APPENDIX 15-6

ENET TELECOMMUNICATIONS IMAPCT ASSESSMENT REPORT

Report

Carrow Wind Farm
Enet Telecommunications
Impact Assessment Report

Document Number:

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Executive Summary

In 2024, Ai Bridges was commissioned to evaluate the possible impacts that the proposed wind farm at Carrow, Co Tipperary could have on existing telecommunications operator networks. The scope of work included field and desktop surveys to determine telecommunications network infrastructure that could be impacted by the proposed development. Consultations with telecom operators were also undertaken to assist in identifying network infrastructure that could be impacted by the proposed wind farm.

In the consultation response from Enet, seven microwave radio links were identified as potentially being impacted by the proposed wind turbines. The Enet radio links were subsequently modelled in radio planning software and a detailed impact analysis was carried out (2D and 3D). The findings of the impact analysis indicate that the proposed turbines would not obstruct any of the Enet radio links. However, it should be noted that the clearance distance between the blade-tip of one of the turbines (T09) and the Fresnel Zone of the Enet radio link between Laghtseefin and McMahon Reinforcements is relatively small at 10.2 m.

The results of the 3D analysis indicate that the proposed turbines will not obstruct the Enet microwave radio links and mitigation measures are not likely to be required. However, to allay any concerns that Enet may have in relation to potential interference due to T09, the following mitigation measure strategy should be implemented as a condition of planning in the event of a successful planning application:

1. *Enet would be re-consulted in the event of a successful planning application.*
2. *During the Construction Phase of the wind farm, it would be proposed that wind turbine T09 would be constructed and yaw wind turbine T09 on a perpendicular, worst-case-scenario, bearing into the Enet microwave radio link.*
3. *Enet would then monitor the telecommunications radio link performance to check for interference / loss of performance.*
4. *Enet would provide evidence-based demonstrable results of any wind turbine interference impacts.*
5. *If interference is detected and can be demonstrated to be attributable to the wind turbine T09, then the mitigation measure as described in this Report (Ref Section 4.1) should be implemented to the agreement of Enet*
6. *It would be an agreed condition of planning that wind turbine T09 would not become operational until all impacts from wind turbine T09 would be remediated according to the agreed mitigation measure proposal. All costs of the mitigation measure strategy would be borne by the developer.*

Sections

Appendix

Section 1 - Introduction

1. Introduction

The Enet network in the vicinity of the proposed wind farm consists of seven Point-to-Point (PTP) microwave radio links. The radio links are listed in the Table below and a Plan View of the Enet network is shown in the Figure below.

Link No.	Operator	Link Description
1	Enet	PTP microwave radio link from Laghtseefin to B.R.C. McMahon Reinforcements
2	Enet	PTP microwave radio link from Laghtseefin to Kilsaran Kifeacle.
3	Enet	PTP microwave radio link from Laghtseefin to VDF Ballydavid.
4	Enet	PTP microwave radio link from Laghtseefin to The Apple Farm.
5	Enet	PTP microwave radio link from Laghtseefin to Amneal – Cashel.
6	Enet	PTP microwave radio link from Laghtseefin to Coolmore Longfield Stud Cashel.
7	Enet	PTP microwave radio link from Laghtseefin to Cignal Clonoulty.

Table 1. Enet Radio Links requiring Analysis

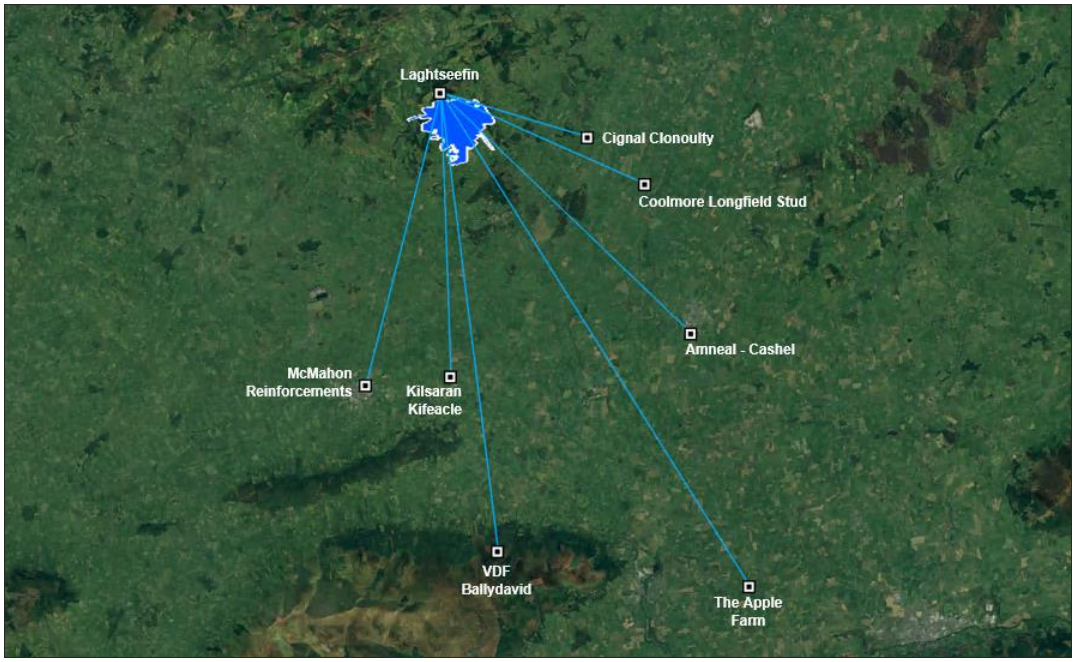

Figure 1. Enet Radio Network – Plan View

In order that the Enet radio network could be modelled as accurately as possible, field surveys of the radio links were carried out. The A-End and B-End of each radio link was surveyed to determine the accuracy of the antenna coordinates, and antenna heights. Photos from the Field Surveys are provided in Section 2.

Following the Field Survey of the Enet radio links a desktop survey was carried out to assess which of the Enet radio links could potentially be impacted by the proposed turbines at Carrow. The Desktop Survey results are provided in Section 3.

In Section 4 mitigation measure solutions have been provided to offset any possible impacts due to the proposed Carrow turbines on the Enet radio link network.

Section 2 – Field Survey

2. Field Survey

In this section the photographs from the Field Survey of the Enet radio link network are provided. The following sites were surveyed:

- Laghtseefin
- B.R.C. McMahon Reinforcements
- Kilsaran Kifeacle
- VDF Ballydavid
- The Apple Farm
- Amneal – Cashel
- Coolmore Longfield Stud
- Mount O'Meara
- Cignal Clonoulty

2.1 Laghtseefin

A photo of the Telecoms Mast-structure at location is shown below.

Figure 2. Telecoms Mast at Laghtseefin

2.2 B.R.C. McMahon Reinforcements

A photo of the mast-structure at location is shown below. (Note: Radio antenna not visible from ground-level survey of site).

Figure 3. Telecoms Mast-site at B.R.C. McMahon Reinforcements

2.3 Kilsaran, Kilfeacle

A photo of the telecoms mast-structure at location is shown below.

Figure 4. Telecoms Mast at Kilsaran

2.4 VDF Ballydavid

A photo of the telecoms mast-structure at location is shown below.

Figure 5. Telecoms Mast at VDF Ballydavid

2.5 The Apple Farm

A photo of the telecoms mast-structure at location is shown below.

Figure 6. Telecoms Mast at The Apple Farm

2.6 Amneal

A photo of the telecoms mast-structure at location is shown below.

Figure 7. Telecoms Mast-structure at Amneal

2.7 Coolmore Longfield Stud

A photo of the telecoms mast-structure at location is shown below.

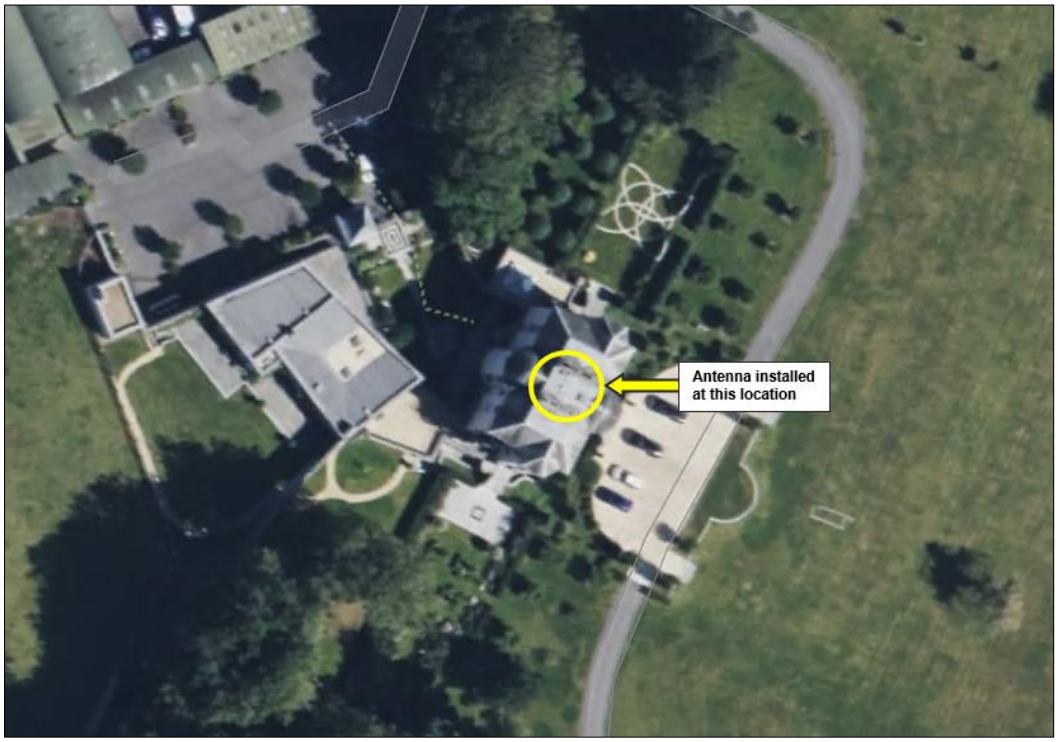

Figure 8. Telecoms Mast-structure at Coolmore Longfield Stud

2.8 Clonouty

A photo of the telecoms mast-structure at location is shown below.

Figure 9. Telecoms Mast at Clonoulty

Section 3 – Enet Transmission Network Analysis

3. Enet Transmission Network Analysis

A Plan View (2D) and a 3D View of Enet radio link network relative to the proposed turbines are shown in the figures below. The results indicate that the proposed turbines would not obstruct the Enet radio links.

The nearest of the proposed turbines to any of the Eir links is T09. 3D analysis indicates that there would be a Clearance Distance of 10.2 m between the blade-tip of T09 and the Fresnel Zone (0.6F1) of the radio link between Laghtseefin and B.R.C. McMahon Reinforcements. At this distance there would be no impact on the Enet Link.

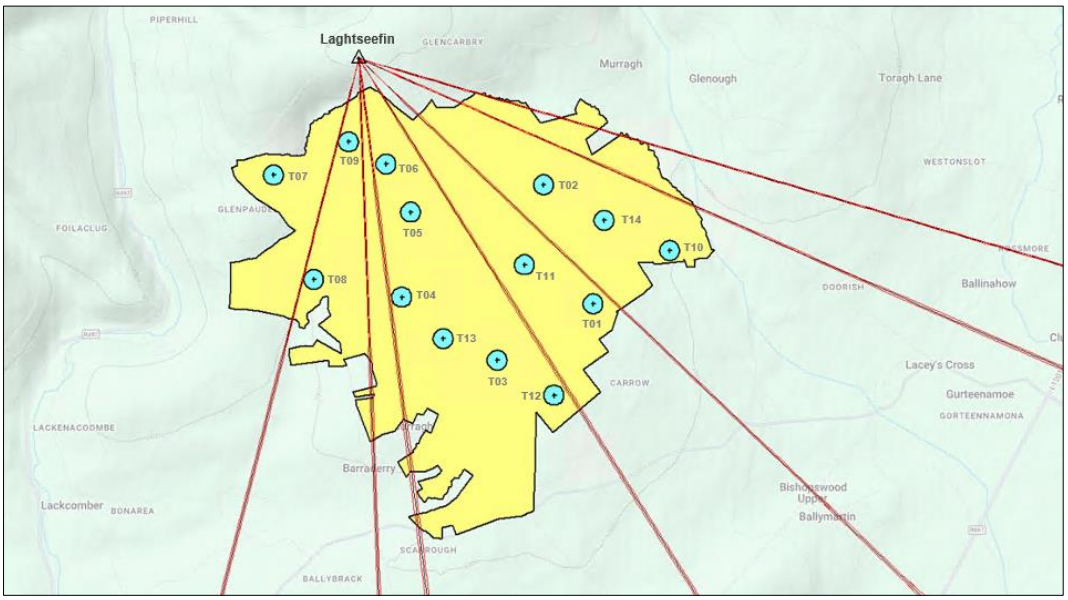

Figure 10. Enet Network - Close-up Plan (2D) View

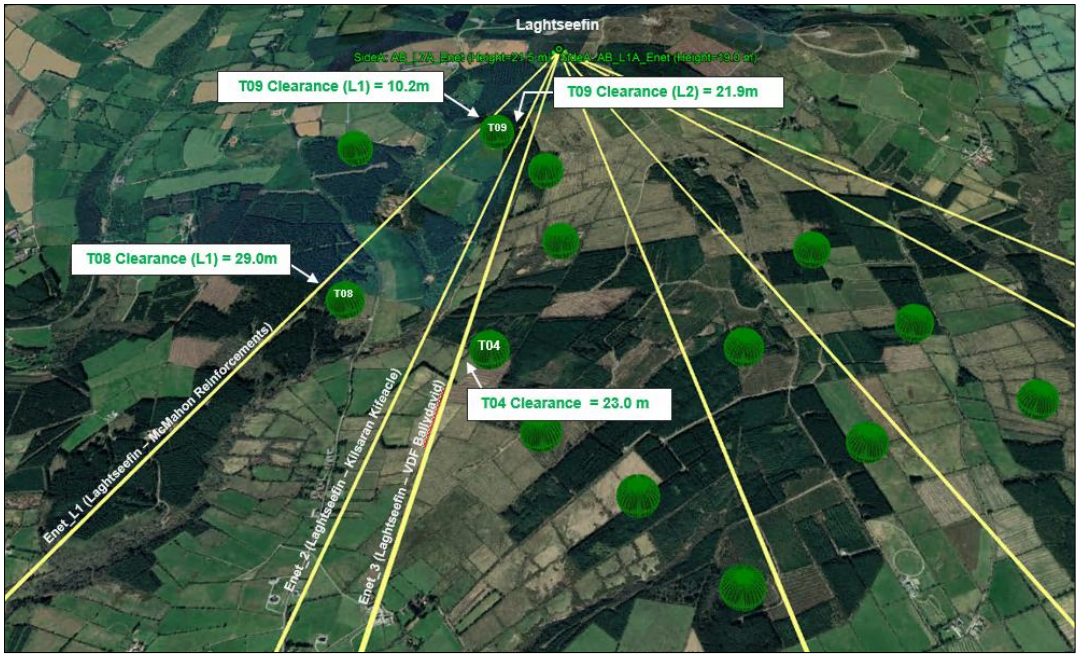

Figure 11. Enet Network – 3D Modelling View

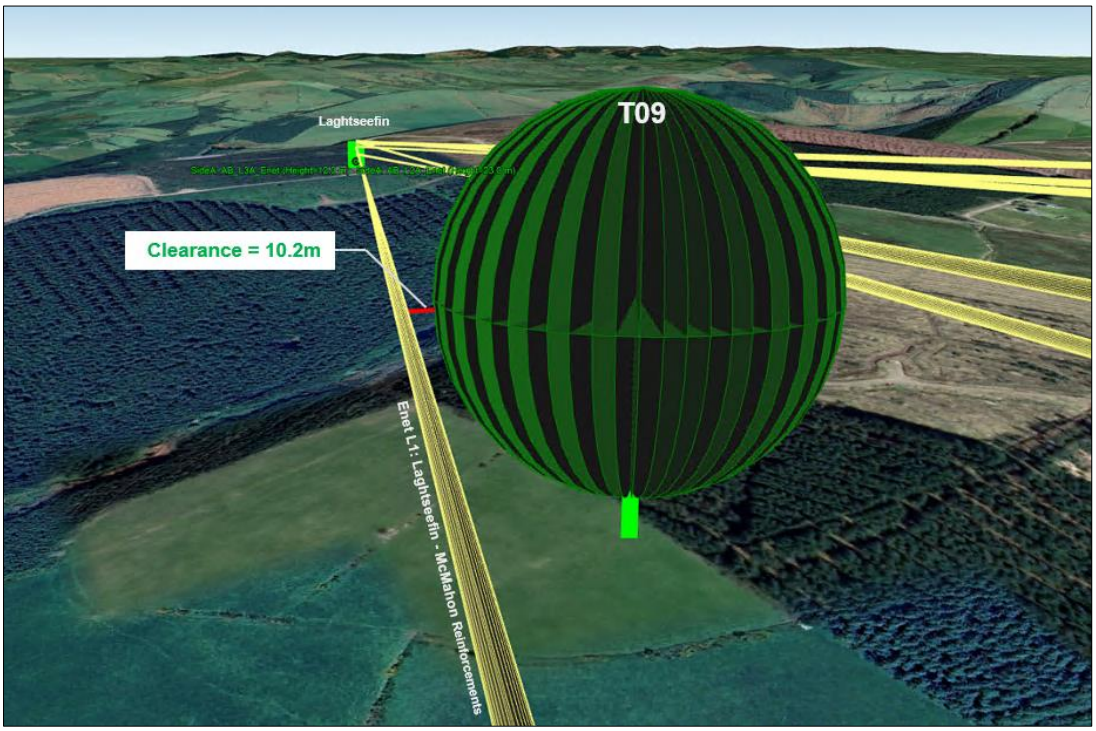

Figure 12. Close-up 3D View of T09 relative to the radio link between Laghtseefin and McMahon Reinforcements

Analysis Results:

The table below provides a brief summary of the Network Analysis findings for the Enet network.

Radio Link ID	Nearest Turbine(s)	Clearance Distance to Radio Link	Result
Enet L1 (Laghtseefin - McMahon Reinforcements)	T08	29.0 m	Clearance
	T09	10.2 m	
Enet L2 (Laghtseefin - Kilsaran Kifeacle)	T09	21.9 m	Clearance
Enet L3 (Laghtseefin - VDF Ballydavid)	T04	23.0 m	Clearance
Enet L4 (Laghtseefin – The Apple Farm)	T12	> 30 m	Clearance
Enet L5 (Laghtseefin - Amneal)	T01	> 30 m	Clearance
Enet L6 (Laghtseefin - Coolmore Longfield Stud)	T02	> 30 m	Clearance
Enet L7 (Laghtseefin - Cignal Clonoulty)	T02	> 30 m	Clearance

Table 2. Analysis Summary – Enet Network

Section 4 – Mitigation Measures

4. Mitigation Measure

The results of the 3D network analysis indicate that the Enet radio links would not be obstructed by any of the proposed turbines at Carrow and mitigation measures should not be required. However, if Enet have any concerns in relation to the proximity of T09 to the radio link between Laghtseefin and McMahon Reinforcements, the mitigation measure outlined below in Section 4.1 is available.

4.1 Mitigation Measure – Re-route Service via an Alternative Enet POP Site

The service to McMahon Reinforcements could be delivered via an alternative Enet POP site. The Enet POP site at Slievereagh has been identified as a site, which could potentially be used for this purpose.

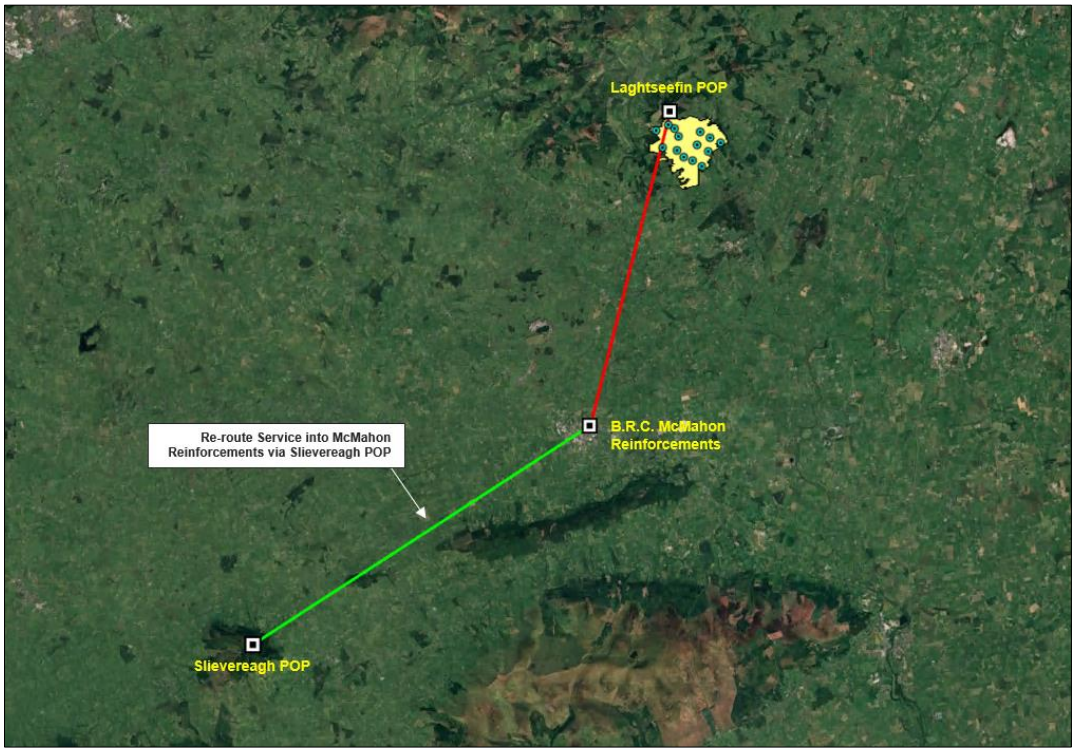

Figure 13. Re-route Service via an Alternative Enet POP Site

To determine if the POP site at Slievereagh could be used to facilitate a viable connection between to McMahon Reinforcements, a radio link Path Profile has been generated.

A Radio Link Budget was also carried out to determine if the proposed radio link (Slievereagh – McMahon Reinforcements) would meet the Radio Link Availability Criteria required by ComReg for radio licensing.

The Radio Link Path Profiles and Radio Link Budgets are based on the following ITU-R Recommendations:

- ITU-R P.525-2
- ITU-R P.526-11
- ITU-R P.676-8

4.1.1 Path Profile – Slievereagh to McMahon Reinforcements

The radio link path profile shows clear Line-of-Sight (LOS) and the link budget results would pass the radio availability criteria. The radio link budget for this link is provided in Appendix A.1.1.

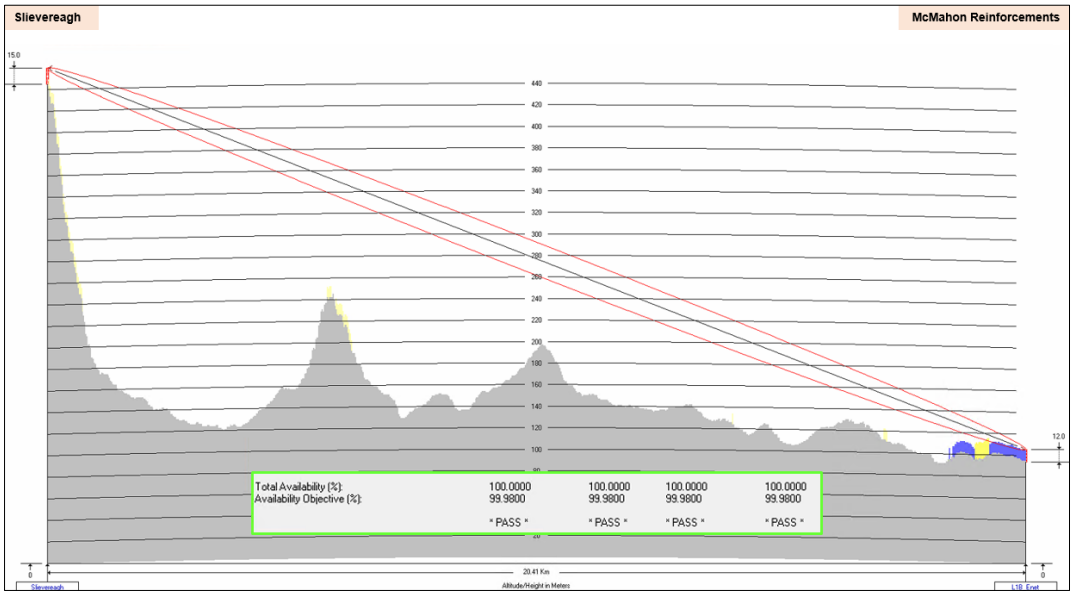

Figure 14. Path Profile – Slievereagh to McMahon Reinforcements

Section 5 – Summary

5. Summary

The final turbine layout for the proposed wind farm development incorporates clearances from all of the Enet transmission radio links. Radio Network analysis (2D and 3D) has been carried out and the results show that that there will be no wind farm interference on any of the Enet radio links. The 3D modelling assessment is based on field survey data and ITU-R radio modelling standards.

The clearance distances between the turbines and the radio links are in-excess of 20 meters, with the exception of the radio link between Laghtseefin and McMahon Reinforcements which shows a clearance distance of 10.2 m. It is not expected that there will be interference at this distance, based on previous wind farm planning applications in other counties. However, an optional mitigation measure strategy has been proposed. The mitigation measure strategy, as detailed below, proposes that a condition of planning be incorporated into a grant of planning, which would invite further consultation with Enet to as to provide assurances that the developer would engage on the construction of T09 to the agreement of Enet.

A Letter of Reliance as to summary findings of this report has been provided based on the following mitigation measure strategy outlined below.

1. *Enet would be re-consulted in the event of a successful planning application.*
2. *During the Construction Phase of the wind farm, it would be proposed that wind turbine T09 would be constructed and yaw wind turbine T09 on a perpendicular, worst-case-scenario, bearing into the Enet microwave radio link.*
3. *Enet would then monitor the telecommunications radio link performance to check for interference / loss of performance.*
4. *Enet would provide evidence-based demonstrable results of any wind turbine interference impacts.*
5. *If interference is detected and can be demonstrated to be attributable to the wind turbine T09, then the mitigation measure as described in this Report (Ref Section 4.1) should be implemented to the agreement of Enet.*
6. *It would be an agreed condition of planning that wind turbine T09 would not become operational until all impacts from wind turbine T09 would be remediated according to the agreed mitigation measure proposal. All costs of the mitigation measure strategy would be borne by the developer.*

Appendix A – Radio Link Budgets

A.1 Radio Link Budget Report (Slievereagh – McMahon Reinforcements)

Link Budget Report

Site Name:	Slievereagh		L1B_Enet (McMahon Reinforcements)				
Type:	Cell	Cell					
Latitude:	52°22'41.7"N		52°28'41.8"N				
Longitude:	8°24'13.3"W		8°09'07.1"W				
Altitude (m):	445.0		94.0				
UserData1:	User Data						
Datum:	World Geodetic System 1984 (WGS 84)						
	Forward Link		Reverse Link				
Transmission Site:	Slievereagh		L1B_Enet				
Reception Site:	L1B_Enet		Slievereagh				
Radio Type:	NetRadio0001		NetRadio0001				
Modulation Scheme:	4-QAM		4-QAM				
Bandwidth (MHz):	2		2				
Roll-Off Factor:	0.2		0.2				
Coding Gain (dB):	0		0				
System Gains (dB):	0		0				
Channel Overhead (%):	20		20				
FEC Overhead (%):	0		0				
Reference Temperature (°K):	290		290				
Receiver Noise Figure (dB):	5		5				
Maximum Data Rate (Mbps):	2.667		2.667				
Maximum Bit Rate (Mbps):	3.333		3.333				
Required Bit Error Rate:	BER 10-3	BER 10-6	BER 10-3	BER 10-6			
Service Threshold (dBm):	-91	-90	-91	-90			
Carrier to Noise Ratio (dB):	14.965	15.965	14.965	15.965			
Cross Polarization Improvement Factor (dB):			20	20	20	20	
Rx Equalization Sig Norm Parameter (Kn,M):			0.1	0.1	0.1	0.1	
Rx Equalization Sig Norm Parameter (Kn,NM):			0.1	0.1	0.1	0.1	
UserData1:	User Data		User Data				
Center Frequency (MHz):	15000		15000				
Channel Bandwidth (MHz):	28		28				
Transmission Power (dBm):	30		30				
Transmission Gains (dB):	0		0				
Transmission System Loss (dB):		0		0			
Transmission Line Loss (dB/100 m):		4		4			
Transmission Line Length (m):		10		10			
Transmission Connection Loss (dB):		0.3		0.3			
Transmission Number of Connections:		2		2			
Transmission Additional Loss (dB):		0		0			
Transmission Losses (dB):	1		1				
Transmission Antenna:	HP2-15		HP2-15				
Transmission Antenna Size (m):		0.6		0.6			
Transmission Antenna Height (m):		15		12			
Transmission Antenna Gain (dBd):		34.86		34.86			
Transmission Antenna Gain (dBi):		37		37			
Transmission Power EIRP (dBm):		66		66			
Reception Gains (dB):	0		0				
Reception System Loss (dB):	0		0				

Reception Line Loss (dB/100 m):		4		4
Reception Line Length (m):	10		10	
Reception Connection Loss (dB):		0.3		0.3
Reception Number of Connections:		2		2
Reception Additional Loss (dB):		0		0
Reception Losses (dB):	1		1	
Reception Antenna:	HP2-15		HP2-15	
Reception Antenna Size (m):	0.6		0.6	
Reception Antenna Height (m):		12		15
Reception Antenna Gain (dBd):		34.86		34.86
Reception Antenna Gain (dBi):		37		37
Link Polarization:	Vertical		Vertical	
Cross Polarization Factor (dB):		30		30
Link Distance (m):	20410.87		20410.87	
Azimuth - True (°):	56.805		237.005	
Azimuth - Magnetic (°):	58.899		239.017	
Transmission Inclination (°):	0.994		-0.994	
Reception Inclination (°):	0.994		-0.994	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	20413.94		20413.94	
Center Frequency (MHz):	15000		15000	
Free Space Loss (dB):	142.16		142.16	
Max Fresnel Radius (m):	10.102		10.102	
Max 2nd Fresnel Radius (m):	14.287		14.287	
Earth Radius Factor (K):	4/3			
Effective Radius (m):	8502056.000			
ITU Recommendation:	ITU-R P.526-11			
Diffraction Model:	Cascade Knife Edge			
Diffraction:	No LOS Diffraction		No LOS Diffraction	
Diffraction Loss (dB):	7.81		7.81	
Clearance Target (%):	60			
Minimum Clearance (m):	-0.863		-0.863	
Minimum Clearance Point (m):		20129.262		20129.262
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	1295.392		1295.392	
Reflection Area 2 (m):	2557 - 2579.5			2557 - 2579.5
Reflection Area 3 (m):	2624.576		2624.576	
Reflection Area 4 (m):	3931.232		3931.232	
Reflection Area 5 (m):	6116.502		6116.502	
Reflection Area 6 (m):	6476.959		6476.959	
Reflection Area 7 (m):	6679.716		6679.716	
Reflection Area 8 (m):	6769.8 - 6814.9			6769.8 - 6814.9
Reflection Area 9 (m):	6859.944		6859.944	
Reflection Area 10 (m):	6927.53		6927.53	
Reflection Area 11 (m):	7220.401		7220.401	
Reflection Area 12 (m):	8211.7 - 8234.2			8211.7 - 8234.2
Reflection Area 13 (m):	8324.3		8324.3	
Reflection Area 14 (m):	8414.414		8414.414	
Reflection Area 15 (m):	8527.057		8527.057	
Reflection Area 16 (m):	8572.114		8572.114	
ITU Recommendation:	ITU-R P.676-8			
Atmospheric Pressure (hPa):	1013		1013	
Standard Temperature (°C):	15		15	
Water Vapor Density (g/m³):	7.5		7.5	
Atmospheric Gases Loss (dB):		0.623		0.623
Total Path Loss (dB):	150.593		150.593	
Reception Signal Level (dBm):		-48.593		-48.593

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	42.407	41.407	42.407	41.407

ITU Recommendation:	ITU-R F.1703-0 / ITU-T G.827			
Objective ITU Quality Grade:	Short Haul SDH Networks			
Unavailability Objective (%):	2.00E-02			
Availability Objective (%):	99.9800			
ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.826			
Error Performance Objective BBER (%):	1.60E-05		1.60E-05	
Error Performance Objective BBER (s/Month):	0.42		0.42	
	SESR ESR	SESR ESR		
Error Performance Objective (%):	1.60E-04	3.20E-03	1.60E-04	3.20E-03
Error Performance Objective (s/Month):	4.205	84.096	4.205	84.096
ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.828			
Error Performance Objective BBER (%):	4.00E-06		4.00E-06	
Error Performance Objective BBER (s/Month):	0.105		0.105	
	SESR ESR	SESR ESR		
Error Performance Objective (%):	1.60E-04	8.00E-04	1.60E-04	8.00E-04
Error Performance Objective (s/Month):	4.205	21.024	4.205	21.024
Multipath Model:	ITU-R P.530-15			
Multipath Planning Type:	Quick Planning			
Multipath Time Frame:	Average annual distribution			
ITU Recommendation:	ITU-R P.453-9			
Point Refractivity Gradient (dN1):	-76.7			
Geoclimatic Factor:	4.05E-05	4.05E-05		
Multipath Occurrence Factor (%):	7.67E-02		7.67E-02	
Precipitation Model:	ITU-R P.530-15			
ITU Recommendation:	ITU-R P.837-5 / ITU-R P.841-4			
Precipitation Time Frame:	Average annual distribution			
Precipitation Rate @ 0.01% (mm/h):	22			
ITU Recommendation:	ITU-R P.838-3			
Specific Attenuation (dB/km):	1.262326	1.262326		
Rainfall Attenuation (dB):	16.242	16.242		
	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	4.48E-07	5.64E-07	4.48E-07	5.64E-07
Selective Fading Outage (%):	5.25E-09	5.25E-09	5.25E-09	5.25E-09
Composite Fading Outage (%):		4.53E-07	5.69E-07	4.53E-07	5.69E-07
Fading Outage (s/Month):	0.012	0.015	0.012	0.015	
Selective Fading Outage (s/Month):	0	0	0	0	
Composite Fading Outage (s/Month):	0.012	0.015	0.012	0.015	
	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Rain (%):	2.73E-04	3.12E-04	2.73E-04	3.12E-04
Unavailability due to Rain (s/Year):		86.078	98.514	86.078	98.514
	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Fading (%):		4.53E-07	5.69E-07	4.53E-07	5.69E-07
Unavailability due to Rain (%):	2.73E-04	3.12E-04	2.73E-04	3.12E-04
Total Unavailability (%):	2.73E-04	3.13E-04	2.73E-04	3.13E-04
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02
Unavailability due to Fading (s/Year):		0.143	0.179	0.143	0.179
Unavailability due to Rain (s/Year):		86.078	98.514	86.078	98.514
Total Unavailability (s/Year):	86.22	98.693	86.22	98.693	
Unavailability Objective (s/Year):		6307.2	6307.2	6307.2	6307.2
Total Availability (%):	99.9997	99.9997	99.9997	99.9997	
Availability Objective (%):	99.9800	99.9800	99.9800	99.9800	
	* PASS *	* PASS *	* PASS *	* PASS *	

AiBridges
Total Communications Solutions
Unit 9, Block B, Quin Road Business Park, Ennis, Co. Clare
Tel: 353 (0) 65 684 8768, Email: info@aibridges.ie

MKO.
Tuam Road,
Galway,
Ireland.
H91 VW84

20th February 2025.

Re: Development of Carrow Windfarm (the **"Project**")

To Whom It May Concern

We, Ai Bridges Limited, confirm that we were commissioned by MKO Ireland (the "**Client**") to prepare the following report in relation to the Project and in particular to Telecommunications EMI:

- *Carrow Wind Farm, Enet Telecommunications Impact Assessment Report*

(the "**Report**")

The purpose of this Letter is to enable MKO (the "**Addressee**") to rely on the findings contained in the Report in relation to a 3D Software Modelling Analysis of the Enet Telecommunications Network traversing the proposed Carrow Wind Farm development.

Executive Summary

Ai Bridges were commissioned to carry out an independent Telecommunications Impact Assessment Study to assess the possible impacts to telecommunications transmission infrastructure due to the proposed Carrow Wind Farm development. The objectives of the Telecommunications Impact Study Report as follows :

i) Assess the existing Enet telecommunications networks in the area.

ii) Predict if any existing telecoms infrastructure could be impacted by interference attributable to the proposed wind turbines.

iii) Show by way of 3D modelling that there is no interference from the proposed wind turbines on the Enet Telecommunications Network and demonstrate that there would be a clearance condition of more than 10m between the blade-tip of the nearest wind turbine (T09) and the Fresnel Zone of Enet microwave radio link between Laghtseefin and B.R.C. McMahon Reinforcements.

Mitigation Measure Process

The findings of the Report shows that mitigation measures are not likely to be required. The results of the 3D analysis indicate that the proposed turbines will not obstruct any of the Enet microwave radio links.

However, to allay any concerns that Enet may have in relation to potential interference to the radio link between Laghtseefin and B.R.C. McMahon Reinforcements due to the proposed turbines, the following mitigation measure strategy should be implemented as a condition of planning in the event of a successful planning application.

AiBridges
Total Communications Solutions
Unit 9, Block B, Quin Road Business Park, Ennis, Co. Clare
Tel: 353 (0) 65 684 8768 Fax: 353 (0) 65 684 8769 Email: info@aibridges.ie

The following mitigation measure strategy is presented:

1. Enet would be re-consulted in the event of a successful planning application

2. During the Construction Phase of the wind farm, it would be proposed that wind turbine T09 would be constructed and yaw wind turbine T09 on a perpendicular, worst-case-scenario, bearing into the microwave radio link.

3. Enet would then monitor the telecommunications radio link performance to check for interference / loss of performance.

4. Enet would provide evidence-based demonstrable results of any wind turbine interference impacts

5. If interference is detected and can be demonstrated to be attributable to the wind turbine T09, then the mitigation measure as described in the Report should be implemented to the agreement of Enet.

6. It would be an agreed condition of planning that wind turbine T09 would not become operational until all impacts from wind turbine T09 would be remediated according to the agreed mitigation measure proposal. All costs of the mitigation measure strategy would be borne by the developer.

Yours Sincerely

_____
For and on behalf of
Ai Bridges Limited