APPENDIX 15-3

AI BRIDGES TELECOM REVIEW

Report

Proposed Repowering of the Existing Kilgarvan Wind Farm

ESB Links Telecommunications Impact Study

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Executive Summary

Following consultations between MKO Ltd and ESB it was identified that ESB have two Point-to-Point (PMP) radio links, operating in the UHF frequency band, that cross through the Proposed Repowering if the Existing Kilgarvan Wind Farm. Ai Bridges Ltd were subsequently commissioned to assess the potential impact of the proposed wind turbines on the ESB radio links and to propose possible mitigation measures if required.

The scope of work included field surveys and a detailed network 3D analysis of the potential impacts of the proposed wind turbines on the ESB radio links. Both ends of each radio UHF radio link were surveyed to assess/verify the accuracy of the radio link details (antenna co-ordinates, antenna installation heights, etc). The findings of the field surveys can be found in Section 4 of this report.

The network analysis was carried out to model the UHF radio links in 3D and to show the links relative to the proposed turbines. The findings of the network analysis are summarized in the table below.

Radio Link ID	Description	Impacts due to Re-Powering Turbines	Mitigation Measure	Residual Impact
Link 1	PMP UHF Radio link from Kilgarvan 38kV Station to Kilgarvan wind Farm Substation	No impacts. Infringement into radio link Fresnel Zone by proposed turbines is less than the current infringement by the existing Kilgarvan Wind Farm turbines.	None	None
Link 2	PMP UHF Radio link from Kenmare 38kV Station to Kilgarvan wind Farm Substation	Potentially impacted by Turbine T09. (Interference Condition of 39.32 m.)	Provision of a Relay Mast Structure within the Proposed Development beside T09	None

Table 1. Radio Link Network Analysis Summary

A mitigation measure has been proposed to remediate the interference condition on the radio link to/from the 38kV Station at Kenmare. This mitigation measure would be to provision a relay mast-structure adjacent to turbine T09. This mitigation measure is outlined in Section 6 of this report.

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Sections

Appendix

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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 Proposed Development is located in County Kerry approximately 7 km northeast of the town of Kilgarvan. The Proposed Development consists of 11 turbines with a maximum turbine tip-height of 200 meters. The proposed turbine co-ordinates are provided in Appendix A.

Wind Farm	Number of Turbines	Turbine Hub-Height	Turbine Rotor Radius
Kilgarvan Re-powering	11	118 m	82m

Table 2. Kilgarvan Re-Powering Wind Farm Turbine Details

The location of the Proposed Development is shown below in Figure 1.

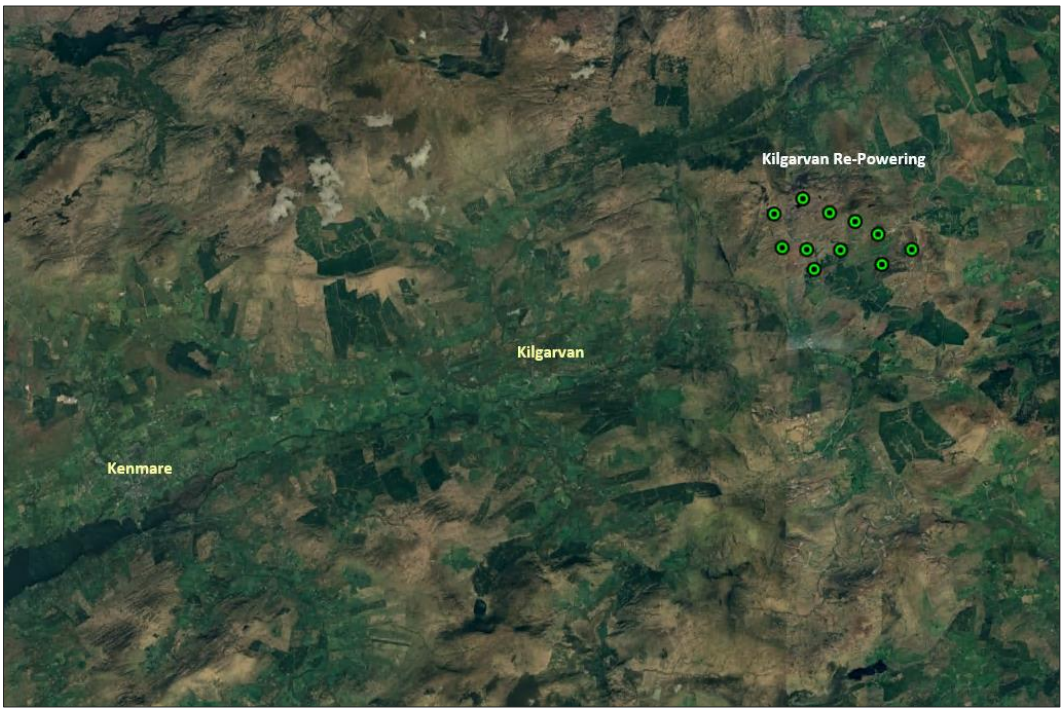

Figure 1. Location of the Proposed Development

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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
- Mitigation Measures
- 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 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 Network Analysis

A desktop survey is carried out to plot and model the proposed wind turbines in a radio planning tool. The radio planning tool uses GIS and terrain mapping databases to enable accurate modelling. This provides a means of graphically showing the turbines in 3D relative to the existing radio link(s). The radio planning tool is then used to calculate the Clearance or Interference Condition distance between the relevant radio link and the nearest turbine(s).

Mitigation Measures

A range of Mitigation Measures are assessed and proposed to offset the potential impact of the proposed turbines on existing radio link(s).

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 the consultation process undertaken with telecom operators is described. The response received from each operator is also provided.

3.1 Telecom Operator Consultations

Consultations were undertaken by the EIAR consultants (MKO) with relevant telecom network operators. Following the round of consultations, ESB Services raises concerns regarding two of their Point-to-Point (PMP) radio links.

Table 2 lists the Telecom Operators contacted and the issues raised by the operator(s). Details from the response received from ESB are provided in Section 3.1.1.

ID	Operator	Response Received (Yes/No)	Issues raised by Operator \ Observations.
1	ESB Services	Yes	ESB raised a concern regarding 2 Point-to-Multipoint (PMP) radio links which pass through the proposed wind fam site.

Table 3. Telecom Operators Consulted

3.1.1 ESB Services Response to Consultations

ESB raised concerns regarding two PMP radio links in the vicinity of the proposed development.

Link ID	Site A	Site B	Link Type
1	ESB Kilgarvan 38 kV Station	Kilgarvan Wind Farm Substation	PMP
2	ESB Kenmare 38 kV Station	Kilgarvan Wind Farm Substation	PMP

Table 4. ESB Links in vicinity of proposed Wind Farm

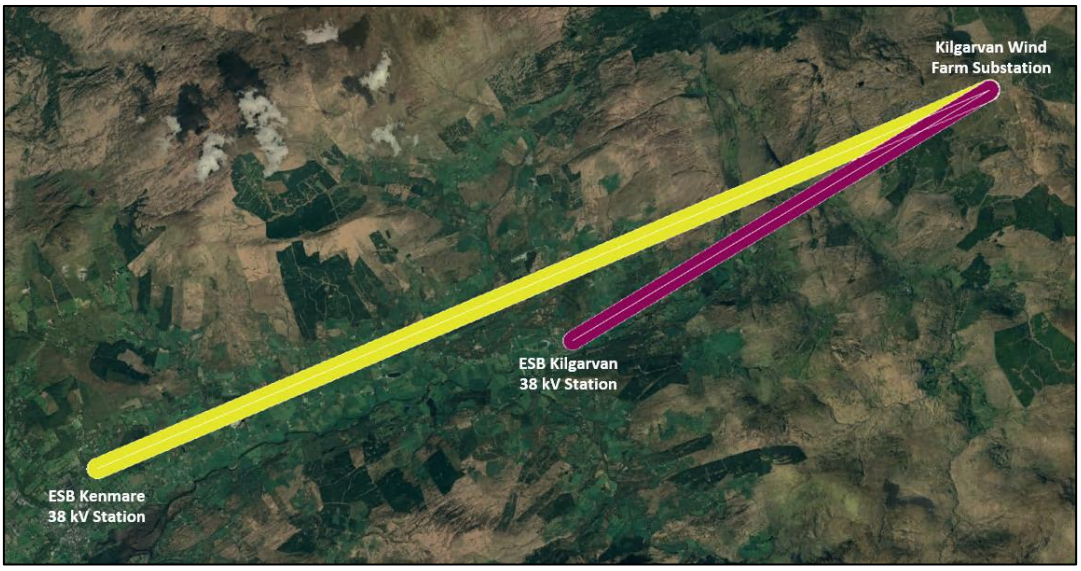

Figure 2. Plan View of ESB PMP Radio Links

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The correspondences between the Ai Bridges Ltd and ESB are provided below.

26/10/22 – Email from Ai Bridges Ltd to ESB

Dear Sirs,

We have been commissioned by MKO (McCarthy Keville O'Sullivan Ltd.) to conduct a detailed technical analysis of the potential impacts on the ESB operated UHF links by wind turbines being proposed as part of the Re-Powering of the existing Kilgarvan Wind Farm. Our engineers have identified that that A-ends and B-end of the links are located at the ESB Sub-stations at Kenmare and Kilgarvan to the Relay High Site Kilgarvan Wind Farm Sub-station respectively. Our engineers have surveyed the Kilgarvan and Kenmare sub-stations and also at the Kilgarvan Wind Farm sub-station.

It is our understanding that there have already been consultations between ESB and MKO and that ESB have requested buffers of 2nd Fresnel with 150m. Ai Bridges has been asked to conduct an analysis of these buffers and clearances requested by ESB.

Our engineers have determined that there are existing operational turbines as highlighted below and our research has shown that the UHF radio network at the Kilgarvan Substation was constructed post commissioning of the Wind Farm. Further analysis shows that the existing wind farms, including turbine details for Grousemount and Midas wind farms and the As Built Kilgarvan Turbines (including Inchincoosh, Lettercannon, Sillahertane, and Kilgarvan Turbines) would cause more of an interference impact than the proposed turbines.

Our engineers completed a detailed analysis in relation to the proposed Re-powering project of Kilgarvan Wind Farm development. Our engineers incorporated the correct co-ordinates in their analysis which shows that there may be an impact from only one of the proposed wind turbines on the 0.6F1 Fresnel Zone. Please note that our engineers have used this reference as the basis of 0.6F1 Fresnel Zone analysis

"Calculation of the Clearance Zone 3.1.doc by JRC ".

Thus our engineers have not observed request for the

"the buffer clearance zone recommended is the 2nd Fresnel zone clearance plus 150m, a buffer zone to allow for location accuracy of the link ends, turbine construction and ellipsoid conversion anomalies, plus 100m for Turbine micro siting."

There is no basis in Irish Telecommunications Licensing to observe this exclusion distances. ComReg have confirmed that that can only deal with a matter of harmful interference due to radio equipment and not by physical structures.

As part of our technical analysis we would look to propose a "micro-sited" location in the viable wind farm development area,

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As highlighted above there are existing impacts from the aforementioned wind farm turbines on the ESB UHF Telemetry networks and these links are “operational” and continue to be operated.

We will be highlighting to the wind farm developer the PQQ process that ESB are engaging in, in relation a call to the market for an alternative technology to replace the UHF Telemetry network currently in use and that in all likelihood the current network will be replaced before a wind farm development would be constructed at the proposed site i.e. in the event of a successful planning application.

We will be submitting our analysis on the basis that in the event of an impact from one of the proposed wind turbines that a viable mitigation measure can be implemented to remediate any potential wind farm impacts on existing telecommunications infrastructure. We will also be stating that is not acceptable for ESB to impose restrictions, which have no basis in Irish Telecommunications Licensing laws, given that there are existing wind farm turbine impacts on both of the UHF links to Kenmare and Kilgarvan sub-stations

We will be recommending , as stated above, that all proposed turbine locations be subject to a condition that they do not interfere with \ encroach into the critical 0.6F1 Fresnel Zones of the UHF Links.

Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

22/11/22 – Email from Ai Bridges Ltd to ESB

Dear Sirs,

We are following up from our recent correspondence below in relation to Kilgarvan Wind Farm

We have been advised by the planning consultants that the proposed mitigation measure solution of “micro-siting” cannot be used as a viable solution due to other constraints.

Our detailed technical analysis has shown that this is a single turbine that may cause an impact on the Kenmare UHF Link and we have noted this to the developers of the wind farm. This is not withstanding the existing interference from the operational wind farms in the vicinity of the proposed Kilgarvan Wind Farm.

We would like to propose the erection of a relay mast to mitigate the possible impacts on the Kenmare UHF link (which originates at the existing Kilgarvan sub-station). The costs of the proposed mitigation solution would be covered by the wind farm developer and they would secure wind farm access to allow erection of same in the event of a successful planning application.

We would thus recommend that the mitigation measure solution agreed in 2021 with ESB in relation to Firlough Wind Farm would be adopted and agreed as an acceptable solution to both parties.

We would be grateful if you could provide a response confirming acceptance of a relay mast within the site boundary the proposed wind farm development as a mitigation measure.

We look forward to hearing from you.

Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

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Section 4 - Field Surveys

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4. Introduction

To assess/verify the accuracy of the radio link details (antenna co-ordinates, antenna installation heights, etc.), field surveys of both ends of each radio link were carried out.

Figure 3 below shows each end of the ESB radio links (Kilgarvan Wind Farm Substation, ESB Kilgarvan 38 kV Station and ESB Kenmare 38 kV Station) relative to the proposed wind farm. A summary of the findings of the field surveys of these sites are provided in Section 4.1 to 4.3 that follows.

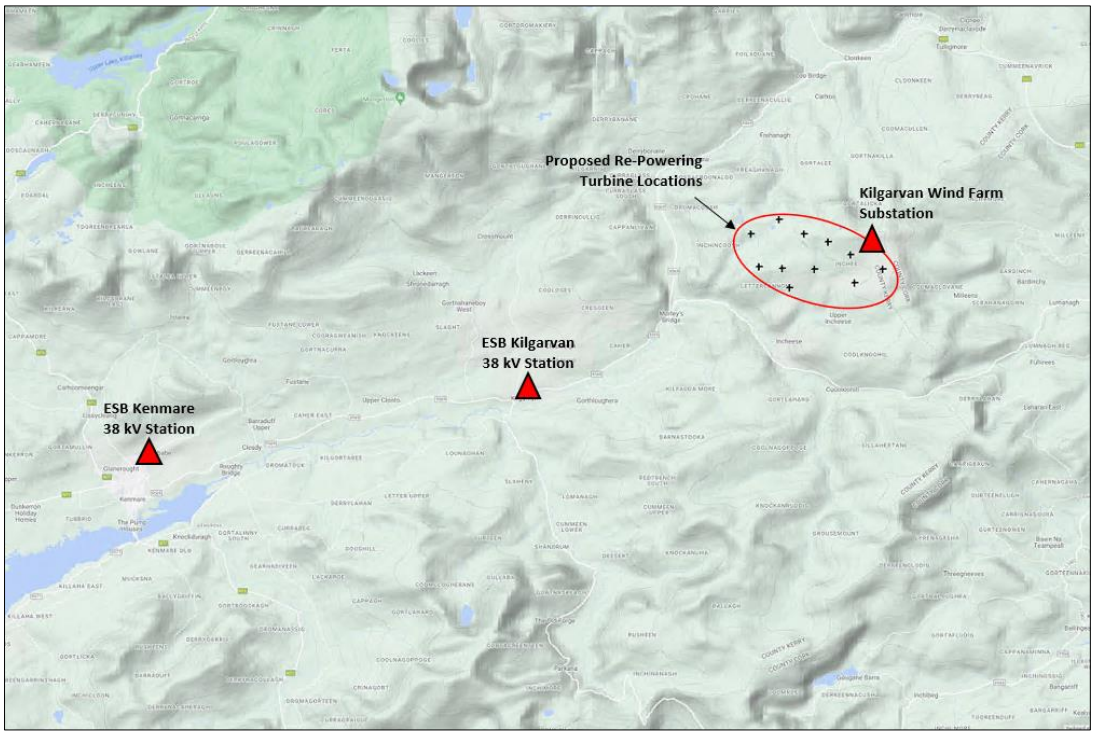

Figure 3. Kilgarvan Re-powering wind farm relative to ESB Radio Link mast-sites

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4.1 Kilgarvan Wind Farm Substation

The survey of this site found that ESB have installed two omni-directional antennae on top of a telegraph pole adjacent to the existing Kilgarvan Substation as shown below in Figure 4. The antennae is installed at an approximate height of 20m AGL. A summary of the Kilgarvan Wind Farm Substation Field Survey is provided below in Table 4.

Figure 4. PMP Antenna at Kilgarvan Wind Farm Substation

Site	Operator	Co-ordinates	Antenna Type	Antenna Install Height (AGL) *
Kilgarvan WF Substation	ESB	51 56 17.93 N 09 18 40.12 W	*UHF Omi-Directional*	*20m*

Table 5. Kilgarvan Wind Farm SS – Field Survey Summary

** Approximate Height recorded from ground level during filed survey*.

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4.2 Kilgarvan 38 kV Station

The survey of this site found that the ESB have installed a directional yagi antenna on top of a telegraph pole adjacent to the 38 kV substation as shown below in Figure 5. The antenna is installed at an approximate height of 20m AGL. A summary of the ESB Kilgarvan Field Survey is provided below in Table 5.

Figure 5. PMP Antenna at ESB Kilgarvan

Site	Operator	Co-ordinates	Antenna Type	Antenna Install Height (AGL) *
Kilgarvan 38 kV	ESB	51 54 13.46 N 09 26 07.97 W	UHF Directional Yagi	20m

Table 6. Kilgarvan 38 kV Station – Field Survey Summary

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4.3 Kenmare 38 kV Station

The survey of this site found that the ESB antenna is installed on top of a telegraph pole within the 38 kV substation as shown below in Figure 5. The antenna is installed at an approximate height of 20m AGL. A summary of the ESB Kenmare Field Survey is provided below in Table 5.

Figure 6. PMP Antenna at ESB Kenmare 38 kV Station

Site	Operator	Co-ordinates	Antenna Type	Antenna Install Height (AGL) *
Kenmare 38kV	ESB	51 53 26.57 N 09 34 28.07 W	UHF Directional Yagi	20m

Table 7. ESB Kenmare 38 kV Station– Field Survey Summary

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Section 5 - Desktop Survey Analysis

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5. Introduction

Based on the findings obtained during field surveys and the telecom operator consultation process, an analysis* of the following links was carried out.

Link ID	Operator	Link Description
1	ESB	PMP radio link from ESB Kilgarvan 38kV – Kilgarvan Wind Farm Substation
2	ESB	PMP radio link from ESB Kenmare 38kV – Kilgarvan Wind Farm Substation

Table 8. Radio Links requiring Analysis

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

5.1.1 Link 1 Analysis (Kilgarvan 38kV – Kenmare Wind Farm Substation)

Figure 5 below shows the ESB PMP radio link from Kilgarvan 38kV to Kilgarvan Wind Farm Substation.

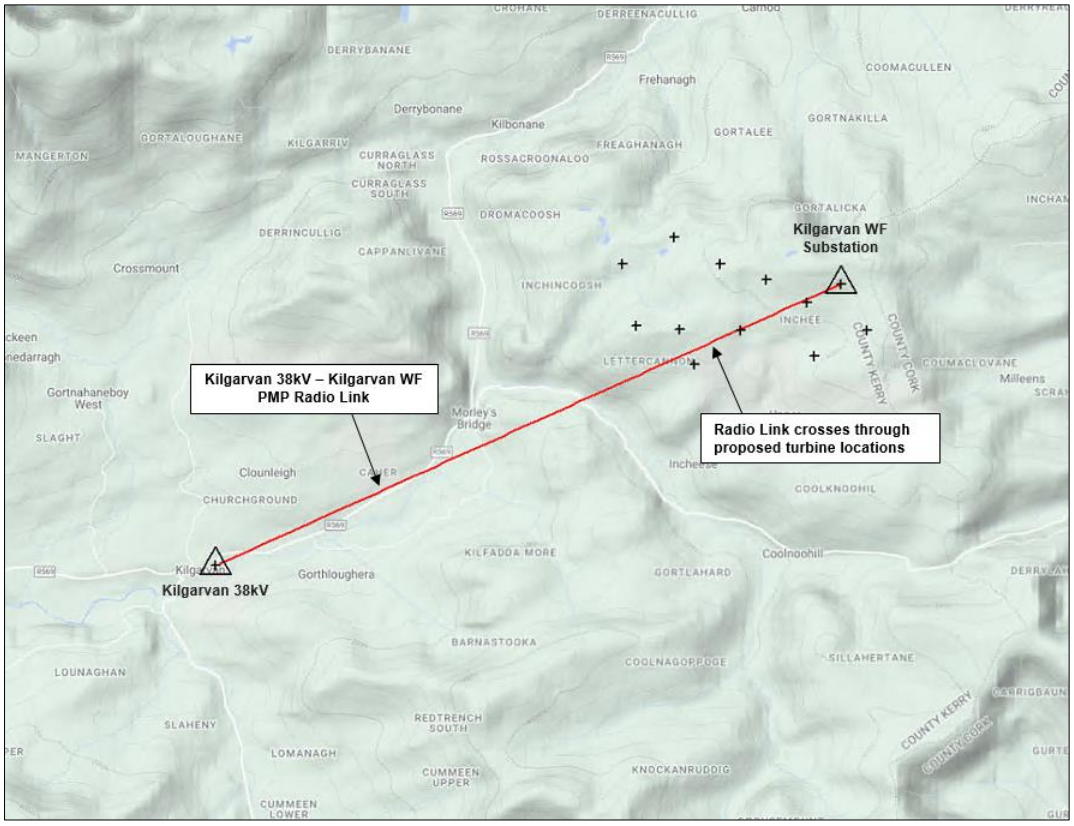

Figure 7. ESB's radio link between Kilgarvan 38 kV and Kilgarvan WF Substation.

The proposed turbines have been modelled in 3D and are shown relative to the ESB radio link in Figure 8. Network analysis calculations indicates one of the proposed turbines (T08) would obstruct the Fresnel Zone (0.6F1) of ESB radio link by 20.9m.

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Although network analysis indicates that Turbine T08 will have an interference condition of 20.91m, it should be noted that the Fresnel Zone of the radio link is already impeded by three of the existing turbines at Kilgarvan (Figure 10). i.e. There will be less of an infringement into the Fresnel Zone due to the proposed turbine layout when compared to the existing turbine layout.

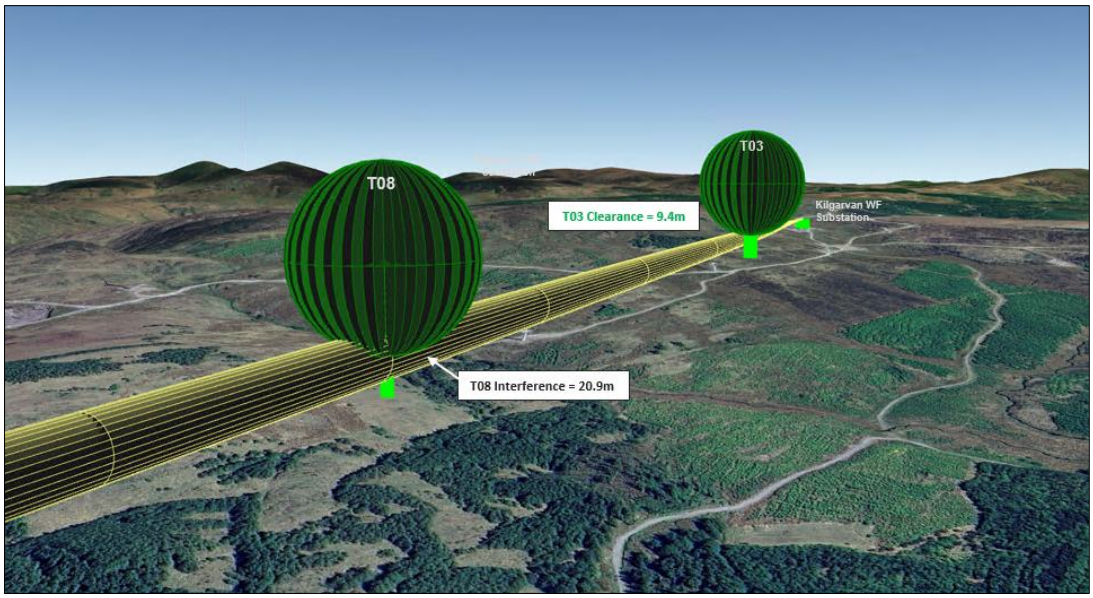

Figure 8. 3D Model showing proposed Re-Powering turbines relative to the radio link – ESB Link 1.

The 3D model indicates that the Fresnel Zone (0.6F1) is not impacted by terrain as shown below in Figure 9. The path profile of this radio link is provided in Appendix B and the radio link budget report is provided in Appendix C.

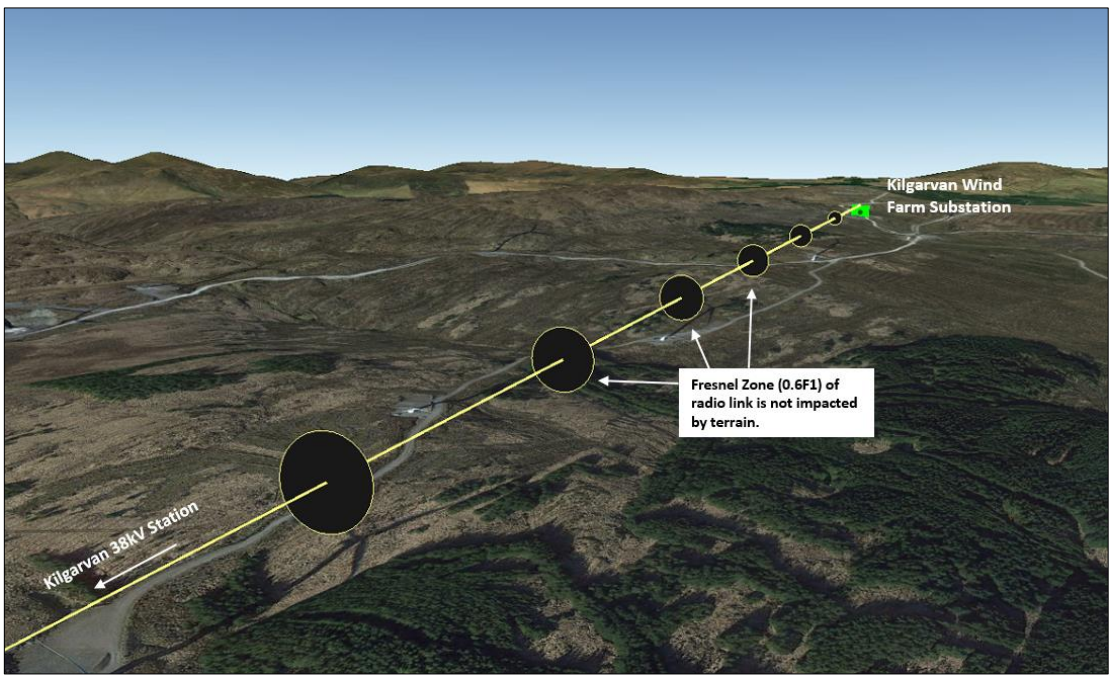

Figure 9. 3D Model showing the Fresnel Zone (0.6F1) of the link is not impacted by terrain - ESB Link 1.

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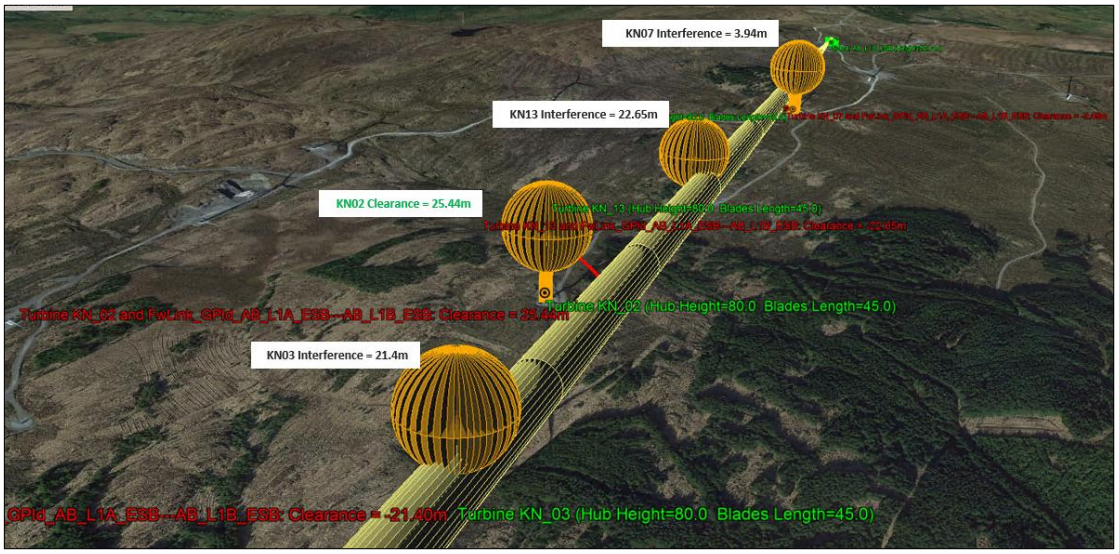

Figure 10. 3D Model showing that the radio link path is obstructed by existing turbines - ESB Link 1.

Table 9 below provides a brief summary of the desktop analysis of Link 1.

Operator	ESB
Link Description	PMP UHF link from Kilgarvan 38kV Station to Kilgarvan WF Substation
Terrain Impacts	No impacts.
Wind Farm Impacts	No impacts. Infringement into radio link Fresnel Zone by proposed Re-Powering turbines is less than the current infringement by the existing Kilgarvan turbines.

Table 9. Link 1 – Analysis Summary

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5.1.2 Link 2 Analysis (Kenmare 38kV – Kenmare Wind Farm Substation)

Figure 11 below shows the ESB PMP radio link from Kenmare 38kV to Kilgarvan Wind Farm Substation.

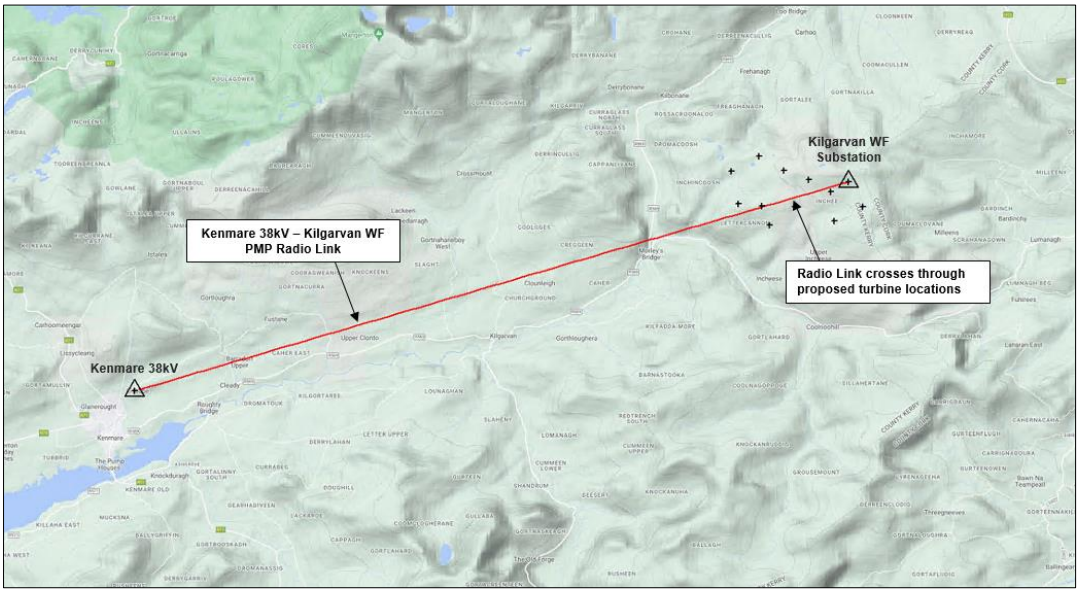

Figure 11. ESB's radio link between Kilgarvan 38 kV and Kilgarvan WF Substation.

The proposed turbines have been modelled in 3D and are shown relative to the ESB radio link in Figure 11. Network analysis calculations indicates one of the proposed turbines (T09) would obstruct the Fresnel Zone (0.6F1) of ESB radio link by 39.32m.

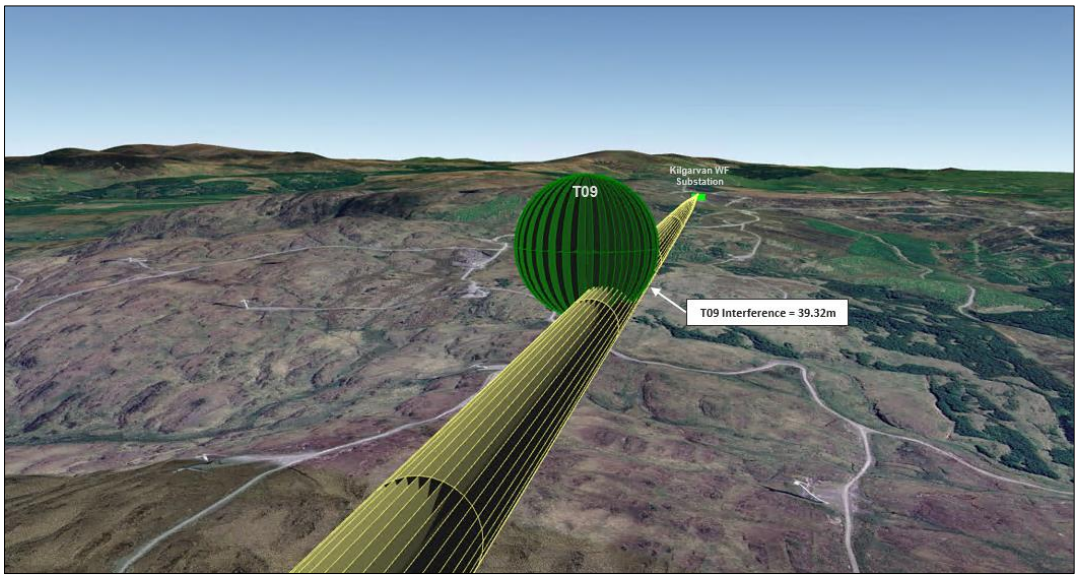

Figure 12. 3D Model showing proposed Re-Powering Turbines relative to ESB Link2.

The 3D model indicates that the Fresnel Zone (0.6F1) is not impacted by terrain as shown below in Figure 13. The path profile of this radio link is provided in Appendix B and the radio link budget report is provided in Appendix C.

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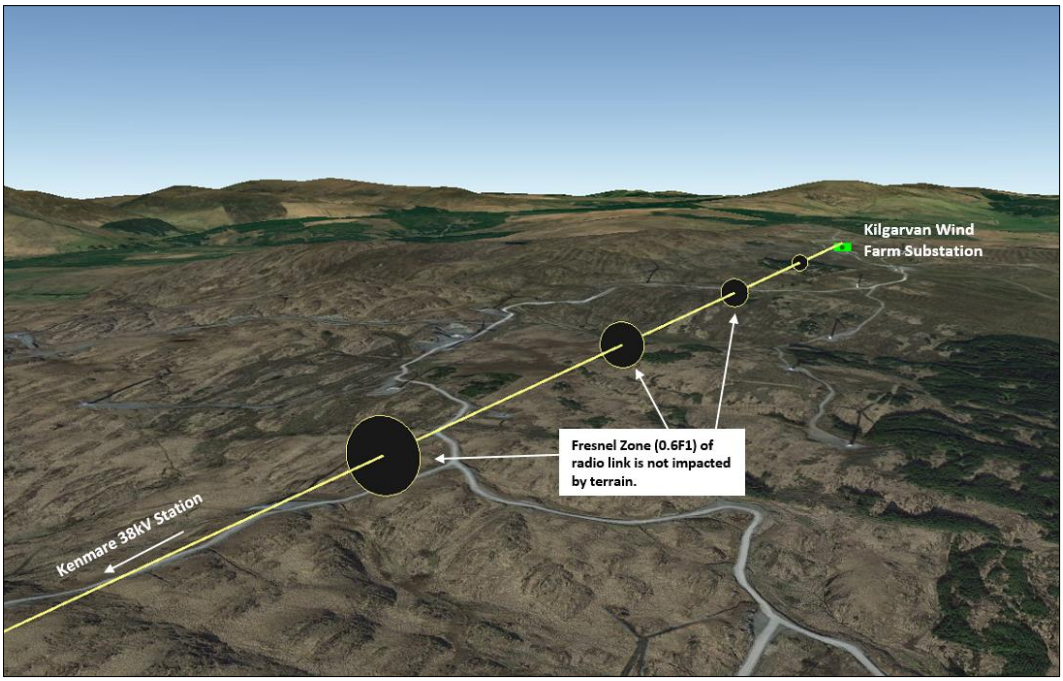

Figure 13. 3D Model showing the Fresnel Zone (0.6F1) of the link is not impacted by terrain - ESB Link 2.

Table 6 below provides a brief summary of the desktop analysis of Link 1.

Operator	ESB
Link Description	PMP UHF link from Kenmare 38kV Station to Kilgarvan WF Substation
Terrain Impacts	No Impacts
Wind farm Impacts	T09 Interference Condition of 39.32 m.

Table 10. Link 2 – Analysis Summary

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Section 6 - Mitigation Measures

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6. Mitigation measures

Section 6.1 that follows describes the mitigation measures available to the wind farm developer to offset the impact of the turbine T09 on the ESB radio link between Kenmare 38kV Station and Kilgarvan Wind Farm Substation.

6.1 Mitigation Measure Solutions

To offset the impact of the turbines on the ESB radio link the following mitigation solutions are available:

i) Provision of Relay Mast located within the Proposed Development site.

This mitigation measure is described in more detail in Section 6.1.1 that follows.

6.1.1 Provision of Relay Mast.

An option of offset the impact of T09 on the ESB communications link would be to provision a relay mast-structure adjacent to turbine T09. This would require a mono-pole structure to be erected ~50m from T09, which would provide an alternative telecommunication site to ESB so that the turbines would not obstruct radio the radio signal path.

A telegraph pole could be used to install the antenna. An outdoor cabinet would also be required to house the radio indoor equipment and electrical power supply, which could be taken from T09. Figure 14 below illustrates how a relay mast could be used to mitigate against an obstructing turbine.

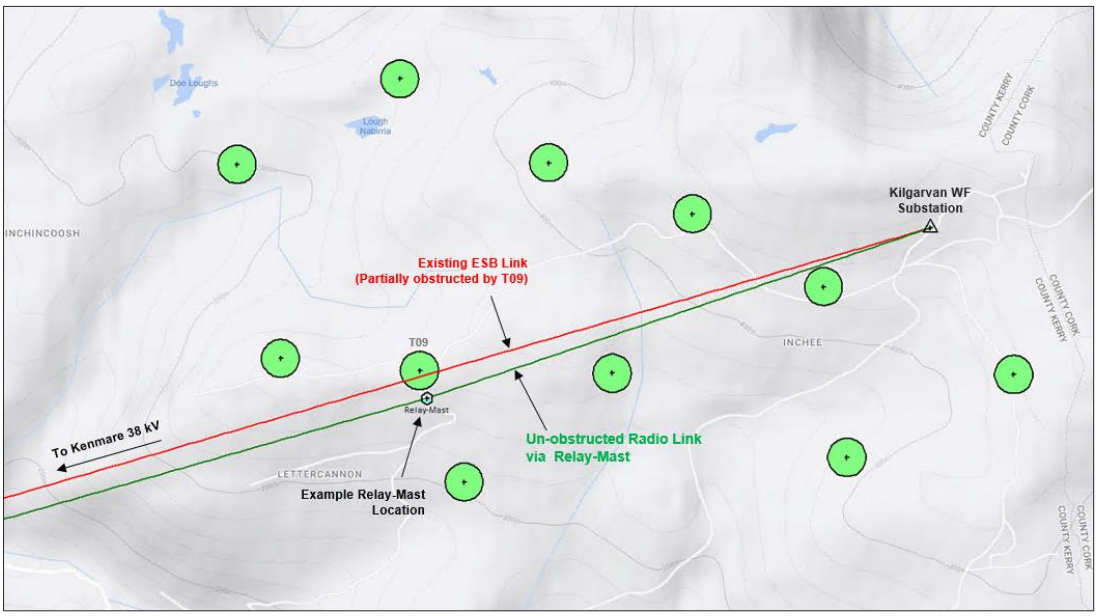

Figure 14. Example of a relay mast used to mitigate against an obstructing turbine.

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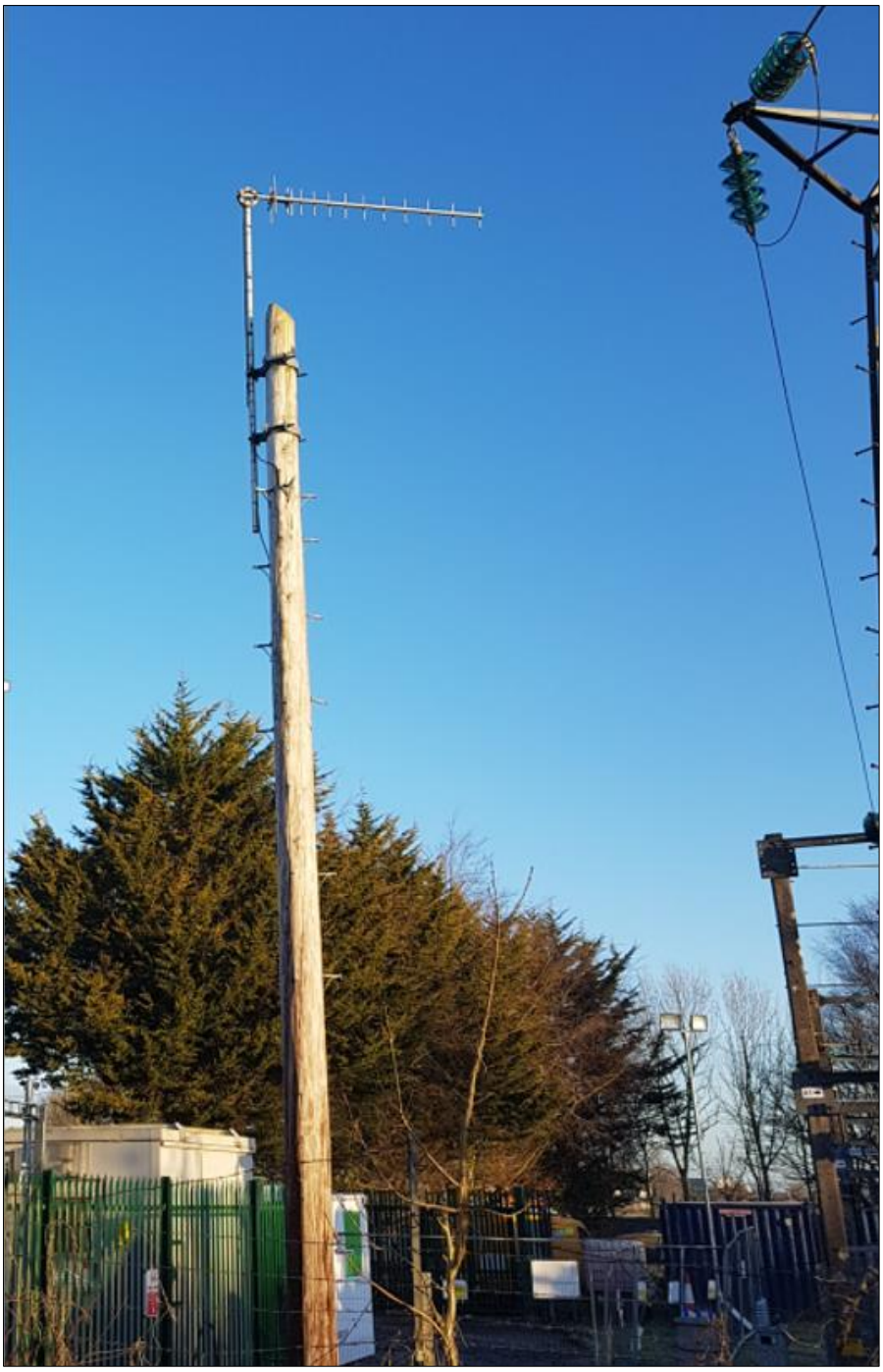

Figure 15. Example of an ESB antenna installed on a telegraph pole.

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Section 7 - Conclusions

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7. Conclusions

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

- The ESB PMP radio link to/from the 38kV Substation at Kilgarvan will not be impacted as any impact due to the proposed turbines will be less than the current impact by the existing Kilgarvan turbines.

- The ESB PMP radio link to/from the 38kV Substation at Kenmare may potentially be impacted by one of the proposed turbines (T09), Radio link analysis indicates that the proposed turbine would infringe into the radio link Fresnel Zone (0.6F1) by 39.32m.

- A mitigation measure has been proposed to remediate the interference condition on the radio link to/from the 38kV Station at Kenmare. This mitigation measure would be to provision a relay mast-structure adjacent to turbine T09. This mitigation measure is outlined in Section 6 of this report.

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APPENDIX A – Kilgarvan Re-Powering Wind Farm Turbine Co-ordinates

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Appendix A – Kilgarvan Re-Powering Wind Farm Turbine Co-ordinates

The co-ordinates of the turbines studies in this report are shown below in Table A1.

Kilgarvan Re-Powering Wind Farm Co. Kerry		
Turbine No.	**Latitude**	**Longitude**
T01	51 55 57.57 N	9 18 21.33 W
T02	51 55 46.08 N	9 18 58.89 W
T03	51 56 09.77 N	9 19 04.15 W
T04	51 56 19.88 N	9 19 33.67 W
T05	51 56 26.97 N	9 20 06.07 W
T06	51 56 38.63 N	9 20 39.56 W
T07	51 56 26.75 N	9 21 16.23 W
T08	51 55 57.75 N	9 19 51.72 W
T09	51 55 58.14 N	9 20 35.15 W
T10	51 55 59.81 N	9 21 06.45 W
T11	51 55 42.66 N	9 20 25.1 W

Table A1 – Kilgarvan Re-Powering Wind Farm Turbine Co-ordinates

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APPENDIX B – Radio Link Path Profiles

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Appendix B – Radio Link Path Profiles

The Path Profiles for both of the ESB PMP radio links are shown below in Figures B.1 and B.2. The Fresnel Zone (0.6F1) of each radio link is shown in green. The profiles show that that there is negligible infringement into the Fresnel Zone due to terrain.

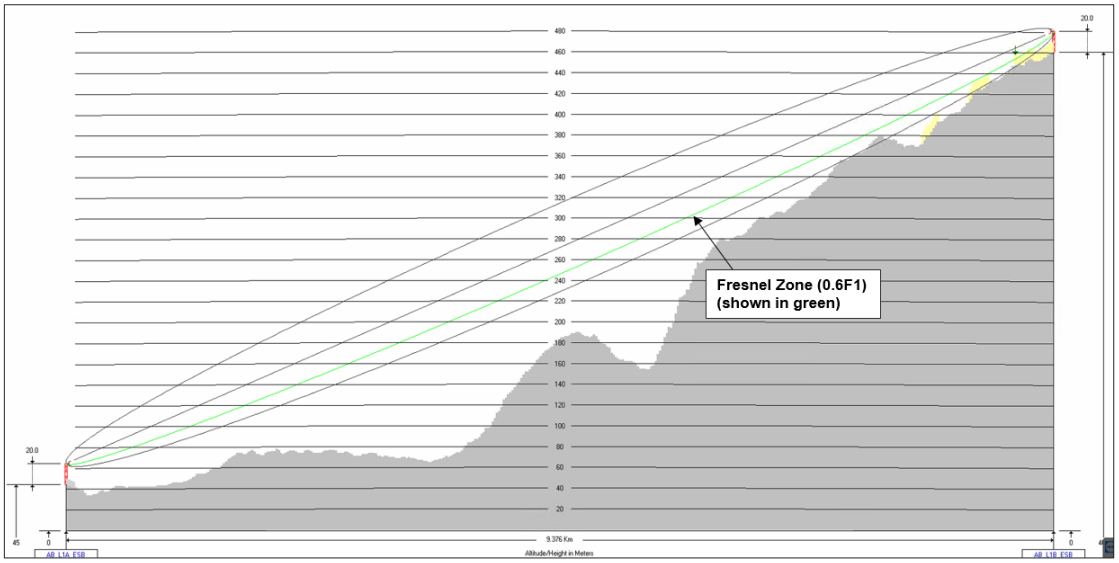

Figure B.1 ESB Link 1 Path Profile (Kilgarvan 38kV – Kilgarvan Wind Farm Substation)

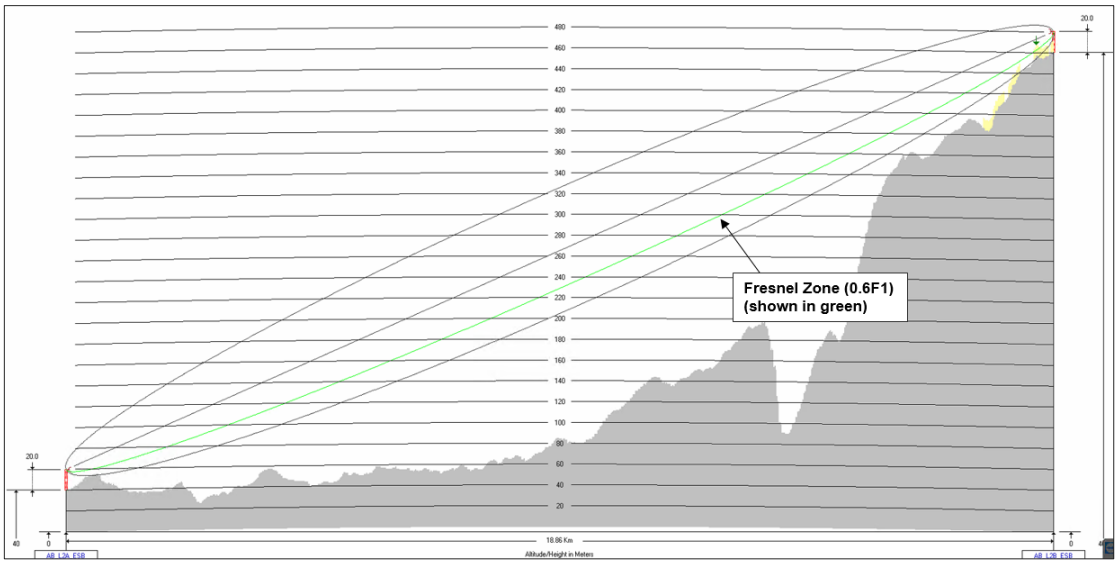

Figure B.2 ESB Link 2 Path Profiles (Kenmare 38kV – Kilgarvan Wind Farm Substation)

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APPENDIX C – Radio Link Budget Reports

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Appendix C – Radio Link Budget Reports

The Radio Link Budget Reports for both of the ESB PMP radio links are provided below in Sections C.1 and C.2.

C.1. ESB Link 1 - Radio Link Budget Report (Kilgarvan 38kV – Kilgarvan Wind Farm Substation)

Link Budget Report

Site Name:	AB_L1A_ESB (Kilgarvan 38kV)		AB_L1B_ESB (Kilgarvan WF Substation)	
Type:	Cell	Cell		
Latitude:	51°54'13.4"N		51°56'17.9"N	
Longitude:	9°26'07.9"W		9°18'40.1"W	
Altitude (m):	45.0		461.0	
UserData1:	User Data			
Datum:	World Geodetic System 1984 (WGS 84)			
	Forward Link		Reverse Link	
Transmission Site:	AB_L1A_ESB		AB_L1B_ESB	
Reception Site:	AB_L1B_ESB		AB_L1A_ESB	
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):	460		460	
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:	Bcd-4506		Bcd-4506	
Transmission Antenna Size (m):		3.675		3.675
Transmission Antenna Height (m):		20		20
Transmission Antenna Gain (dBd):		6		6
Transmission Antenna Gain (dBi):		8.14		8.14
Transmission Power EIRP (dBm):		37.14		37.14
Reception Gains (dB):	0		0	
Reception System Loss (dB):	0		0	

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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: Bcd-4506		Bcd-4506		
Reception Antenna Size (m):	3.675		3.675	
Reception Antenna Height (m):		20		20
Reception Antenna Gain (dBd):		6		6
Reception Antenna Gain (dBi):		8.14		8.14
Link Polarization:	Vertical		Vertical	
Cross Polarization Factor (dB):		30		30
Link Distance (m):	9375.636		9375.636	
Azimuth - True (°):	65.693		245.791	
Azimuth - Magnetic (°):	68.561		248.616	
Transmission Inclination (°):	-2.541		2.541	
Reception Inclination (°):	-2.541		2.541	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	9384.86		9384.86	
Center Frequency (MHz):	460		460	
Free Space Loss (dB):	105.144		105.144	
Max Fresnel Radius (m):	39.098		39.098	
Max 2nd Fresnel Radius (m):	55.293		55.293	
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):	2.95		2.95	
Clearance Target (%):	60			
Minimum Clearance (m):	-2.534		-2.534	
Minimum Clearance Point (m):		9009.4		9009.4
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	491.8 - 512.7			491.8 - 512.7
Reflection Area 2 (m):	575.513		575.513	
Reflection Area 3 (m):	1307.985		1307.985	
Reflection Area 4 (m):	4698.282		4698.282	
Reflection Area 5 (m):	4802.921		4802.921	
Reflection Area 6 (m):	6288.8 - 6330.6			6288.8 - 6330.6
Reflection Area 7 (m):	6665.491		6665.491	
Reflection Area 8 (m):	6958.48		6958.48	
Reflection Area 9 (m):	7418.891		7418.891	
Reflection Area 10 (m):	7481.7 - 7502.6			7481.7 - 7502.6
Reflection Area 11 (m):	7711.88		7711.88	
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):		0.026		0.026
Total Path Loss (dB):	108.12		108.12	
Reception Signal Level (dBm):		-63.84		-63.84
	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	27.16	26.16	27.16	26.16
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			

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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 (%):	1.44E-04	1.44E-04

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):	0.002799	0.002799
Rainfall Attenuation (dB):	0.066	0.066

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	1.98E-08	2.49E-08	1.98E-08	2.49E-08
Selective Fading Outage (%):	6.27E-12	6.27E-12	6.27E-12	6.27E-12
Composite Fading Outage (%):		1.98E-08	2.49E-08	1.98E-08	2.49E-08

Fading Outage (s/Month):	0.001	0.001	0.001	0.001
Selective Fading Outage (s/Month):	0	0	0	0
Composite Fading Outage (s/Month):	0.001	0.001	0.001	0.001

	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 (%):		1.98E-08	2.49E-08	1.98E-08	2.49E-08
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	1.98E-08	2.49E-08	1.98E-08	2.49E-08
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):		0.006	0.008	0.006	0.008
Unavailability due to Rain (s/Year):		0	0	0	0
Total Unavailability (s/Year):	0.006	0.008	0.006	0.008
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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C.2. ESB Link 2 - Radio Link Budget Report (Kenmare 38kV – Kilgarvan Wind Farm Substation)

Link Budget Report

Site Name:	AB_L2A_ESB (Kenmare 38kV)			AB_L2B_ESB Kilgarvan WF Substation)			
Type:	Cell	Cell					
Latitude:	51°53'26.5"N		51°56'17.9"N				
Longitude:	9°34'28.0"W		9°18'40.1"W				
Altitude (m):	40.0		461.0				
UserData1:	User Data						
Datum:	World Geodetic System 1984 (WGS 84)						
	Forward Link		Reverse Link				
Transmission Site:	AB_L2A_ESB		AB_L2B_ESB				
Reception Site:	AB_L2B_ESB		AB_L2A_ESB				
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):	460		460				
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:	Bcd-4506		Bcd-4506				
Transmission Antenna Size (m):		3.675		3.675			
Transmission Antenna Height (m):		20		20			
Transmission Antenna Gain (dBd):		6		6			
Transmission Antenna Gain (dBi):		8.14		8.14			
Transmission Power EIRP (dBm):		37.14		37.14			
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:	Bcd-4506		Bcd-4506				
Reception Antenna Size (m):	3.675		3.675				

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Reception Antenna Height (m):		20		20
Reception Antenna Gain (dBd):		6		6
Reception Antenna Gain (dBi):		8.14		8.14
Link Polarization:	Vertical	Vertical		
Cross Polarization Factor (dB):		30		30
Link Distance (m):	18856.531		18856.531	
Azimuth - True (°):	73.563	253.77		
Azimuth - Magnetic (°):	76.483		256.595	
Transmission Inclination (°):	-1.279		1.279	
Reception Inclination (°):	-1.279		1.279	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	18861.23		18861.23	
Center Frequency (MHz):	460		460	
Free Space Loss (dB):	111.207		111.207	
Max Fresnel Radius (m):	55.448		55.448	
Max 2nd Fresnel Radius (m):	78.415		78.415	
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):	2.949		2.949	
Clearance Target (%):	60			
Minimum Clearance (m):	-2.387		-2.387	
Minimum Clearance Point (m):		18528.332		18528.332
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	387.872		387.872	
Reflection Area 2 (m):	447.5 - 467.4			447.5 - 467.4
Reflection Area 3 (m):	785.689		785.689	
Reflection Area 4 (m):	885.1 - 905			885.1 - 905
Reflection Area 5 (m):	1064.161		1064.161	
Reflection Area 6 (m):	1123.8 - 1143.7			1123.8 - 1143.7
Reflection Area 7 (m):	1223.3 - 1322.7			1223.3 - 1322.7
Reflection Area 8 (m):	1422.196		1422.196	
Reflection Area 9 (m):	1481.9 - 1501.8			1481.9 - 1501.8
Reflection Area 10 (m):	8781.8 - 8861.4			8781.8 - 8861.4
Reflection Area 11 (m):	8921.049		8921.049	
Reflection Area 12 (m):	9000.6 - 9020.5			9000.6 - 9020.5
Reflection Area 13 (m):	9080.176		9080.176	
Reflection Area 14 (m):	9199.5 - 9219.4			9199.5 - 9219.4
Reflection Area 15 (m):	9378.538		9378.538	
Reflection Area 16 (m):	9497.884		9497.884	
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):		0.052		0.052
Total Path Loss (dB):	114.208		114.208	
Reception Signal Level (dBm):		-69.928		-69.928

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	21.072	20.072	21.072	20.072

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

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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 (%):			2.98E-03		2.98E-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):	0.0028		0.0028		
Rainfall Attenuation (dB):		-0.111		-0.111	

	BER 10-3	BER 10-6	BER 10-3	BER 10-6	
Fading Outage (%):	2.35E-06	3.14E-06	2.35E-06	3.14E-06	
Selective Fading Outage (%):	3.74E-10	3.74E-10	3.74E-10	3.74E-10	
Composite Fading Outage (%):		2.35E-06	3.15E-06	2.35E-06	3.15E-06

Fading Outage (s/Month):	0.062	0.083	0.062	0.083	
Selective Fading Outage (s/Month):		0	0	0	0
Composite Fading Outage (s/Month):		0.062	0.083	0.062	0.083

	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 (%):		2.35E-06	3.15E-06	2.35E-06	3.15E-06
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Total Unavailability (%):	2.35E-06	3.15E-06	2.35E-06	3.15E-06	
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02	

Unavailability due to Fading (s/Year):	0.74	0.992	0.74	0.992
Unavailability due to Rain (s/Year):	0	0	0	0
Total Unavailability (s/Year):	0.74	0.992	0.74	0.992
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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Report

Proposed Repowering of the Existing Kilgarvan Wind Farm

Vodafone Links Telecommunications Impact Study

Document Number:				
Author:	DMG\PT\BC			
Approved for Release:	Rev 2.0	KH	**Date:**	07/03/23
Document Filename:	*Kilgarvan Wind Farm Re-powering Project - Vodafone Links Telecommunications Impact Study*			

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Executive Summary

Following consultations between MKO Ltd and Vodafone Ireland it was identified that Vodafone have three Point-to-Point (PTP) radio links that cross through the Proposed Repowering of the Existing Kilgarvan Wind Farm (the Proposed Development). Ai Bridges Ltd were subsequently commissioned to assess the potential impact of the proposed wind turbines on the Vodafone radio links and to propose possible mitigation measures if required.

The scope of work included field surveys and a detailed network 3D analysis of the potential impacts of the proposed wind turbines on the Vodafone radio links. Both ends of each radio link were surveyed to assess/verify the accuracy of the radio link details (antenna co-ordinates, antenna installation heights, etc). The findings of the field surveys can be found in Section 4 of this report.

The network analysis was carried out to model the microwave radio links in 3D and to show the links relative to the proposed turbines. The findings of the network analysis are summarized in the table below.

Radio Link ID	Description	Impacts due to Re-Powering Turbines
KYIHEKY037	13 GHz PTP microwave radio link from Inchee to Capparoe.	No impacts. 3D Network analysis indicates that the proposed turbines will not obstruct the Fresnel Zone of the radio link.
KYIHEKY016	15 GHz PTP microwave radio link from Inchee to Kilmurry.	Potentially impacted. 3D Network analysis indicates that the Fresnel Zone of the radio would be obstructed by one of the proposed turbines (T10). It should be noted that Fresnel Zone of this radio link is already obstructed by two existing turbines.
KYIHEKY085	26 GHz PTP microwave radio link from Inchee to Kilfadda More.	No impacts. 3D Network analysis indicates that the proposed turbines will not obstruct the Fresnel Zone of the radio link.

Table 1. Radio Link Network Analysis Summary

To offset the possible impact of Turbine T10 on the Vodafone radio link between Inchee and Kilmurry (ID: KYIHEKY016) a range of possible mitigation measures have been proposed. These mitigation measure are outlined in Section 6 of this report. To determine the most appropriate mitigation solution, additional analysis would be required along with consultations with Vodafone Ireland and the wind farm developer.

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Sections

Appendix

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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 Proposed Wind Farm Site Information

The Proposed Development is located in County Kerry approximately 7km northeast of the town of Kilgarvan. The Telecoms Mast-Site at Inchee is approximately 1 km northeast of the proposed development.

The Proposed Development consists of 11 turbines with a maximum turbine tip-height of 200 meters. The proposed turbine co-ordinates are provided in Appendix A.

Wind Farm	Number of Turbines	Turbine Hub-Height	Turbine Rotor Radius
Kilgarvan Re-powering	11	118 m	82m

Table 2. Kilgarvan Re-Powering Wind Farm Turbine Details

The location of the Proposed Development is shown below in Figure 1.

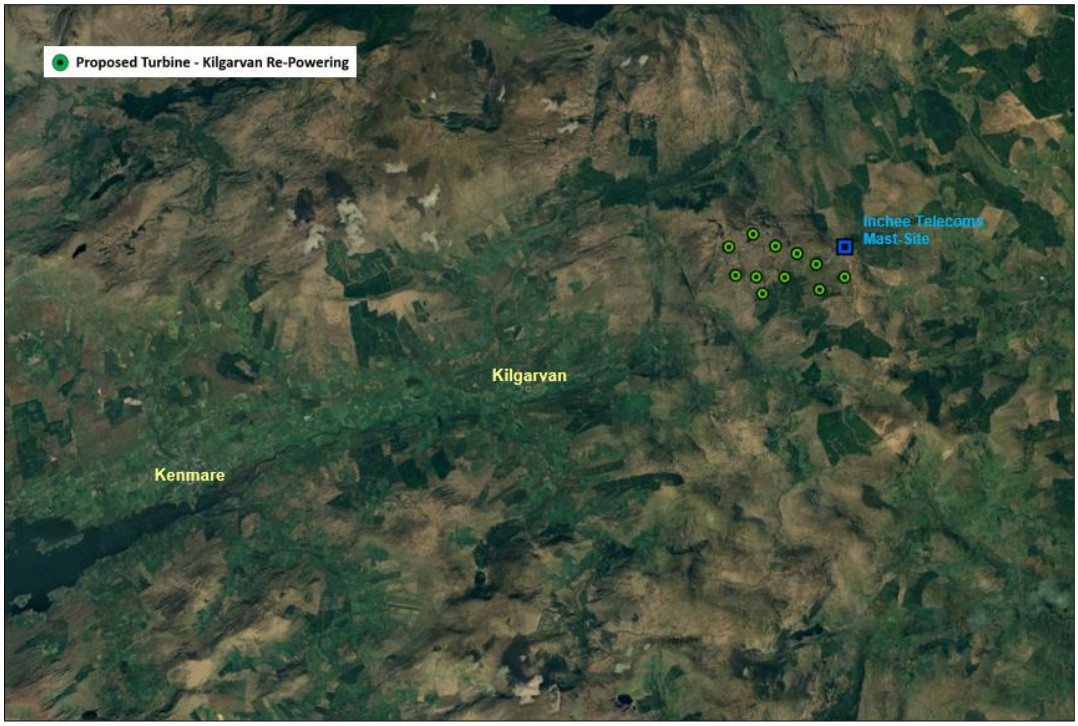

Figure 1. Location of the Proposed Development

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1.2 Existing Telecoms Baseline Infrastructure

It should be noted that there are existing wind farms in the vicinity of the Proposed Development. The existing wind farms are listed below:

- Kilgarvan
- Inchincoosh
- Lettercannon
- Midas
- Grousemount
- Barnastooka
- Sillahertane

As part of the Proposed Development, all turbines at Inchincoosh, Lettercannon and Kilgarvan will be removed and replaced by the turbine layout shown previously in Section 1.1.

Figure 2 below shows the existing turbines in the vicinity of the Proposed Development. It is proposed that the wind turbines marked in orange will be removed.

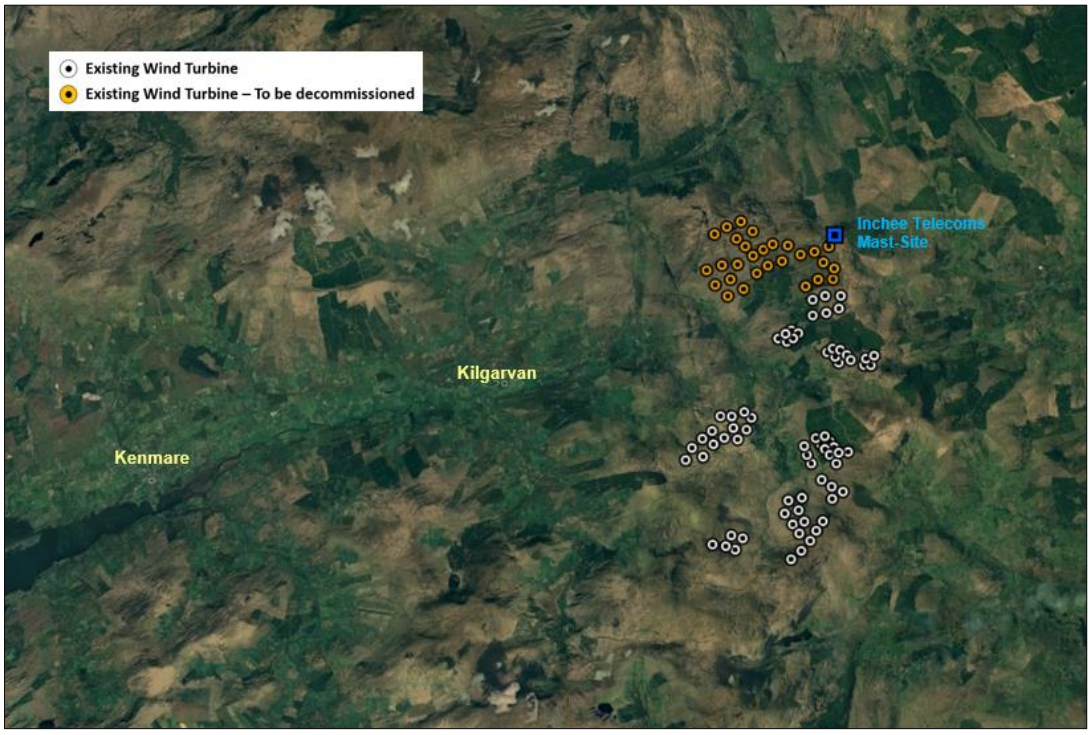

Figure 2. Existing Operational Wind Farms

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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
- Mitigation Measures
- 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 Development on their networks. The consultation process is used to assist in identifying telecoms infrastructure that could be impacted by the Proposed 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 Network Analysis

A desktop survey is carried out to plot and model the proposed wind turbines in a radio planning tool. The radio planning tool uses GIS and terrain mapping databases to enable accurate modelling. This provides a means of graphically showing the turbines in 3D relative to the existing radio link(s). The radio planning tool is then used to calculate the Clearance or Interference Condition distance between the relevant radio link and the nearest turbine(s).

Mitigation Measures

A range of Mitigation Measures are assessed and proposed to offset the potential impact of the proposed turbines on existing radio link(s).

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 the consultation process undertaken with telecom operators is described. The response received from each operator is also provided.

3.1 Telecom Operator Consultations

Consultations were undertaken by the EIAR consultants (MKO) with relevant telecom network operators. Following the round of consultations, Vodafone Ireland raises concerns regarding three of their Point-to-Point (PTP) radio links.

Table 3 lists the Telecom Operators contacted and the issues raised by the operator(s). Details from the response received from Vodafone are provided in Section 3.1.1.

ID	Operator	Response Received (Yes/No)	Issues raised by Operator \ Observations.
1	Vodafone Ireland	Yes	Vodafone raised a concern regarding 3 Point-to-Point (PTP) radio links which pass through the proposed wind fam site.

Table 3. Telecom Operators Consulted

3.1.1 Vodafone Ireland Response to Consultations

Vodafone raised concerns regarding three PTP radio links in the vicinity of the Proposed Development.

Link No	Vodafone Link ID	Site A	Site B	Link Type
1	KYIHEKY037	Inchee	Capparoe	PTP (13 GHz)
2	KYIHEKY016	Inchee	Kilmurry	PTP (15 GHz)
3	KYIHEKY085	Inchee	Kilfadda More	PTP (26 GHz)

Table 4. Vodafone Links in vicinity of Proposed Development

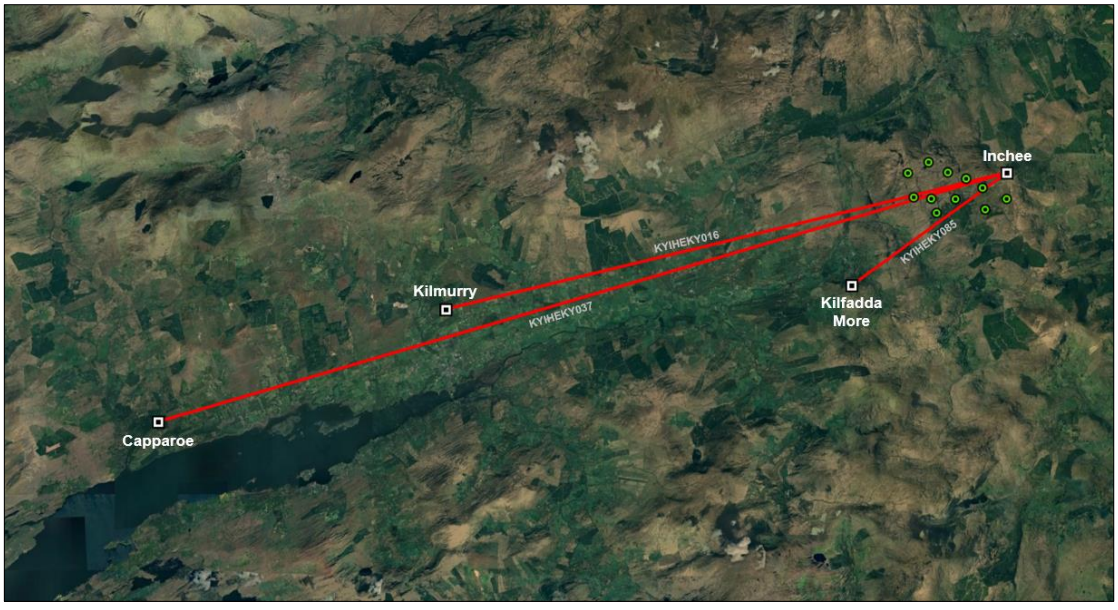

Figure 3. Plan View of Vodafone PTP Radio Links

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Section 4 - Field Surveys

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4. Introduction

To assess/verify the accuracy of the radio link details (antenna co-ordinates, antenna installation heights, etc.), field surveys of both ends of each radio link were carried out.

Figure 4 below shows each end of the Vodafone Ireland radio links (Inchee, Capparoe, Kilmurry and Kilfadda More) relative to the proposed wind farm. A summary of the findings of the field surveys of these sites are provided in Section 4.1 to 4.4 that follows.

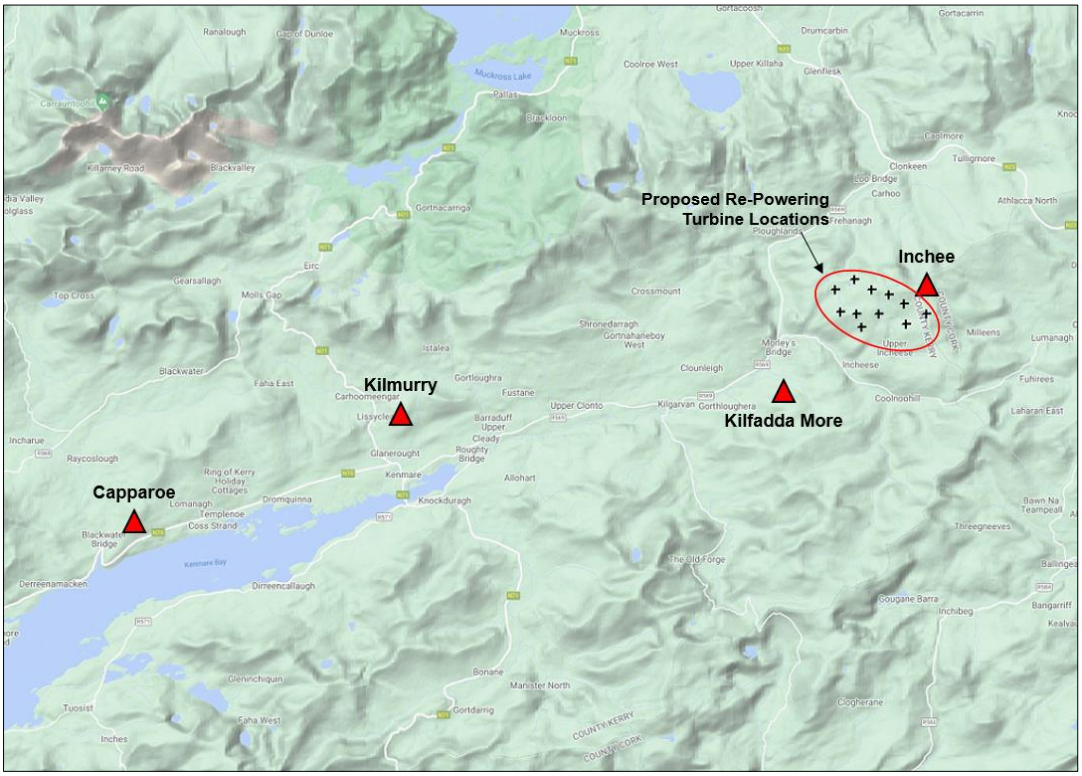

Figure 4. Location of the Proposed Development relative to Vodafone Radio Link mast-sites

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4.1 Inchee Mast-Site (KYIHE)

A photograph of the mast at Inchee is show below in Figure 5. During the field survey, antennas aligned in the direction of Capparoe, Kilmurry and Kilfadda More were identified. These antennas are highlighted in the photo below and are shown with their approximate installation heights AGL (Above Ground Level). A summary of the Inchee Field Survey is provided below in Table 5.

Figure 5. Telecoms Mast - Inchee

Mast-Site	Mast Co-ordinates	Radio Link	Antenna Type	Antenna Install Height (AGL) *
Inchee (KYIHE)	51 56 25.99 N 09 18 20.93 W	Inchee - Capparoe	0.6m Dish	30 m
		Inchee - Kilmurry	0.6m Dish	30 m
		Inchee - Kilfadda More	0.6m Dish	15 m

Table 5. Field Survey Summary - Inchee

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** Approximate Height recorded from ground level during field survey*.

4.2 Capparoe Mast-Site (KY037)

A photograph of the mast at Capparoe is show below in Figure 6. During the field survey, the antenna aligned in the direction of Inchee was identified. This antenna is highlighted in the photo below and is shown with its approximate antenna installation height above ground level (AGL). A summary of the Capparoe Field Survey is provided below in Table 6.

Figure 6. Telecoms Mast - Capparoe

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Mast-Site	Mast Co-ordinates	Radio Link	Antenna Type	Antenna Install Height (AGL) *
Capparoe (KY037)	51 51 50.57 N 09 43 42.34 W	Inchee - Capparoe	0.6m Dish	30 m

Table 6. Field Survey Summary - Capparoe

4.3 Kilmurry Mast-Site (KY016)

A photograph of the mast at Kilmurry is show below in Figure 7. During the field survey, the antenna aligned in the direction of Inchee was identified. This antenna is highlighted in the photo below and is shown with its approximate antenna installation height above ground level (AGL). A summary of the Kilmurry Field Survey is provided below in Table 7.

Figure 7. Telecoms Mast - Kilmurry

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Mast-Site	Mast Co-ordinates	Radio Link	Antenna Type	Antenna Install Height (AGL) *
Kilmurry (KY016)	51 53 55.87 N 09 35 05.19 W	Inchee - Kilmurry	0.6m Dish	19 m

Table 7. Field Survey Summary - Kilmurry

4.4 Kilfadda More Mast-Site (KY085)

A photograph of the mast at Kilfadda more is show below in Figure 8. During the field survey, the antenna aligned in the direction of Inchee was identified. This antenna is highlighted in the photo below and is shown with its approximate antenna installation height above ground level (AGL). A summary of the Kilmurry Field Survey is provided below in Table 8.

Figure 8. Telecoms Mast – Kilfadda More

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Mast-Site	Mast Co-ordinates	Radio Link	Antenna Type	Antenna Install Height (AGL) *
Kilfadda More (KY085)	51 54 22.63 N 09 22 56.00 W	Inchee - Kilfadda More	0.6m Dish	15 m

Table 8. Field Survey Summary - Kilfadda More

Section 5 - Desktop Survey Analysis

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5. Introduction

Based on the findings obtained during field surveys and the telecom operator consultation process, an analysis* of the following links was carried out.

Link ID	Operator	Link Description
KYIHEKY037	Vodafone	PTP radio link from Inchee – Capparoe
KYIHEKY016	Vodafone	PTP radio link from Inchee – Kilmurry
KYIHEKY085	Vodafone	PTP radio link from Inchee – Kilfadda More

Table 9. Radio Links requiring Analysis

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

5.1.1 KYIHEKY037 Link Analysis (Inchee – Capparoe)

Figure 9 below shows a Plan View of the Vodafone radio link from Inchee to Capparoe.

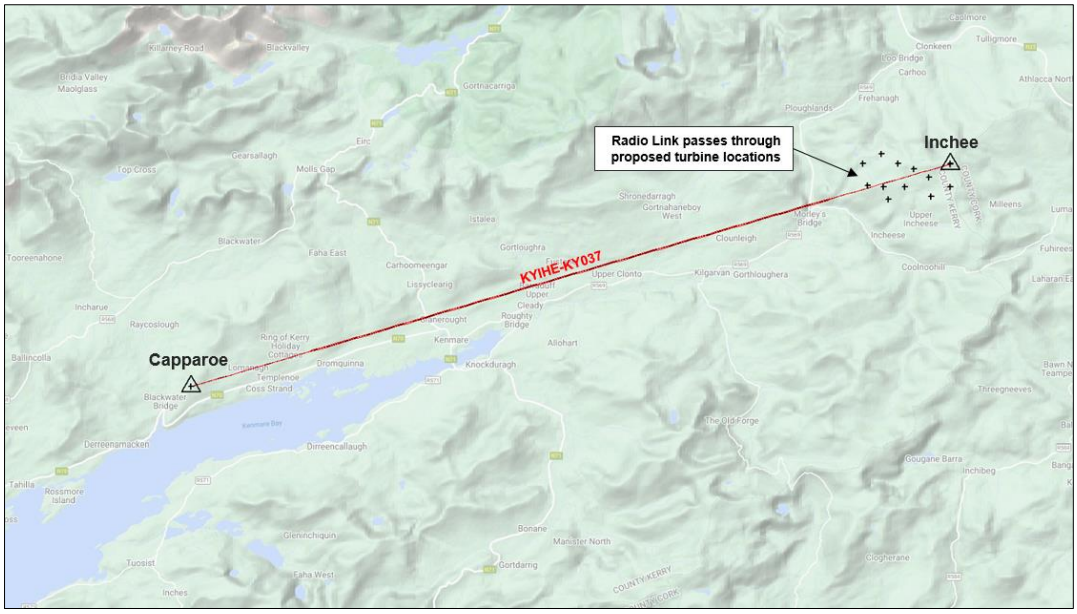

Figure 9. Vodafone's radio link between Inchee and Capparoe.

The proposed turbines have been modelled in 3D and are shown relative to the Vodafone radio link in Figure 10. Network analysis calculations indicate that none of the proposed turbines will obstruct either the First or Second Fresnel Zone (F1 or F2) of the radio link.

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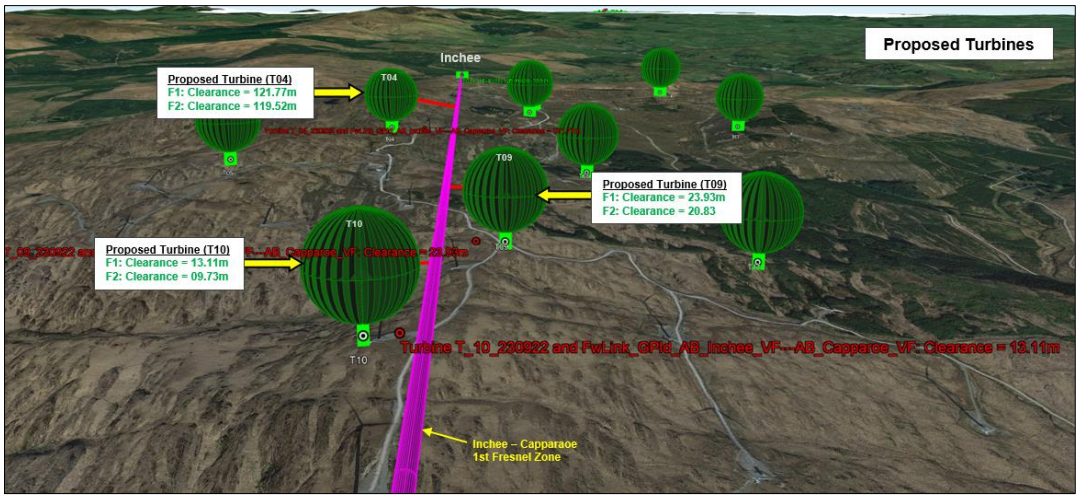

Figure 10. 3D Model showing proposed Re-Powering turbines relative to the Vodafone Radio Link.

The nearest of the proposed turbines to the radio link is Turbine T10. The results of the analysis show a Clearance Condition of 13.1m to the 1st Fresnel Zone (F1) and 9.7 m to the 2nd Fresnel Zone (F2) for Turbine T10. It should also be noted that the 2nd Fresnel Zone of this radio link is partially obstructed by an existing turbine, as shown below in Figure 11.

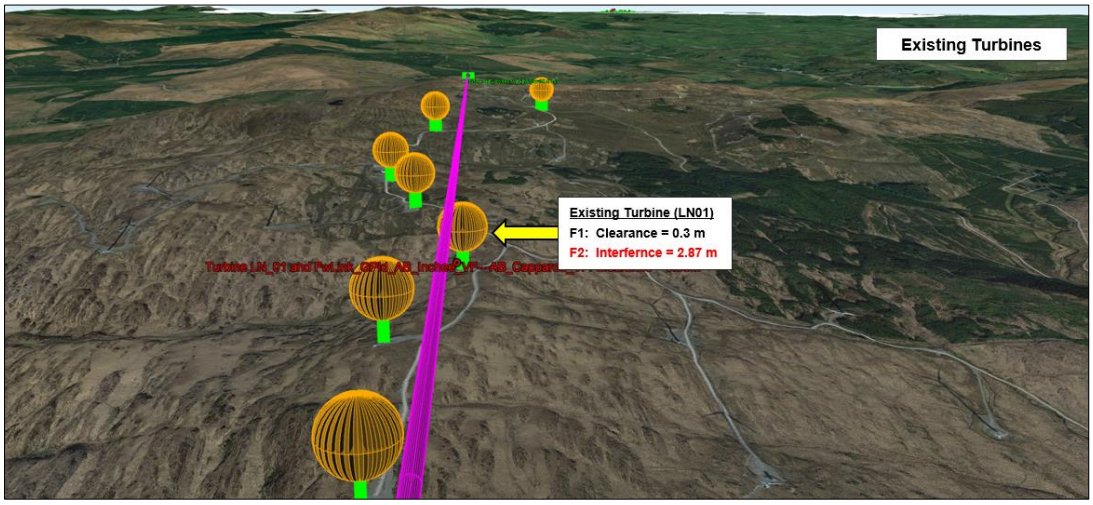

Figure 11. 3D Model showing that that 2nd Fresnel Zone of the radio link is partially obstructed by an existing turbine.

Table 10 below provides a brief summary of the desktop analysis of Link KYIHE-KY037.

Link ID	Turbines within 150m of Radio Link	Clearance Condition to Radio Link Fresnel Zone (m)		Impacts of Proposed Wind Farm
		F1	F2	
KYIHE-KY037 (Inchee – Capparoe)	T04	121.77	119.52	No impacts.
	T09	23.93	20.83	No impacts.
	T10	13.11	9.73	No impacts.

Table 10. KYIHE-KY037 (Inchee to Capparoe) Link Analysis – Summary

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5.1.2 KYIHEKY016 Link Analysis (Inchee – Kilmurry)

Figure 12 below shows the Vodafone PTP radio link from Inchee to Kilmurry.

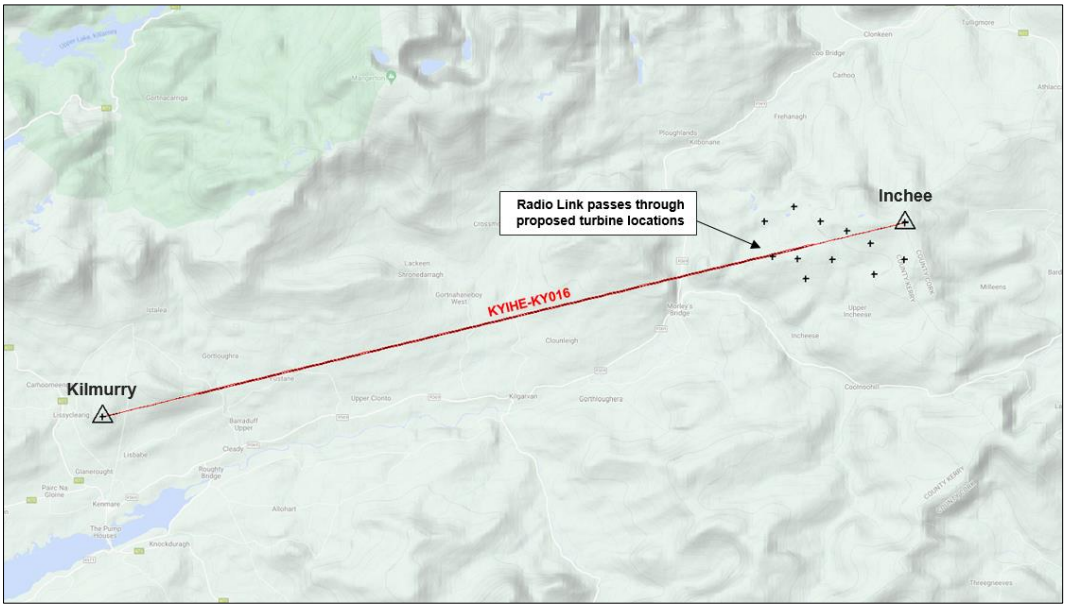

Figure 12. Vodafone's radio link between Inchee and Kilmurry.

The proposed turbines have been modelled in 3D and are shown relative to the Vodafone radio link in Figure 13. Network analysis calculations indicate that one of the proposed turbines will obstruct the radio link Fresnel Zone (F1 and F2) of the radio link.

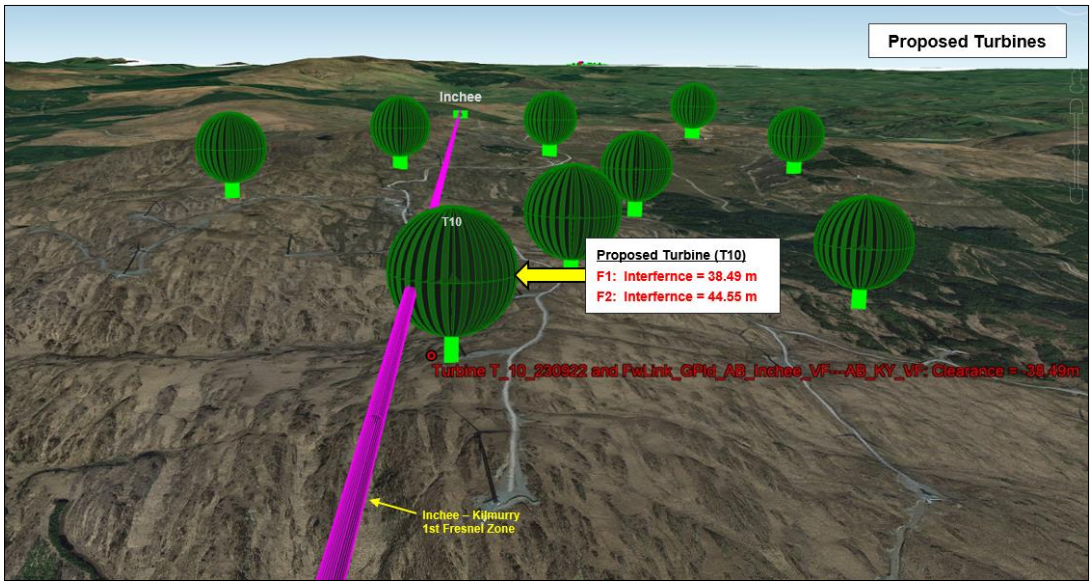

Figure 13. 3D Model showing proposed Re-Powering turbines relative to the Vodafone Radio Link.

The proposed turbine that would obstruct the radio link Fresnel Zone is Turbine T10.

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It should be noted that the Fresnel Zone (F1 and F2) of this radio link is already obstructed by two existing turbines, as shown below in Figure 14.

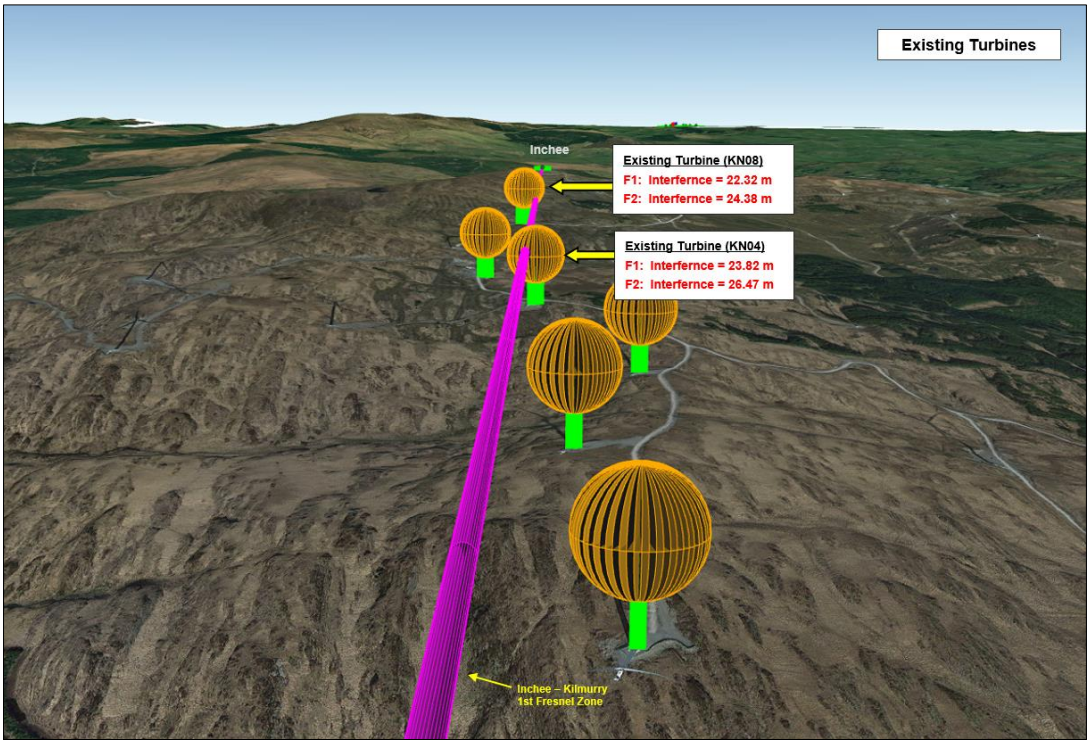

Figure 14. 3D Model showing that the Fresnel Zone of the radio link is obstructed by two existing turbines.

Table 11 below provides a brief summary of the desktop analysis of Link 2.

Link ID	Turbines within 150m of Radio Link	Clearance Condition to Radio Link Fresnel Zone (m)		Impacts of Proposed Wind Farm
		F1	F2	
KYIHE-KY016 (Inchee – Kilmurry)	T04	61.19	59.09	No impacts.
	T10	-38.49	-44.55	Fresnel Zone Obstructed.

Table 11. KYIHE-KY016 (Inchee to Kilmurry) Link Analysis –Summary

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5.1.3 KYIHEKY085 Link Analysis (Inchee – Kilfadda More)

Figure 15 below shows the Vodafone PTP radio link from Inchee to Kilfadda More.

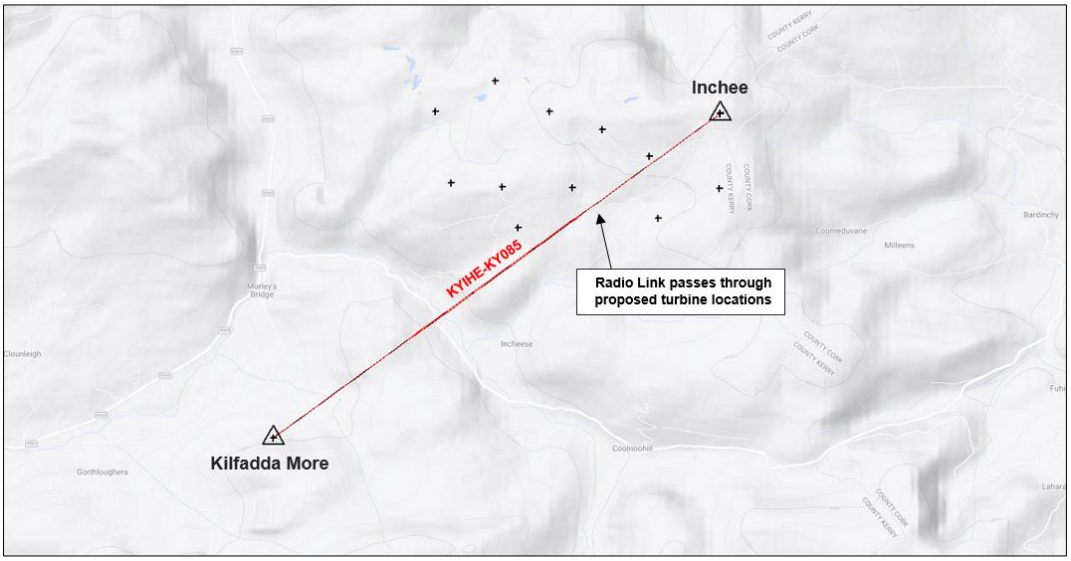

Figure 15. Vodafone's radio link between Inchee and Kilmurry.

The proposed turbines have been modelled in 3D and are shown relative to the Vodafone radio link in Figure 16. Network analysis calculations indicate that none of the proposed turbines will obstruct either the First or Second Fresnel Zone (F1 or F2) of the radio link.

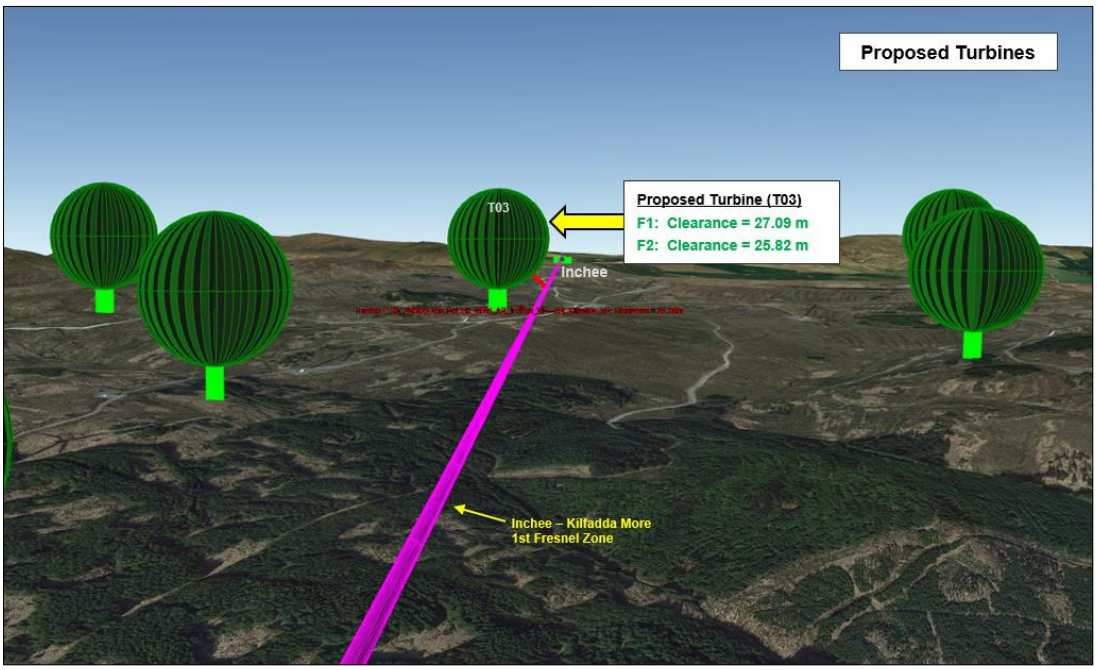

Figure 16. 3D Model showing proposed turbines relative to the Vodafone Radio Link.

The nearest of the proposed turbines to the radio link is Turbine T03. The results of the analysis show a Clearance Condition of 27.09 m to the 1st Fresnel Zone (F1) and 28.82 m to the 2nd Fresnel Zone (F2) for Turbine T03.

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It should also be noted that there is an existing turbine that is less than 2m from the radio link Fresnel Zone (F1 and F2).

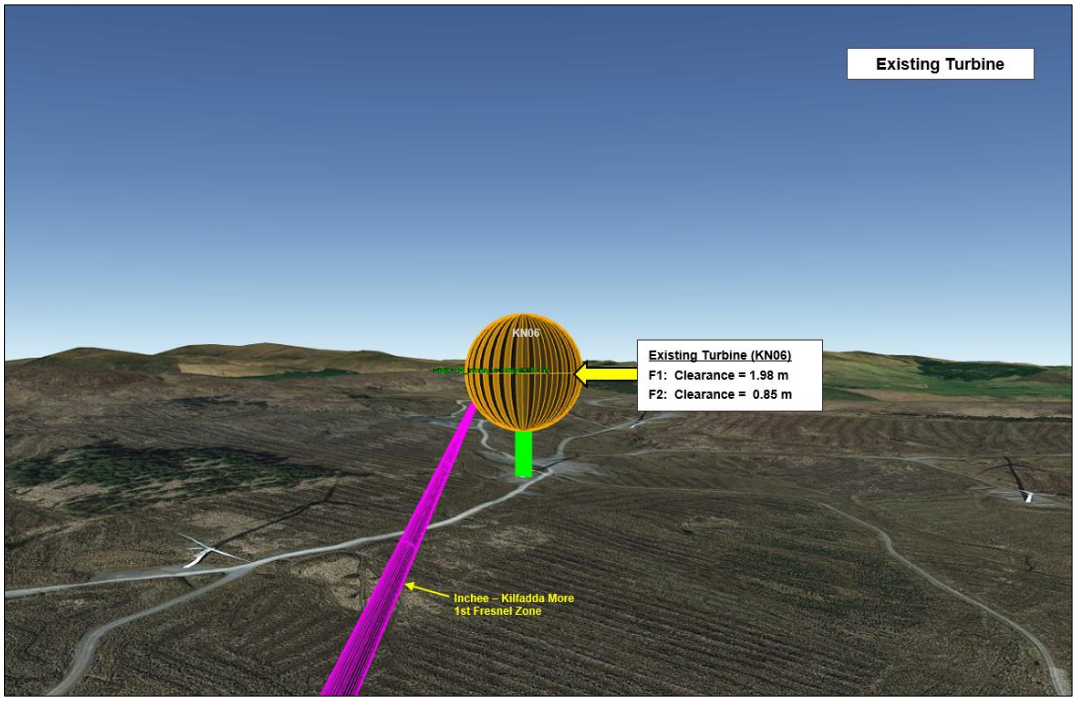

Figure 17. 3D Model showing existing turbine which is less than 2m from the radio link Fresnel Zone.

Table 12 below provides a brief summary of the desktop analysis of Link KYIHE-KY085.

Link ID	Turbines within 150m of Radio Link	Clearance Condition to Radio Link Fresnel Zone (m)		Impacts of Proposed Wind Farm
		F1	F2	
KYIHE-KY085 (Inchee – Kilfadda More)	T03	27.09	25.82	No Impacts

Table 12. KYIHE-KY085 Link Analysis (Inchee to Kilfadda More) – Summary

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Section 6 - Mitigation Measures

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6. Mitigation Measures

Section 6.1 that follows describes the mitigation measures available to the wind farm developer to offset the impact of Turbine T10 on the Vodafone radio link between Inchee and Kilmurry.

6.1 Mitigation Measure Solutions

To offset the impact of the turbines on the Vodafone radio link the following mitigation solutions are available:

Option 1 - Relay radio link via an existing Vodafone Mast-Site.

Option 2 - Construction of Relay Mast located within the proposed wind farm site boundary.

These mitigation measures are described in more detail in Sections 6.1.1 to 6.1.2 that follow.

6.1.1 Option 1 - Relay radio link via an existing Vodafone Mast-Site.

An option of offset the impact of T10 on the Vodafone communications link (KYIHE-KY016) would be to relay the radio link via an existing Vodafone Mast Site. Figure 18 below illustrates how the existing mast-site at Kilfadda More could potentially be used to relay an un-obstructed radio link from Inchee to Kilmurry. From the photograph taken of the Kilfadda Telecoms Mast (Figure 19), there is existing steelwork on the mast which could potentially be used to install a radio dish antenna(s).

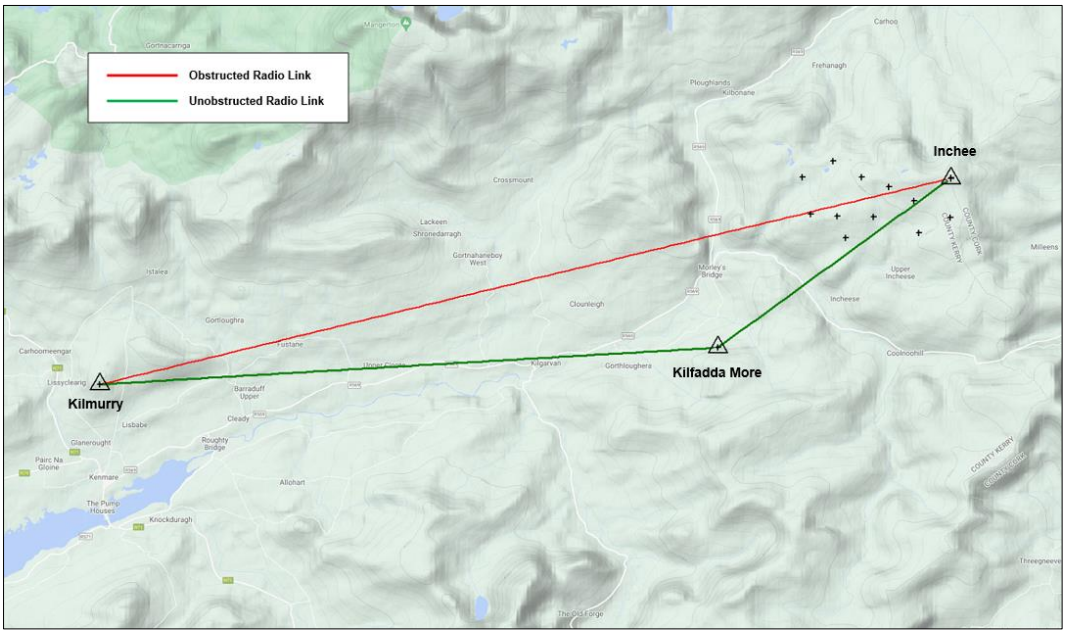

Figure 18. Example of an Existing Vodafone mast used to mitigate against an obstructing turbine.

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Figure 19. Existing Steelwork on Kilfadda More Mast which could potentially be used to install radio dish antenna.

To determine if the existing Telecoms Mast at Kilfadda More could be used to facilitate viable connections between Inchee and Kilmurry, radio link path profiles were generated. Radio Link Budgets were also carried out to determine if the proposed radio 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 Profiles are shown in Section 6.1.1.1 and Section 6.1.1.2 that follow. The Radio Link Budgets can be found in Appendix B1.

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6.1.1.1 Path Profile – Inchee to Kilfadda More

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

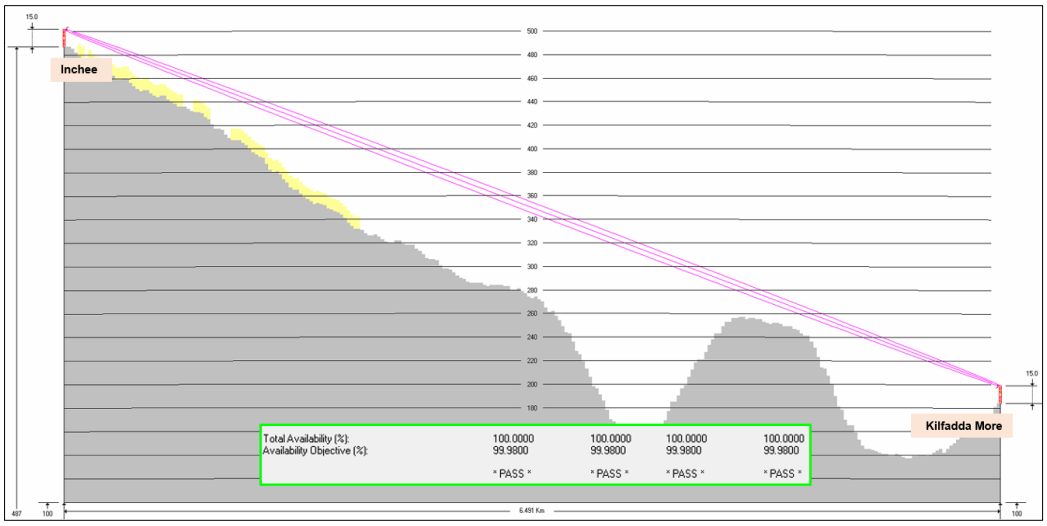

Figure 20. Path Profile – Inchee to Kilfadda More

6.1.1.2 Path Profile – Kilfadda More to Kilmurry

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

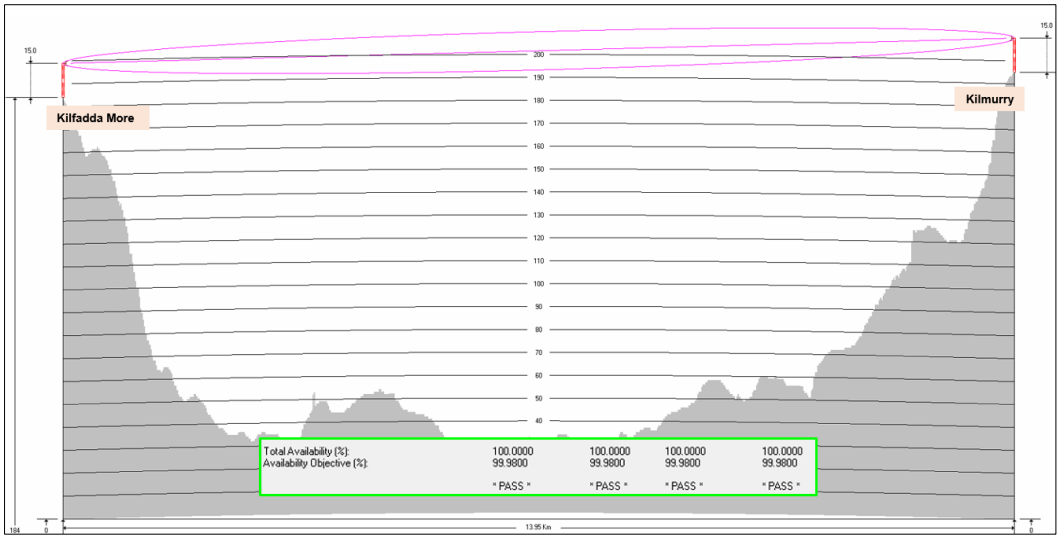

Figure 21. Path Profile – Kilfadda More to Kilmurry

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6.1.2 Option 2 - Construction of Relay Mast.

Another option of offset the impact of T10 on the Vodafone communications link would be to provision a relay mast-structure adjacent to turbine T10. This would require a mono-pole structure to be erected ~50m from T10, which would provide an alternative telecommunication site to Vodafone so that the turbines would not obstruct radio the radio signal path.

Figures 22 and 23 below illustrates how a relay mast could be used to mitigate against an obstructing turbine.

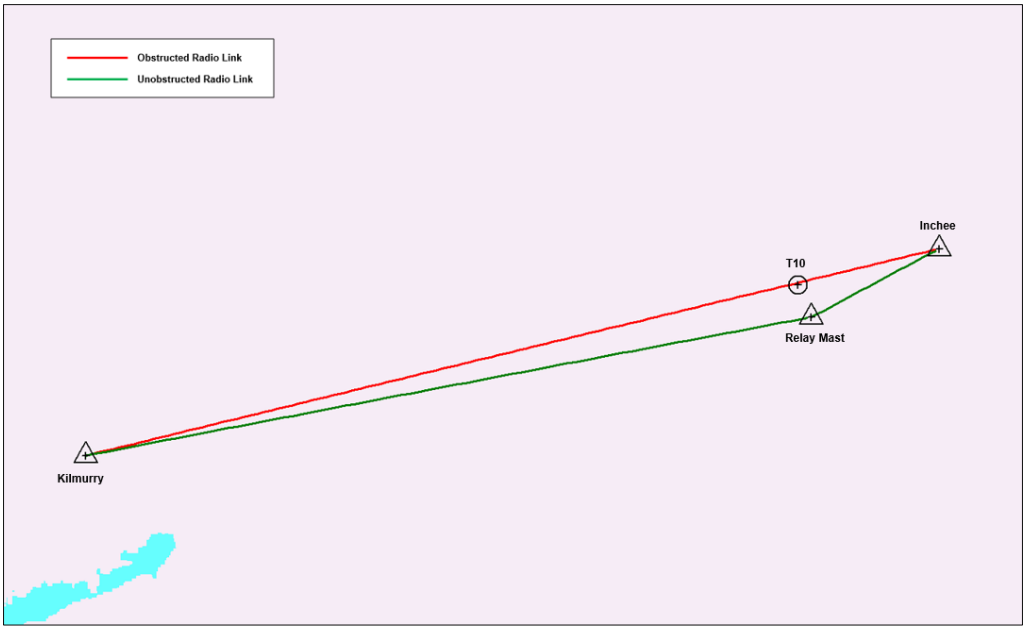

Figure 22. Illustration of how a relay mast could be used to mitigate against an obstructing turbine.

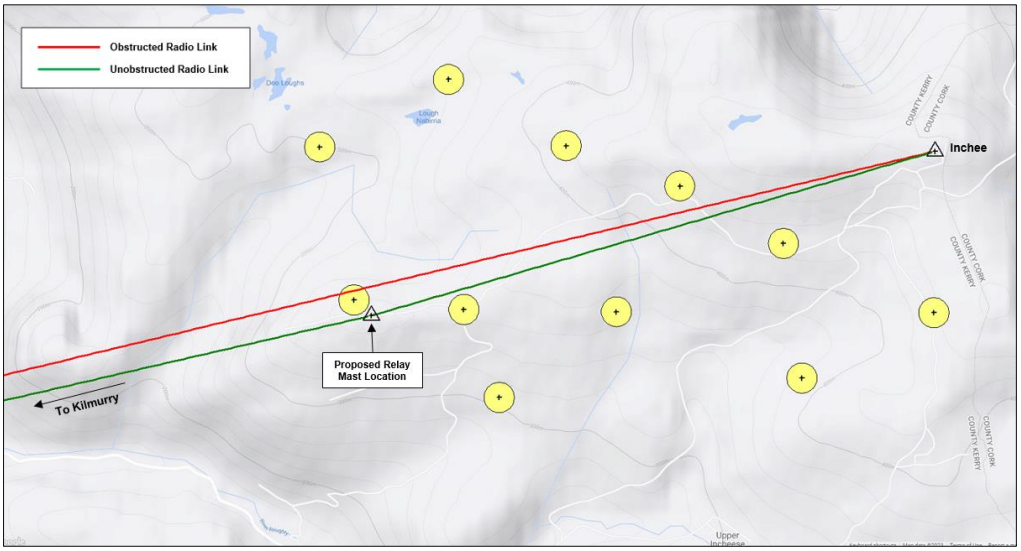

Figure 23. Proposed Relay Mast Location.

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A mast similar to that shown in Figure 24 could be used to install the required relay link antenna. An outdoor cabinet would also be required to house the radio indoor equipment and electrical power supply, which could be taken from T10.

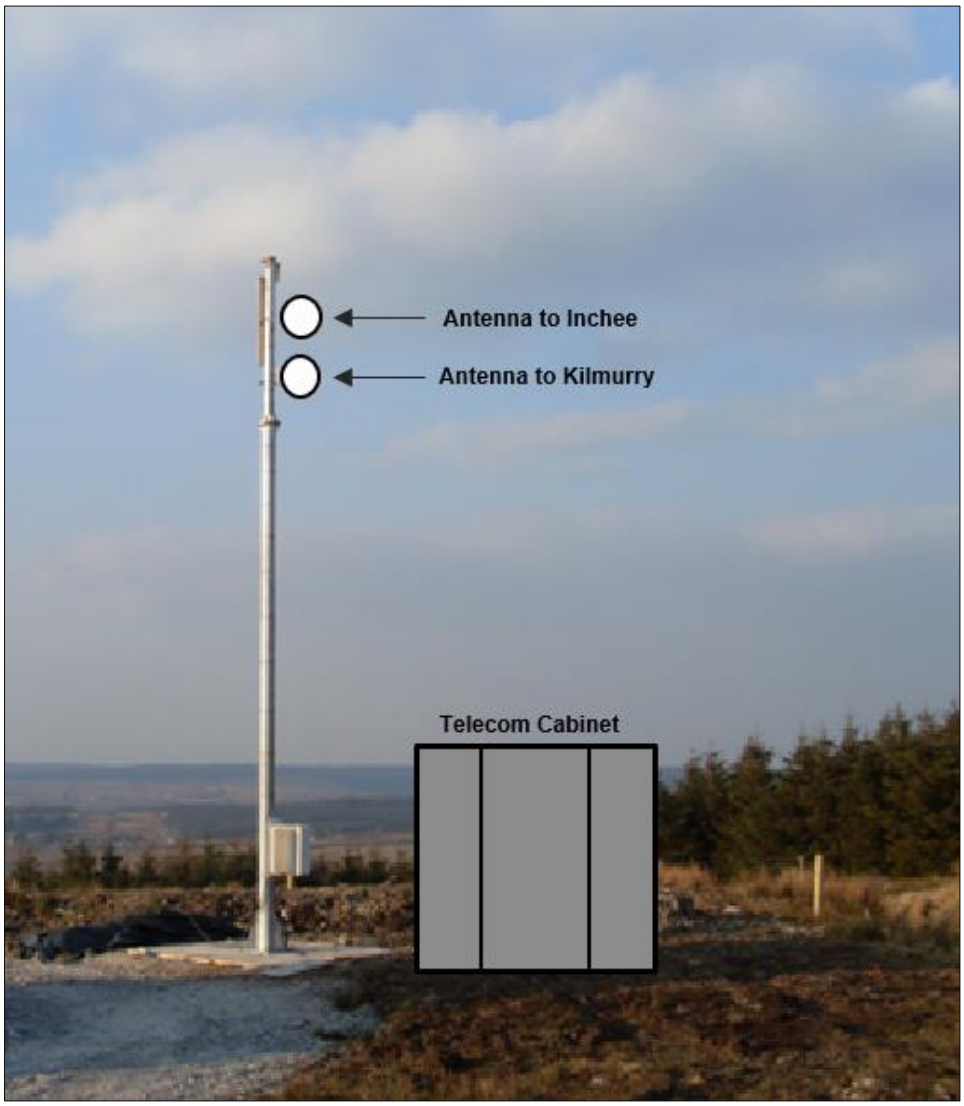

Figure 24. Relay Mast Proposal

To determine if a relay mast at the proposed location could be used to facilitate viable connections to/from Kilmurry, radio link path profiles were generated. Radio Link Budgets were also carried out to determine if the proposed radio 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 Profiles are shown in Section 6.1.2.1 and Section 6.1.2.2 that follow. The Radio Link Budgets can be found in Appendix B2.

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6.1.2.1 Path Profile – Inchee to Proposed Relay Mast

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

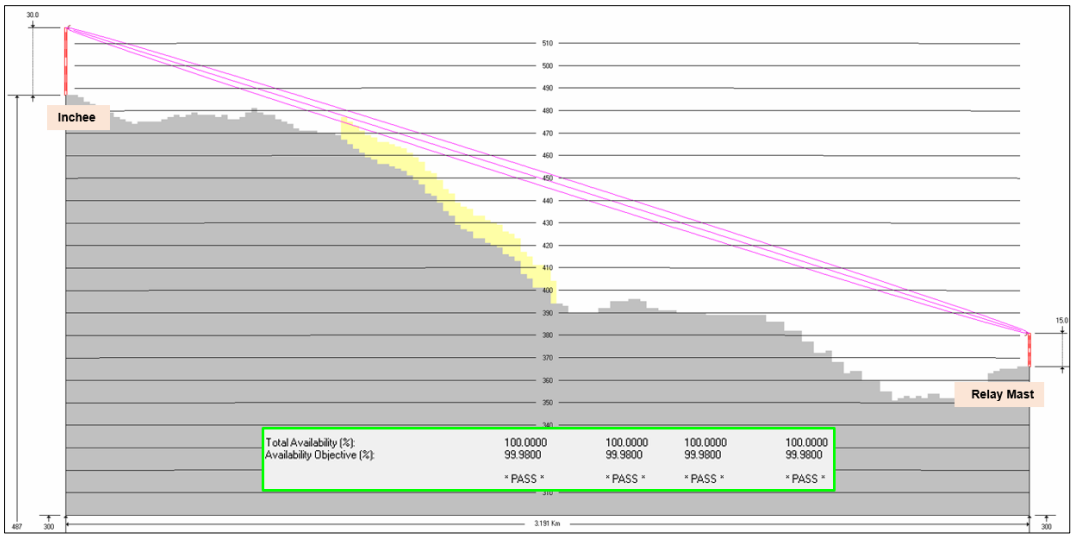

Figure 25. Path Profile – Inchee to Proposed Relay Mast

6.1.2.2 Path Profile – Proposed Relay Mast to Kilmurry

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

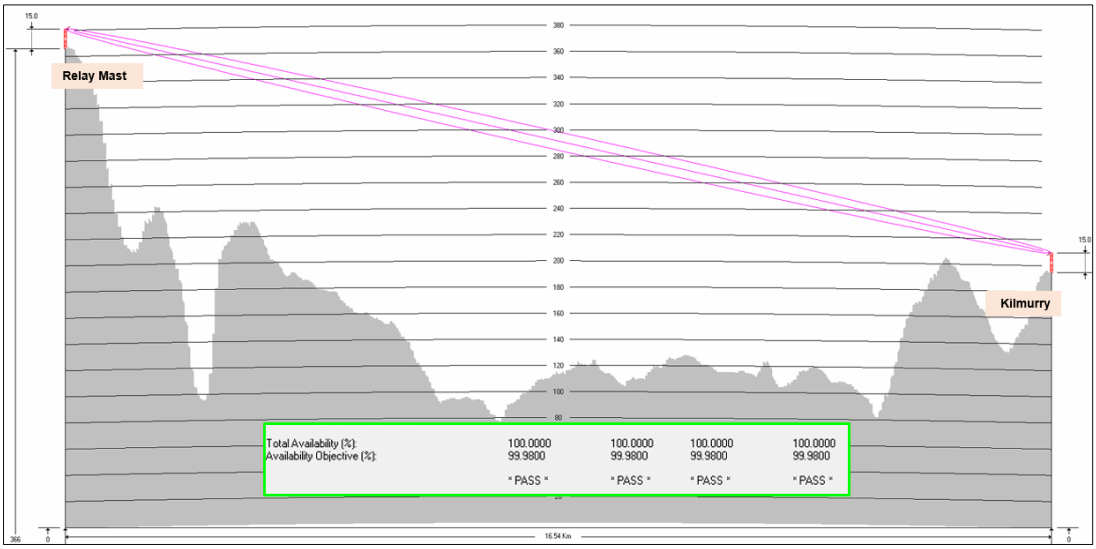

Figure 26. Path Profile – Proposed Relay Mast to Kilmurry

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Section 7 - Conclusions

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7. Conclusions

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

- The Vodafone radio link from Inchee to Capparoe will not be impacted. Radio link analysis indicates that there is a clearance of 13.11 m between the blade-tip of the nearest turbine (T10) and the Fresnel Zone (F1) of the radio link.

- The Vodafone radio link from Inchee to Kilmurry may potentially be impacted by one of the proposed turbines (T10), Radio link analysis indicates that the proposed turbine would infringe into the radio link Fresnel Zone (F1) by 38.49 m.

  Although Turbine T10 would obstruct the Fresnel Zone of the radio link, it should be noted that the Fresnel Zone is already obstructed by two existing turbines.

- The Vodafone radio link from Inchee to Kilfadda More will not be impacted. Radio link analysis indicates that there is a clearance of 27.09 m between the blade-tip of the nearest turbine (T03) and the Fresnel Zone (F1) of the radio link.

Radio Link ID	Nearest Turbine	Clearance Condition to Fresnel Zone (F1)	Impact due to Proposed Wind Turbines
KYIHEKY037 (Inchee – Capparoe)	T10	13.11 m	No Impacts
KYIHEKY016 (Inchee – Kilmurry)	T10	-38.49 m (Interference)	Potentially Impacted Subject to Mitigation
KYIHEKY085 (Inchee – Kilfadda More)	T03	27.09 m	No Impacts

Table 13. Radio Link Analysis Summary

- A number of mitigation measures have been proposed to remediate the interference condition on the Inchee to Kilmurry radio link (KYIHEKY016) and are provided in Section 6.

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APPENDIX A – Proposed Repowering of the Existing Kilgarvan Wind Farm Turbine Co-ordinates

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Appendix A – Proposed Repowering of the Existing Kilgarvan Wind Farm Turbine Co-ordinates

The co-ordinates of the turbines studies in this report are shown below in Table A1.

Kilgarvan Re-Powering Wind Farm Co. Kerry		
Turbine No.	**Latitude**	**Longitude**
T01	51 55 57.57 N	9 18 21.33 W
T02	51 55 46.08 N	9 18 58.89 W
T03	51 56 09.77 N	9 19 04.15 W
T04	51 56 19.88 N	9 19 33.67 W
T05	51 56 26.97 N	9 20 06.07 W
T06	51 56 38.63 N	9 20 39.56 W
T07	51 56 26.75 N	9 21 16.23 W
T08	51 55 57.75 N	9 19 51.72 W
T09	51 55 58.14 N	9 20 35.15 W
T10	51 55 59.81 N	9 21 06.45 W
T11	51 55 42.66 N	9 20 25.1 W

Table A1 – Proposed Development Turbine Co-ordinates (Turbine Layout 23.09.22)

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APPENDIX B – Radio Link Budget Reports

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Appendix B – Radio Link Budget Reports

B1. Option 1 - Relay Radio Link via an Existing Vodafone Mast-Site.

The Radio Link Budget Reports for the radio links associated with Mitigation Measure Option 1 are provided in Sections B.1.1 and B.1.2 below.

B.1.1 Radio Link Budget Report (Inchee – Kilfadda More)

Link Budget Report

Site Name:	AB_Inchee_VF (Inchee)		AB_Kilfadda_VF (Kilfadda More)	
Type:	Cell	Cell		
Latitude:	51°56'25.9"N		51°54'22.6"N	
Longitude:	9°18'20.9"W		9°22'56.0"W	
Altitude (m):	487.0		184.0	
UserData1:	User Data			
Datum:	World Geodetic System 1984 (WGS 84)			
	Forward Link		Reverse Link	
Transmission Site:	AB_Inchee_VF		AB_Kilfadda_VF	
Reception Site:	AB_Kilfadda_VF		AB_Inchee_VF	
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):	15		15	
Transmission Antenna Gain (dBd):	38.96		38.96	
Transmission Antenna Gain (dBi):	41.1		41.1	

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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):		15		15
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):	6491.102		6491.102	
Azimuth - True (°):	234.006		53.946	
Azimuth - Magnetic (°):	236.764		56.728	
Transmission Inclination (°):	2.673		-2.673	
Reception Inclination (°):	2.673		-2.673	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	6498.17		6498.17	
Center Frequency (MHz):	26000		26000	
Free Space Loss (dB):	136.995		136.995	
Max Fresnel Radius (m):	4.327		4.327	
Max 2nd Fresnel Radius (m):	6.12		6.12	
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):	7.343		7.343	
Minimum Clearance Point (m):		106.218		106.218
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	318.654		318.654	
Reflection Area 2 (m):	365.862		365.862	
Reflection Area 3 (m):	625.506		625.506	
Reflection Area 4 (m):	4709		4709	
Reflection Area 5 (m):	4827.02		4827.02	
Reflection Area 6 (m):	4874.228		4874.228	
Reflection Area 7 (m):	4992.248		4992.248	
Reflection Area 8 (m):	5039.456		5039.456	
Reflection Area 9 (m):	5133.872		5133.872	
Reflection Area 10 (m):	5912.8 - 5936.4			5912.8 - 5936.4
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):		0.86		0.86
Total Path Loss (dB):	137.855		137.855	
Reception Signal Level (dBm):		-27.655		-27.655

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	63.345	62.345	63.345	62.345

ITU Recommendation: ITU-R F.1703-0 / ITU-T G.827

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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 (%): 8.26E-04 8.26E-04

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): 3.070083 3.070083
Rainfall Attenuation (dB): 14.753 14.753

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	2.46E-11	3.10E-11	2.46E-11	3.10E-11
Selective Fading Outage (%):	8.96E-12	8.96E-12	8.96E-12	8.96E-12
Composite Fading Outage (%):		3.36E-11	3.99E-11	3.36E-11	3.99E-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 (%):		3.36E-11	3.99E-11	3.36E-11	3.99E-11
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	3.36E-11	3.99E-11	3.36E-11	3.99E-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 (Kilfadda More - Kilmurry)

Link Budget Report

Site Name:	AB_Kilfadda_VF	(Kilfadda More)	AB_KY_VF (Inchee)				
Type:	Cell	Cell					
Latitude:	51°54'22.6"N	51°53'55.8"N					
Longitude:	9°22'56.0"W	9°35'05.1"W					
Altitude (m):	184.0	195.0					
UserData1:	User Data						
Datum:	World Geodetic System 1984 (WGS 84)						
	Forward Link	Reverse Link					
Transmission Site:	AB_Kilfadda_VF	AB_KY_VF					
Reception Site:	AB_KY_VF	AB_Kilfadda_VF					
Radio Type:	NetRadio0001	NetRadio0001					
Modulation Scheme:	4-QAM	4-QAM					
Bandwidth (MHz):	2	2					
Roll-Off Factor:	0.2	0.2					
Coding Gain (dB):	0	0					
System Gains (dB):	0	0					
Channel Overhead (%):	20	20					
FEC Overhead (%):	0	0					
Reference Temperature (°K):	290	290					
Receiver Noise Figure (dB):	5	5					
Maximum Data Rate (Mbps):	2.667	2.667					
Maximum Bit Rate (Mbps):	3.333	3.333					
Required Bit Error Rate:	BER 10-3	BER 10-6	BER 10-3	BER 10-6			
Service Threshold (dBm):	-91	-90	-91	-90			
Carrier to Noise Ratio (dB):	14.965	15.965	14.965	15.965			
Cross Polarization Improvement Factor (dB):			20	20	20	20	
Rx Equalization Sig Norm Parameter (Kn,M):			0.1	0.1	0.1	0.1	
Rx Equalization Sig Norm Parameter (Kn,NM):			0.1	0.1	0.1	0.1	
UserData1:	User Data		User Data				
Center Frequency (MHz):	15000		15000				
Channel Bandwidth (MHz):	28		28				
Transmission Power (dBm):	30		30				
Transmission Gains (dB):	0		0				
Transmission System Loss (dB):		0		0			
Transmission Line Loss (dB/100 m):		4		4			
Transmission Line Length (m):		10		10			
Transmission Connection Loss (dB):		0.3		0.3			
Transmission Number of Connections:		2		2			
Transmission Additional Loss (dB):		0		0			
Transmission Losses (dB):	1		1				
Transmission Antenna:	HP2-15		HP2-15				
Transmission Antenna Size (m):		0.6		0.6			
Transmission Antenna Height (m):		15		15			
Transmission Antenna Gain (dBd):		34.86		34.86			
Transmission Antenna Gain (dBi):		37		37			
Transmission Power EIRP (dBm):		66		66			
Reception Gains (dB):	0		0				
Reception System Loss (dB):	0		0				
Reception Line Loss (dB/100 m):		4		4			
Reception Line Length (m):	10		10				
Reception Connection Loss (dB):		0.3		0.3			
Reception Number of Connections:		2		2			
Reception Additional Loss (dB):		0		0			
Reception Losses (dB):	1		1				
Reception Antenna:	HP2-15		HP2-15				
Reception Antenna Size (m):	0.6		0.6				

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Reception Antenna Height (m):		15		15
Reception Antenna Gain (dBd):		34.86		34.86
Reception Antenna Gain (dBi):		37		37
Link Polarization:	Vertical	Vertical		
Cross Polarization Factor (dB):		30		30
Link Distance (m):	13947.854		13947.854	
Azimuth - True (°):	266.676	86.516		
Azimuth - Magnetic (°):	269.458		89.377	
Transmission Inclination (°):	-0.045		0.045	
Reception Inclination (°):	-0.045		0.045	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	13947.858			13947.858
Center Frequency (MHz):	15000		15000	
Free Space Loss (dB):	138.852		138.852	
Max Fresnel Radius (m):	8.351		8.351	
Max 2nd Fresnel Radius (m):	11.81		11.81	
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):	14.722		14.722	
Minimum Clearance Point (m):		13938.288		13938.288
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	162.629		162.629	
Reflection Area 2 (m):	2037.6 - 2056.8			2037.6 - 2056.8
Reflection Area 3 (m):	2133.3 - 2152.4			2133.3 - 2152.4
Reflection Area 4 (m):	2229.0 - 2248.1			2229.0 - 2248.1
Reflection Area 5 (m):	2286.377		2286.377	
Reflection Area 6 (m):	2343.775		2343.775	
Reflection Area 7 (m):	2382 - 2420.3			2382 - 2420.3
Reflection Area 8 (m):	2649.901		2649.901	
Reflection Area 9 (m):	2688.2 - 2764.7			2688.2 - 2764.7
Reflection Area 10 (m):	5653.760		5653.760	
Reflection Area 11 (m):	5749.424		5749.424	
Reflection Area 12 (m):	5806.823		5806.823	
Reflection Area 13 (m):	5864.2 - 5883.4			5864.2 - 5883.4
Reflection Area 14 (m):	6112.9 - 6132			6112.9 - 6132
Reflection Area 15 (m):	6189.5 - 6227.7			6189.5 - 6227.7
Reflection Area 16 (m):	6285.1 - 6323.4			6285.1 - 6323.4
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):		0.426		0.426
Total Path Loss (dB):	139.278		139.278	
Reception Signal Level (dBm):		-37.278		-37.278

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	53.722	52.722	53.722	52.722

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

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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 (%):	3.92E-01		3.92E-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):	1.262304		1.262304	
Rainfall Attenuation (dB):	12.085		12.085	

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	2.30E-07	2.89E-07	2.30E-07	2.89E-07
Selective Fading Outage (%):	6.62E-09	6.62E-09	6.62E-09	6.62E-09
Composite Fading Outage (%):		2.36E-07	2.96E-07	2.36E-07 2.96E-07

Fading Outage (s/Month):	0.006	0.008	0.006	0.008
Selective Fading Outage (s/Month):		0	0	0 0
Composite Fading Outage (s/Month):		0.006	0.008	0.006 0.008

	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 (%):		2.36E-07	2.96E-07	2.36E-07 2.96E-07
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	2.36E-07	2.96E-07	2.36E-07	2.96E-07
Unavailability Objective (%):	2.00E-02	2.00E-02	2.00E-02	2.00E-02

Unavailability due to Fading (s/Year):		0.075	0.093	0.075 0.093
Unavailability due to Rain (s/Year):		0	0	0 0
Total Unavailability (s/Year):	0.075	0.093	0.075	0.093
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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B2. Option 2 – Construction of Relay Mast

The Radio Link Budget Reports for the radio links associated with Mitigation Measure Option 2 are provided in B.2.1 and B.2.2 below.

B.2.1 Radio Link Budget Report (Inchee – Proposed Relay Mast)

Link Budget Report

Site Name:	AB_Inchee_VF (Inchee)			RLY_01 (Proposed Relay Mast)			
Type:	Cell	Cell					
Latitude:	51°56'25.9"N		51°55'57.0"N				
Longitude:	9°18'20.9"W			9°21'01.4"W			
Altitude (m):	487.0		366.0				
UserData1:	User Data						
Datum:	World Geodetic System 1984 (WGS 84)						
	Forward Link		Reverse Link				
Transmission Site:	AB_Inchee_VF			RLY_01			
Reception Site:	RLY_01		AB_Inchee_VF				
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):			30		15		
Transmission Antenna Gain (dBd):			38.96		38.96		
Transmission Antenna Gain (dBi):			41.1		41.1		
Transmission Power EIRP (dBm):			70.1		70.1		

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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):		15		30
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):	3191.13		3191.13	
Azimuth - True (°):	253.718		73.683	
Azimuth - Magnetic (°):	256.477		76.457	
Transmission Inclination (°):	2.44		-2.44	
Reception Inclination (°):	2.44		-2.44	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	3194.026		3194.026	
Center Frequency (MHz):	26000		26000	
Free Space Loss (dB):	130.826		130.826	
Max Fresnel Radius (m):	3.034		3.034	
Max 2nd Fresnel Radius (m):	4.291		4.291	
Earth Radius Factor (K):	4/3			
Effective Radius (m):	8502056.000			
ITU Recommendation:	ITU-R P.526-11			
Diffraction Model:	Cascade Knife Edge			
Diffraction:	No LOS Diffraction		No LOS Diffraction	
Diffraction Loss (dB):	7.886		7.886	
Clearance Target (%):	60			
Minimum Clearance (m):	-1.053		-1.053	
Minimum Clearance Point (m):		921.662		921.662
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	683.813		683.813	
Reflection Area 2 (m):	723.455		723.455	
Reflection Area 3 (m):	3082.116		3082.116	
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):		0.423		0.423
Total Path Loss (dB):	139.135		139.135	
Reception Signal Level (dBm):		-28.935		-28.935

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	62.065	61.065	62.065	61.065

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

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Error Performance Objective (%):	1.60E-04	3.20E-03	1.60E-04	3.20E-03
Error Performance Objective (s/Month):	4.205	84.096	4.205	84.096

ITU Recommendation:	ITU-R F.1668-1 / ITU-T G.828			
Error Performance Objective BBER (%):	4.00E-06		4.00E-06	
Error Performance Objective BBER (s/Month):		0.105		0.105
	SESR	ESR	SESR	ESR
Error Performance Objective (%):	1.60E-04	8.00E-04	1.60E-04	8.00E-04
Error Performance Objective (s/Month):	4.205	21.024	4.205	21.024

Multipath Model:	ITU-R P.530-15			
Multipath Planning Type:	Quick Planning			
Multipath Time Frame:	Average annual distribution			
ITU Recommendation:	ITU-R P.453-9			
Point Refractivity Gradient (dN1):	-76.7			
Geoclimatic Factor: 4.05E-05	4.05E-05			
Multipath Occurrence Factor (%):	7.06E-05		7.06E-05	

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):	3.069982		3.069982	
Rainfall Attenuation (dB):	9.282		9.282	

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Fading Outage (%):	2.37E-12	2.98E-12	2.37E-12	2.98E-12
Selective Fading Outage (%):	2.23E-13	2.23E-13	2.23E-13	2.23E-13
Composite Fading Outage (%):		2.59E-12	3.20E-12	2.59E-12	3.20E-12

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 (%):		2.59E-12	3.20E-12	2.59E-12	3.20E-12
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Unavailability (%):	2.59E-12	3.20E-12	2.59E-12	3.20E-12
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.2.2 Radio Link Budget Report (Inchee – Proposed Relay Mast)

Link Budget Report

Site:	RLY_01	AB_KY_VF					
Name:							
Type:	Cell	Cell					
Latitude:	51°55'57.0"N	51°53'55.8"N					
Longitude:	9°21'01.4"W	9°35'05.1"W					
Altitude (m):	366.0	195.0					
UserData1:	User Data						
Datum:	World Geodetic System 1984 (WGS 84)						
	Forward Link	Reverse Link					
Transmission Site:	RLY_01	AB_KY_VF					
Reception Site:	AB_KY_VF	RLY_01					
Radio Type:	NetRadio0001	NetRadio0001					
Modulation Scheme:	4-QAM	4-QAM					
Bandwidth (MHz):	2	2					
Roll-Off Factor:	0.2	0.2					
Coding Gain (dB):	0	0					
System Gains (dB):	0	0					
Channel Overhead (%):	20	20					
FEC Overhead (%):	0	0					
Reference Temperature (°K):	290	290					
Receiver Noise Figure (dB):	5	5					
Maximum Data Rate (Mbps):	2.667	2.667					
Maximum Bit Rate (Mbps):	3.333	3.333					
Required Bit Error Rate:	BER 10-3	BER 10-6	BER 10-3	BER 10-6			
Service Threshold (dBm):	-91	-90	-91	-90			
Carrier to Noise Ratio (dB):	14.965	15.965	14.965	15.965			
Cross Polarization Improvement Factor (dB):			20	20	20	20	
Rx Equalization Sig Norm Parameter (Kn,M):			0.1	0.1	0.1	0.1	
Rx Equalization Sig Norm Parameter (Kn,NM):			0.1	0.1	0.1	0.1	
UserData1:	User Data		User Data				
Center Frequency (MHz):	15000		15000				
Channel Bandwidth (MHz):	28		28				
Transmission Power (dBm):	30		30				
Transmission Gains (dB):	0		0				
Transmission System Loss (dB):		0		0			
Transmission Line Loss (dB/100 m):		4		4			
Transmission Line Length (m):		10		10			
Transmission Connection Loss (dB):		0.3		0.3			
Transmission Number of Connections:		2		2			
Transmission Additional Loss (dB):		0		0			
Transmission Losses (dB):	1		1				
Transmission Antenna:	HP2-15		HP2-15				
Transmission Antenna Size (m):		0.6		0.6			
Transmission Antenna Height (m):		15		15			
Transmission Antenna Gain (dBd):		34.86		34.86			
Transmission Antenna Gain (dBi):		37		37			
Transmission Power EIRP (dBm):		66		66			
Reception Gains (dB):	0		0				
Reception System Loss (dB):	0		0				
Reception Line Loss (dB/100 m):		4		4			
Reception Line Length (m):	10		10				
Reception Connection Loss (dB):		0.3		0.3			
Reception Number of Connections:		2		2			
Reception Additional Loss (dB):		0		0			
Reception Losses (dB):	1		1				
Reception Antenna:	HP2-15		HP2-15				
Reception Antenna Size (m):	0.6		0.6				

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Reception Antenna Height (m):		15		15
Reception Antenna Gain (dBd):		34.86		34.86
Reception Antenna Gain (dBi):		37		37
Link Polarization:	Vertical	Vertical		
Cross Polarization Factor (dB):		30		30
Link Distance (m):	16536.447		16536.447	
Azimuth - True (°):	256.985	76.8		
Azimuth - Magnetic (°):	259.759		79.661	
Transmission Inclination (°):	0.592		-0.592	
Reception Inclination (°):	0.592		-0.592	
ITU Recommendation:	ITU-R P.525-2			
Free Space Distance (m):	16537.332			16537.332
Center Frequency (MHz):	15000		15000	
Free Space Loss (dB):	140.331		140.331	
Max Fresnel Radius (m):	9.093		9.093	
Max 2nd Fresnel Radius (m):	12.859		12.859	
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):	12.853		12.853	
Minimum Clearance Point (m):		48.982		48.982
Terrain Reflection Dispersion (°):		0.5		
Reflection Area 1 (m):	244.912		244.912	
Reflection Area 2 (m):	284.098		284.098	
Reflection Area 3 (m):	1028.6 - 1048.2			1028.6 - 1048.2
Reflection Area 4 (m):	1929.905		1929.905	
Reflection Area 5 (m):	2948.738		2948.738	
Reflection Area 6 (m):	3046.703		3046.703	
Reflection Area 7 (m):	3477.7 - 3536.5			3477.7 - 3536.5
Reflection Area 8 (m):	3712.863		3712.863	
Reflection Area 9 (m):	3850.014		3850.014	
Reflection Area 10 (m):	3928.4 - 3948.0			3928.4 - 3948.0
Reflection Area 11 (m):	3987.165		3987.165	
Reflection Area 12 (m):	4085.1 - 4124.3			4085.1 - 4124.3
Reflection Area 13 (m):	4222.28		4222.28	
Reflection Area 14 (m):	4281.059		4281.059	
Reflection Area 15 (m):	4339.837		4339.837	
Reflection Area 16 (m):	4379 - 4398.6			4379 - 4398.6
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):		0.505		0.505
Total Path Loss (dB):	140.836		140.836	
Reception Signal Level (dBm):		-38.836		-38.836

	BER 10-3	BER 10-6	BER 10-3	BER 10-6
Service Threshold (dBm):	-91	-90	-91	-90
Link Gross Margin (dB):	52.164	51.164	52.164	51.164

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

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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 (%):			6.00E-02		6.00E-02
Precipitation Model: ITU-R P.530-15					
ITU Recommendation:		ITU-R P.837-5 / ITU-R P.841-4			
Precipitation Time Frame:		Average annual distribution			
Precipitation Rate @ 0.01% (mm/h):		22			
ITU Recommendation:		ITU-R P.838-3			
Specific Attenuation (dB/km):		1.262312		1.262312	
Rainfall Attenuation (dB):		13.832		13.832	
	BER 10-3	BER 10-6	BER 10-3	BER 10-6	
Fading Outage (%):	3.85E-08	4.85E-08	3.85E-08	4.85E-08	
Selective Fading Outage (%):	2.53E-09	2.53E-09	2.53E-09	2.53E-09	
Composite Fading Outage (%):			4.10E-08	5.10E-08	4.10E-08 5.10E-08
Fading Outage (s/Month):		0.001	0.001	0.001	0.001
Selective Fading Outage (s/Month):			0	0	0 0
Composite Fading Outage (s/Month):			0.001	0.001	0.001 0.001
	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 (%):			4.10E-08	5.10E-08	4.10E-08 5.10E-08
Unavailability due to Rain (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Total Unavailability (%):		4.10E-08	5.10E-08	4.10E-08	5.10E-08
Unavailability Objective (%):		2.00E-02	2.00E-02	2.00E-02	2.00E-02
Unavailability due to Fading (s/Year):			0.013	0.016	0.013 0.016
Unavailability due to Rain (s/Year):			0	0	0 0
Total Unavailability (s/Year):		0.013	0.016	0.013	0.016
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
	* PASS *	* PASS *	* PASS *	* PASS *	

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