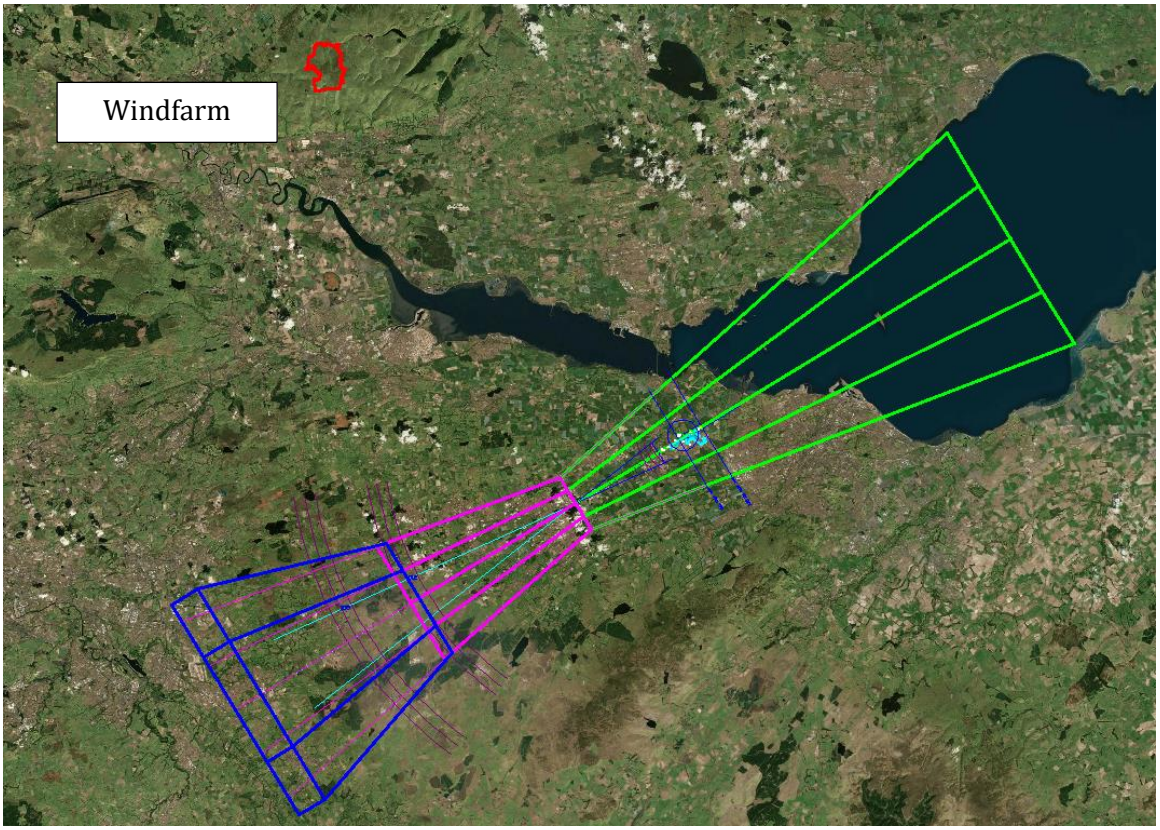

Figure 7 – NDB/DME RWY 06

The windfarm would have a maximum arrival / initial MOCA of 3347ft (MOC 300m). This is below the FAF/FAP and reversal altitude of 4000ft, which would be unaffected.

The windfarm is outside the intermediate approach areas and would not affect the intermediate segment MOCA of 2500ft.

The RCF missed approach turns left after reaching 3000ft. The required final Missed Approach MOC to clear the turbines is 50m, which enforces a minimum turning altitude of 719.9m + 50m = 769.9m / 2526ft. This is below the actual RCF turning altitude and therefore the missed approach is unaffected.

The windfarm would have no impact on the published NDB/DME RWY 06 procedure.

2.2.8 ILS/DME/NDB(L) RWY 24 CAT I / CAT II

The proposed windfarm is outside the CAT I (cyan) and CAT II (brown) OAS for the ILS. They are also outside the Missed Approach protection areas.

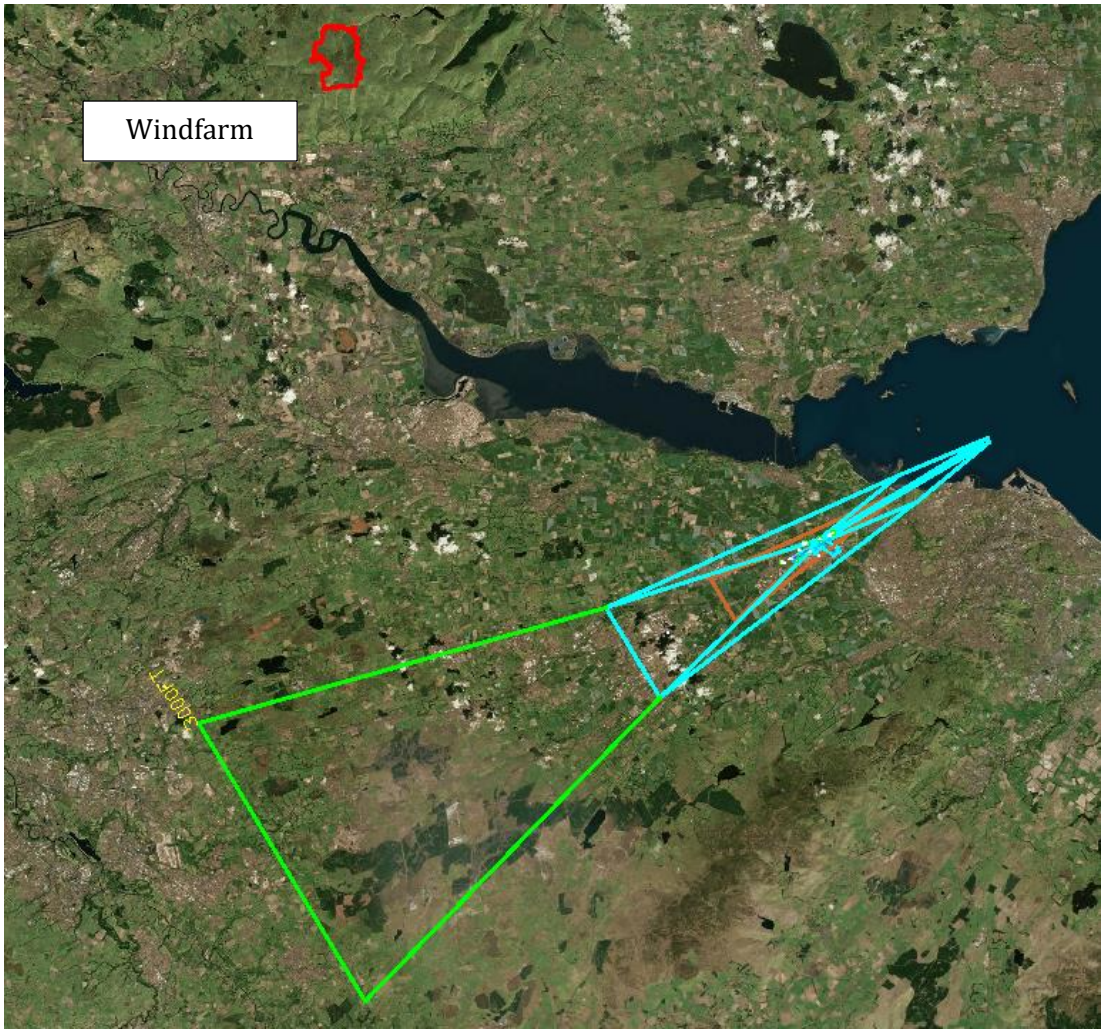

Figure 8 – ILS/DME/NDB(L) RWY 24 CAT I & CAT II

As the windfarm is outside the OAS Surfaces, they do not need to be taken into consideration for determination of the procedure OCA.

The RCF missed approach turns right after reaching 3000ft. The required final Missed Approach MOC to clear the turbines is 50m, which enforces a minimum turning altitude of 719.9m + 50m = 769.9m / 2526ft. This is below the actual RCF turning altitude and therefore the missed approach is unaffected.

Initial Approach Racetrack & Direct Arrival via VOR DME TLA

The proposed windfarm lies outside the protection areas associated with the initial approach racetrack on NDB(L) EDN, therefore it does not need to be considered towards the minimum altitude for the racetrack (currently published as 3000ft).

Additionally, the proposed windfarm lies outside the protection areas associated with the direct arrival via VOR DME TLA.

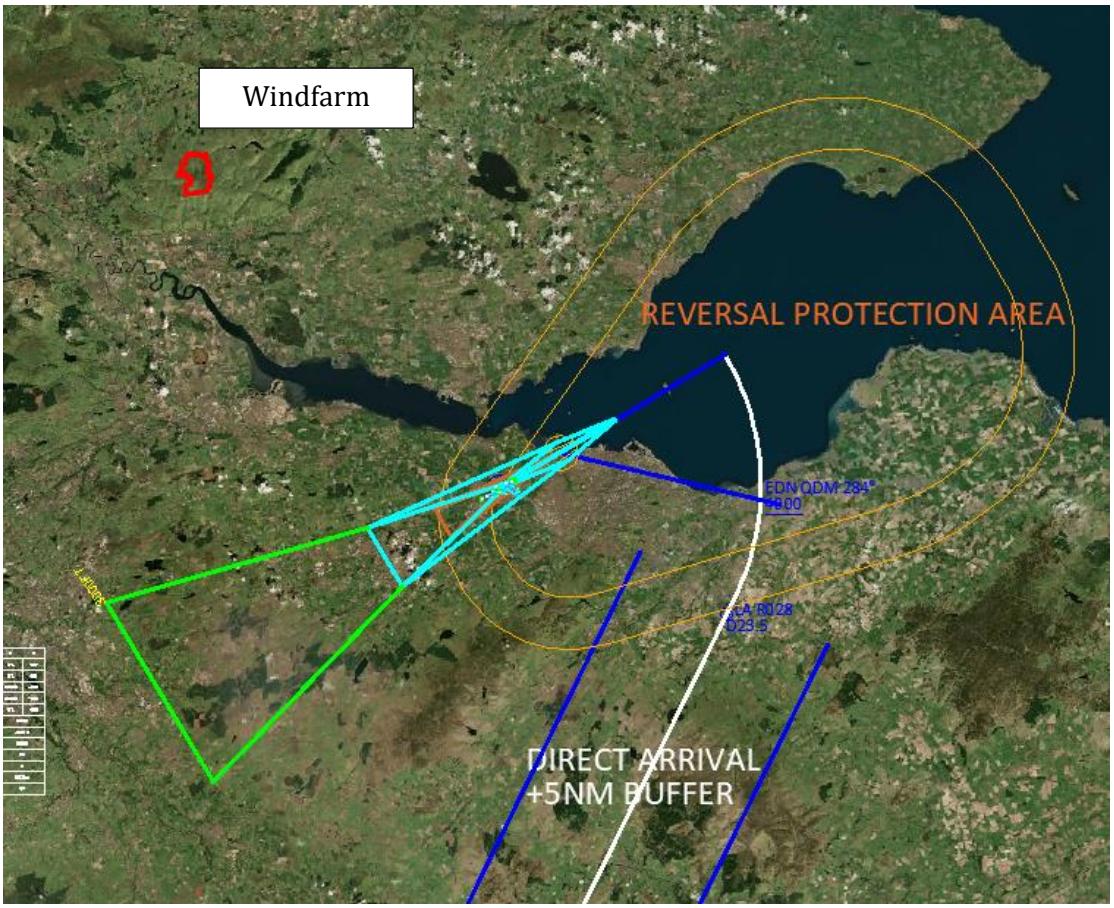

Figure 9 – ILS RWY 24 Racetrack and Direct Arrivals vs Windfarm

The proposed windfarm would have no impact on the published ILS CAT I & CAT II RWY 24.

2.2.9 LOC/DME/NDB(L) RWY 24

See Section 2.2.8 (common protection areas including Racetrack and Direct Arrivals).

The proposed windfarm would have no impact on the published LOC/DME/NDB(L) RWY 24 procedure.

2.2.10 NDB(L)/DME RWY 24

The proposed windfarm is outside the Final and Missed Approach protection area of the NDB(L) EDN Navigation Splay; therefore it would not impact the procedure OCA.

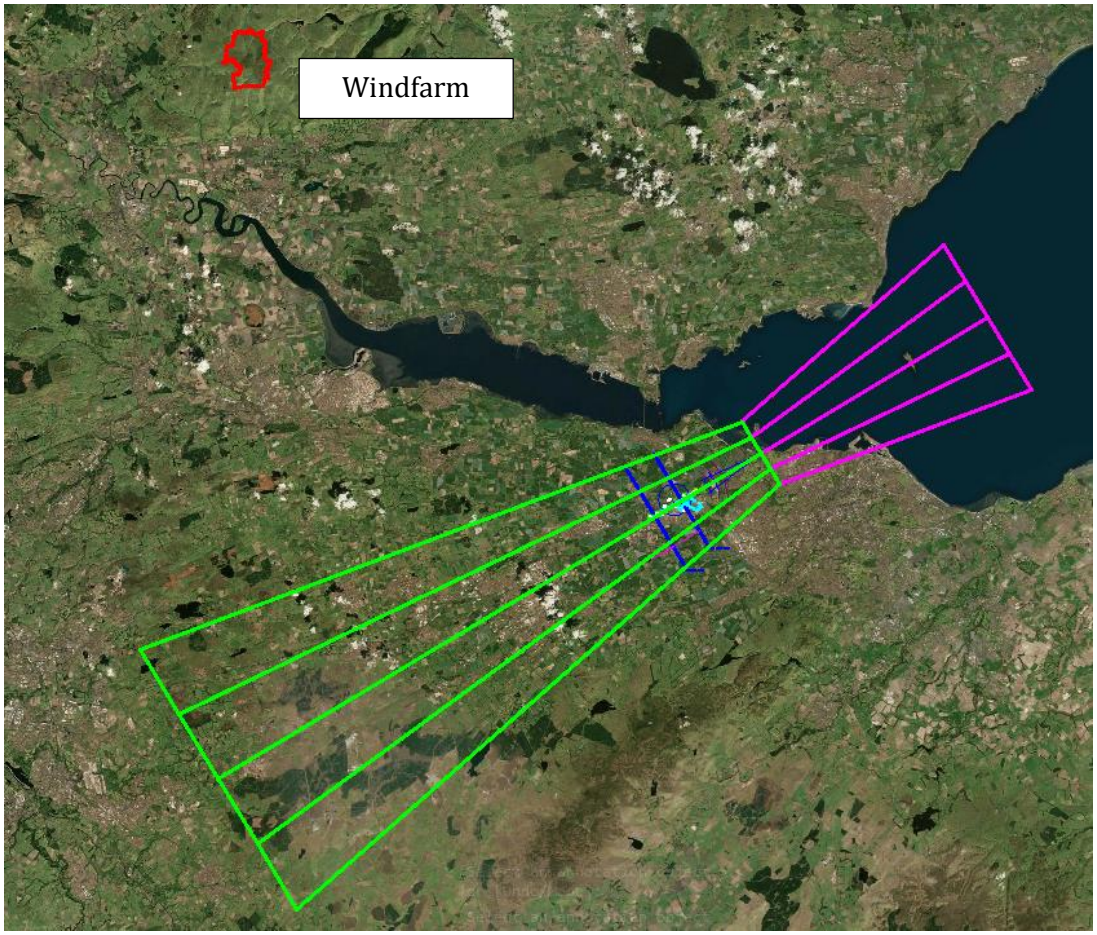

Figure 10 - NDB(L)/DME RWY 24

The RCF missed approach turns right after reaching 3000ft. The required final Missed Approach MOC to clear the turbines is 50m, which enforces a minimum turning altitude of 719.9m + 50m = 769.9m / 2526ft. This is below the actual RCF turning altitude and therefore the missed approach is unaffected.

As seen in Section 2.2.8 the initial approach racetrack on NDB(L) EDN remains unaffected as well.

The windfarm would have no impact on the published NDB(L)/DME RWY 24 procedure.

2.2.11 Visual Circling

The proposed windfarm is outside the Visual Manoeuvring Circling VM(C) Obstacle Clearance areas for all aircraft categories (A, B, C and D).

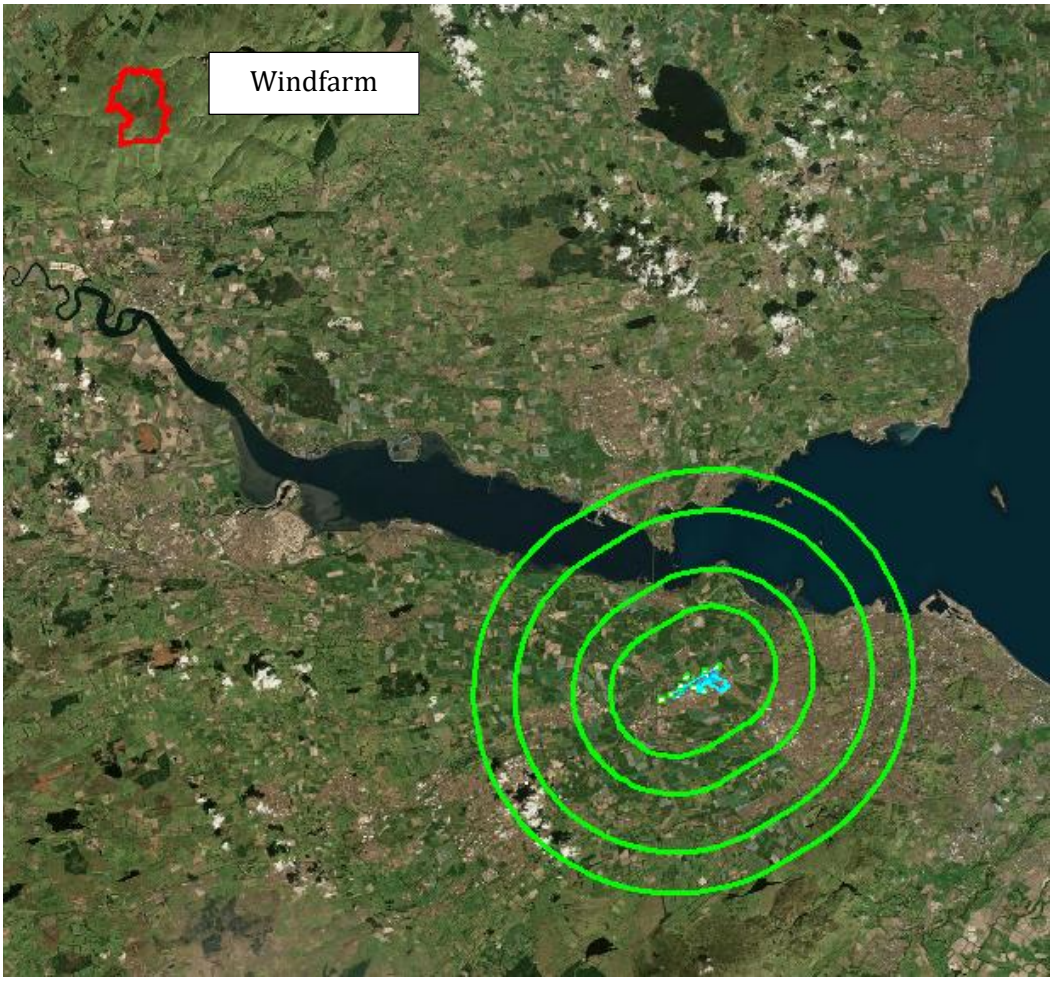

Figure 11 – Visual Circling Total Area

The windfarm would have no impact on the Visual Circling.

2.2.12 Holding

STAR Holds

The STAR Holds would be unaffected as their minimum altitude is FL70 – see Section 2.2.4.

NDB(L) UW Hold

The NDB(L) UW Hold has an existing Lowest Holding Altitude (LHA) 4000ft.

With a maximum MOC of 300m the windfarm would not impact the hold:

- 719.9m + 300m MOC = 1019.9m / 3347ft.
- Existing LHA = 4000ft.

NDB(L) EDN Hold

The NDB(L) EDN Hold has an existing LHA of 3000ft.

With a maximum MOC of 300m the windfarm could potentially impact the hold:

- 719.9m + 300m MOC = 1019.9m / 3347ft.
- Existing LHA = 3000ft.

However, it was determined the windfarm is outside of the lateral protection areas and buffers for the NDB(L) EDN Hold, therefore not causing any impact to its LHA:

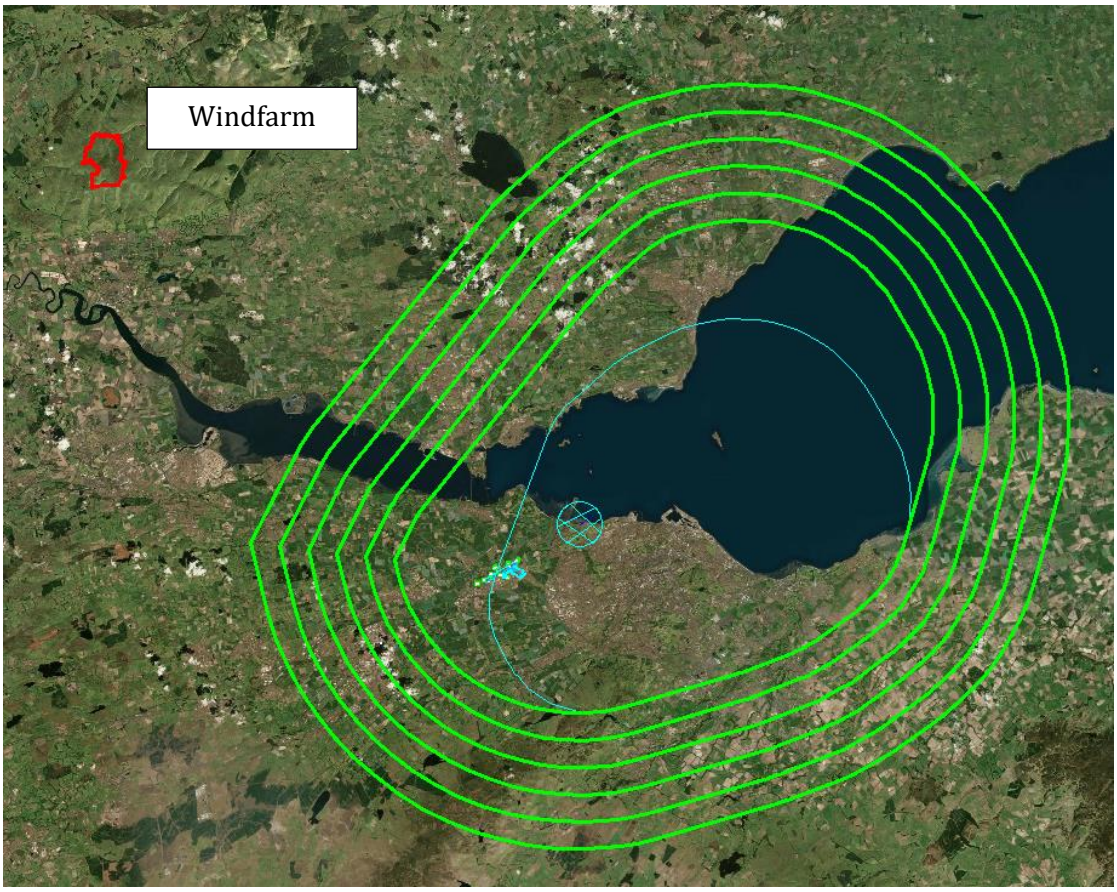

Figure 12 – NDB(L) EDN Hold

The windfarm would have no impact on any of the holds for Edinburgh Airport.

2.2.13 Visual Segment Surface (VSS)

The windfarm lies outside of the VSS for both Runway 06 and Runway 24.

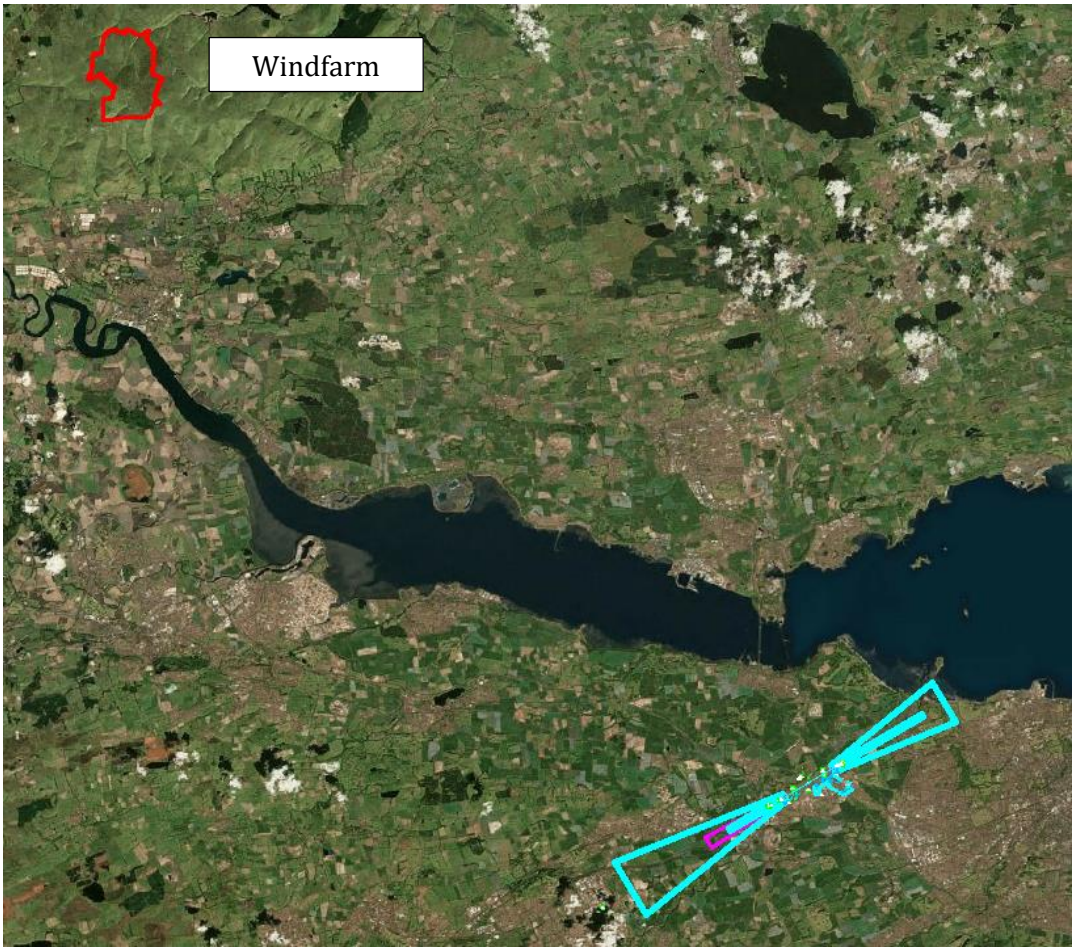

Figure 13 – RWY 06 & RWY 24 VSS

The windfarm would have no impact on any of the VSS.

2.2.14 Minimum Sector Altitudes (MSA)

MSA 25NM NDB(L) UW

The proposed windfarm lies within the north-western quarter of the MSA 25NM NDB(L) UW, which published MSA is 3400ft. The windfarm does not need to be considered towards any other sector of the MSA as it is outside their protection areas and associated buffers.

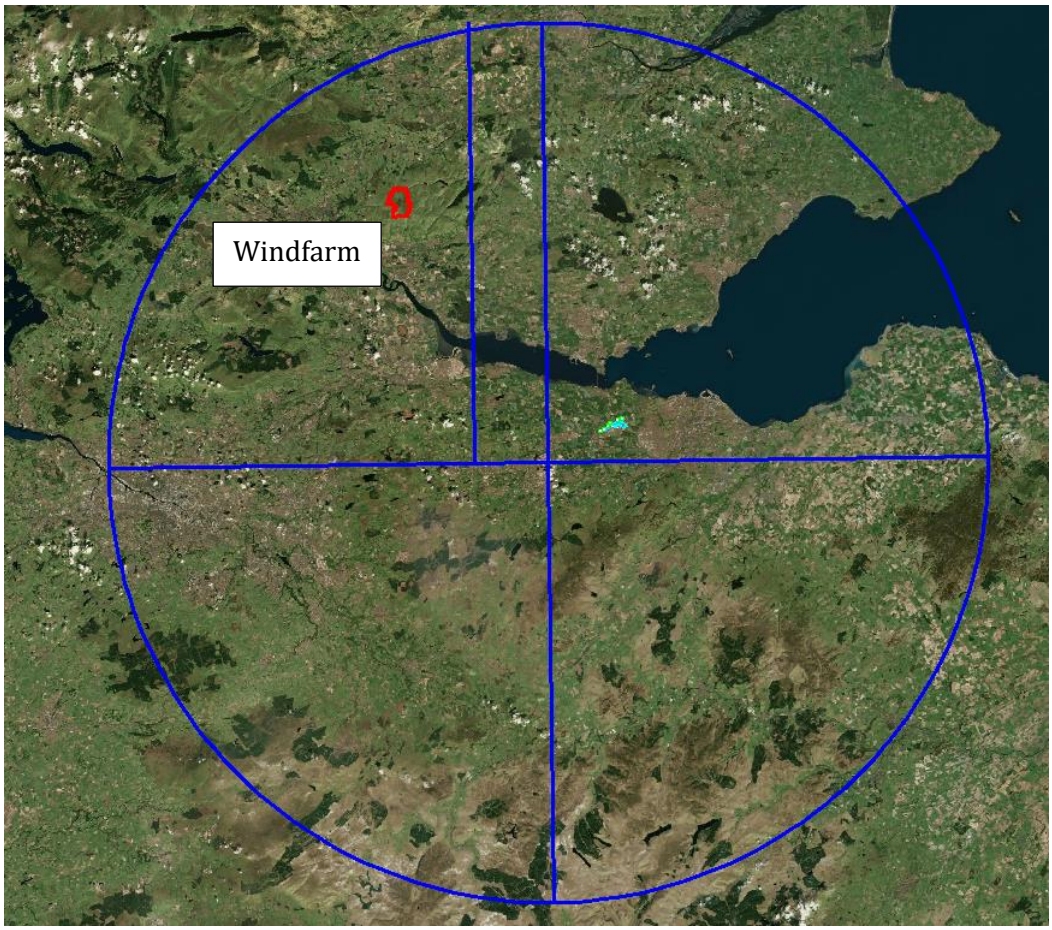

Figure 14 – NDB(L) UW MSA vs Windfarm

The proposed windfarm would produce a MOCA of 719.9m + 300m = 1019.9m / 3347ft. This is below the NW quadrant published MSA which has a MOCA of 3400ft.

The proposed windfarm would have no impact on the published NDB(L) UW MSA.

MSA 25NM NDB(L) EDN

The proposed windfarm lies within the north-western quarter of the MSA 25NM NDB(L) EDN, which published MSA is 3400ft. The windfarm does not need to be considered towards any other sectors of the MSA as it is outside their protection areas and associated buffers.

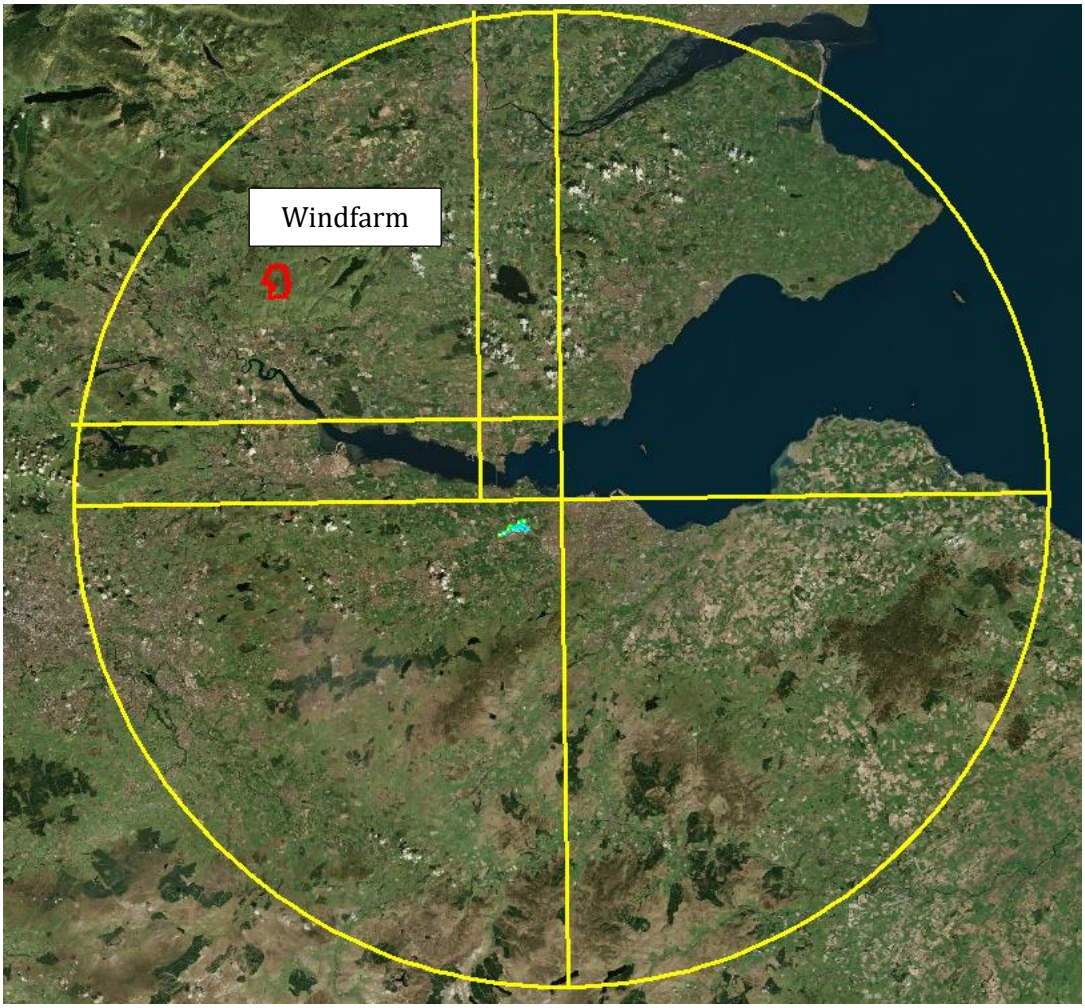

Figure 15 – NDB(L) EDN MSA vs Windfarm

The proposed windfarm would produce a MOCA of 719.9m + 300m = 1019.9m / 3347ft. This is below the NW quadrant published MSA which has a MOCA of 3400ft.

The proposed windfarm would have no impact on the published NDB(L) EDN MSA.

MSA 25NM ARP

We have additionally protected for an MSA based on the ARP owing to the fact the minimum levels shown outside the ATCSMAC are based on the ARP as per note 4 in the ATCSMAC chart:

"4. Minimum Sector Altitudes are based on obstacles and spot heights within 25NM of the Aerodrome Reference Point".

The proposed windfarm lies within the north-western quarter of the MSA 25NM ARP, which published MSA is 3400ft. The windfarm does not need to be considered towards any other sectors of the MSA as it is outside their protection areas and associated buffers.

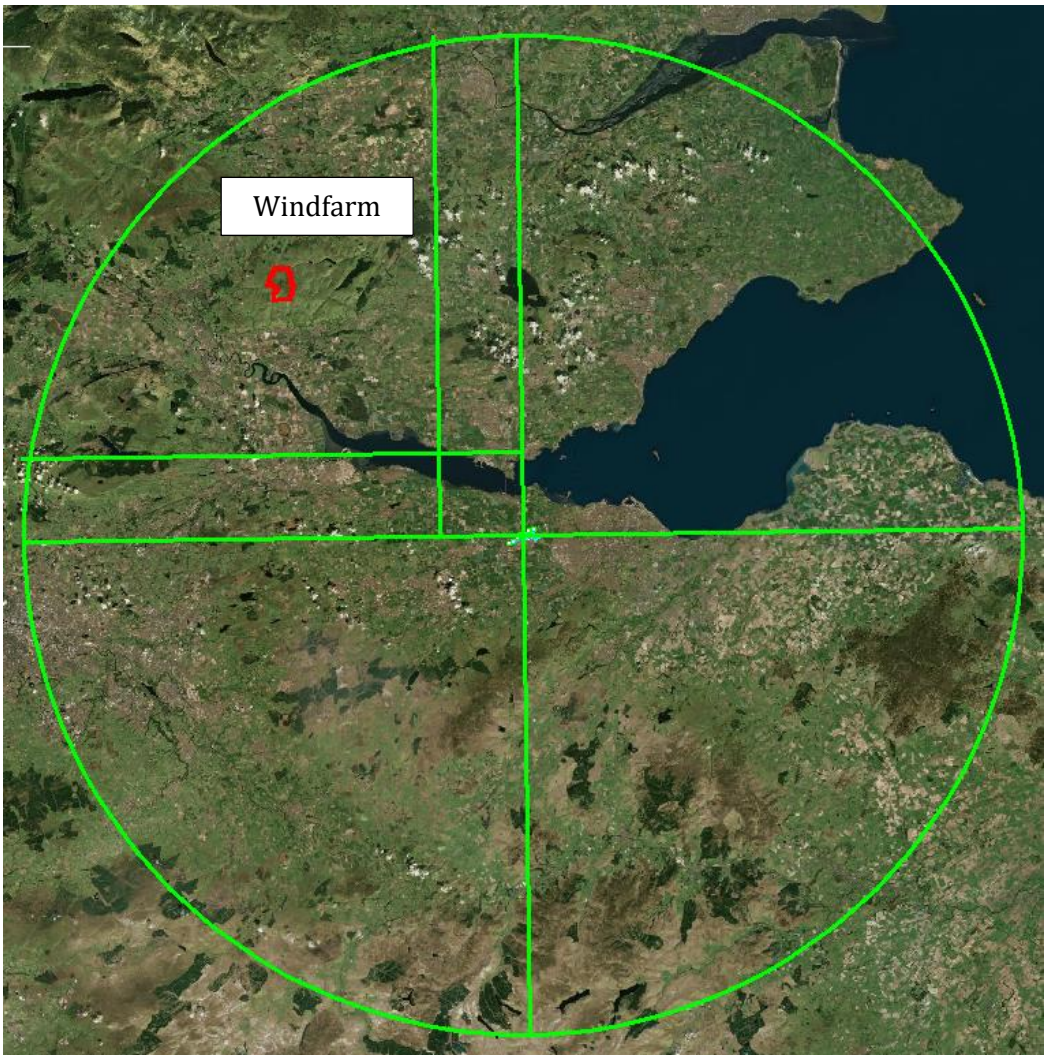

Figure 16 –ARP MSA vs Windfarm

The proposed windfarm would produce a MOCA of 719.9m + 300m = 1019.9m / 3347ft. This is below the NW quadrant published MSA which has a MOCA of 3400ft.

The proposed windfarm would have no impact on the published ARP MSA.

3 Conclusions

Impact on the IFPs

IFPs are not impacted by the windfarm.