APPENDIX 15-5

THREE IRELAND IMPACT ASSESSMENT REPORT

Report

Clonberne Wind Farm
Three Ireland Impact Assessment
Report

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Executive Summary

Ai Bridges was commissioned to evaluate the possible impacts that the proposed wind farm at Clonberne, Co Galway could have on the Three Ireland telecommunications network

The scope of work included field and desktop surveys to determine the Three Ireland microwave radio link(s) that could be impacted by the proposed development. Consultations with Three Ireland were also undertaken to assist in identifying network infrastructure that could be impacted by the proposed wind farm.

Using the information obtained during the field survey assessments and consultation responses, a desktop impact analysis was carried out and the Three Ireland radio network was analysed using radio planning \ modelling software (2D and 3D).

Results from the impact analysis indicate that Three Ireland have a Point-to-Point (PTP) microwave radio link between the telecom mast-sites at Cloonriddia and Castle that would be impacted by one of the proposed turbines (Turbine T06).

Operator	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Impact of proposed Turbine Layout
Three Ireland	PTP microwave radio link between Cloonriddia and Castle.	T06	-19.1 m (Infringement into Fresnel Zone)	Impacted. (Mitigation Measures Required)

Table 1. Microwave radio links potentially impacted by proposed turbine layout at Clonberne.

Mitigation measures to offset the potential impacts of the proposed turbine layout including: turbine micro-siting and/or re-routing the impacted radio link via an existing telecoms mast have been presented in Section 6 of this report.

The mitigation measure of re-routing the impacted radio link via an existing telecoms mast was proposed to Three Ireland. In the response received from Three Ireland, they have stated that they do not have any objection to the proposed development proceeding on the basis of an agree mitigation measure of re-routing the radio link prior to the construction of the wind farm and all mitigation measure construction costs (estimate of €10K - €15K) would be covered by the wind farm developer.

Sections

Appendix

Section 1 - Wind Farm Site Information

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 proposed wind farm development is located approximately 11 km northeast of Tuam, Co. Galway. The coordinates of the turbines assessed in this report are provided in Appendix A. The dimensions of the turbines assessed in this report are provided in Table 2 below.

Wind Farm	Number of Turbines	Turbine Hub Height	Turbine Rotor Diameter
Clonberne	11	99 m	162 m

Table 2. Wind Farm Turbine Details

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

Figure 1. Location of proposed wind farm.

Section 2 - Methodology

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 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. Mast-site coordinates are then obtained and inputs from relevant 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 telecommunications sites in the vicinity relative to the proposed wind farm at Clonberne. Figure 2 below shows the proposed wind farm site boundary plotted in the radio planning tool.

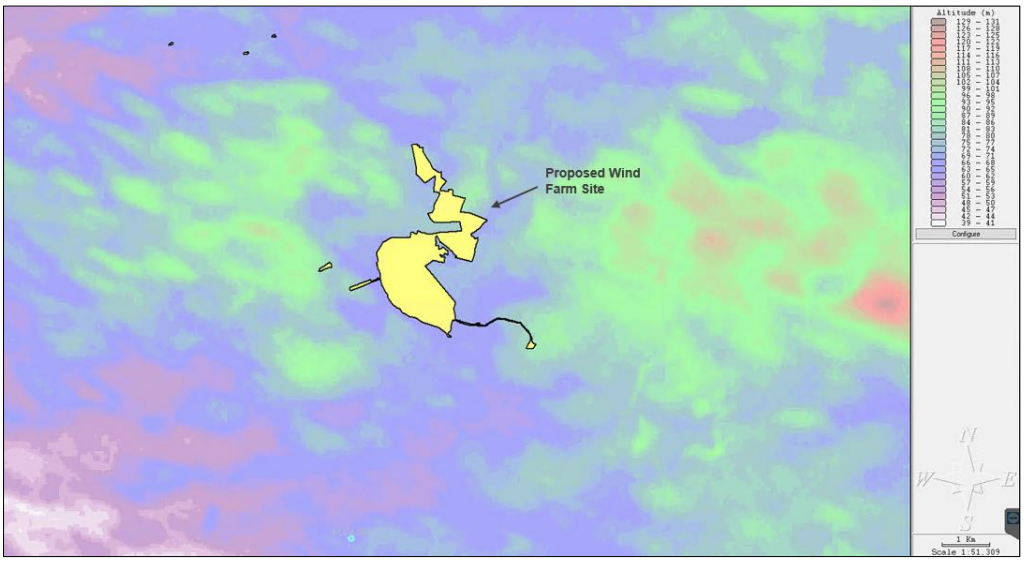


Figure 2. Wind Farm Boundary plotted in Radio Planning Software

The findings from the consultations and field surveys are collated and the communications networks requiring further analysis are identified. Network modeling is used to assess the impact of the turbines on the communications networks. The results from the network modeling are used to determine if mitigation measures are required. Figure 3 below shows an example of a microwave radio link that crosses over/near the wind farm boundary modelled in radio planning software.

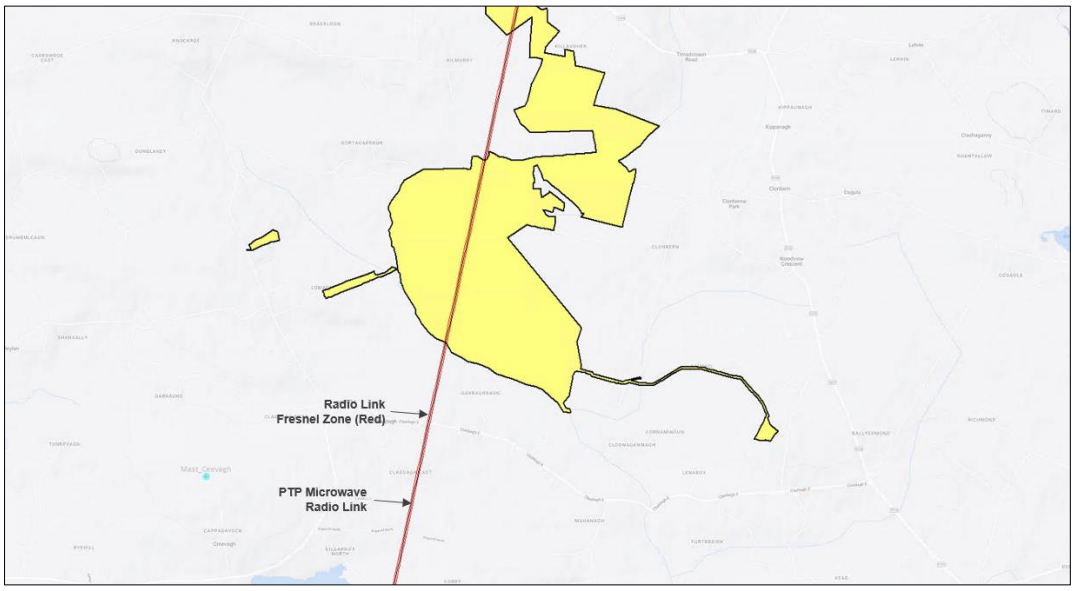


Figure 3. Example of a microwave radio link crossing over/near the proposed wind farm boundary modelled in radio planning software.

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.

Section 3 - Telecom Operator Consultations

3. Introduction

In this section the consultation process undertaken with telecom operator(s) is described. The response received from each operator is also provided.

3.1 Telecom Operator Consultations

Consultations beginning in February 2024 were undertaken with Three Ireland to assist in identifying telecommunication infrastructure that could be impacted by proposed wind farm. Three Ireland were requested to raise any concerns they may have regarding impacts to their networks due to the proposed wind farm development. The response received from Three Ireland is provided in Sections 3.1.1.

ID	Operator	Response Received (Yes/No)	Issues raised by Operator \ Observations.
1	Three Ireland	Yes	Three Ireland have raised a concern regarding one Licensed PTP microwave radio link.

Table 3. Telecom Operators Consulted

3.1.1 Three Ireland Consultations

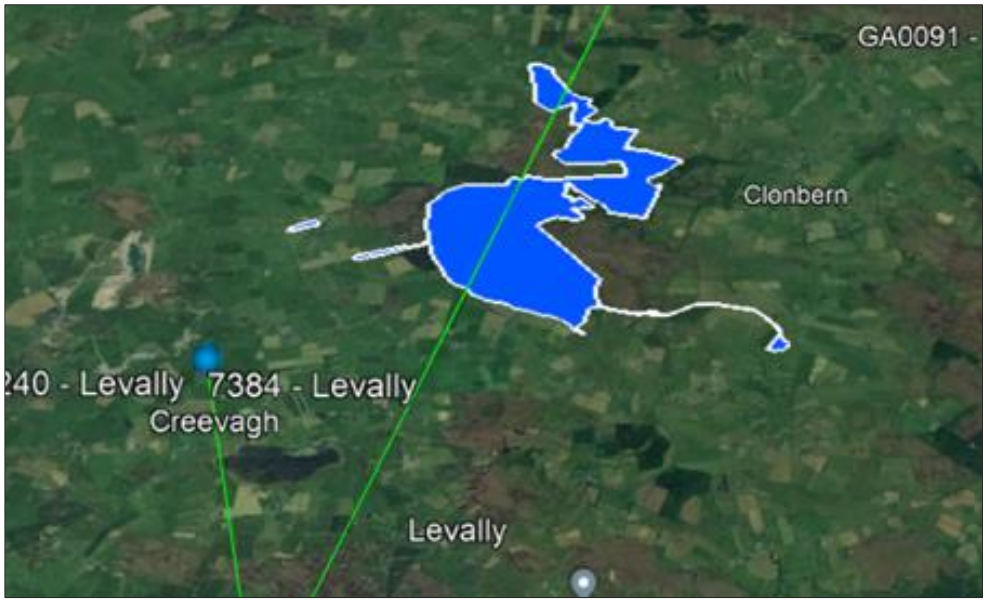
The consultations between Ai Bridges Ltd and Three Ireland are provided below. The EMI Network Analysis findings (presented in Section 5.1 of this report) were provided to, and discussed with Three Ireland during the course of the consultation process.

23.02.24 Three Ireland response to Consultations

"Hi Dave,

One link passing through this area. Please see details below."

Link Name / ID	Band MHz\GHz	Link Length	Site A					Site B				
			Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
ML020358	18GHz	14.7km	53.5055	-8.70691	153147	250825	30m	53.6345	-8.66064	156350	265155	22.4m



15.03.24 Ai Bridges Ltd Email to Three Ireland

Hello John,

I am following up with you in relation to a recent correspondence that we have been having with your Network Planning Team in relation to a wind farm development. We have previously engaged with you back to August 2022 on another project at Woodcock Hill.

We have completed a detailed Telecommunications Impact Assessment for the proposed Wind Farm development at Clonberne, Co. Galway as requested by a the wind farm developer. We have been in correspondence with your Planning Engineers, correspondence included below. The results of our radio link analysis indicate that one of the radio links that have been identified by Three Ireland will potentially be impacted by turbines in the proposed development. The radio link is highlighted in the table below (i.e. Cloonriddia – Castle) and shows only one of the turbines will impact the link and turbine micro-siting is not an option due to other environmental constraints.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance/Interference	Wind Farm Impacts
Three Ireland Link 1	Cloonriddia to Castle	T03	31.6 m	No Impacts.
		T06	-19.1 m (Infringement into Fresnel Zone)	Interference Impact (Mitigation measures required)
		T09	39.9 m	No Impacts.

The developer has requested us to propose a suitable mitigation measure to offset the potential impact on your existing telecommunication infrastructure. We have carried out a detailed Radio Planning Analysis , the results of which show that an telecoms mast at Creevagh shown in the figure below could be used as a relay for the impacted Three Ireland radio link. Our engineers have also reported the following from the due diligence surveys that they carried out

> *A database of telecommunications mast-sites indicates that Three Ireland have an existing presence at the Creevagh mast-site. Also, the response provided by Three Ireland during Consultations indicate that they already have an existing radio link between the mast-sites at Cloonriddia and Creevagh. Field Survey results from the mast-site at Creevagh also indicate that Three Ireland have an existing radio link between Cloonriddia and Creevagh.*

We are recommending that all mitigation measure costs would be borne by the developer and should the Planning Application for the wind farm be successful, it is expected that turbines would be erected within a 3-5 year timeframe.

We have conducted a due-diligence field survey and also completed Path Profiles and Radio Link Budgets to ensure that the proposed relay links would pass the 99.99% availability criteria required by ComReg for licensed radio links. For your reference, we have attached an extract from our Telecoms Impact Assessment Report relating to the Three Ireland Telecommunications Infrastructure. This report extract contains all Radio Link Path Profiles, Radio Link Budgets which are based on the following ITU-R Recommendations.

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

We would be grateful if you could review the details contained in this email and let us know if you would be available for an initial call to discuss our Telecoms Impact Assessment and Mitigation Measure Proposal. We can confirm that

1. The wind farm developer would cover the mitigation measure costs for a link re-route
2. Any link re-routes would take place in advance of the construction and operation of the wind farm.

Thank you for your co-operation on this. We look forward to hearing from you

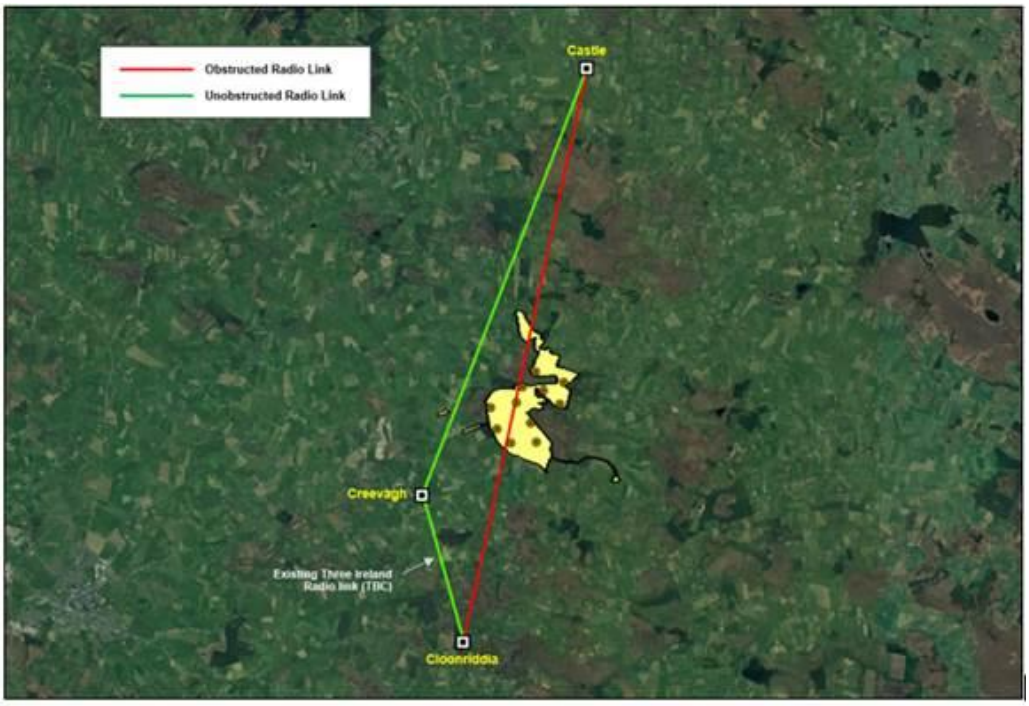


Figure 11. Example of how an existing telecoms mast could be relay the radio link between Cloonriddia and Castle.

Best Regards,
Kevin Hayes,

20.03.24 Three Ireland response to AiBridges Ltd

"Hi Kevin,

Thanks for your mail below. It is clear that the proposed development will certainly impact the radio link as pointed out below.

We don't have any objection to the proposed development proceeding. Is it possible to propose in the application that a condition of the planning permission is that the developer should bear the cost to re-route the impacted radio link.

I don't believe that this should be too onerous and probably would be less than for us €10k to complete this work.

Given the time-scales of 3 to 5 years, it doesn't make sense to make any decisions now on what the re-route solution will be. The proposed solution below would not be of interest to us as it would involve a degradation of our overall solution whereby the site impacted is now routed over an additional hop whereas our preference is always for a direct single hop to fibre where possible.

Additionally, the landscape in 3 to 5 years' time may be significantly different to today given that we might have additional fibre points and the topology of the network is likely to change in the intervening years. I would suggest that it doesn't really make sense for your team to conduct this analysis as they will rarely arrive at a solution which is preferable to the operators involved.

In any case, we don't have any objection to the development proceeding on the condition that we will be re-imbursed for the costs to re-route the affected site.

20.03.24 Ai Bridges Ltd Email to Three Ireland

Hello John,

Thank you for the prompt response

Would you be happy that the following would be a condition of planning that in the event of a successful grant of planning can be included as follows

1. The wind farm developer would bear the mitigation measure costs to re-route the impacted Three Ireland radio link with a cost estimate of €10K - €15K
2. The wind farm developer is in agreement with Three Ireland that any link re-route solution via single radio hop to a fibre backhaul point, would take place in advance of the construction and operation of the wind farm.

Best Regards,
Kevin Hayes,

21.03.24 Three Ireland response to AiBridges Ltd

"Hi Kevin,

Yes, I would be happy with the below. You should probably remove the section in yellow below as it's not a given that a solution via single radio hop will be possible.

Kind Regards,
John

1. *The wind farm developer would bear the mitigation measure costs to re-route the impacted Three Ireland radio link with a cost estimate of €10K - €15K*
2. *The wind farm developer is in agreement with Three Ireland that any link re-route solution, via single radio hop to a fibre backhaul point, would take place in advance of the construction and operation of the wind farm.*

21.03.24 Ai Bridges Ltd Email to Three Ireland

Hello John,

Thank you for confirming same, we will update the text below and include in our findings for inclusion as a condition of planning as part of the Telecoms Impact Assessment

Best Regards,
Kevin Hayes,

Section 4 - Field Surveys

4. Introduction

To assess the accuracy of the network information (radio link co-ordinates, antenna heights etc.) provided by the telecom operators, field surveys of the telecom-mast sites in the vicinity of the proposed wind farm were carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded. The telecom mast-sites surveyed for this study are shown relative to the proposed wind farm site in Figure 4 below. The findings from the field surveys of each of the mast-sites are presented in Section 4.1 and Section 4.2

Figure 4. Telecom Mast-Sites Surveyed.

4.1 Mast-Site A (Cloonriddia)

Telecommunications Mast-Site A is located in the townland of Cloonriddia, County Galway, and is approximately 5 km south of the proposed wind farm. A photo of the mast-structure at this location is shown below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 4.

Figure 5. Mast A

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast A	Three Ireland

Table 4. Field Survey Summary – Mast-Site A

4.2 Mast-Site B (Castle)

Telecommunications Mast-Site B is located in the townland of Castle, County Galway, and is approximately 6 km north of the proposed wind farm. A photo of the mast-structure at this location is shown below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 5.

Figure 6. Mast B

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast B	Three Ireland

Table 5. Field Survey Summary – Mast-Site B

Section 5 - Desktop Survey Analysis

5. Introduction

Based on the findings of the consultation process, there is one Three Ireland microwave radio link in the vicinity of the proposed development that requires a detailed technical analysis:

- PTP 18GHz microwave radio link between Cloonriddia and Castle.

Section 5.1 below outlines the desktop survey analysis findings* for the microwave radio link listed above.

5.1 Three Ireland Network Analysis

The Three Ireland network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) microwave radio link. The radio link is listed in Table 4 below and a Plan View of the Three Ireland network is shown in Figure 7.

Link No.	Operator	Link Description
1	Enet	PTP microwave radio link from Cloonriddia to Castle.

Table 6. Three Ireland Radio Links requiring Analysis

Figure 7. Three Ireland Radio Network – Plan View

Figure 8 below shows a close-up plan view of the Three Ireland microwave radio link relative to the proposed wind farm site. The plan view indicates that the radio link is potentially impacted by the proposed turbine layout.

** The Desktop Survey Analysis findings are subject to accuracy of the information (GPS co-ordinates, turbine dimensions, etc.) provided to Ai Bridges.*

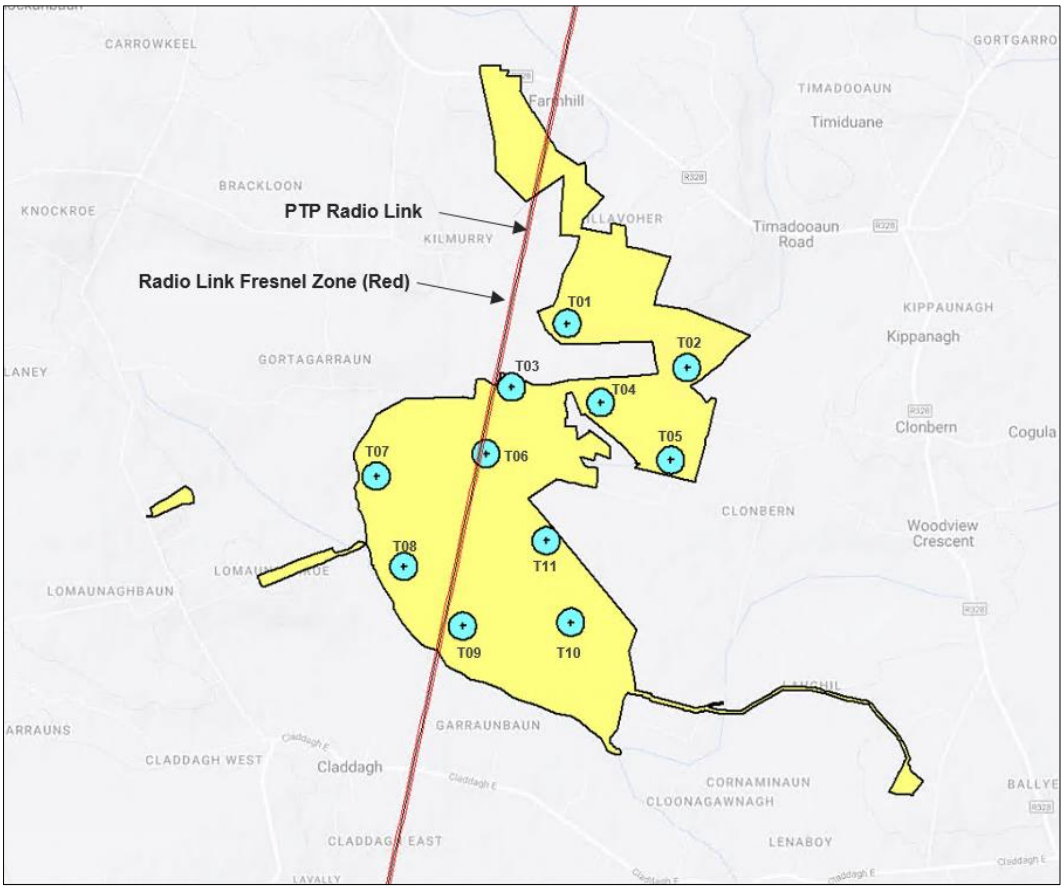


Figure 8. Enet Network – Close-up Plan View.

To further assess the potential impacts, the radio links were modelled in 3D and the Clearance Distances between the Fresnel Zones (F2) and the blade-tip of the nearest turbines have been calculated. A 3D view of the microwave radio links relative to the proposed turbine layout is shown below in Figure 9.

The results of the 3D analysis indicate that Three Ireland radio link would be impacted by one of the proposed turbines. The analysis indicates that there would be an Interference Condition of 19.1 m due to turbine T06.

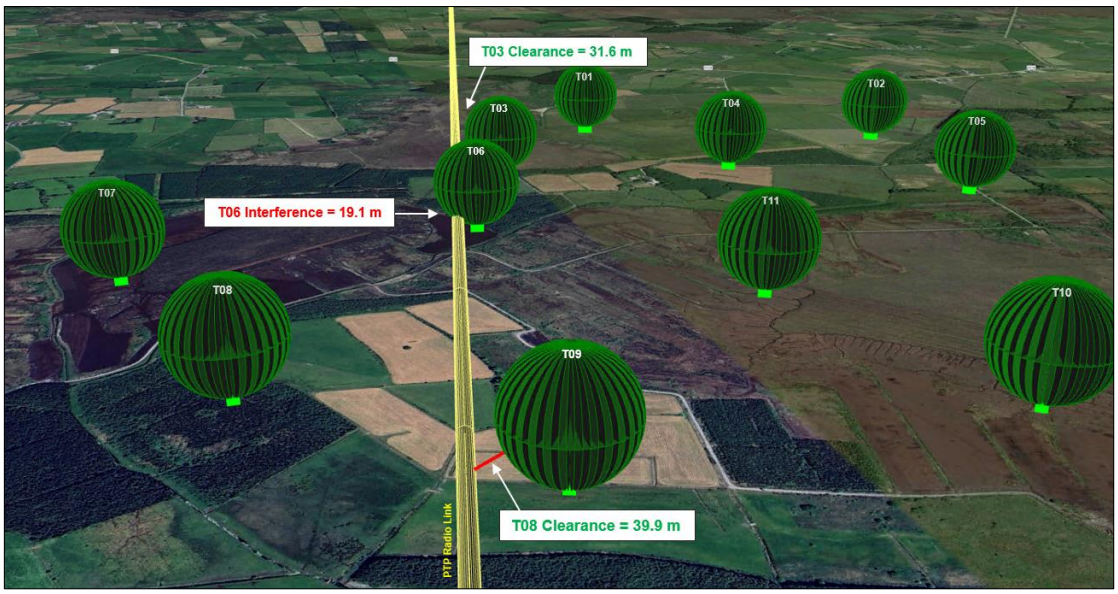


Figure 9. Three Ireland Network – 3D View.

Table 7 below provides a summary of the radio link interference analysis for the closest turbines to the Three Ireland radio link.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance/Interference	Wind Farm Impacts
Three Ireland Link 1	Cloonriddia to Castle	T03	31.6 m	No Impacts.
		T06	-19.1 m (Infringement into Fresnel Zone)	Interference Impact (Mitigation measures required)
		T09	39.9 m	No Impacts.

Table 7. Three Ireland Network – Analysis Summary

Section 6 - Mitigation Measures

6. Mitigation Measures

Section 6.1 that follow, describe the mitigation measures available to the wind farm developer to offset the potential impact of the T06 on the Three Ireland Network.

6.1 Mitigation Measure Solutions – Three Ireland Network

To offset the potential impact of T06 on the Three Ireland radio link from Cloonriddia to Castle the following mitigation solutions are available:

Option 1 – Micro-site Turbines T06

Option 2 – Relay the Three Ireland radio link via an existing Telecoms Mast

These mitigation measures are described in Sections 6.1.1 and 6.1.2 that follow.

6.1.1 Option 1 – Micro-site Turbines T06

An option of offset the potential impact of T06 on the Three Ireland radio link between Cloonriddia and Castle would be to micro-site the turbine away from the radio link.

Figure 10 below illustrates how micro-siting T06 could result in a Clearance Condition between the turbine and the 2nd Fresnel Zone of the radio link.

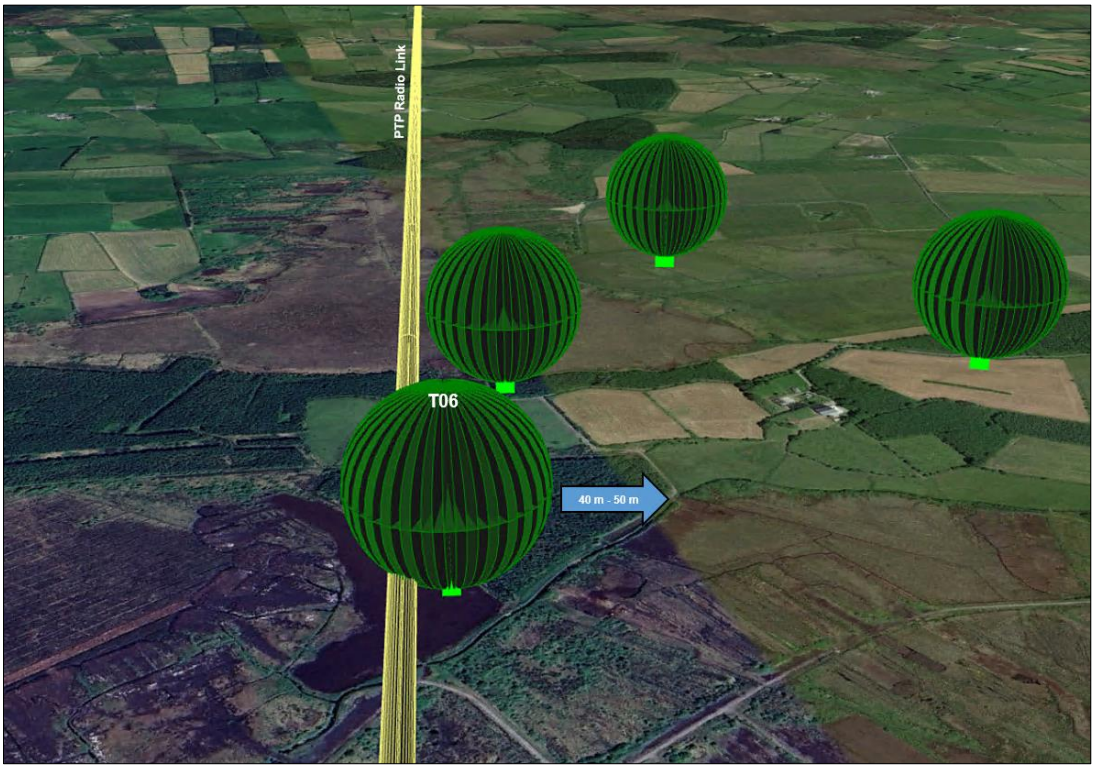


Figure 10. Micro-siting Turbine T06

6.1.2 Option 2 - Relay the Three Ireland radio link via an existing Telecoms Mast.

An alternative option to mitigate for the impact on the radio link to between Cloonriddia and Castle would be to use an existing telecoms mast to relay the radio link.

Figure 11 below illustrates how the existing telecoms mast-site at Creevagh could be used to relay a radio link between Cloonriddia and Castle.

Note: A database of telecommunications mast-sites indicates that Three Ireland have an existing presence at the Creevagh mast-site. Also, the response provided by Three Ireland during Consultations (Section 3.1.1) indicate that they already have an existing radio link between the mast-sites at Cloonriddia and Creevagh. Field Survey results from the mast-site at Creevagh (See Appendix C) also indicate that Three Ireland have an existing radio link between Cloonriddia and Creevagh.

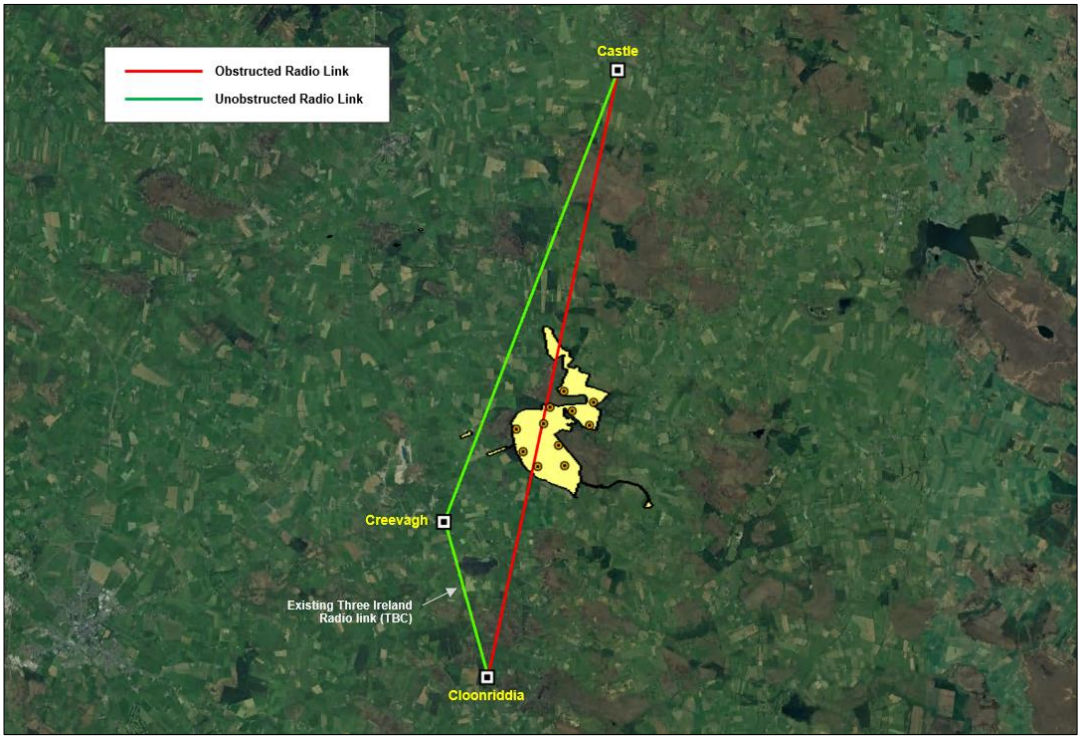


Figure 11. Example of how an existing telecoms mast could be relay the radio link between Cloonriddia and Castle.

To determine if Creevagh could be used as a viable relay-mast, radio link path profiles were generated. Radio Link Budgets were also carried out to determine if the proposed links 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

The radio Path Profile is shown in Section 6.1.2.1 that follows. The Radio Link Budget can be found in Appendix B.

6.1.2.1 Path Profile – Cloonriddia to Creevagh

The radio link path profile shows clear Line-of-Sight (LOS) and the link budget results would pass the radio availability criteria required by ComReg.

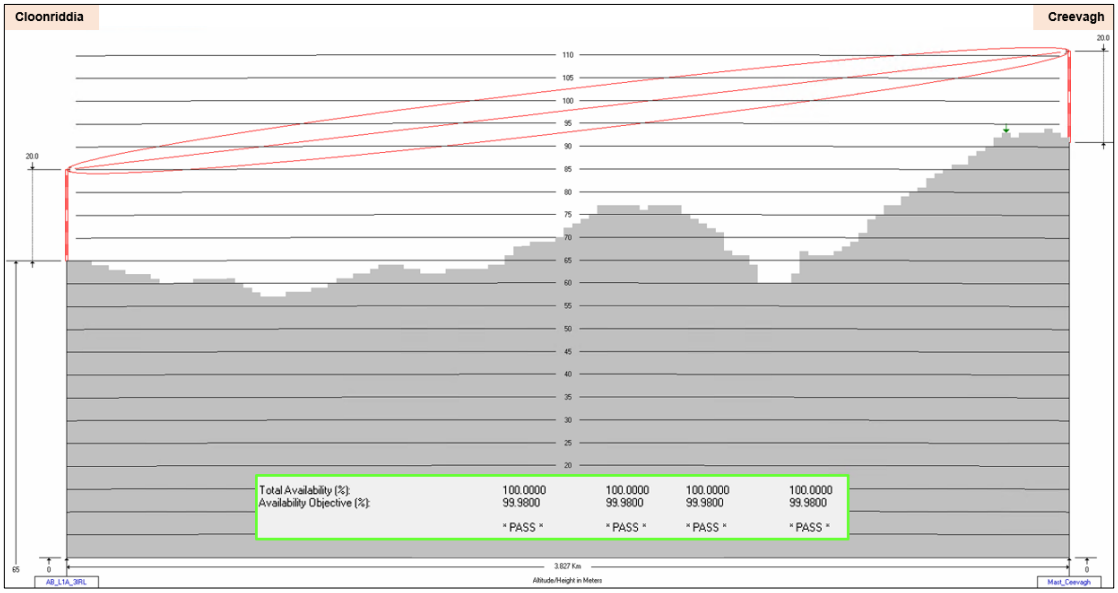


Figure 12. Path Profile – Cloonriddia to Creevagh

6.1.2.2 Path Profile – Creevagh to Castle

The radio link path profile shows clear Line-of-Sight (LOS) and the link budget results would pass the radio availability criteria required by ComReg.

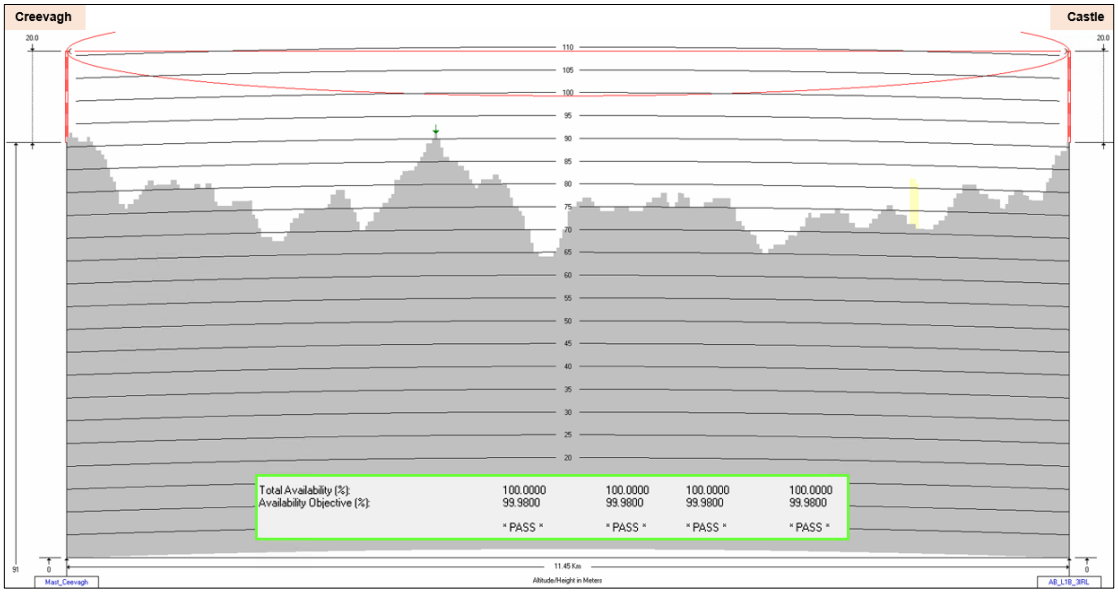


Figure 13. Path Profile – Creevagh to Castle

Section 7 - Conclusions

7. Conclusions

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

- Results from the telecom operator consultations and desktop survey analysis indicate that the Three Ireland Radio link between Cloonriddia and Castle would be impacted by the proposed turbine layout.

- Extensive field survey and software modelling analysis was carried out to determine viable mitigation measures to offset the impact of the proposed wind turbine layout. The mitigation measures that were assessed included; turbine micro-siting and the option of re-routing the impacted radio link.

- The mitigation measure of re-routing the impacted radio link via an existing telecoms mast was proposed to Three Ireland. In the response received from Three Ireland, they have stated that they do not have any objection to the proposed development proceeding provided that the developer would bear the cost of re-routing the impacted radio link. The estimated cost of a radio link re-route solution has been estimated to be €10K - €15K.

Operator	Impacted PTP Link	Mitigation Measure	Estimated Mitigation Cost	Mitigation Agreed
Three Ireland	PTP microwave radio links from Cloonriddia to Castle	Re-route link to a fibre backhaul point	€10K - €15K	Yes

Table 8. Mitigation Measures Summary

APPENDIX A – Wind Farm Turbine Coordinates

Appendix A – Wind Farm Turbine Co-ordinates

The development is in the pre-planning stage and the Final Turbine Layout is yet to be finalized. The turbine layout considered in this Telecommunications Impact Study is provided below.

Turbine ID	Co-ordinates (WGS 84)	
	Latitude	Longitude
T01	53° 33' 58.428"N	08° 40' 47.352"W
T02	53° 33' 50.040"N	08° 40' 09.084"W
T03	53° 33' 46.296"N	08° 41' 05.172"W
T04	53° 33' 43.380"N	08° 40' 36.624"W
T05	53° 33' 32.436"N	08° 40' 14.232"W
T06	53° 33' 33.624"N	08° 41' 13.344"W
T07	53° 33' 29.376"N	08° 41' 48.480"W
T08	53° 33' 12.204"N	08° 41' 39.660"W
T09	53° 33' 0.864"N	08° 41' 20.868"W
T10	53° 33' 1.584"N	08° 40' 46.200"W
T11	53° 33' 17.100"N	08° 40' 54.048"W

Table 9. Wind Farm Layout - Turbine Co-ordinates

APPENDIX B – Radio Link Budget Reports

Appendix B – Radio Link Budget Reports

B.1 Radio Link Budget Report (Cloonriddia – Creevagh)

Link Budget Report

Site:	Cloonriddia	Creevagh
Name:		
Type:	Cell	Cell
Latitude:	53°30'19.8"N	53°32'18.8"N
Longitude:	8°42'24.7"W	8°43'21.0"W
Altitude (m):	65.0	91.0

UserData1: User Data

Datum: World Geodetic System 1984 (WGS 84)

	Forward Link		Reverse Link			
Transmission Site:	AB_L1A_3IRL		Mast_Ceevagh			
Reception Site:	Mast_Ceevagh		AB_L1A_3IRL			
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):	26000		26000			
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:	HP2-26		HP2-26			
Transmission Antenna Size (m):		0.6		0.6		
Transmission Antenna Height (m):		20		20		
Transmission Antenna Gain (dBd):		38.96		38.96		
Transmission Antenna Gain (dBi):		41.1		41.1		
Transmission Power EIRP (dBm):		70.1		70.1		
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:	HP2-26		HP2-26	
Reception Antenna Size (m):	0.6		0.6	
Reception Antenna Height (m):		20		20
Reception Antenna Gain (dBd):		38.96		38.96
Reception Antenna Gain (dBi):		41.1		41.1
Link Polarization:	Vertical		Vertical	
Cross Polarization Factor (dB):		30		30
Link Distance (m):	3827.053		3827.053	
Azimuth - True (°):	344.306		164.293	
Azimuth - Magnetic (°):	346.881		166.88	
Transmission Inclination (°):	-0.389		0.389	
Reception Inclination (°):	-0.389		0.389	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	3827.142		3827.142	
Center Frequency (MHz):	26000		26000	
Free Space Loss (dB):	132.397		132.397	
Max Fresnel Radius (m):	3.323		3.323	
Max 2nd Fresnel Radius (m):	4.699		4.699	
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):	0		0	
Clearance Target (%):	60			
Minimum Clearance (m):	15.342		15.342	
Minimum Clearance Point (m):		3585.852		3585.852
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	337.681		337.681	
Reflection Area 2 (m):	627.122		627.122	
Reflection Area 3 (m):	1238.164		1238.164	
Reflection Area 4 (m):	1398.965		1398.965	
Reflection Area 5 (m):	1495.4 - 1559.8			1495.4 - 1559.8
Reflection Area 6 (m):	3328.6 - 3360.7			3328.6 - 3360.7
Reflection Area 7 (m):	3425.052		3425.052	
Reflection Area 8 (m):	3489.372		3489.372	
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):		0.506		0.506
Total Path Loss (dB):	132.903		132.903	
Reception Signal Level (dBm):		-22.703		-22.703

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	68.297	67.297	68.297	67.297

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 (%):	2.09E-03		2.09E-03	

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):	3.069491		3.069491	
Rainfall Attenuation (dB):	10.382		10.382	

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	2.24E-11	2.83E-11	2.24E-11	2.83E-11
Selective Fading Outage (%):	4.53E-12	4.53E-12	4.53E-12	4.53E-12
Composite Fading Outage (%):		2.70E-11	3.28E-11	2.70E-11	3.28E-11

Fading Outage (s/Month):	0	0	0	0
Selective Fading Outage (s/Month):		0	0	0	0
Composite Fading Outage (s/Month):		0	0	0	0

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Unavailability due to Rain (s/Year):		0	0	0	0

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Fading (%):		2.70E-11	3.28E-11	2.70E-11	3.28E-11
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	2.70E-11	3.28E-11	2.70E-11	3.28E-11
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):		0	0	0	0
Unavailability due to Rain (s/Year):		0	0	0	0
Total Unavailability (s/Year):	0	0	0	0
Unavailability Objective (s/Year):		6307.2	6307.2	6307.2	6307.2

Total Availability (%):	100.0000	100.0000	100.0000	100.0000
Availability Objective (%):	99.9800	99.9800	99.9800	99.9800

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B.2 Radio Link Budget Report (Creevagh – Castle)

Link Budget Report

Site:	Creevagh	Castle
Name:		
Type:	Cell	Cell
Latitude:	53°32'18.8"N	53°38'04.3"N
Longitude:	8°43'21.0"W	8°39'38.2"W
Altitude (m):	91.0	91.0
UserData1:	User Data	
Datum:	World Geodetic System 1984 (WGS 84)	

	Forward Link	Reverse Link
Transmission Site:	Mast_Ceevagh	AB_L1B_3IRL
Reception Site:	AB_L1B_3IRL	Mast_Ceevagh
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):	18000	18000
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:	HP2-18-NSMA	HP2-18-NSMA
Transmission Antenna Size (m):	0.6	0.6
Transmission Antenna Height (m):	20	20
Transmission Antenna Gain (dBd):	36.46	36.46
Transmission Antenna Gain (dBi):	38.6	38.6
Transmission Power EIRP (dBm):	67.6	67.6
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:	HP2-18-NSMA	HP2-18-NSMA
Reception Antenna Size (m):	0.6	0.6
Reception Antenna Height (m):	20	20

Reception Antenna Gain (dBd):		36.46		36.46
Reception Antenna Gain (dBi):		38.6		38.6
Link Polarization:	Vertical	Vertical		
Cross Polarization Factor (dB):		30		30
Link Distance (m):	11450.864		11450.864	
Azimuth - True (°):	20.922	200.972		
Azimuth - Magnetic (°):	23.509		203.551	
Transmission Inclination (°):	0		0	
Reception Inclination (°):	0		0	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	11450.864			11450.864
Center Frequency (MHz):	18000		18000	
Free Space Loss (dB):	138.722		138.722	
Max Fresnel Radius (m):	6.907		6.907	
Max 2nd Fresnel Radius (m):	9.769		9.769	
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):	0		0	
Clearance Target (%):	60			
Minimum Clearance (m):	14.207		14.207	
Minimum Clearance Point (m):		4219.610		4219.610
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	314.402		314.402	
Reflection Area 2 (m):	413.687		413.687	
Reflection Area 3 (m):	976.3 - 1009.4			976.3 - 1009.4
Reflection Area 4 (m):	2862.7 - 2928.9			2862.7 - 2928.9
Reflection Area 5 (m):	3127.476		3127.476	
Reflection Area 6 (m):	3888.7 - 3921.8			3888.7 - 3921.8
Reflection Area 7 (m):	4219.610		4219.610	
Reflection Area 8 (m):	4418.18		4418.18	
Reflection Area 9 (m):	4682.940		4682.940	
Reflection Area 10 (m):	4782.2 - 4815.3			4782.2 - 4815.3
Reflection Area 11 (m):	5444.1 - 5510.3			5444.1 - 5510.3
Reflection Area 12 (m):	5940.55		5940.55	
Reflection Area 13 (m):	6139.1 - 6205.3			6139.1 - 6205.3
Reflection Area 14 (m):	6304.6 - 6370.8			6304.6 - 6370.8
Reflection Area 15 (m):	6470 - 6536.3			6470 - 6536.3
Reflection Area 16 (m):	6734.829		6734.829	
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):		0.693		0.693
Total Path Loss (dB):	139.416		139.416	
Reception Signal Level (dBm):		-34.216		-34.216

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	56.784	55.784	56.784	55.784

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 (%):	6.24E-01		6.24E-01	

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):	1.708854		1.708854	
Rainfall Attenuation (dB):	13.477		13.477	

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	1.81E-07	2.27E-07	1.81E-07	2.27E-07
Selective Fading Outage (%):	5.61E-09	5.61E-09	5.61E-09	5.61E-09
Composite Fading Outage (%):		1.86E-07	2.33E-07	1.86E-07	2.33E-07

Fading Outage (s/Month):	0.005	0.006	0.005	0.006	
Selective Fading Outage (s/Month):		0	0	0	0
Composite Fading Outage (s/Month):		0.005	0.006	0.005	0.006

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Unavailability due to Rain (s/Year):		0	0	0	0

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Unavailability due to Fading (%):		1.86E-07	2.33E-07	1.86E-07	2.33E-07
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	1.86E-07	2.33E-07	1.86E-07	2.33E-07
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):	0.059	0.073	0.059	0.073
Unavailability due to Rain (s/Year):	0	0	0	0
Total Unavailability (s/Year): 0.059	0.073	0.059	0.073	
Unavailability Objective (s/Year):	6307.2	6307.2	6307.2	6307.2

Total Availability (%):	100.0000	100.0000	100.0000	100.0000
Availability Objective (%):	99.9800	99.9800	99.9800	99.9800

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APPENDIX C – Creevagh Telecoms Mast

Appendix C – Creevagh Telecoms Mast

In Section 6.1 of this report, it has been proposed that the telecoms mast at Creevagh could potentially be used as a relay site for the Three Ireland connection between Cloonriddia and Castle. A field survey of the telecoms mast at Creevagh was carried out to assess the suitability of the site for this proposal. The findings of the filed survey are presented below.

Figure 15 below shows that there is a dish antenna at Creevagh in the direction of the mast-site at Cloonriddia. This indicates that Three Ireland have an existing radio link between Cloonriddia and Creevagh.

Figure 14. Existing radio link from Creevagh to Cloonriddia.

During the field survey of the mast-site at Creevagh, the northern face of the mast was also surveyed to determine if there is available space on the mast-structure to accommodate the installation of a new radio link to Castle (i.e. in the event that Three Ireland be agreeable to using the mast as a relay site).

As shown below in Figure 16, there is adequate space on the telecoms mast at Creevagh for a radio link installation to the telecoms mast-site at Castle.

Figure 15. Available space on Creevagh Telecoms Mast for potential radio link to Castle.