



APPENDIX 14-3

TELECOMMUNICATIONS IMPACT STUDY

	Procedure: 001	Rev: 5.0
Title: Balivor Wind Farm Telecommunications Impact Study	Approved: KH	Date: 11/10/21

Report

Balivor Wind Farm Telecommunications Impact Study

Document Number:

Author: David McGrath \ Patrick Tinney

Approved for Release: Rev 5.0 KH **Date:** 11/10/21

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Executive Summary

Ai Bridges was commissioned to evaluate the possible impacts that the proposed wind farm development at Balivor, Co. Meath and Co Westmeath could have the existing telecommunications operator networks that were identified during consultations with the EIAR consultants. The scope of work included detailed technical desktop analysis and to engage in further consultations with the telecommunications operators for more technical information. Consultations with telecom operators were undertaken to assist in identifying network infrastructure that could be impacted by the proposed wind farm and also to agree suitable buffer clearance zones for preliminary design layouts.

During the consultation process, eight telecom operators were contacted. At the time of writing this report, six of these operators have responded to the consultation request. The responses received from each of the telecom operators can be found in Section 3 of this report.

Using the information obtained during the desktop survey assessments and consultation process a desktop impact analysis was carried out and all of the telecommunication operator networks were analysed using radio planning \ modelling software. The resulting data was used to create shape files based on the 2nd Fresnel Zone calculations for each link that was identified during the consultation process.

Results from the impact analysis indicate that there are fourteen licensed microwave transmission radio links as well as a UHF broadcast link which passes through the proposed wind farm, however. The results of 3D network analysis were used to generate the shapefiles with the 2nd Fresnel Zone clearance buffers

All of the Telecommunication Operators contacted during the initial consultation process in November 2020 did not raise any concerns regarding telecommunications networks operating in the licence-exempt frequency bands. Also it should be noted that during the initial consultation phase by the EIAR Consultant that the Emergency Services TETRA Operator requested a buffer zone of 500m around the telecommunications mast site that is located within the wind farm layout networks and this has been addressed within the analysis without having to engage in any further consultations. Further consultations with Imagine Broadband were undertaken between July 2021 and September 2021 where a detailed 3D software link analysis was sent to them for their review. Imagine Broadband accepted the results of the analysis and accepted the calculated clearance zones.

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Section 1 - Wind Farm Site Information

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1. Introduction

In this section a brief summary of the wind farm site is provided. Details regarding the site's geographic location and the proposed wind turbine dimensions are presented.

1.1 Wind Farm Site Information

The wind farm development is located approximately 3 km east of Balivor and spans Counties Meath and Westmeath. The turbine dimensions used in this report are provided in Table 1 below.

Wind Farm	Number of Turbines	Turbine Hub Height	Turbine Tip-height (max)
Balivor	26	115m	200m

Table 1. Balivor Wind Farm Turbine Details

The location of the proposed Balivor wind farm development is shown below in Figure 1.

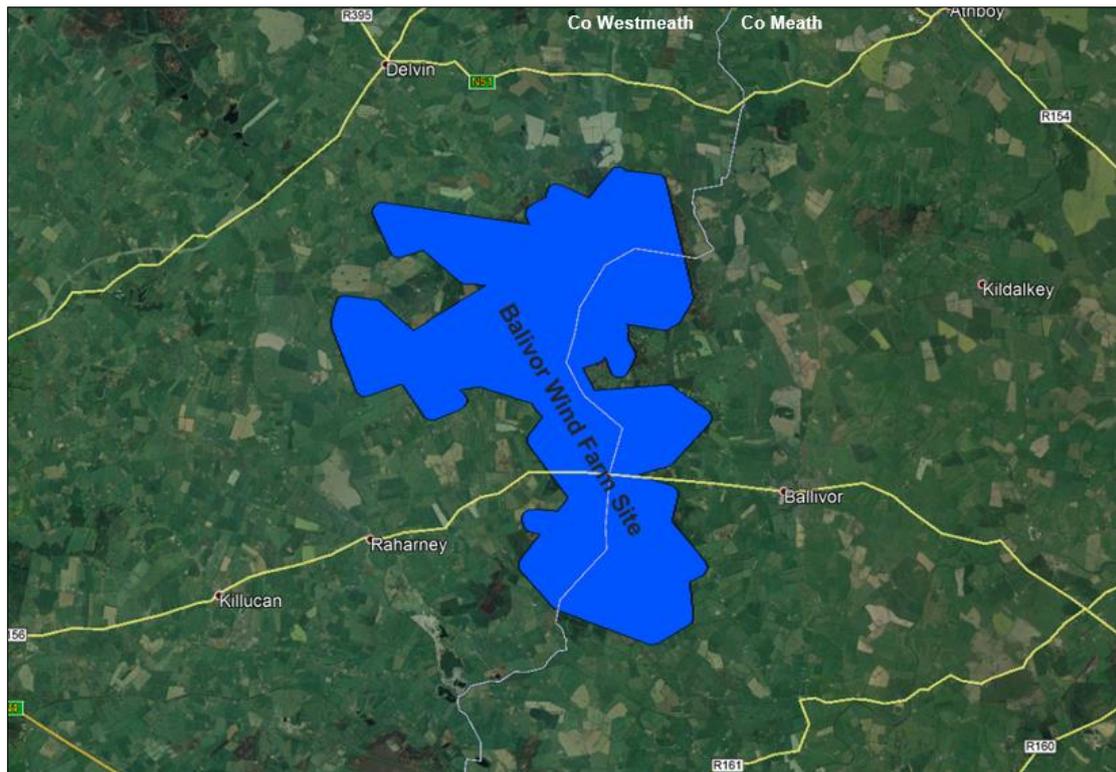


Figure 1. Location of proposed Wind Farm at Balivor, County Meath.

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Section 2 - Methodology

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2. Introduction

In this section a brief summary of the Telecommunication Impact Study Methodology is provided.

2.1 Methodology

There are four primary stages in preparing and compiling a communication impact study:

- Telecom Operator Consultations
- Field Surveys
- Desktop Survey Network Modelling and Analysis
- Report Generation

A summary of each of these stages is provided below:

Telecom Operator Consultations

Consultations are commenced with telecom operators who are requested to raise any concerns they have regarding the impact of the proposed wind farm on their networks. The consultation process is used to assist in identifying telecoms infrastructure that could be impacted by the proposed wind farm development.

Field Surveys

Field Surveys (if required) are undertaken and the co-ordinates of communication masts are recorded. During the field surveys of the communication sites, approximations of antenna size, bearing and height are made for the antennas installed on each of the masts surveyed.

Desktop Survey and Analysis

A desktop survey is carried out to plot the wind turbines in a radio planning tool. The radio planning tool uses GIS and terrain mapping databases to enable accurate modelling. Relevant mast-site coordinates are obtained and inputs from various operators \ service providers are converted from Irish National grid (Easting and Northing in meters) to degrees minutes seconds format and then imported into the radio planning tool. This provides a means of graphically showing the telecommunications sites in the vicinity relative to the proposed wind farm at Balivor. Figure 2 below shows the proposed wind farm site boundary plotted in the radio planning tool.

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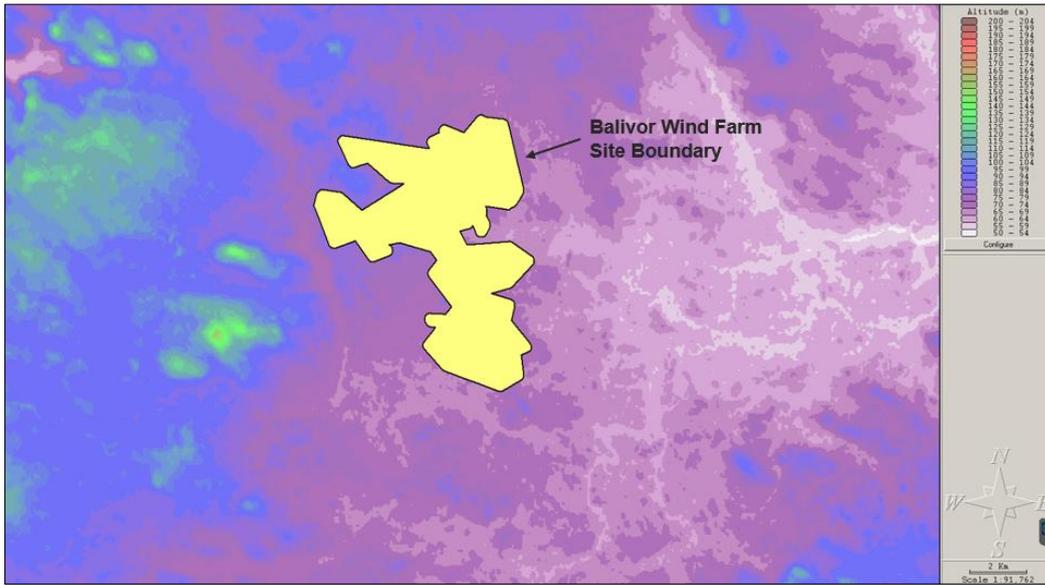


Figure 2. Wind Farm Site Boundary plotted in Radio Planning Software

The findings from the consultations and desktop surveys are collated and the communications networks requiring further analysis are identified. 3D network modeling is used to assess the potential impact on the communications networks. The results from the network modeling are used to generate Exclusion Zones (i.e. areas which should be exempt from turbines to prevent interference to existing microwave radio links). Figure 3 below shows an example of a microwave radio link that crosses through the proposed wind farm modelled in radio planning software.

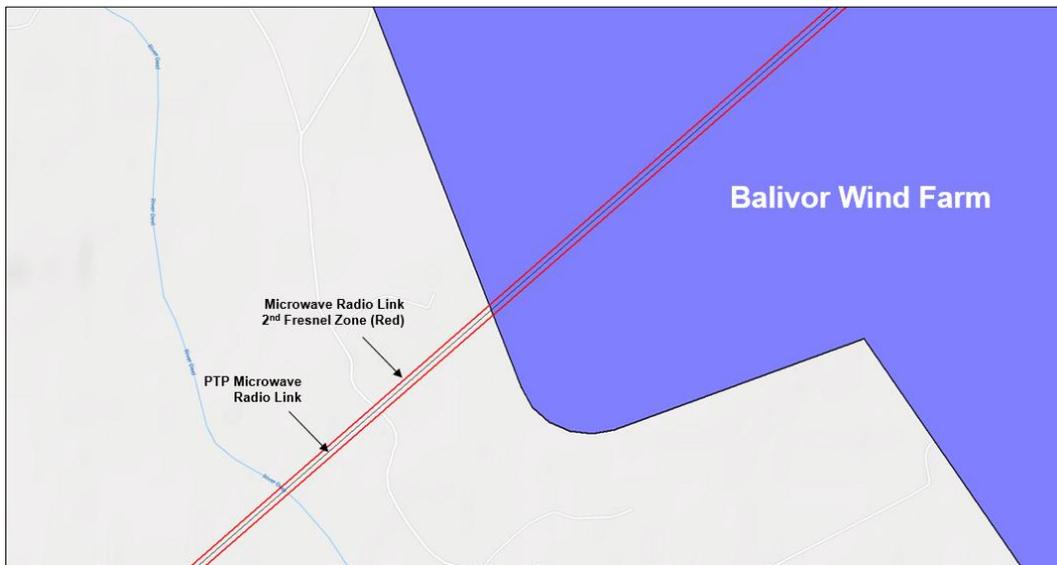


Figure 3. Example of microwave radio link crossing through the proposed wind farm modelled in radio planning software.

Report Generation

The final stage of the communications impact study process is to collate the data and present the findings & analysis into a report for submission.

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Section 3 - Telecom Operator Consultations

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3. Introduction

In this Section a summary of the consultations undertaken by the EIAR consultant, McCarthy, Keville O’Sullivan (MKO), with the telecommunications operators is documented. A summary of the follow-up consultations undertaken by Ai Bridges Ltd in October 2020 is also provided

3.1 Telecom Operator Consultations

During consultations with MKO the follow Telecom Operators raised concerns regarding telecommunications infrastructure they operate in the vicinity of the proposed wind farm.

Operator	Issues raised by Operator \ Observations
Enet	Raised concerns regarding 2 x PTP Microwave Radio Links
Eir Mobile (Meteor)	Raised concerns regarding 3 x PTP Microwave Radio Links
OpenEir	Raised concerns regarding 1 x PTP Microwave Radio Link
Imagine Broadband	Raised concerns regarding 1 x PTP Microwave Radio Link
2RN	Raised concerns regarding 1 x UHF Feeder Radio Link
Tetra Ireland (TI)	Raised concerns regarding 1 x Tetra Basestation
Three Ireland	Raised concerns regarding 3 x PTP Microwave Radio Links
Vodafone Ireland	Raised concerns regarding 4 x PTP Microwave Radio Links

Table 2. Telecom Operators with network infrastructure in vicinity of proposed wind farm (MKO Consultations)

To ascertain additional technical detail regarding the telecommunications infrastructure listed in Table 2 above, Ai Bridges contacted each of the Telecom operators. During these consultations a clearance buffer of 30m from the 2nd Fresnel Zone was specified. The operators were requested to raise any concerns they had regarding impacts to their networks due to the proposed wind farm development. The responses received from the Telecom Operators are provided in Sections 3.1.1 to 3.1.8 that follow. Table 3 below provides a summary of the responses received.

ID	Operator	Response Received (Yes/No)	Issues raised by Operator \ Observations.
1	Enet	Yes	Enet provided a corrected set of co-ordinates.
2	Eir Mobile (Meteor)	Yes	Radio Link details provided.
3	OpenEir	Yes	OpenEir provided a corrected set of co-ordinates.
4	Imagine Broadband	Yes	Radio Link details provided.
5	2RN	Yes	Radio Link details provided.
6	Tetra Ireland (TI)	No	No response received.
7	Three Ireland	No	No response received.
8	Vodafone Ireland	Yes	Radio Link details provided.

Table 3. Summary of Telecom Operator Responses (AiBridges Ltd Consultations)

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3.1.1 Enet Consultations

The consultation responses between Enet and Ai Bridges are shown below.

02/11/20 - Enet Response to Consultation

“Apologies but the coordinates for Site B in red below were slightly incorrect on my original mail, the coordinates in red are the correct ones:”

Site A Coordinates	Site A Antenna Height	Site B Coordinates	Site B Antenna Height	Link Frequency
53°38'21.08"N 7°16'28.13"W	15m	53°24'18.20"N 6°44'45.50"W	20m	7GHz
53°38'21.08"N 7°16'28.13"W	15m	53°26'36.29"N 6°51'36.83"W	10m	13GHz

Can the KML exclusion zone be updated and then I can check?”

04/11/20 - Ai Bridges Ltd Response

We have updated the Telecommunications Constrains Map based on the new co-ordinates that you provided to us on Monday.

The updated .KML file is attached to this email.

As previously mentioned we would be grateful if you could contact us as soon as possible if you have any concerns, as the wind farm design submissions are to be closed by the end of this week.

04/11/20 - Enet Response to Consultation

“The KML looks accurate now with the updated coordinates.”

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3.1.2 Eir Mobile (Meteor) Consultations

The consultation responses between OpenEir and Ai Bridges are shown below.

12/11/20 – Eir Mobile Response to Consultation

“The link details of the three links are below, dont take the coordinates from these the link details, the coordinates given originally as you have are more accurate.”

Open in Browser		Path Profile	
Sites / Sector ID		* MH 4302_10	* MH 2016
Location ID:	BSC203 / RNC303	TBC / TBC	
Name:	Coillte Ballivor	Kildalkey	
Latitude/Longitude:	53°32'32"N, 006°59'55"W	53°34'10"N, 006°53'48"W	
Northing/ Easting:	5934452.97 632616.63	5937683.42 639282.01	
UTM Zone:	29U	29U	
Ground Elevation:	70 m	70 m	
Antenna/Path Azimuth:	85.75 Deg	245.83 Deg	
Mech./Elec./Path Tilt:	0.04 Down	0.009 Down	
Frequencies			
Plan:	Low	High	
Channel/Frequency Pol.:	14 18470.000 V	14 19480.000 V	
Radios			
Make:	Huawei	Huawei	
Model:	RTN900_18G55M_ISM8XMC3	RTN900_18G55M_ISM8XMC3	
Bit Rate:	78.596 (ADM)	78.596 (ADM)	
Bandwidth:	55.00 MHz	55.00 MHz	
Power:	20.00 dBm	20.00 dBm	
Branching Loss:	Tx: .00 dB Rx: .00 dB	Tx: .00 dB Rx: .00 dB	
Antennas (Primary)			
Make:	HATC	HATC	
Model:	A18S06HAC	A18S06HAC	
Gain:	38.90 dBi	38.90 dBi	
Height:	27	25	
Latitude/Longitude:	53°32'32"N, 006°59'55"W	53°34'10"N, 006°53'48"W	
EIRP:	58.90 dBm	58.90 dBm	
Other			
Field Margin:		.00 dB	
Absorption Loss:		0.45 dB	
Free Space Loss:		134.92 dB	
Total Propagation Loss:		135.37 dB	
Receive Signal Level:	-38.33 dBm	-38.33 dBm	
Open in Browser		Path Profile	
Sites / Sector ID		* MH 4224_01	* MH 4302_10
Location ID:	BSC203 / RNC303	BSC203 / RNC303	
Name:	Trim ESB	Coillte Ballivor	
Latitude/Longitude:	53°32'46"N, 006°47'41"W	53°32'32"N, 006°59'55"W	
Northing/ Easting:	5935291.44 646111.45	5934452.97 632616.63	
UTM Zone:	29U	29U	
Ground Elevation:	60 m	70 m	
Antenna/Path Azimuth:	269.03 Deg	88.86 Deg	
Mech./Elec./Path Tilt:	0.008 Up	0.099 Down	
Frequencies			
Plan:	Low	High	
Channel/Frequency Pol.:	02 12835.000 H 02 12835.000 V	02 13101.000 H 02 13101.000 V	
Radios			
Make:	ERICSSON	ERICSSON	
Model:	TN13/2XASA/056/A1A-2XRegPwr	TN13/2XASA/056/A1A-2XRegPwr	
Bit Rate:	326-326 (ADM)	326-326 (ADM)	
Bandwidth:	56.00 MHz	56.00 MHz	
Power:	18.00 dBm	18.00 dBm	
Branching Loss:	Tx: .50 dB Rx: .50 dB	Tx: .50 dB Rx: .50 dB	
Antennas (Primary)			
Make:	ERICSSON	ERICSSON	
Model:	ML 13/0 0.6M HP 2P	ML 13/0 0.6M HP 2P	
Gain:	36.00 dBi	36.00 dBi	
Height:	24.45	27.1	
Latitude/Longitude:	53°32'46"N, 006°47'41"W	53°32'32"N, 006°59'55"W	
EIRP:	53.50 dBm	53.50 dBm	
Other			
Field Margin:		.00 dB	
Absorption Loss:		0.32 dB	
Free Space Loss:		137.32 dB	
Total Propagation Loss:		137.64 dB	
Receive Signal Level:	-48.64 dBm	-48.64 dBm	
Open in Browser		Path Profile	
Sites / Sector ID		* MH 4302_10	* WH 4299_01
Location ID:	BSC203 / RNC303	BSC203 / RNC303	
Name:	Coillte Ballivor	Delvin	
Latitude/Longitude:	53°32'32"N, 006°59'55"W	53°38'32"N, 007°07'14"W	
Northing/ Easting:	5934452.97 632616.63	5945367.71 624245.67	
UTM Zone:	29U	29U	
Ground Elevation:	70 m	91 m	
Antenna/Path Azimuth:	321.69 Deg	141.59 Deg	
Mech./Elec./Path Tilt:	0.012 Up	0.104 Down	
Frequencies			
Plan:	Low	High	
Channel/Frequency Pol.:	03 14641.000 V	03 15061.000 V	
Radios			
Make:	ERICSSON	ERICSSON	
Model:	TN15/2XASA/056/A1A-2XRegPwr	TN15/2XASA/056/A1A-2XRegPwr	
Bit Rate:	94-406 (ADM)	94-406 (ADM)	
Bandwidth:	56.00 MHz	56.00 MHz	
Power:	21.00 dBm	21.00 dBm	
Branching Loss:	Tx: .00 dB Rx: .00 dB	Tx: .00 dB Rx: .00 dB	
Antennas (Primary)			
Make:	ERICSSON	ERICSSON	
Model:	ML15/0 0.6M HP 1P	ML15/0 0.6M HP 1P	
Gain:	36.60 dBi	36.60 dBi	
Height:	27.1	20	
Latitude/Longitude:	53°32'32"N, 006°59'55"W	53°38'32"N, 007°07'14"W	
EIRP:	57.60 dBm	57.60 dBm	
Other			
Field Margin:		.00 dB	
Absorption Loss:		0.01 dB	
Free Space Loss:		138.72 dB	
Total Propagation Loss:		138.73 dB	
Receive Signal Level:	-44.53 dBm	-44.53 dBm	

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3.1.3 OpenEir Consultations

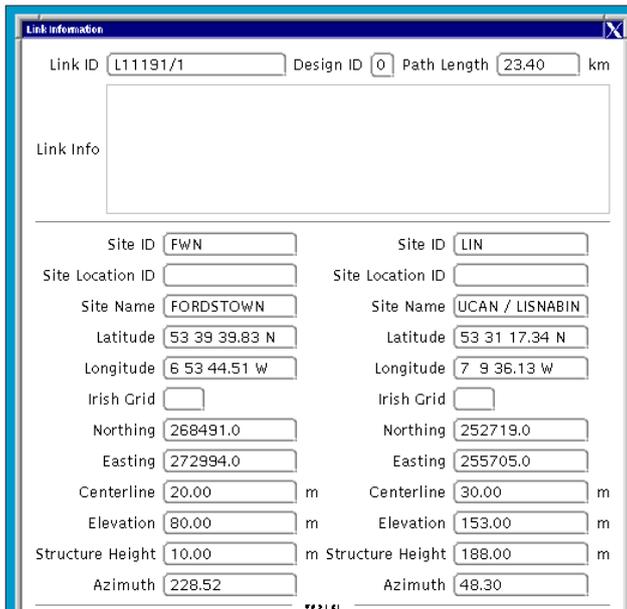
The consultation responses between OpenEir and Ai Bridges are shown below.

03/11/20 – OpenEir Response to Consultation

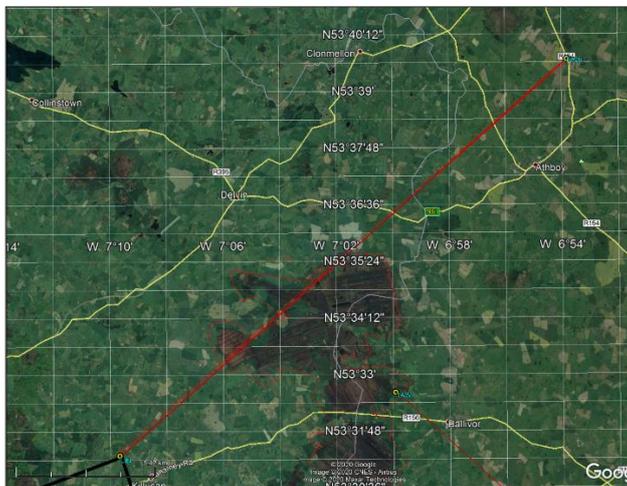
The link is 13 GHz and nominal site details are shown below. These site co-ordinates are subject to verification as some records predate accurate gps surveys and at best they may be done with standard gps with an accuracy of +/- 10 to 30 metres.

A buffer clearance of 2nd Fresnel zone +/- 30m should be ok but only provided the radio end points are accurately surveyed and also on the understanding that micrositing will not allow this buffer to be decreased.

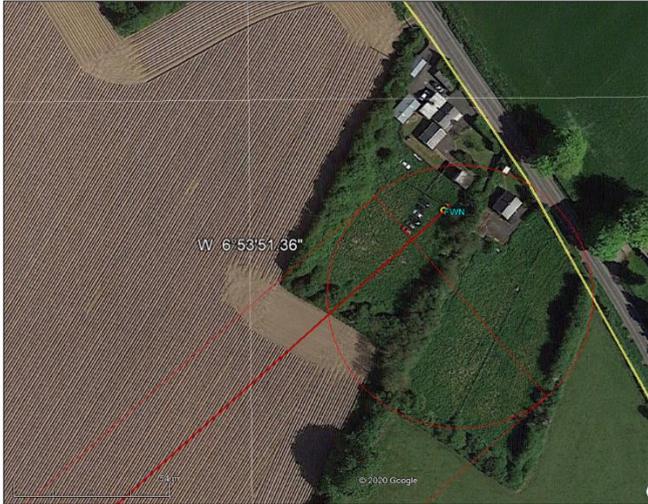
When I overlay the proposed Google Earth link buffer kmz file with the eircom radio network kmz file I see a significant discrepancy between the eircom radio paths and the radio dish locations on the map. But there is an even bigger discrepancy between the radio paths and the buffer zone proposed in your file. I know there can be problems with using and converting between different projection systems, but for the moment there does seem some problem with your proposal.



Link Information	
Link ID	L11191/1
Design ID	0
Path Length	23.40 km
Link Info	
Site ID	FWN
Site ID	LIN
Site Location ID	
Site Location ID	
Site Name	FORDSTOWN
Site Name	UCAN / LISNABIN
Latitude	53 39 39.83 N
Latitude	53 31 17.34 N
Longitude	6 53 44.51 W
Longitude	7 9 36.13 W
Irish Grid	
Irish Grid	
Northing	268491.0
Northing	252719.0
Easting	272994.0
Easting	255705.0
Centerline	20.00 m
Centerline	30.00 m
Elevation	80.00 m
Elevation	153.00 m
Structure Height	10.00 m
Structure Height	188.00 m
Azimuth	228.52
Azimuth	48.30



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03/11/20 - Ai Bridges Ltd Response

Hello Thomas,

Thank you for your prompt response.

We have used the co-ordinates that were proposed to us by the third party Environmental Consultant who requested these co-ordinates from Eir during the initial round of consultations.

Would you be able to provide the most accurate co-ordinates that you have so that we can accurately plot the link clearance buffers.

22/02/21 - Ai Bridges Ltd Response

Hello Thomas,

I am just following up with you from our call earlier this week and form the correspondences that we have dating back to November last year.

As discussed we have observed and recorded the following co-ordinates for the OpenEir link. Our co-ordinates match the location of the mast locations below

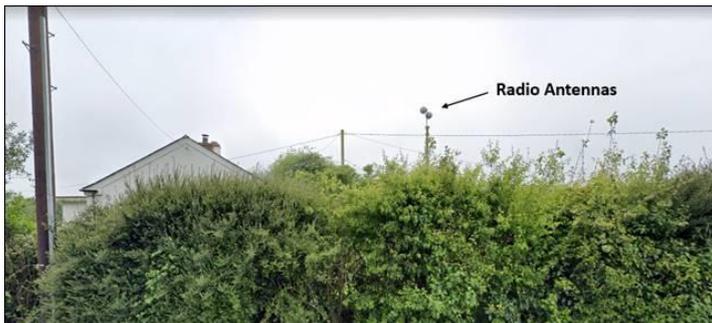
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- Fordstown: 53 39 40.58 N 06 53 47.76 W
- Lisnabin: 53 31 18.04 N 07 09 39.39 W

Would you be able to confirm that we can use these co-ordinates in our impact analysis ?

Site ID: FWN



Site ID: LIN



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22/02/21 - OpenEir Response

Hi Kevin,

Thanks for the update. I have recorded this as corrected duplicate sites. A recent query is for locations 500m+ SE of this link so there is no conflict either way to date.

Regards,
Tom

3.1.4 Imagine Broadband Consultations

The consultation responses between Imagine Broadband and Ai Bridges are shown below.

03/11/20 – Imagine Response to Consultation

*“This is an 11GHz link with a 0.9mt dish both ends.
Cignal Cockstown – dish height 15mt
Rathcore – dish height 24mt”*

11/07/21 – Ai Bridges Ltd Response

Hello Ronnie,

I am just following up with you in relation to consultations that we have had with Imagine in relation to Ballivor Wind Farm . On the 11GHz link identified below we have calculated the 2nd Fresnel , at the mid-point of the link, to be 16m

We have completed our analysis based on the mid-point value of the 2nd Fresnel which is the worst case scenario. We then add an additional set-back buffer from the 2nd Fresnel to the tip of the nearest turbine blade. This set-back buffer of an additional 30m allows for an additional “comfort” factor for telecoms operators.

The technically accepted distance of an obstruction from the boresight of a link is 0.6F1 to avoid microwave radio link interference

We recommend to wind farm developers that they should use a more conservative calculation based on 2nd Fresnel radius at the mid-point of the link with an additional 30m set-back buffer. In this case of the Imagine link our recommendation provides clearance of 46m from the mid-point of the link. (Note : We have agreed with Vodafone 20m for the 2nd Fresnel based on projects and for other projects (under NDA) we have agreed set back buffers of 14m and in some cases we have agreed 0.6F1 from boresight with statutory consultees)

The acting Environmental consultant (MKO) for this Ballivor Wind Farm Project have recently sent out another consultation to yourselves and they received the following response

We need a 50m clearance buffer from the centre if our MW path.
Please let us know the radius of the turbine blades when you have this information.

It should also be noted that the actual proposed turbine location is not at the mid-point and the assumed mid-point Fresnel of 16 mtr is not accurate. We have carried out another analysis based on the actual co-ordinates and we are seeing that the tip of the nearest turbine blade is 33m from the 2nd Fresnel

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As we have other project references with yourselves where we maintain 30m set-back from the 2nd Fresnel would you be able to confirm that this set-back is acceptable so that we can revert to the wind farm developer as they are trying to close out their final site layout for planning application purposes ?

Plan View - 33m Clearance between blade Tip and 2nd Fresnel Zone



Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

02/07/21 – Imagine Response to Consultation

“Hi Kevin,

Thank you for your detailed response.

The last mail we received from the acting environmental consultant (MKO) could not confirm the extent of the turbine blades into our MW path:

The radius of the turbine blades has not yet been determined for this development

The proposed set back is now accepted.

We trust that during the construction of this wind farm the set back area will be demarcated.

Kind Regards,

*Paul Brunel.
Transmission Planning.”*

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27/09/21 – Ai Bridges Ltd Response

Hello Paul, Ronnie

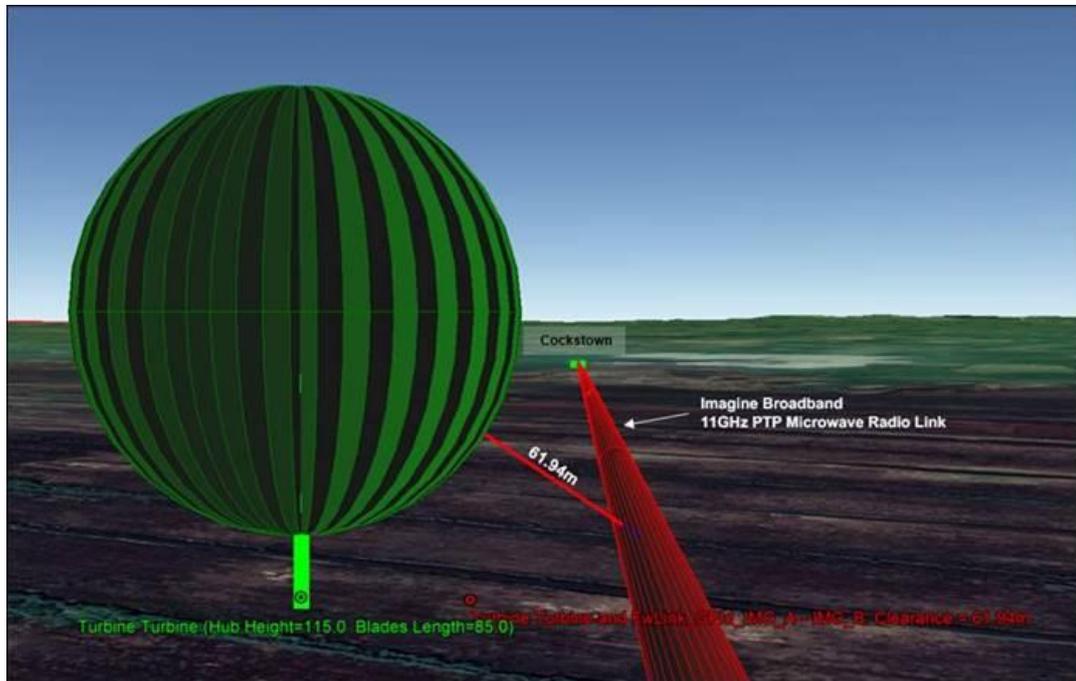
We are following up with you in relation to the Ballivor Wind Farm Development from our last correspondence on July 2nd 2021.

In our previous 2-dimensional analysis (including link path profile and plan view analysis) we determined that there was a 33m clearance from the mid-point of the link, based on 2nd Fresnel radius at the mid-point of the 11GHz link with an additional 30m set-back buffer.

The wind farm developer has requested that we conduct a detailed 3-dimensional analysis of the link. A 3D analysis provided height calculations which is not possible in a 2D analysis. Our analysis has shown that the clearance increases to 61.94m based on a wind turbine hub height of 115 m and blade length of 85m. Would you be able confirm that these link clearance analysis findings are acceptable to Imagine Broadband.

If possible we would be grateful if you can confirm same by close of business today as we are looking to issue a Statement of Reliance as to our findings.

We look forward to hearing from you.



Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

27/09/21 – Imagine Response to Consultation

“Good Morning Kevin,

Thanks for your mail.

We can confirm that the new greater clearance distance is accepted.

Kind Regards,

Paul Brunel.

Transmission Planning.

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3.1.5 2RN Response to Consultations

The consultation responses between 2RN and Ai Bridges are shown below.

04/11/20 – 2RN Response to Consultation

“284m for antenna height above sea level at Cairn Hill please – the lower of our receive antennas there is just 15m above ground level.

*Three Rock: 53.244475, -6.238146, 577m
Cairn Hill: 53.807232, -7.715463, 284m”*

04/11/20 - Ai Bridges Ltd Response

Would you be able to confirm the above ground levels (AGL) for the receive and transmit antenna respectively for each mast below

- Cairn Hill : 15m
- Three Rock : ??

04/11/20 – 2RN Response to Consultation

“The link is just one way so we are interested in the receive at Cairn Hill (15m above ground) and the transmit at Three Rock (120m above ground – so actually 566m above sea level).”

04/11/20 - Ai Bridges Ltd Response

Thanks for this, so just to confirm AGL antenna heights are:

- Cairn Hill : 15m
- Three Rock : 120m”

04/11/20 – 2RN Response to Consultation

“Correct. Thanks.”

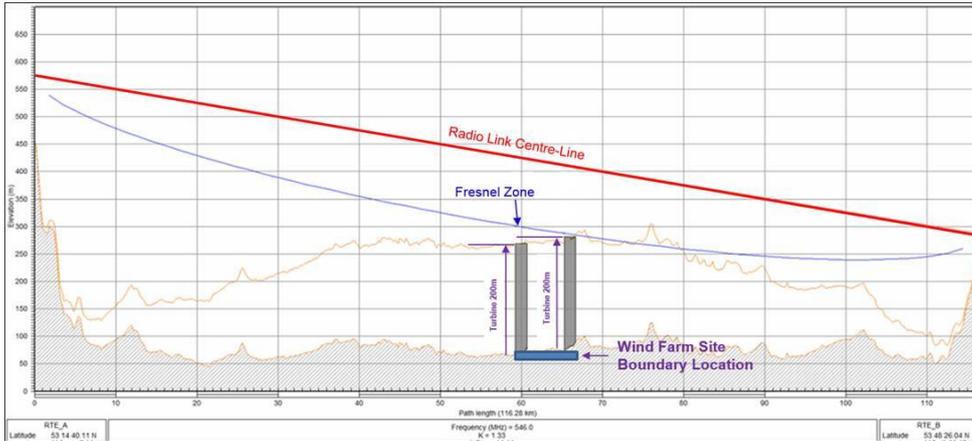
05/11/20 - Ai Bridges Ltd Response

Our engineers have re-run the path analysis based on the information received yesterday and they have also plotted 2 turbines with the worst case scenario maximum turbine height (200m) at the extremities of the wind farm site boundary (as the link passes over).

The Path Profile shows that the 2RN link would pass over/clear both turbines locations.

I would be grateful if you could confirm that we can provide this to the wind farm developer for their initial design layout on the basis that there will be no impact on the 2nd Fresnel zone

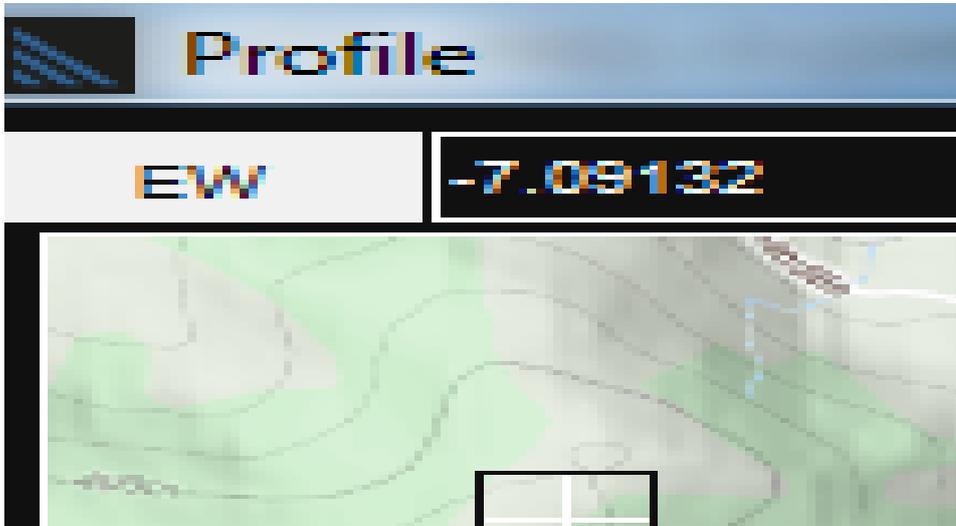
	Procedure: 001	Rev: 5.0
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05/11/20 – 2RN Response to Consultation

“I’ve had a go myself. It looks like from your diagram that the 200m block applied to represent the possible turbines is fixed to the flat earth/k=1 profile and is not moved up with the curved (k=1.33) earth profile shown with a more faint line. Is this correct? Using the curved profile - which I think we should – puts the path right through the turbine zone, so we would at least need to keep a clear path through the middle of the zone, with a bit of buffering to help with some Fresnel zone clearance.”

My plot below shows a curved earth (k=1.33) with the 200m windfarm “block” on top, showing 1st and 2nd Fresnel zones.”



3.1.6 Tetra Ireland (TI) Consultations

16/03/21 - Ai Bridges Ltd Consultation Follow-Up :

Hello Tom,

We are just following up with you in relation to the correspondence that we sent out below on 02/11/20 regarding the proposed Wind Farm development at Balivor, Co. Meath.

	Procedure: 001	Rev: 5.0
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During previous consultations it was identified that Tetra Ireland have a Basestation that would be potentially impacted by the proposed wind farm.

As we are trying to close out all operator consultation by today, we would be grateful if you could confirm that the information below for this Basestation is correct.

We would be grateful if you could confirm if you are satisfied with the constraints map that we have provided below which allows for an exclusion buffer around the Tetra Ireland Basestation.

16/03/21 – Tetra Ireland Response to Consultation:

David,

The exclusion zone as mapped is sufficient.

Regards,
Tom

3.1.7 Three Ireland Consultations

16/03/21 - Ai Bridges Ltd Consultation Follow-Up :

Hello Alister,

We are just following up with you in relation to the correspondence that we sent out below on 02/11/20 on the proposed Wind Farm development at Ballivor, Co. Meath

During previous consultations it was identified that Three Ireland have three links that would be potentially impacted by the proposed wind farm.

As we are trying to close out all operator consultation by today we would be grateful if you could confirm that the information below for these three links are correct.

We would be grateful if you could confirm if you are satisfied with the constraints map that we have provided below which allows for an exclusion buffer around each of the Three Ireland links

16/03/20 – Three Ireland Response to Consultation

Hi Kevin,

The requested details are as follows;

Link 4 – Kinnegad>Ballivor Coillte – 18GHz 30m/30m
 Link 5 – VF Delvin>Ballivor Coillte – 26GHz 30m/30m
 Link 8 – VF Delvin>Coillte Grange More – 18GHz 30m/30m

All site coordinates are correct.

I am satisfied that the proposed Turbine locations on the constraints map give sufficient clearance and that the 3Ireland microwave network will not be potentially affected.

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3.1.8 Vodafone Ireland Consultations

The consultation responses between Vodafone Ireland and Ai Bridges are shown below:

03/11/20 – Vodafone Response to Consultation

“Links are as follows in this area:

*MH013 Loughanstown (53.6252, -7.0231) – WHLIN Kilucan (53.5215, -7.1601) Height 30m, distance 14.6km
 MH009 Faughan Hill (53.6677, -6.7978) – WHLIN Kilucan (53.5215, -7.1601) Height 16m (MH009) 31m (WHLIN), distance 28.72km
 MH094 Balivor (53.5422, -6.9985) – WHLIN Kilucan (53.5215, -7.1601) Height 15m, distance 10.96km
 MH081 Balivor Bord na Móna (53.5323, -7.0436) – KECAP Cappagh (53.4041, -6.7449) Height 30m, distance 24.38km.”*

 <i>Total Broadband Solutions</i>	Procedure: 001	Rev: 5.0
Title: Balivor Wind Farm Telecommunications Impact Study	Approved: KH	Date: 11/10/21

Section 4 - Desktop Survey Analysis

	Procedure: 001	Rev: 5.0
Title: Balivor Wind Farm Telecommunications Impact Study	Approved: KH	Date: 11/10/21

4. Introduction

Based on the findings obtained during field surveys and the telecom operator consultation process, an analysis of the telecom networks operating in the vicinity of Balivor was carried out. Three telecommunications technologies were considered for analysis:

- 4.1 Licensed Transmission Networks
- 4.2 Tetra Network
- 4.3 TV Transmission Networks

Sections 4.1 to 4.3 below outline the desktop survey analysis findings for each of the technologies listed above.

4.1 Licensed Transmission Networks

Table 4 below lists the licensed transmission radio links that required a desktop analysis. The results of the desktop analysis for these links are provided in Sections 4.1.1 to 4.6.

Link ID	Operator	Operator ID	Link Description
1	Enet	1	Derrynagarragh - Killickaweeny PTP Link
2	Enet	1	Derrynagarragh - Rathcore PTP Link
3	Eir Mobile (Meteor)	2	Killaconnigan - Sheepstown PTP Link
4	Eir Mobile (Meteor)	2	Killaconnigan - Clonylogan PTP Link
5	Eir Mobile (Meteor)	2	Killaconnigan - Fosterstown PTP link
6	OpenEir	3	Fordstown - Killucan PTP Link
7	Imagine Broadband	4	Cockstown - Rathcore PTP Link
8	Three Ireland	5	Kinnegad - Killaconnigan (Balivor) PTP Link
9	Three Ireland	5	Delvin - Killaconnigan (Balivor) - New PTP Link
10	Three Ireland	5	Delvin - Grange More - New PTP Link
11	Vodafone Ireland	6	Killaconnigan - Rathwire (Killucan) PTP Link
12	Vodafone Ireland	6	Grange More - Killickaweeny PTP Link
13	Vodafone Ireland	6	Loughanstown - Rathwire (Killucan) PTP Link
14	Vodafone Ireland	6	Killucan - Faughan Hill Trunk Radio Link

Table 4. Licensed Radio Links requiring Analysis

Note 1: All calculations and are subject to the accuracy of the; GPS co-ordinates, turbine dimensions and radio link parameters provided to Ai Bridges Ltd.

Note 2: Every microwave radio link has multiple Fresnel Zones (1st Fresnel Zone, 2nd Fresnel Zone, 3rd Fresnel Zone, etc). Obstructions in these zones can impact the operation of a microwave radio link.

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In radio frequency analysis, it is normal to use the 1st Fresnel Zone in radio interference calculations; however, the 2nd Fresnel Zone is sometimes used to provide worse-case-scenario results as it encompasses a larger area around the centreline of the microwave link. Figure B1 below shows an illustration of a radio link's Fresnel Zones (F1 & F2).

It should also be noted that the Fresnel Zone size is dependent on the radio link frequency and link distance. To determine if a nearby obstacle (e.g. turbine) obstructs the Fresnel Zone of a radio link, a cross-sectional analysis is required.

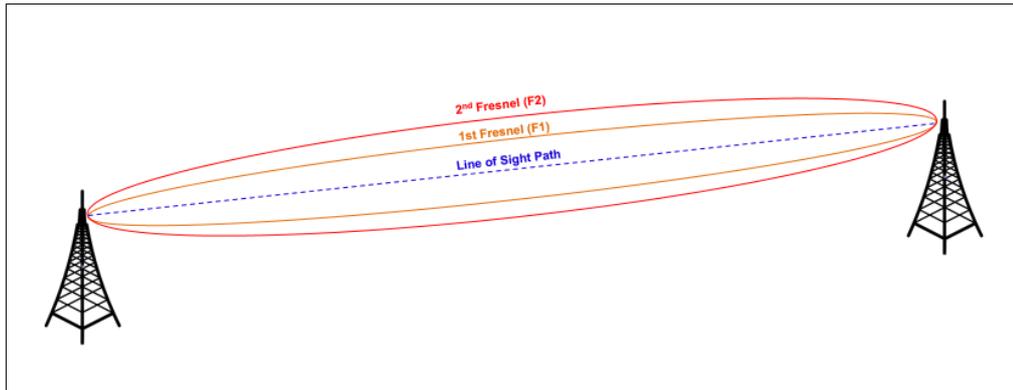


Figure 4. Illustration showing the 1st Fresnel and 2nd Fresnel Zone of a radio link.

Note 3: Where the frequency of a particular radio link has not been provided, a frequency of 13GHz has been used in radio link calculations. 13GHz is a relatively low frequency for PTP microwave radio links and has a larger Fresnel Zone compared to higher frequency links (i.e. worse-case scenario frequency used).

Note 4: Exclusion Zones have been calculated by determining the 2nd Fresnel Zone distance at the Mid-point of the radio link (worse-case scenario) and then plotting this distance around both sides of the radio link centre-line. (The Total Exclusion Zone distance will be the 2nd Fresnel x 2).

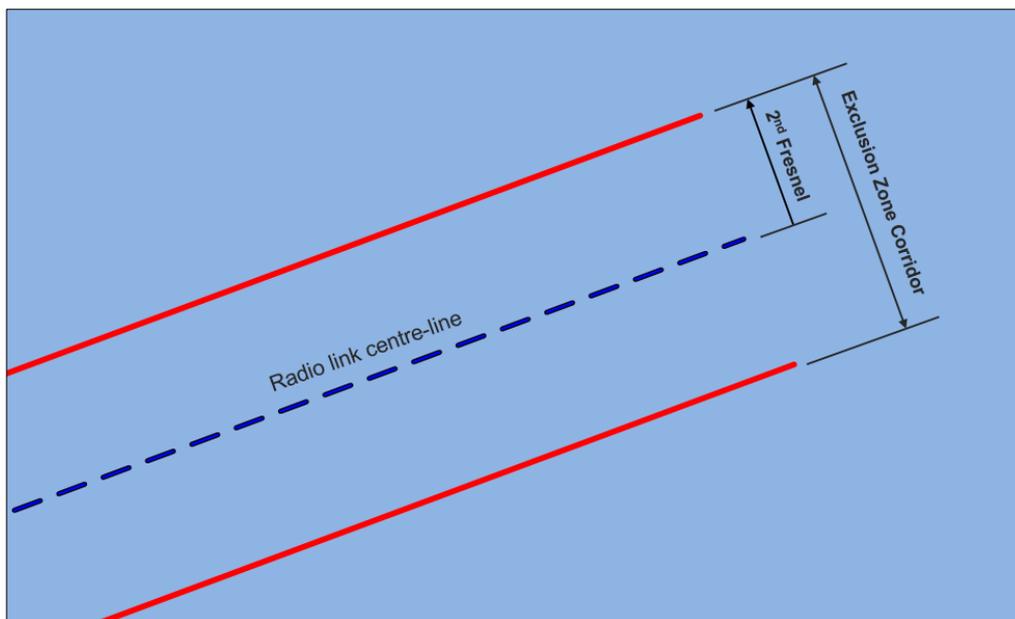


Figure 5. Illustration showing radio link Exclusion Zone

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4.1.1 Enet Network Exclusion Zones

Table 5 below provides details regarding the two PTP radio links operated by Enet.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone Total Corridor (m)
		Site A	Site B			
Enet	Derrynagarragh - Killickaweeny PTP Link	53°38'21.08"N 7°16'28.13"W	53°24'18.20"N, 6°44'45.50"W	7 GHz	31	62
Enet	Derrynagarragh - Rathcore PTP Link	53°38'21.08"N 7°16'28.13"W	53°26'36.29"N 6°51'36.83"W	13GHz	20	40

Table 5. Licensed Transmission Links - Enet

The Enet radio links that traverse the wind farm have been plotted in specialised radio planning software and are shown in Figure 6. An Exclusion Zone has been generated for each radio link and is shown below Figure 7.

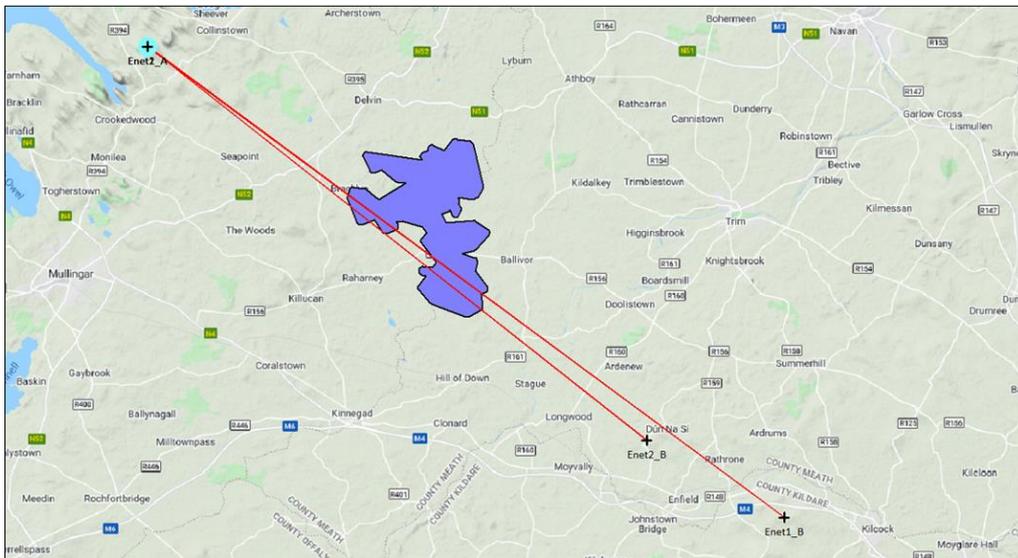


Figure 6. Enet's microwave radio links passing through the proposed wind farm.

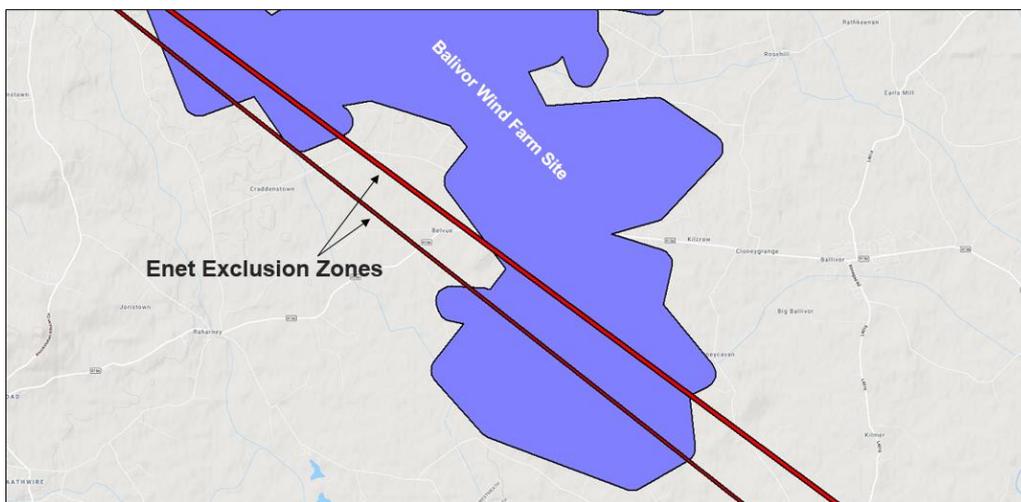


Figure 7. Exclusion Zones – Enet Network

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4.1.2 Eir Mobile Network Exclusion Zones

Table 6 below provides details regarding the three PTP radio links operated by Eir Mobile.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone Total Corridor (m)
		Site A	Site B			
Eir Mobile	Killaconnigan - Sheepstown PTP Link	53° 28' 11.602"N 7° 5' 58.980"W	53.542383 - 6.9994477	18 GHz	9	18
Eir Mobile	Killaconnigan - Clonylogan PTP Link	53.617673 - 7.0971452	53.542383 - 6.9994477	13 GHz *	11	22
Eir Mobile	Killaconnigan - Fosterstown PTP link	53.617673 - 7.0971452	53.5288 - 7.0450437	13 GHz *	11	22

Table 6. Licensed Transmission Links – Eir Mobile

The Eir Mobile radio links that traverse the wind farm have been plotted in specialised radio planning software and are shown in Figure 8. An Exclusion Zone has been generated for each radio link and is shown below Figure 9.

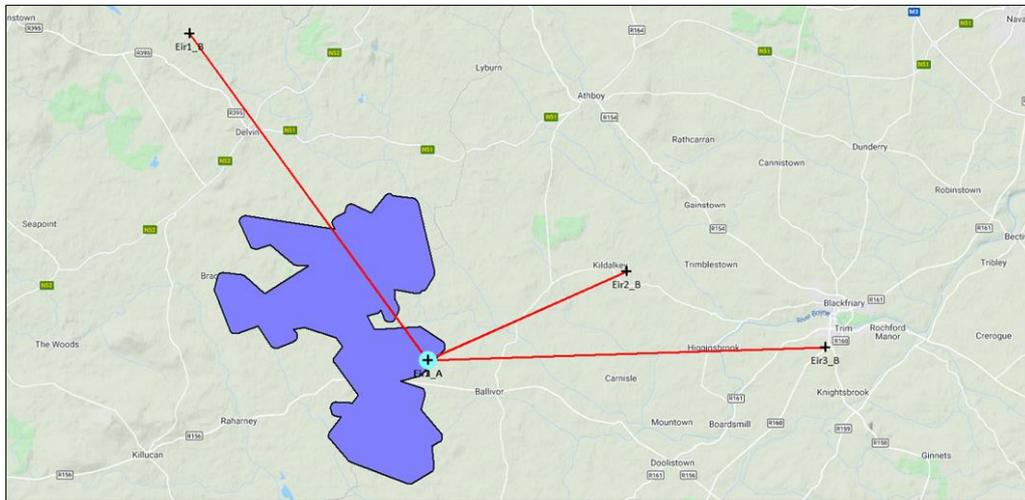


Figure 8. Eir Mobile's microwave radio links passing through the proposed wind farm.

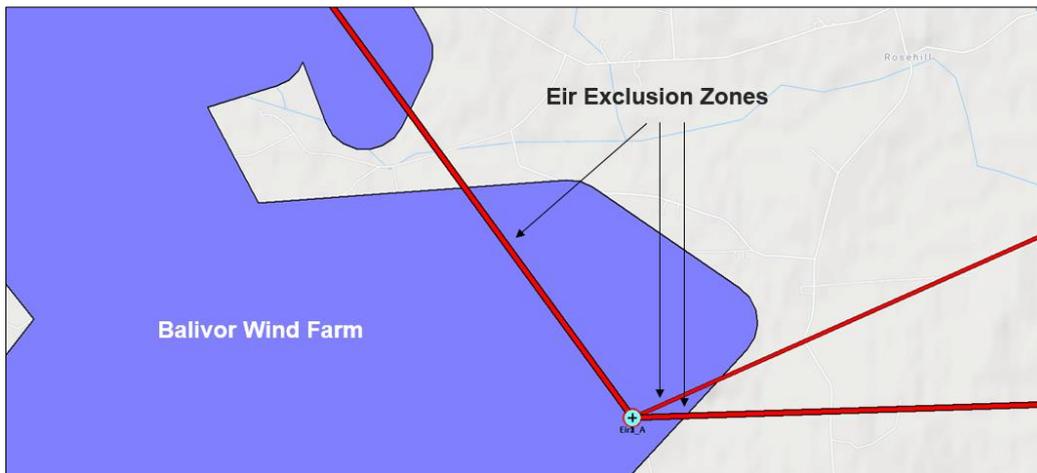


Figure 9. Exclusion Zones - Eir Mobile Network

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4.1.3 OpenEir Network Exclusion Zones

Table 7 below provides details regarding the three PTP radio links operated by OpenEir.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone Total Corridor (m)
		Site A	Site B			
OpenEir	Fordstown - Killucan PTP Link	53° 39' 39.83"N 6° 53' 44.51"W	53° 31' 17.34"N 7° 9' 36.13"W	13 GHz	16	32

Table 7. Licensed Transmission Links – OpenEir

The OpenEir radio links that traverse the wind farm have been plotted in specialised radio planning software and are shown in Figure 10. An Exclusion Zone has been generated for each radio link and is shown below Figure 11.

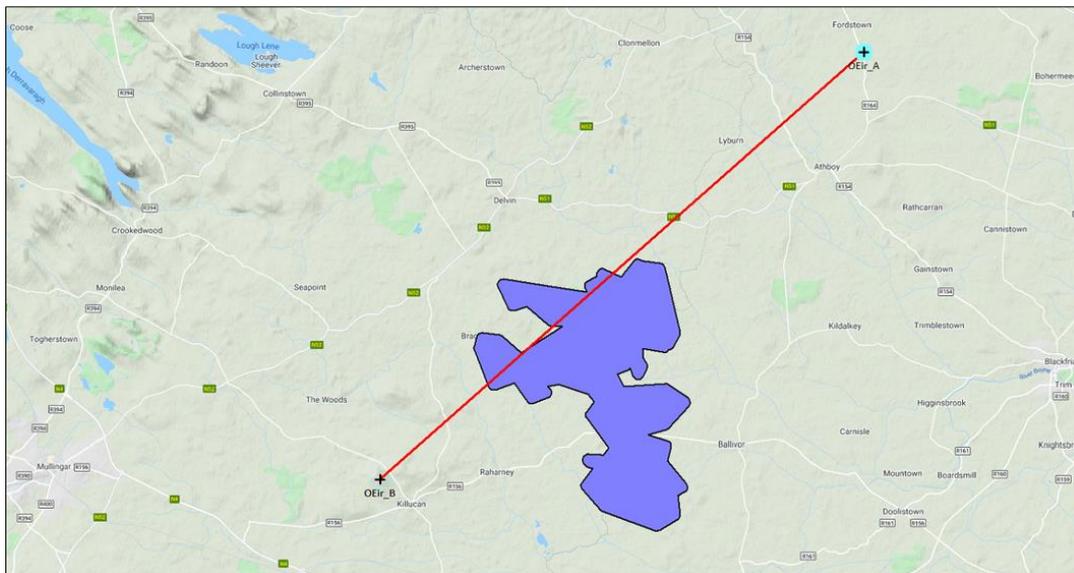


Figure 10. OpenEir microwave radio link passing through the proposed wind farm.

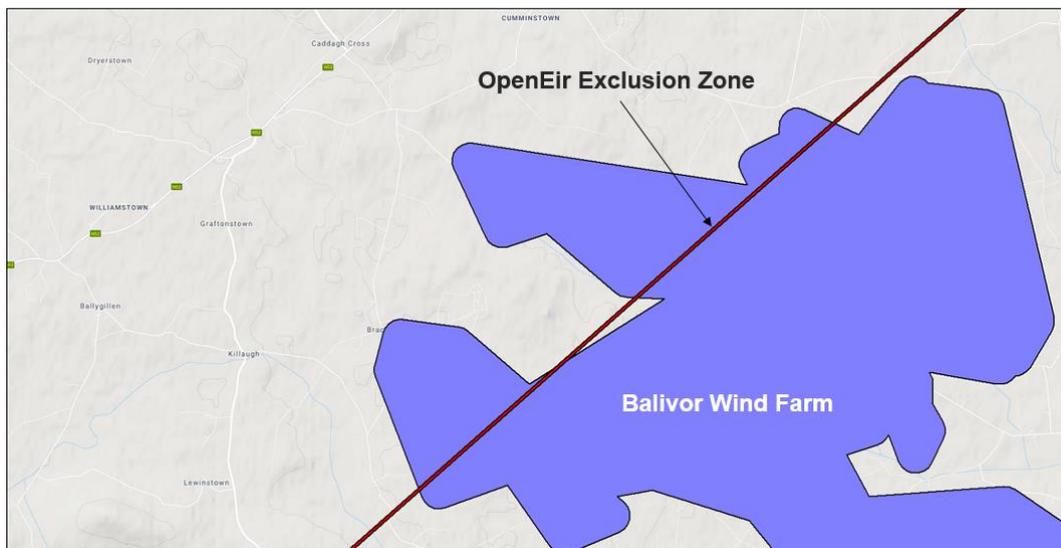


Figure 11. Exclusion Zone – OpenEir Network

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4.1.4 Imagine Broadband Network Exclusion Zones

Table 8 below provides details regarding the PTP radio link operated by Imagine Broadband.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone Total Corridor (m)
		Site A	Site B			
Imagine Broadband	Cockstown - Rathcore PTP Link	53.590497 - 7.022789	53.442111 - 6.853837	11 GHz	16	32

Table 8. Licensed Transmission Links – Imagine Broadband

The Imagine Broadband radio link that traverses the wind farm has been plotted in specialised radio planning software and is shown in Figure 12. An Exclusion Zone has been generated for the radio link and is shown below Figure 13.

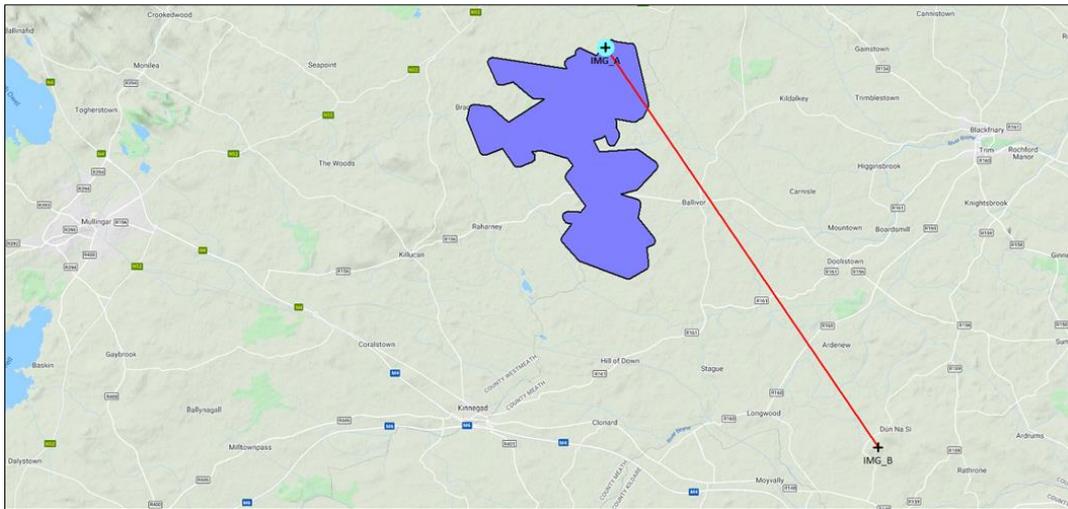


Figure 12. Imagine Broadband microwave radio link passing through the proposed wind farm.



Figure 13. Exclusion Zone - Imagine Broadband Network

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Note: The Exclusion Zone generated has been used by the wind farm developers to site a turbine adjacent to the Imagine Broadband radio link.

When viewed from above (Figure 14) there is a 33m clearance distance between the turbine blade-tip and the radio link 2nd Fresnel Zone.

When the turbine and radio link are modelled in 3D (Figure 15), the results indicate that that actual clearance distance between the turbine blade-tip and that radio link 2nd Fresnel Zone will be 61.94m. At this distance, the proposed turbine meets the 30m clearance criteria that has been accepted by Imagine Broadband (See Section 3.1.4) and there will be no impact to the operation of the radio link.



Figure 14. Proposed Turbine relative to Imagine BB Radio Link – Plan View

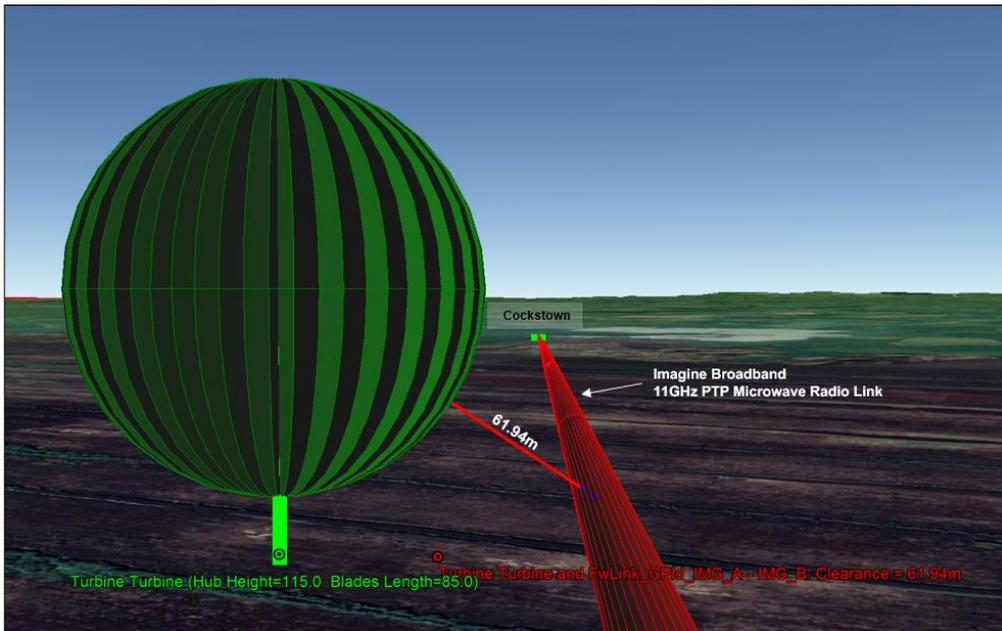


Figure 15. Proposed Turbine relative to Imagine BB Radio Link – 3D View

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4.1.5 Three Ireland Network Exclusion Zones

Table 9 below provides details regarding the three PTP radio links operated by Three Ireland.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone Total Corridor (m)
		Site A	Site B			
Three Ireland	Kinnegad - Killaconnigan (Balivor) PTP Link	53° 28' 11.602"N 7° 5' 58.980"W	53.542383 - 6.9994477	18 GHz	9	18
Three Ireland	Delvin - Killaconnigan (Balivor) - New PTP Link	53.617673 - 7.0971452	53.542383 - 6.9994477	13 GHz *	11	22
Three Ireland	Delvin - Grange More - New PTP Link	53.617673 - 7.0971452	53.5288 - 7.0450437	13 GHz *	11	22

Table 9. Licensed Transmission Links – Three Ireland

The Three Ireland radio links that traverse the wind farm have been plotted in specialised radio planning software and are shown in Figure 16. An Exclusion Zone has been generated for each radio link and is shown below Figure 17.

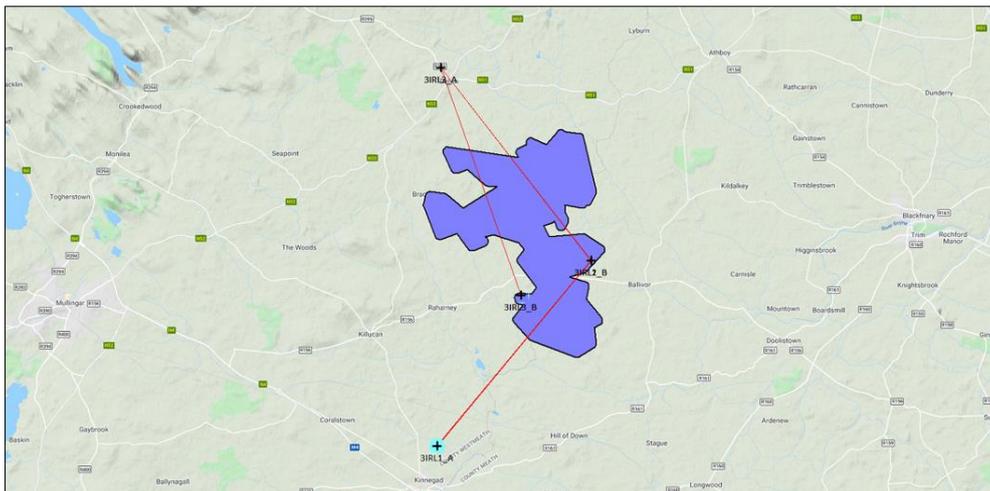


Figure 16. Three Ireland microwave radio links passing through the proposed wind farm.

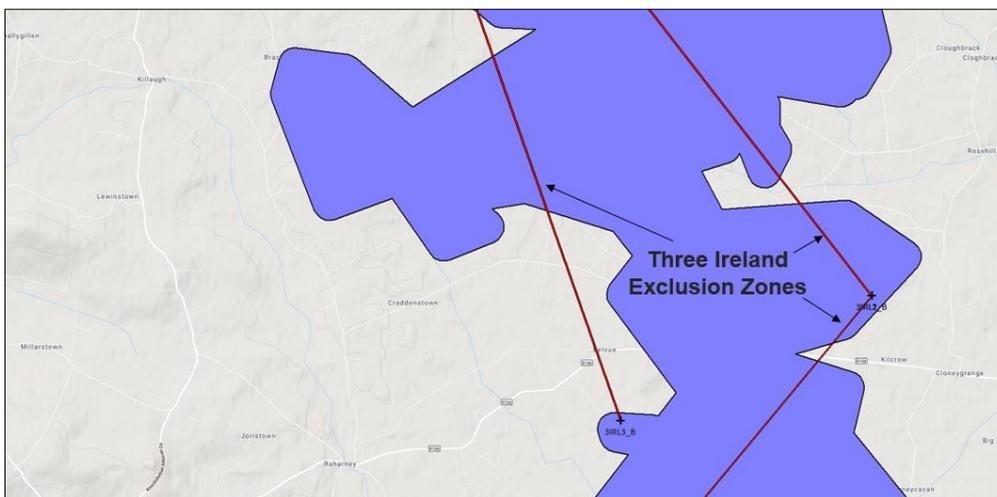


Figure 17. Exclusion Zones - Three Ireland Network

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4.1.6 Vodafone Ireland Network Exclusion Zones

Table 10 below provides details regarding the three PTP radio links operated by Vodafone Ireland.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone Total Corridor (m)
		Site A	Site B			
Vodafone Ireland	Killaconnigan - Rathwire (Killucan) PTP Link	53.542440823 - 6.999427491	53.521679042 - 7.160940681	13 GHz	11	22
Vodafone Ireland	Grange More - Killickaweeny PTP Link	53.532348 - 7.043619	53.40505551 - 6.745971972	13 GHz	17	34
Vodafone Ireland	Loughanstown - Rathwire (Killucan) PTP Link	53.6291134517687 - 7.02712544879474	53.521679042 - 7.160940681	18 GHz	11	22
Vodafone	Kilucan - Faughan Hill Trunk Radio Link	53.521679042 - 7.160940681	53.66845851 - 6.799454942	8 GHz	23	46

Table 10. Licensed Transmission Links – Vodafone Ireland

The Vodafone radio links that traverse the wind farm have been plotted in specialised radio planning software and are shown in Figure 18. An Exclusion Zone has been generated for each radio link and is shown below Figure 19.

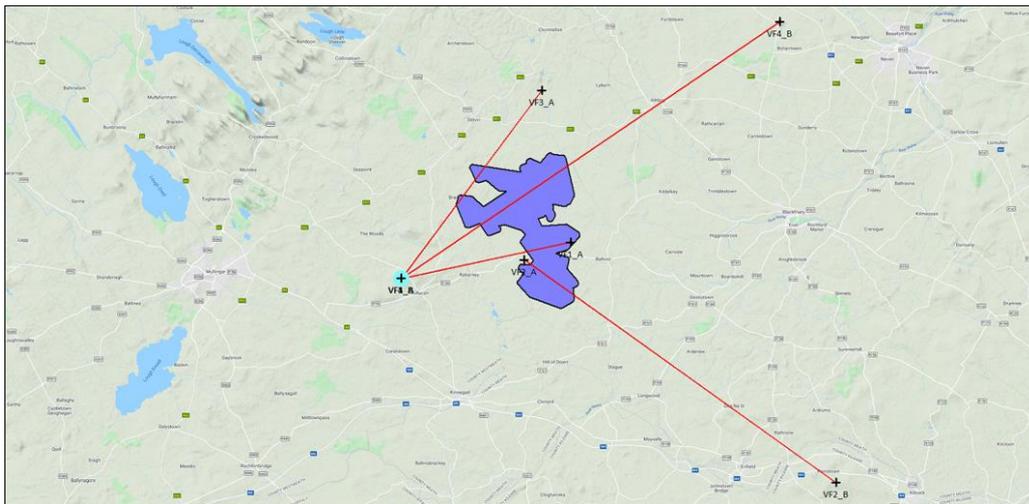


Figure 18. Vodafone Ireland microwave radio links passing through the proposed wind farm.

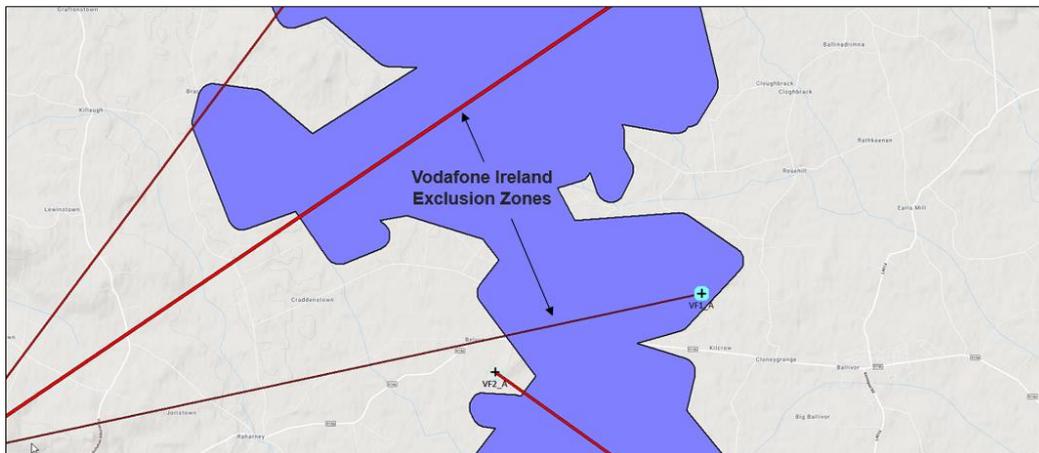


Figure 19. Exclusion Zones – Vodafone Ireland Network

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4.2 TETRA Network

Tetra Ireland have stated in their consultation response to MKO that they require a 500m exclusion buffer from the telecommunications mast where they are operating their Emergency services base station. This exclusion zone is shown below in Figure 20.

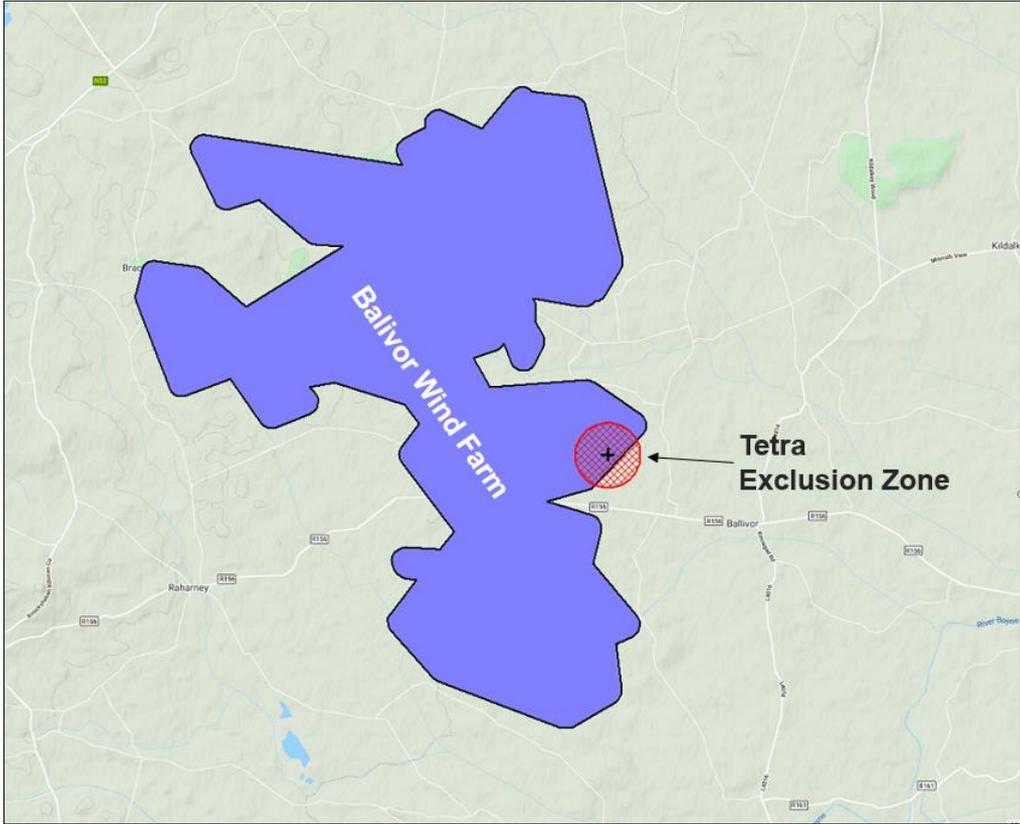


Figure 20. Exclusion Zone - Tetra Ireland Network

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4.3 TV Transmission Network

During consultations 2RN raised concerns regarding their UHF Feeder link from Three Rock to Cairn Hill. The link consist of a 116km UHF. As the link is relatively long and operates at low frequency it has a larger 2nd Fresnel Zone when compared to the licensed PTP microwave radio links listed in Section 4.1.

Operator	Description	Link Co-ordinates		Freq	2nd Fresnel (m)	Exclusion Zone (m)
		Site A	Site B			
2RN	Three Rock - Cairn Hill PTP Link	53.244455 - 6.238067	53.807227 - 7.715351	546 MHz	185	370

Table 11. TV Transmission Link – 2RN

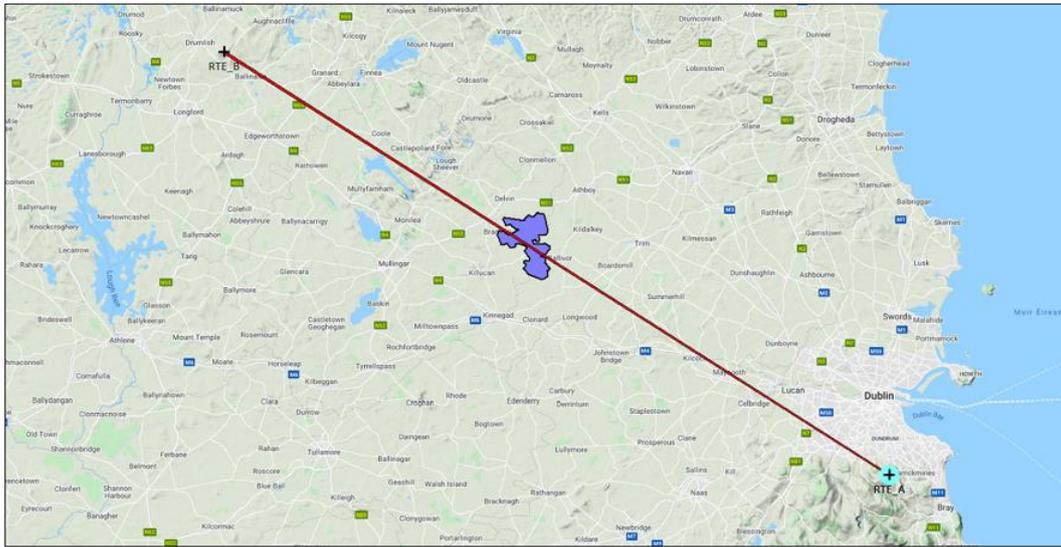


Figure 21. 2RN's radio link passing through the proposed wind farm.



Figure 22. Exclusion Zone - 2RN Network.

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4.4 Telecommunication Desktop Survey Analysis Summary

All of the telecommunications links and networks analysed in Sections 4.1 to 4.3 have been summarised in tabular format and is included in Appendix B. This table of information includes the agreed industry standard operator buffers that are applied to each telecommunication link and/or network.

 <i>Total Broadband Solutions</i>	Procedure: 001	Rev: 5.0
Title: Balivor Wind Farm Telecommunications Impact Study	Approved: KH	Date: 11/10/21

Section 5 - Conclusions

	Procedure: 001	Rev: 5.0
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5. Conclusions

From the findings made in this report the following conclusions have been made:

- There are fourteen licensed microwave transmission radio links that cross the proposed wind farm site boundaries. Using the technical information provided by the telecommunications operators a 2D analysis has been used to generate a clearance buffer based on the 2nd Fresnel Zone around each link. One of the operators, (Eir) indicated that they would possibly be removing their link within 2 years from date of consultation. Clearance buffer zones have been generated for each buffer zone and generated in shapefile format.
- A 3D software analysis of the Imagine Broadband link was carried out and the resulting analysis showed a clearance of 61.94m from the nearest proposed wind turbine to the link. Imagine Broadband accepted the proposed clearance calculations.
- There is one Tetra Basestation located within the proposed wind farm site boundary. A 500m Exclusion zone around the Tetra base-station has been generated and provided in shapefile format.
- There is one television transmission radio link that crosses the wind farm site boundary. Using the details provided by the broadcast operator (2RN), a clearance buffer zone around this radio link has been generated and provided in shapefile format.
- Figure 23 below has been provided to illustrate each of the telecommunication microwave transmission links that cross over\near the proposed wind farm site boundary. All of the clearance buffer \exclusion zones have been provided in shapefile format can be used for preliminary design of the site layout.

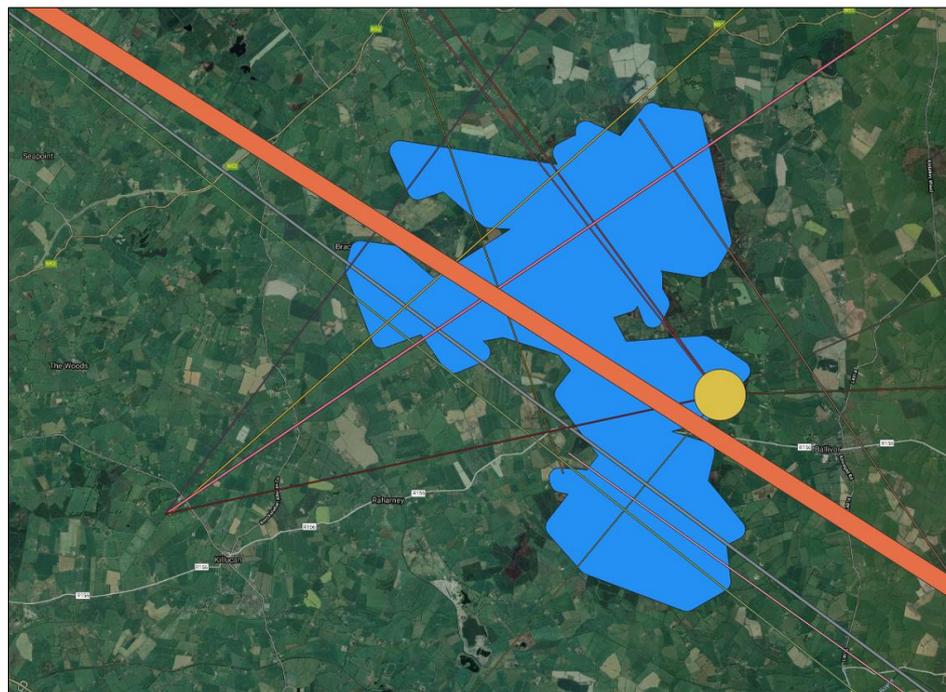


Figure 23. Balivor Wind Farm Telecoms Network Exclusion Zones.

 <i>Total Broadband Solutions</i>	Procedure: 001	Rev: 5.0
Title: Balivor Wind Farm Telecommunications Impact Study	Approved: KH	Date: 11/10/21

APPENDICES

	Procedure: 001	Rev: 5.0
Title: Balivor Wind Farm Telecommunications Impact Study	Approved: KH	Date: 11/10/21

Appendix A – Balivor Wind Farm Turbine Co-ordinates

The development is in the pre-planning stage and exact details regarding the quantity, location and turbine dimension have yet to be finalized.

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Appendix B – Balivor Wind Farm Telecommunications Exclusion Zones

Project : Ballivor Wind Farm - Telecommunications Impact Assessment

Link ID	Operator	Description	Co-ordinates		Antenna Heights		Link Distance	Freq used in Calculations for Fresnel Zone	Fresnel No	Fresnel Exclusion Zone Total Corridor (m)	Fresnel Radius at midpoint of link (m) (Worse-Case-Scenario)	Operator Buffer Distance (m)**	Fresnel Exclusion Zone + Operator Buffer distance (m)	Exclusion Zone Radius (m)
			Site A	Site B	Site A	Site B								
1	Imagine (IMG)	Cockstown - Rathcore PTP Link	53.590497 -7.022789	53.442111 -6.853837	TBC	TBC	20 km	13 GHz*	2	30	15	30	90	45
2	2RN	Three Rock - Cairn Hill PTP Link	53.244455 -6.238067	53.807227 -7.715351	120	15	116 km	546 MHz	2	370	185	30	430	215
3	Vodafone (VF1)	Killaconnigan - Rathwire (Killucan) PTP Link	53.542440823 -6.999427491	53.521679042 -7.160940681	TBC	TBC	11 km	13 GHz	2	22	11	30	82	41
4	Vodafone (VF2)	Grange More - Killickaveeny PTP Link	53.532348 -7.043619	53.40505551 -6.745971972	TBC	TBC	24 km	13 GHz	2	34	17	30	94	47
5	Vodafone (VF3)	Loughanstown - Rathwire (Killucan) PTP Link	53.6291134517687 -7.02712544879474	53.521679042 -7.160940681	TBC	TBC	15 km	18 GHz	2	22	11	30	82	41
6	Vodafone (VF4)	Kilucan - Faughan Hill Trunk Radio Link	53.521679042 -7.160940681	53.66845851 -6.739454942	TBC	TBC	29 km	8 GHz	2	46	23	30	106	53
7	Three Ireland (3IRL1)	Kinnegad - Killaconnigan (Balivor) PTP Link	53° 28' 11.602"N 7° 5' 58.980"W	53.542383 -6.9994477	TBC	TBC	10 km	18 GHz	2	18	9	30	78	39
8	Three Ireland (3IRL2)	Delvin - Killaconnigan (Balivor) - New PTP Link	53.617673 -7.0971452	53.542383 -6.9994477	TBC	TBC	11 km	13 GHz*	2	22	11	30	82	41
9	Three Ireland (3IRL3)	Delvin - Grange More - New PTP Link	53.617673 -7.0971452	53.5288 -7.0450437	TBC	TBC	11 km	13 GHz*	2	22	11	30	82	41
10	Enet (Enet1)	Derrynagaragh - Killickaveeny PTP Link	53° 38' 21.08" N 7° 16' 28.13" W	53° 24' 18.20" N 6° 44' 45.50" W	15	20	44 km	7 GHz	2	62	31	30	122	61
11	Enet (Enet2)	Derrynagaragh - Rathcore PTP Link	53° 38' 21.08" N 7° 16' 28.13" W	53° 26' 36.29" N 6° 51' 36.83" W	15	10	35 km	13 GHz	2	40	20	30	100	50
12	Eir Meteor (Eir1)	Killaconnigan - Sheepstown (Delvin) PTP Link	53° 32' 32.94" N 6° 53' 58.28" W	53° 38' 33.12" N 7° 7' 16.93" W	TBC	TBC	14 km	13 GHz*	2	26	13	30	86	43
13	Eir Meteor (Eir2)	Killaconnigan - Clonylogan (Kildalkey) PTP Link	53° 32' 32.94" N 6° 53' 58.28" W	53° 34' 10.92" N 6° 53' 51.15" W	TBC	TBC	7 km	13 GHz*	2	18	9	30	78	39
14	Eir Meteor (Eir3)	Killaconnigan - Fosterstown (Trim) PTP Link	53° 32' 32.94" N 6° 53' 58.28" W	53° 32' 47.03" N 6° 47' 45.02" W	TBC	TBC	14 km	13 GHz*	2	26	13	30	86	43
15	OpenEir (Deir)	Fordstown - Killucan PTP Link	53° 39' 40.58" N 6° 53' 47.76" W	53° 31' 18.04" N 7° 9' 39.39" W	20	30	23 km	13 GHz*	2	32	16	30	92	46
16	Tetra	Killaconnigan TETRA Basestation	53.54248 -6.9992342	N/A	-	-	N/A	N/A	N/A	500m (Radius from Basestation)	-	N/A	-	-
17	Ballyboy Aerodrome	Ballyboy Airfield			-	-	-	-	N/A	5km from Aerodrome ARP (Midpoint of Runway)	-	N/A	-	-

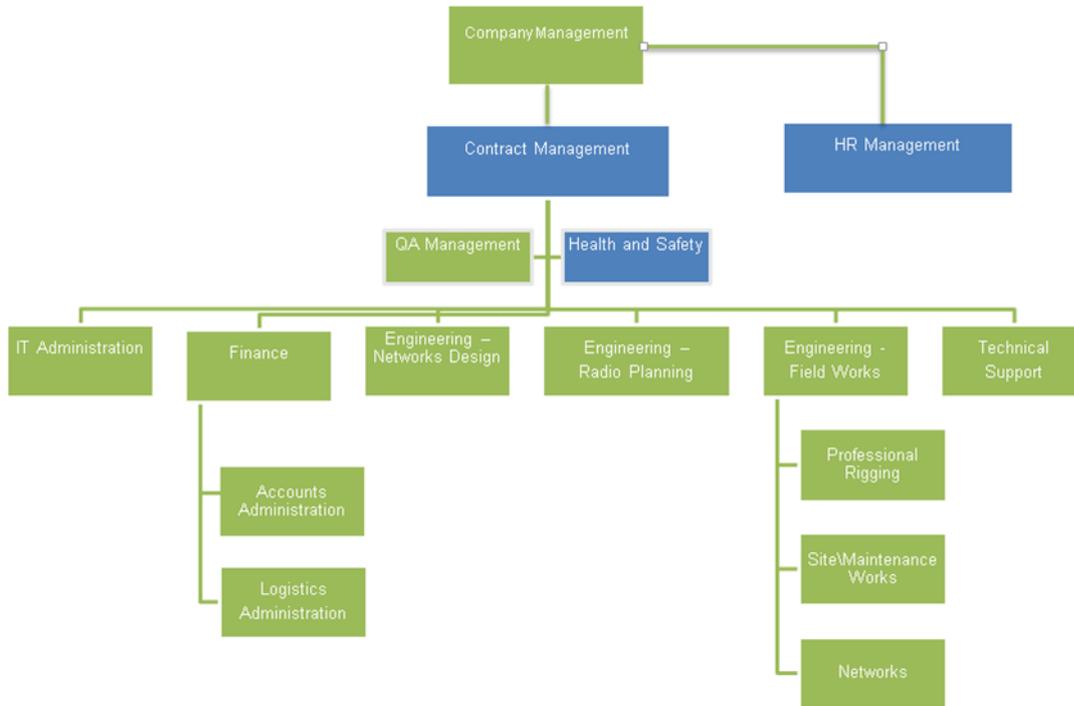
* 13 GHz Assumed for Worse Case Scenario

** On a recent project 2RN have agreed 30m from 2nd Fresnel. Clarification being sought from 2RN to confirm that this buffer can be applied to Balivor

Ai Bridges – Statement of Authority

1. Proposed Team

The following diagram shows the Ai Bridges Limited Organizational Structure.



Ai Bridges have a team of qualified and trained personnel within the company that deals with Telecommunications & Aviation Impact Assessment Studies. The staff engaged in carrying out the scope of services on this wind farm project are included herein.

2. Kevin Hayes Technical – Experience - Qualifications - Expertise

Kevin Hayes served as the main engineering lead within the company organization to deal with the delivery of the Telecommunications Assessment Study.

Professional Qualifications :

- B.Eng Hons Electronic Engineering – Telecommunications & Industrial Automation – U.L. 1991
- M.Eng Hons Electronic Engineering – Telecommunications Engineering – U.L. 2003
- Harris Radio Design Certification 2008
- WiMAX Certified Engineer 2005
- Redline Communications Certified Engineer – 2004
- PM Certified Professional 1999

Relevant Employment Experience :

- Telecommunications Network & Software Design Engineer
- Founding Director Ai Bridges (2000 – present)
- In excess of 20 years of Telecommunications Network Design & Project Management
- Experienced analysing and troubleshooting RF issues.
- Research and Development responsibilities for all telecommunications projects managed at Ai Bridges
- Currently researching 3D Software Modelling Predictions of wind farm impacts on Aviation & Aeronautical Surfaces.

Reference Project Site :

- Managed Hunters Hill and Crockagarron Wireless Signal Interference Remediation Project
- Managed Slieve Kirk – Carrickatheane – Curryfree Wind Farm Wireless Signal Interference Field Surveys Project and Reception
- Designed Software Prediction Model and Model Template Kilavoy Telecommunications, Television and Aviation Environmental Impact Study
- Managed the Clydagh Wind Farm Wireless Signal Interference Field Surveys Project.
- Co-ordinated and assisted with previous Ai Bridges contract for Glenora wind Farm Wireless Signal Interference Field Surveys Project.
- Advised on Ai Bridges contract for Woodhouse Wind Farm Wireless Signal Interference Project.
- Advised and co-ordinated assisted with previous Ai Bridges contract for Grouselodge Wind Farm Wireless Signal Interference Field Surveys Project.
- Managed contract for Bruckana Wind Farm Wireless Signal Interference Field Surveys Project.
- Managed Mount Lucas Wind Farm Wireless Signal Interference Field Surveys Project.
- Software Modelling on previous Ai Bridges contract for Athea Wind Farm Wireless Signal Interference Field Surveys Project.
- Design of “self-help” transmitter contract for Dromada Wind Farm Wireless Signal Interference Field Surveys Project.
- Managed the ESB Wireless Wind Farm Wireless Signal Interference Framework for 5 years.
- Managed and designed the software prediction model for the TVI & Broadband EMI Interference Studies for Woodhouse Grousemount, Cappahwite, Oweninny, Raheenlagh Wind Farm.

- Responsibility for software prediction modelling on contract for Tievnameeta Wind Farm Telecommunications, Television and Aviation Environmental Impact Study
- Glencarbry TETRA Network – Interference Modelling Service

- Development of the 3D prediction model for Aviation, 3G Broadband and EMI Interference Projects for

- Development of a proprietary 3D model for TV Interference for analog and digital terrestrial broadcast based on the ITUT standards.

- Development of the software prediction modelling on contract for UK, NI & Scotland Aviation and MET Radar Interference Analysis on FITS Wind Farm Project.