

V 1.0



**Firlough wind farm  
Sligo Airport  
Special Aeronautical Study**



# Firlough wind farm Special aeronautical study

## 0. Document Information

Document title	Firlough wind farm Special aeronautical study
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### 0.1 *Copyright Statement*

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### 0.2 *Document versions*

Version No.	Pages affected	Date
ASAP internal		
0.1	All	22.12.2022
Customer		
1.0	All	23.12.2022

### 0.3 *Document version trail*

Version 0.1	Name	Date
Assessment done by procedure designer	Gabriella Laki	21.12.2022
Check and final sign-off by senior procedure designer*	Ian Whitworth	22.12.2022

\* By this sign-off, the Senior Procedure Designer confirms that a full verification of the correctness (to the best of his/her knowledge) of the contents of this Special aeronautical study has been carried out and conforms to the latest version of ICAO Doc 8168 (Aircraft Operations) Volume II.

### 0.4 *Procedure designer concerns*

I Gabriella Laki have no specific concerns and consider that all safety issues concerning the proposed Firlough wind farm are covered in this document.

## 0.5 Abbreviations used

A/C.	Aircraft
Alt.	Altitude
Alt. Req.	Altitude Required
ARP	Aerodrome Reference Point
ATT	Along-track tolerance
AMSL	Above Mean Sea Level
Cat.	Category
Cont.	Controlling
Diff.	Difference
Dist.	Distance
Eq. Alt.	Equivalent Altitude
ETP	Earliest Turning Point
FAF	Final Approach Fix
FAP	Final Approach Point
FAS	Final Approach Segment
FAWP	Final Approach Waypoint
FHP	Fictitious Heliport Point
HL	Height Loss
HRP	Heliport Reference Point
IAS	Indicated Air Speed
IAWP	Initial Approach Waypoint
IFR	Instrument flight rules

Int. Seg.	Intermediate Segment
ISA	International Standard Atmosphere
IWP	Intermediate Approach Waypoint
MAPt	Missed Approach Point
MACG	Missed approach climb gradient
MOCA	Minimum obstacle clearance altitude
MRVA	Minimum Radar Vectoring Altitude
OAS	Obstacle Assessment Surface
OCA	Obstacle clearance altitude
PAPI	Precision Approach Path Indicator
Pub.	Published
Req.	Required
RDH	Reference Datum Height
RWY	Runway
SOC	Start of Climb
Surf.	Surface
TAA	Terminal Arrival Altitude
TAS	True Air Speed
THR	Threshold
VFR	Visual flight rules
VPA	Vertical Path Angle
XTT	Cross-track tolerance

### 0.5.1 Obstacle assessment tables and abbreviations

- Obstacle data:**

ID	Latitude	Longitude	Alt.	VT

- **I**dentification, **P**osition, **A**ltitude and **V**ertical **T**olerance

- Assessment parameters:**

Area	Dist. in	Do	Dz	Dr	DCA	HL	MOC

- Obstacle protection **A**rea (primary [**P**], secondary [**S**] or buffer [**B**]).
- **D**istance from the **i**nnner edge of the secondary area.
- **D**istance to **o**bstacle (Do/Dz/Dr).
- **D**istance to **C**limb **A**ltitude
- **H**eight **L**oss applied.
- **M**inimum **O**bstacle **C**learance applied.

- Calculated values:**

Surf. alt.	Diff.	Ac. alt.	Alt. req.

- Obstacle protection **S**urface **a**ltitude at position.
- **D**ifference between obstacle altitude and surface altitude.
- **A**ircraft **a**ltitude at obstacle position.
- **A**ltitude **r**equired to clear obstacle.

- Results:**

OCA	MACG (%)	PDG (%)	Cont.	Close-in	Disreg.

- Minimum **O**bstacle **C**learance **A**ltitude.
- **MACG**.
- **P**rocedure **D**esign **G**radient
- **C**ontrolling obstacle or **N**ot.
- Considered **C**lose-**i**n obstacle or **N**ot.
- Obstacle can be **D**isregarded in the visual segment.



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# Firlough wind farm Special aeronautical study



## 1. General

This document details the Special aeronautical study that was done concerning the impact of the proposed Firlough wind farm on the flight procedures at Sligo airport (EISG), Ireland.

### 1.1 Geodesic datum

WGS-84, which was established as the working datum.

<b>Reference Latitude</b>	N 00° 00' 00"	<b>Semi Major Axis</b>	6378137 m
<b>Reference Longitude</b>	W 009° 00' 00"	<b>Eccentricity</b>	0.0818191908426215
<b>False Easting</b>	500000	<b>Scaling Factor</b>	0.9996
<b>False Northing</b>	0	<b>Projection Type</b>	Transverse Mercator

### 1.2 Altitude units

All altitudes and heights used in this study are in metres and all bearings are magnetic unless specified otherwise.

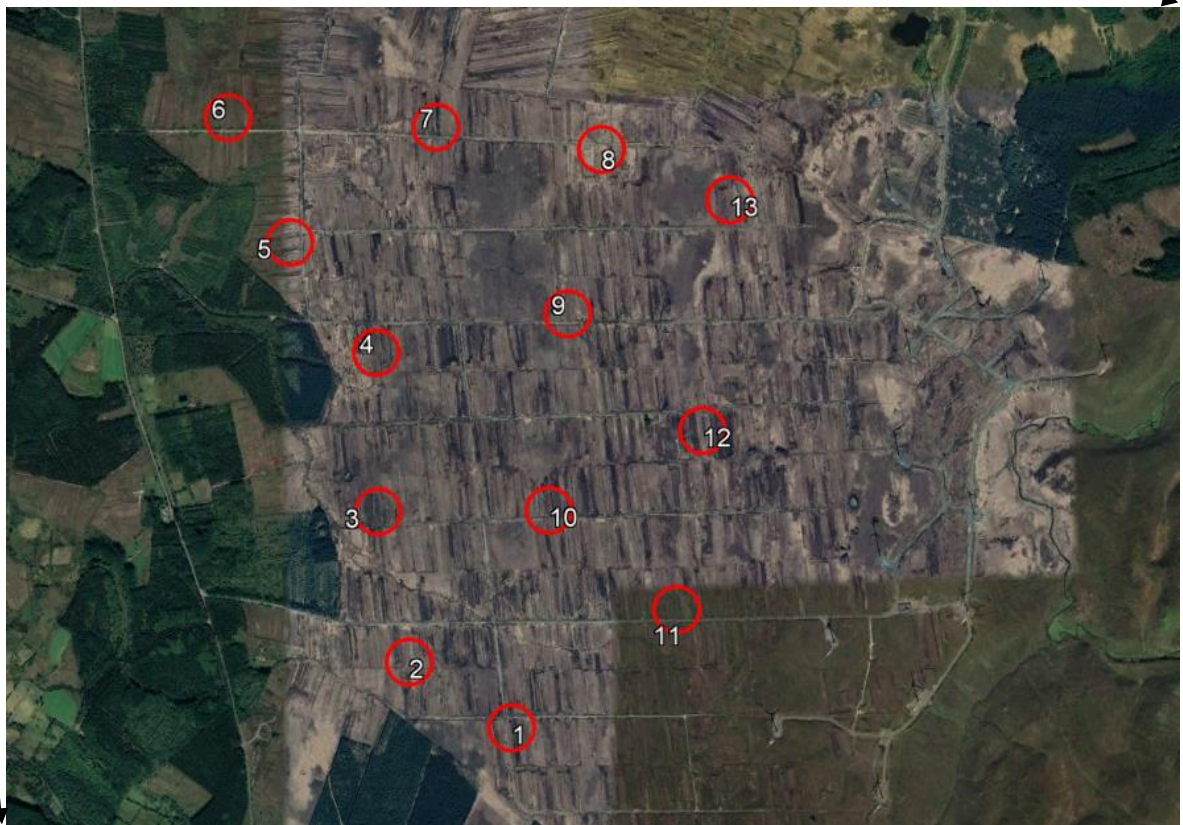
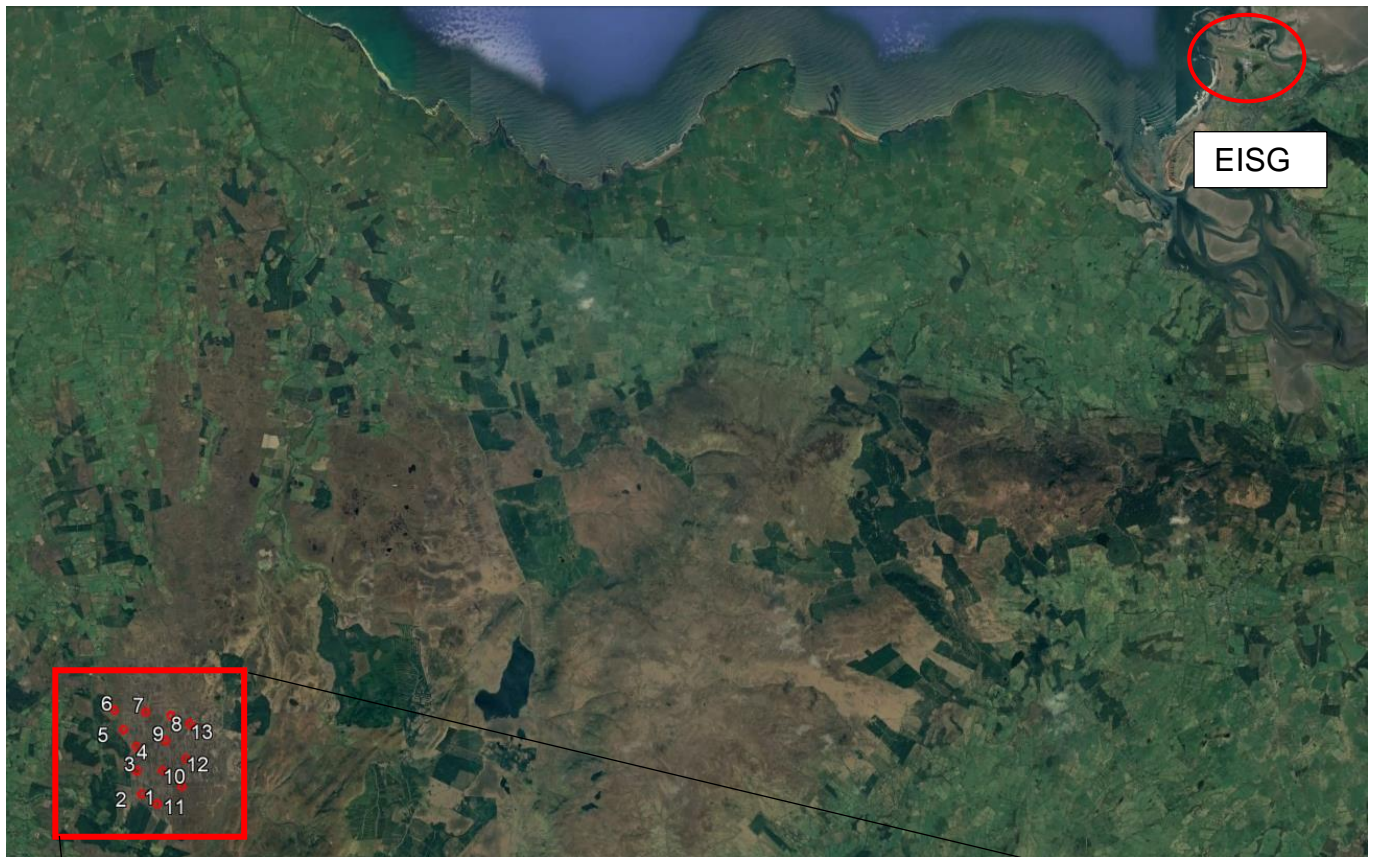
### 1.3 AIP data

Aeronautical information for Sligo airport was extracted from the Ireland AIP (01 DEC 22) and used in this study.

### 1.4 Proposed position and altitude

ID	Latitude (WGS84)	Longitude (WGS84)	Ground Elevation (meters AMSL)	Hub height	Turbine Blade length (m)	Elevation (meters AMSL)
Position 1	54°7'45.916618"	-8°58'25.149698"	144.104	107.5	77.5	290.354
Position 2	54°7'53.172305"	-8°58'44.530134"	134.392	107.5	77.5	280.642
Position 3	54°8'9.804473"	-8°58'50.480904"	130.049	107.5	77.5	276.299
Position 4	54°8'27.430378"	-8°58'50.845133"	126.994	107.5	77.5	273.244
Position 5	54°8'39.713431"	-8°59'7.253897"	114.476	107.5	77.5	260.726
Position 6	54°8'53.582386"	-8°59'19.122193"	110.589	107.5	77.5	256.839
Position 7	54°8'52.400006"	-8°58'39.529999"	129.053	107.5	77.5	275.303
Position 8	54°8'49.837896"	-8°58'8.225676"	139.364	107.5	77.5	285.614
Position 9	54°8'31.667567"	-8°58'14.557076"	139.032	107.5	77.5	285.282
Position 10	54°8'9.938504"	-8°58'18.109671"	142.417	107.5	77.5	288.667
Position 11	54°7'58.998606"	-8°57'54.03566"	160.049	107.5	77.5	306.299
Position 12	54°8'18.721306"	-8°57'49.170792"	159.019	107.5	77.5	305.269
Position 13	54°8'44.171809"	-8°57'44.020475"	151.908	107.5	77.5	298.158

The highest structure of the proposed Firlough wind farm has an AMSL elevation of 306.3 m. In the following assessments this elevation was associated with all turbine positions but only position 11 is shown in this safety assessment document.



## 2. Approach procedures

The wind farm is situated in a distance of more than 14.5 NM from the ARP, therefore no further check of the final and missed approach procedures is required.

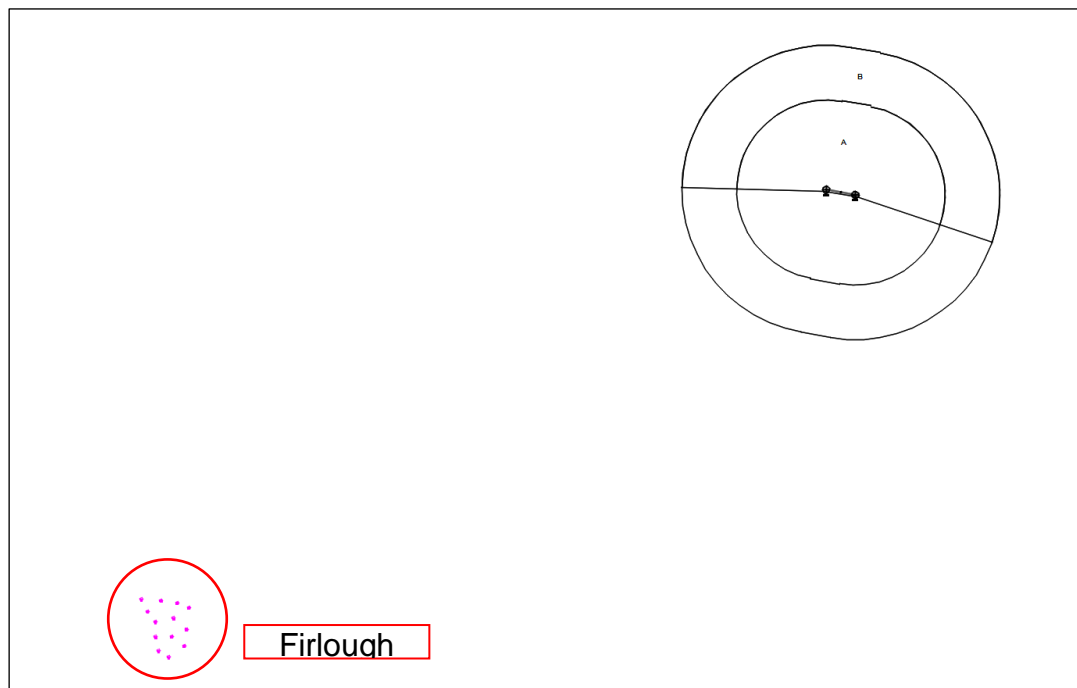
The ICAO minimum obstacle clearance (MOC) in the primary obstacle protection area for any arrival and initial approach segment is 300 m. If the published minimum OCA is greater than the elevation of the proposed structure plus the MOC of 300m then the structure is not critical for that procedure but if it is not then a more in-depth assessment would be required when the proposed structure is inside the obstacle protection areas. See the following table for this initial assessment.

ID	Alt.	MOC required	MOCA (ft)	IAF procedure altitude (ft)	MOC achieved
11	306.3	300.0	1989.2	3000	608.1

As can be seen in the previous table the 3000 ft procedure altitude is not affected by the Firlough wind farm.

Some of the procedures have a minimum obstacle clearance altitude (MOCA) of 1200ft in the initial approach segment. However, the minimum approach altitude prior to the IAFs, which are within 10 NM of the airport, is defined by MSA or TAA minimums. For these assessments see sections 5 Terminal arrival altitudes (TAAs) and 6 Minimum Safe Altitudes (MSAs).

## 3. Visual manoeuvring



As can be seen in the previous diagram, the wind farm is outside the visual circling obstacle protection area.

**The visual manoeuvring is not affected by the Firlough wind farm.**



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### 4. Holding procedures

The ICAO minimum obstacle clearance (MOC) in the primary obstacle protection area for a holding pattern is 300 m. If the published minimum OCA is greater than the elevation of the proposed structure plus the MOC of 300m then the structure is not critical for that procedure but if it is not then a more in-depth assessment would be required when the proposed structure is inside the obstacle protection areas. See the following table for this initial assessment.

ID	Alt.	MOC required	MOCA (ft)	Minimum holding altitude (ft)	MOC achieved
11	306.3	300.0	1989.2	3000	608.1

**The holding procedures are not affected by the Firlough wind farm.**

### 5. Terminal arrival altitudes (TAAs)

The ICAO minimum obstacle clearance (MOC) in a TAA sector is 300 m. If the published minimum OCA is greater than the elevation of the proposed structure plus the MOC of 300m then the structure is not critical for that procedure but if it is not then a more in-depth assessment would be required when the proposed structure is inside the obstacle protection areas. See the following table for this initial assessment.

ID	Alt.	MOC required	MOCA (ft)	TAA altitude (ft)	MOC achieved
11	306.3	300.0	1989.2	3000	608.1

**The TAAs are not affected by the Firlough wind farm.**

### 6. Minimum Safe Altitudes (MSAs)

The ICAO minimum obstacle clearance (MOC) in a MSA sector is 300 m. If the published minimum OCA is greater than the elevation of the proposed structure plus the MOC of 300m then the structure is not critical for that procedure but if it is not then a more in-depth assessment would be required when the proposed structure is inside the obstacle protection areas. See the following table for this initial assessment.

ID	Alt.	MOC required	MOCA (ft)	MSA altitude (ft)	MOC achieved
11	306.3	300.0	1989.2	2900	577.6

**The MSAs are not affected by the Firlough wind farm.**



## 7. Risk Assessment

### 7.1 Risk value explanation

To simplify the risk evaluation ASAP has created simplified risk assessment values from the guidelines as laid out in ICAO Safety Management Manual (SMM), document 9859 Part 6.

Included in the following ICAO table is how the ASAP risk assessment values correspond to the ICAO values.

**Table 6-1. ICAO Risk assessment matrix principles + ASAP values**

SEVERITY OF CONSEQUENCES			LIKELIHOOD OF OCCURRENCE			ASAP risk assessment	
Aviation definition	Meaning	Value	Qualitative definition	Meaning	Value	Meaning	Value
Catastrophic	Equipment destroyed. Multiple deaths.	5	Frequent	Likely to occur many times	5	High risk	5
Hazardous	A large reduction in safety margins, physical distress or a workload such that the operators cannot be relied upon to perform their tasks accurately or completely. Serious injury or death to a number of people. Major equipment damage.	4	Occasional	Likely to occur sometimes	4		
Major	A significant reduction in safety margins, a reduction in the ability of the operators to cope with adverse operating conditions as a result of an increase in workload, or as a result of conditions impairing their efficiency. Serious incident. Injury to persons.	3	Remote	Unlikely, but possible to occur	3	Medium Risk	3-4
Minor	Nuisance. Operating limitations. Use of emergency procedures. Minor incident.	2	Improbable	Very unlikely to occur	2	Low Risk	2
Negligible	Little consequence	1	Extremely improbable	Almost inconceivable that the event will occur	1		1



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### 7.2 Risk evaluation

Procedure	No risk - 0	Low risk - 1 to 2	Medium risk - 3 to 4	High risk - 5
RNP Y RWY 10	0			
RNP Z RWY 10	0			
NDB Y RWY 10	0			
NDB Z RWY 10	0			
RNP RWY 28	0			
NDB RWY 28	0			
Visual circling	0			
<b>Total assessed risk value</b>	<b>0</b>		<b>No risk</b>	

### 8. Conclusion

The Firlough wind farm will not affect the flight procedures at Sligo airport.

### 9. End of document