

Appendix 16-2- Derryadd Wind Farm Telecommunication Impact Assessment



AiBridges Total Broadband Solutions	Procedure: 001	Rev: 3.0
Title: Derryadd Wind Farm EMI Impact Assessment	Approved: KH	Date: 07/03/25

Report

Derryadd Wind Farm EMI Impact Assessment Report

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Executive Summary

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

Eleven telecommunications mast-sites were identified as sites with network infrastructure that could potentially be impacted by the wind farm development and a field survey of each of these mast-sites was carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded. The findings of the field surveys are provided in Appendix B of this report.

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

Using the information obtained during the field survey assessments and consultation process a desktop impact analysis was carried out and all of the telecommunication operator networks were analysed using radio planning \ modelling software. Results from the impact analysis indicate that there are nineteen radio links in the vicinity of the proposed wind farm. 2D and 3D network analysis indicate that there would be no impact to these links, as the proposed turbines would not obstruct the applicable radio link Fresnel Zones (0.6F, F1 or F2). The clearance distances between the radio link Fresnel Zone and the blade-tip of the nearest turbine are shown below in Table 1. A full set of radio link clearance calculations are provided in Appendix C.

Operator	Link Description	Nearest Turbine	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Impact of wind farm
Enet	Cairn Hill to Fermoyle National School.	T08	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Enet	Sliabh Bawn to Aughine Community Centre.	T05	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Eir	Barnacor to Garrycam.	T01	60.6 m	No Impacts. (Subject to Final Turbine Layout).
Eir	Woodlawn to Garrycam	T10	> 100 m	No Impacts.
Eir	Emoe Cross to Garrycam.	T13	9.2 m	No Impacts. (Subject to Final Turbine Layout).
Eir	Cornadowagh to Garrycam.	T20	> 100 m	No Impacts. (Subject to Final Turbine Layout).
ESB	Garrycam to Roscommon	T13	32.5 m (0.6F1 Fresnel Zone used for UHF radio links)	No Impacts. (Subject to Final Turbine Layout).

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ESB	Garrycam to Aghamore	T08	> 100 m (0.6F1 Fresnel Zone used for UHF radio links)	No Impacts. (Subject to Final Turbine Layout).
Imagine Broadband	Barnacor to Cairn Hill.	T06	27.6 m	No Impacts. (Subject to Final Turbine Layout).
2RN	Cairn Hill to Maghera.	T14	> 100 m	No Impacts. (Subject to Final Turbine Layout).
2RN	Cairn Hill to Coolderry (#1)	T18	23.7 m	No Impacts. (Subject to Final Turbine Layout).
2RN	Cairn Hill to Coolderry (#2)	T18	28.1 m	No Impacts. (Subject to Final Turbine Layout).
Three Ireland	Lanesborough to Sliabh Bawn	T02	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Three Ireland	Garrycam to Sliabh Bawn	T05	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Vodafone	Woodlawn to Garrycam	T10	> 100 m	No Impacts.
Vodafone	Bord na Mona Mount Dillon to Ballyfeeny.	T01	46.1 m	No Impacts. (Subject to Final Turbine Layout).
Vodafone	Lanesborough to Ballyfeeny.	T04	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Vodafone	Cornadowagh to Garrycam.	T20	> 100 m	No Impacts. (Subject to Final Turbine Layout).

Table 1. Microwave radio links in vicinity of proposed wind farm.

3D analysis indicates that there would be a clearance condition between the blade-tip of T13 and the 0.6F1 Fresnel Zone of ESB Link 1 (Garrycam – Roscommon). However, if it is a requirement that the 2nd Fresnel Zone of the radio link should be obstruction-free, this could be achieved by relocating the UHF antenna at Roscommon Substation. This mitigation measure is described in Section 5.3 of this report.

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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 wind farm development is located in County Longford southwest of Longford Town. The development is in the pre-planning stage and exact details regarding the quantity, location and turbine dimensions have yet to be finalized.

Wind Farm	Number of Turbines	Turbine Hub Height	Turbine Rotor Diameter
Derryadd	25 (TBC)	109m (TBC)	81m (TBC)

Table 2. Wind Farm Turbine Details

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



Figure 1. Location of proposed wind farm.

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Section 2 - Methodology

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2. Introduction

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

2.1 Methodology

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

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

A summary of each of these stages is provided below:

Telecom Operator Consultations

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

Field Surveys

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

Desktop Survey and Analysis

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

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

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



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

Report Generation

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

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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 beginning in September 2022 were undertaken with telecom network operators to assist in identifying telecommunication infrastructure that could be impacted by proposed wind farm. The operators were requested to raise any concerns they may have regarding impacts to their networks due to the proposed wind farm development. Table 3 lists the telecom operators contacted and the issues raised by the operators. The responses received from each of the Telecom Operators are provided in Sections 3.1.1 to 3.1.19.

ID	Operator	Response Received (Yes/No)	Issues raised by Operator \ Observations.
1	Enet	Yes	Enet have raise a concern regarding two Licensed PTP microwave radio links.
2	An Garda Síochána	No	No response received. (No response expected.)
3	Broadcast Authority of Ireland (BAI)	Yes	No issues
4	BT Ireland	Yes	No issues
5	Eir	Yes	Eir have raise a concern regarding four Licensed PTP microwave radio links.
6	ESB Networks	Yes	ESB Networks have raise a concern regarding two UHF PMP radio links.
7	Irish Aviation Authority (IAA)	No	No response received. (No response expected.)
8	Imagine Broadband	Yes	Imagine Broadband have raise a concern regarding one Licensed PTP microwave radio link.
9	Longford County Council	No	No response received. (No response expected.)
10	Viatel	No	No response received. (No response expected.)
11	2RN	Yes	2RN have raise a concern regarding one DTT off-air (UHF) radio link and two microwave radio links.
12	Tetra Ireland (TI)	No	No response received. (No response expected.
13	Three Ireland	Yes	Three Ireland have raise a concern regarding two Licensed PTP microwave radio links.
14	Virgin Media	Yes	Virgin Media have raise a concern regarding one Licensed PTP microwave radio link.
15	Vodafone Ireland	Yes	Vodafone have raise a concern regarding four Licensed PTP microwave radio links.
16	Dept. of Defence	No	No response. (DoD is a statutory consultee and have previously stated that they will only respond to the Planning Authority under an RFI at Planning Application Stage.)
17	Airwave	No	No response. (No response expected.)
18	CIE / Irish Rail	No	No response. (No response expected.)
19	Irish Water	Yes	No issues.

Table 3. Telecom Operators Consulted

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3.1.1 Enet Response to Consultations

Enet provided the following email response to consultations:

"We have two links passing through this area:"

		Link	Site A					Site B				
Link Name / ID	MHz\GHz	z\GHz Length	Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
RTE Cairn Hill – SCP0130 Fermoyle National School	11GHz	27.4km	53.807213	-7.715414			15m	53.624528	-7.993194			6m
Cignal Slieve Bawn – SCP0126 Aughine Community Centre	11GHz	19.7km	53.728561	-8.067622			15m	53.664000	-7.788750			12m

3.1.2 An Garda Síochána

To date no response has been received.

3.1.3 Broadcast Authority of Ireland (BAI)

The BAI provided the following email response to consultations:

"The BAI does not perform an in-depth analysis of the effect of wind turbines on FM networks. However, we are not aware of any issues from existing windfarms into existing FM networks. Also, the proposed windfarms are not located close to any existing or planned FM transmission sites."

3.1.4 BT Ireland

BT provided the following email response to consultations:

"We only have a network presence in Louth and Waterford."

3.1.5 Eir Response to Consultations

Eir provided the following email response to consultations:

"We have 4 transmission links within the proposed area that would be at risk, the end points of the transmission links are below, if you could design around this and keep a buffer back from the link."

#	Band	A-end					B-end			
Link1	11Ghz	LD_4292	20m	53°40'36.65"N	7°57'25.08"W	<>	LD_4247	20m	53°39'32.93"N	7°43'34.94"W
Link2	13Ghz	LD_1917	15m	53°40'1.74"N	7°52'8.91"W	<>	LD_4247	19m	53°39'32.93"N	7°43'34.94"W
Link3	13Ghz	EMJ	12m	53°38'45.62"N	8° 8'10.07"W	<>	EAH	26m	53°39'32.72"N	7°43'39.13"W
Link4	13Ghz	LD_2102	12m	53°35'21.53"N	7°56'16.04"W	<>	LD_4247	16m	53°39'32.93"N	7°43'34.94"W

3.1.6 ESB Networks Response to Consultations

ESB provided the following email response to consultations:

"Please see below details of links affected."

			Site A				Site B					
Link Name / ID	Band MHz\GHz	Link z Length	Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
Ardagh - Roscommon	460 MHz	28 km	53.659088	-7.72752			36	53.638622	-8.165863			10
Ardagh - Aghamore	460 MHz	17km	53.659088	-7.72752			36	53.673544	-7.975771			10

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3.1.7 IAA Response to Consultations

To date no response has been received.

3.1.8 Imagine Broadband Response to Consultations

Imagine Broadband provided the following email response to consultations:

	-			
	LD010 PTI Lanesborough	LD001 RTE Cairn Hill		
Latitude	53 40 36.66 N	53 48 25.07 N		
Longitude	007 57 25.05 W	007 42 55.74 W		
Decimal Lat	53.67685	53.80696389		
Decimal Lon	-7.95695833	-7.71548333		
Elevation (m)	43.83	268.53		
Eastings	602843	618740		
Northings	769680	784196		
Antenna height (m)	15.00	15.00		
Frequency (MHz)	2) 11000.00			
Path length (km))) 21.48			

"One of our links traverse this development, details below:



We require a 50m set-back from our central path."

3.1.9 Longford County Council Response to Consultations

To date no response has been received.

3.1.10 Viatel Response to Consultations

To date no response has been received.

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3.1.11 2RN Response to Consultations

2RN provided the following email response to consultations:

"We have the	following links	s passing ove	er the pro	posed site.

	Band Link				Site A				Site B				
1	Link Name / ID MHz\GHz	MHz\GHz	MHz\GHz Length	Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
E	OTT Off air feed CHL-MGH	658 MHz	115000	53.807196	-7.715363			396	52.968807	-8.718352			737
	vlicrowave link CHL- oolderry	6 GHz	60600	53.807196	-7.715363			287	53.320410	-8.125628			115
	Vicrowave link CHL- oolderry	6 GHz	60600	53.807196	-7.715363			297	53.320410	-8.125628			123

There is also the risk of interference to broadcast services in the area, we would therefore ask that a protocol be signed between 2rn and the developer should the site go ahead."

3.1.12 Tetra Ireland (TI) Response to Consultations

To date no response has been received.

3.1.13 Three Ireland Response to Consultations

Three Ireland provided the following email response to consultations:

"I have reviewed the location for the proposed Derryadd wind farm development and 3Ireland have 2 microwave transmission links that traverse the area. I have attached a spreadsheet with the link details."

Link no.	Link Ref	Freq.	Length	Site A	x	Y	Dish Height	Site B	х	Y	Dish Height
1	ML052403	26GHz	8.6km	LF0053	201636	269297	30m	RS0103	195588	275417	30m
2	ML051293	11GHz	23.8km	LF0045	218139	267729	23m	RS0103	195588	275417	30m

3.1.14 Virgin Media Response to Consultations

Virgin Media provided the following email response to consultations:

"See below":

	Band	Link	Site A			Site B						
Link Name / ID	MHz\GHz	MHz\GHz Length	Lat	Long	Easting	Northing	Ant Height	Lat	Long	Easting	Northing	Ant Height
Lanesborough NS	18GHz	8.1km	53°40'25.44"N	7°59'15.55"W			10mts	53°43'42.94"N	8°4'3.22"W			10mts

3.1.15 Vodafone Ireland Response to Consultations

Vodafone provided the following email response to consultations: *"Below are the details of our links in the proposed area:*

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When the proposed turbine locations are finalised please send them on for further analysis."

3.1.16 Department of Defence Response to Consultations

To date no response has been received.

3.1.17 Airwave Response to Consultations

To date no response has been received.

3.1.18 CIE Response to Consultations

To date no response has been received.

3.1.19 Irish Water Response to Consultations

Irish Water provided the following email response to consultations:

"There are no Irish Water communications links traversing this proposed development."

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Section 4 - Field Surveys

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4. Introduction

To assess the accuracy of the network information (radio link co-ordinates, antenna heights etc.) provided by the telecom operators, field surveys of the telecom-mast sites within 5km of the proposed wind farm development site were carried out. During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded. The telecom mast-sites surveyed for this study (labelled Mast-Site A, B, C, D, E, F, G, H, I, J, K, L & M) are shown relative to the proposed wind farm site in Figure 4 below. The findings from the field surveys of the mast-sites are presented in Appendix B of this report.



Figure 4. Telecom Mast-Sites Surveyed.

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Section 5 - Desktop Survey Analysis

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5. Introduction

Based on the findings of the consultation process, there are six Telecom Operators with networks in the vicinity of the proposed wind farm that require a detailed technical analysis:

- Enet Network
- Eir Network
- ESB Network
- Imagine Broadband Network
- 2RN Network
- Three Ireland Network
- Virgin Media Network
- Vodafone Ireland Network

Section 5.1 to Section 5.8 below outlines the desktop survey analysis findings* for the Telecom Operator networks listed above.

5.1 Enet Network Analysis

The Enet network in the vicinity of the proposed wind farm consists of two Point-to-Point (PTP) microwave radio links. The radio links are listed in Table 4 below and a Plan View of the Enet network is shown in Figure 5.

Link ID	Operator	Link Description
1	Enet	PTP microwave radio link from Cairn Hill to Fermoyle National School (N.S)
2	Enet	PTP microwave radio link from Sliabh Bawn to Aughine Community Centre



Table 4. Enet Radio Links requiring Analysis

Figure 5. Enet Ireland Radio Network - Plan View

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

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Figure 6 below shows a close-up view of the Enet microwave radio links relative to the proposed wind farm site. Desktop survey analysis indicates that the PTP radio links are over 400m from the nearest of the proposed turbines. At this distance there will be no impact to the radio link due to the wind farm development.



Figure 6. Enet Network – Close-up Plan View.

Table 5 below provides a brief summary of the 3D radio link interference analysis for the closest turbines (T08 and T08) to the Enet radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	D Link Description Near Turbin		Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
Enet Link 1	Cairn Hill to Fermoyle N.S.	T08	> 100 m	No Impacts.
Enet Link 2	inet Sliabh Bawn to T0 ink 2 Aughine C.C.		> 100 m	No Impacts.

Table 5. Enet Network – Analysis Summary

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5.2 Eir Network Analysis

The Eir network in the vicinity of the proposed wind farm consists of four Point-to-Point (PTP) microwave radio links. The radio links are listed in Table 6 below and a Plan View of the Eir network is shown in Figure 7.

Link ID	Operator	Link Description
1	Eir	PTP microwave radio link from Barnacor to Garrycam
2	Eir	PTP microwave radio link from Woodlawn to Garrycam
3	Eir	PTP microwave radio link from Emoe Cross to Garrycam
4	Eir	PTP microwave radio link from Cornadowagh to Garrycam

Table 6. Eir Radio Links requiring Analysis



Figure 7. Eir Ireland Radio Network – Plan View

Figure 8 below shows a Close-up view of the Eir microwave radio links relative to the proposed wind turbines. The plan view indicates that Turbines T01 and T13 would be relatively near two of the Eir links.



Figure 8. Eir Network – Close-up Plan View

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

The results of the 3D analysis indicate that the proposed turbines do not obstruct the Fresnel Zones of the radio links and there would be no impact due to the wind farm development.



Figure 9. Eir Network – 3D View.

Table 7 below provides a brief summary of the 3D radio link interference analysis for the closest turbines to the Eir radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
Eir Link 1	Barnacor to Garrycam.	T01	60.6 m	No impacts
Eir Link 2	Woodlawn to Garrycam	T10	> 100 m	No impacts
Eir Link 3	r Emoe Cross to Garrycam		9.2 m	No impacts
Eir Link 4	Cornadowagh to Garrycam	T20	> 100 m	No impacts

Table 7. Eir Network – Analysis Summary

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5.3 ESB Network Analysis

The ESB network in the vicinity of the proposed wind farm consists of two Point-to-Multipoint (PMP) UHF radio links. The radio links are listed in Table 8 below and a Plan View of the ESB network is shown in Figure 10.

Link ID	Operator	Link Description
1	ESB	PMP UHF radio link from Garrycam (Ardagh) to Roscommon
2	ESB	PMP UHF radio link from Garrycam (Ardagh) to Aghamore

Table 8. Eir Radio Links requiring Analysis



Figure 10. ESB Radio Network – Plan View

Figure 11 below shows a Close-up view of the ESB UHF radio links relative to the proposed wind turbines. The plan view indicates that Turbine T13 would be relatively near to ESB Link 1 (Garrycam to Roscommon).



Figure 11. ESB Network – Close-up Plan View.

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To further assess the potential impact of the turbines, the radio links were modelled in 3D and the Clearance Distances between the Fresnel Zones (F2, F1 and 0.6F1) have been calculated.



Figure 12. ESB Network – 3D View showing 2nd Fresnel Zone of radio links



Figure 13. ESB Network – 3D View showing 1st Fresnel Zone of radio links



Figure 14. ESB Network – 3D View showing 0.6F1 Fresnel Zone of radio links

The results of the 3D analysis indicates that there would be a relatively small infringement (10m) by T13 into the 2nd Fresnel Zone of ESB Link 1(Garrycam – Roscommon). However, it should be noted that in radio planning the 2nd Fresnel Zone is not normally considered for radio links

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with frequencies below 1GHz (e.g. UHF radio links). For sub-1GHz links, the 0.6F1 Fresnel Zone is typically used in interference assessments.

There is a clearance distance of 32.5 m between the blade-tip of T13 and the 0.6F1 Fresnel Zone of ESB Link 1. The clearance distance from the nearest turbine to the Fresnel Zone (0.6F1, F1 and F2) of ESB Link 2 is over 100 m. As the proposed turbines do not obstruct the 0.6F1 Fresnel Zone of the radio links, there should be no impact due to the wind farm development.

Table 9 provides a brief summary of the 3D radio link interference analysis for the closest turbines (T08 and T13) to the ESB UHF telemetry radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Link Description Nearest Turbine(s) Freshe Blade-		Wind Farm Impacts
ESB Link 1	Garrycam to Roscommon	T13	32.5 m	No impacts
ESB Link 2	ESB Link 2 Garrycam to Aghamore T08		> 100 m	No impacts

Table 9. ESB Network – Analysis Summary

* 0.6F1 Fresnel Zone used in calculations, as the frequency of the ESB radio links is less than 1 GHz (460 MHz).

Note: If it is a requirement that the 2nd Fresnel Zone of ESB Link 1 should be obstruction-free, this could be achieved by relocating the UHF antenna at Roscommon Substation. Figure 15 below shows the location within the compound where the antenna could be relocated to.



Figure 15. UHF Radio Antenna at ESB Roscommon Substation

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3D analysis indicates that relocating the UHF antenna to the new location at Roscommon Substation would result in a Clearance Condition to each of the radio link Fresnel Zones (F2, F1 and 0.6F1).



Figure 16. ESB Link 1 – 3D View showing clearance condition to 2nd Fresnel Zone (when antenna is relocated at Roscommon Substation)



Figure 17. ESB Link 1 – 3D View showing clearance condition to 1st Fresnel Zone (when antenna is relocated at Roscommon Substation)



Figure 18. ESB Link 1 – 3D View showing clearance condition to 0.6F1 Fresnel Zone (when antenna is relocated at Roscommon Substation)

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5.4 Imagine Broadband Network Analysis

The Imagine Broadband network in the vicinity of the proposed wind farm consists of one Pointto-Point (PTP) microwave radio link. The radio link is listed in Table 10 below and a Plan View of the Imagine network is shown in Figure 19.

Link ID	Operator	Link Description
1	Imagine	PTP microwave radio link from Barnacor, Lanesborough to Cairn Hill

Table 10. Imagine Broadband Radio Links requiring Analysis



Figure 19. Imagine Broadband Radio Network – Plan View

Figure 20 below shows a Close-up view of the Imagine Broadband microwave radio link relative to the proposed wind turbines. The plan view indicates that Turbine T06 would be relatively the Imagine Broadband radio link.



Figure 20. Imagine Broadband Network – Close-up Plan View.

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To further assess the potential impact of the turbines, the radio link has been modelled in 3D and the Clearance Distances between the Fresnel Zone(s) of the link and the blade-tip of the nearest turbine(s) have been calculated. A 3D view of the microwave radio link relative to the proposed turbines is shown below in Figure 21.

The results of the 3D analysis indicate that the proposed turbines do not obstruct the Fresnel Zones of the radio link and there would be no impact due to the wind farm development.



Figure 21. Imagine Broadband Network – 3D View.

Table 11 below provides a brief summary of the 3D radio link interference analysis for the closest turbine to the Imagine radio link that traverses the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
Imagine Link 1	Cairn Hill to Lanesborough.	T06	27.6 m	No impacts

 Table 11. Imagine Broadband Network – Analysis Summary

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5.5 2RN Network Analysis

The 2RN network in the vicinity of the proposed wind farm consists of one DTT Off-air radio link and two PTP microwave radio links. The radio links are listed in Table 12 below and a Plan View of the 2RN network is shown in Figure 22.

Link ID	Operator	Link Description
1	2RN	UHF DTT off-air radio link from Cairn Hill to Maghera
2	2RN	PTP microwave radio link from Cairn Hill to Coolderry (#1)
3	2RN	PTP microwave radio link from Cairn Hill to Coolderry (#2)

Table 12. 2RN Radio Links requiring Analysis



Figure 22. 2RN Radio Network – Plan View

Figure 23 below shows a Close-up view of the 2RN radio links relative to the proposed wind turbines. The plan view indicates that Turbine T14 would be relatively near to the link to Maghera and T18 would be relatively near to the links to Coolderry.



Figure 23. 2RN Network – Close-up Plan View.

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To further assess the potential impact of the turbines, the radio links have been modelled in 3D and the Clearance Distances between the Fresnel Zone(s) of the links and the blade-tip of the nearest turbines have been calculated. A 3D view of the microwave radio links relative to the proposed turbines is shown below in Figure 24.

The results of the 3D analysis indicate that the proposed turbines do not obstruct the Fresnel Zones of the radio links and there would be no impact due to the wind farm development.



Figure 24. 2RN Network – 3D View.

Table 13 below provides a brief summary of the 3D radio link interference analysis for the closest turbines to the 2RN radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
2RN Link 1	Cairn Hill to Maghera	T14	> 100 m (137.4 m)	No impacts
2RN Link 2	Cairn Hill to Coolderry (#1)	T18	23.7 m	No impacts
2RN Link 3	Cairn Hill to Coolderry (#2)	T18	28.1 m	No impacts

Table 13. 2RN Network – Analysis Summary

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5.6 Three Ireland Network Analysis

The Three Ireland network in the vicinity of the proposed wind farm consists of two Point-to-Point (PTP) microwave radio links. The radio links are listed in Table 14 below and a Plan View of the Three Ireland network is shown in Figure 25.

Link ID	Operator	Link Description
1	Three	PTP microwave radio link from Lanesborough to Sliabh Bawn
2	Three	PTP microwave radio link from Garrycam to Sliabh Bawn



Table 14. Three Ireland Radio Links requiring Analysis

Figure 25. Three Ireland Radio Network - Plan View

Figure 26 below shows a close-up view of the Three Ireland microwave radio links relative to the proposed wind farm site. Desktop survey analysis indicates that the PTP radio links are over 800m from the nearest of the proposed turbines. At this distance there will be no impact to the radio links due to the wind farm development.

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Figure 26. Three Ireland Network – Close-up Plan View

Table 15 below provides a brief summary of the 3D radio link interference analysis for the closest turbines to the Three Ireland radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
Three Ireland Link 1	Lanesborough to Sliabh Bawn.	T02	> 100 m	No Impacts.
Three Ireland Link 2	Garrycam to Sliabh Bawn	T05	> 100 m	No Impacts.

 Table 15. Three Ireland Network – Analysis Summary

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5.7 Virgin Media Network Analysis

The Virgin Media network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) microwave radio link. The radio link is listed in Table 16 below and a Plan View of the Virgin Media network is shown in Figure 27.

Link ID	Operator	Link Description
1	Virgin Media	PTP microwave radio link from Lanesborough N.S. to Sliabh Bawn

LAMAGH Melviev ALLYTO Clonbalt Wood Willsbrook Termonbarry LISSONUEP BREVCARTS Sliabh Bawn Cloondara Longford Lackar Curraghroe Rhynmount ncraft PROSPEC Cla CLOONCAR Ballymacormici BALLAGH ooskey Clonadra Anratab Lansborough N.S Moyde Clor RATHELIN Curragha Corree TURREEN 0 Lisnacusha St Albans Keenagl Formoyle Letterguillon DERRYDOWNA CHLIPHTRACH Soran FEARAGE Kiltaffrey CORNADOWAGH Newtowncashel LEDWITHSTOWN

Table 16. Virgin Media Radio Links requiring Analysis

Figure 27. Virgin Media Radio Network – Plan View

Figure 28 below shows a close-up view of the Virgin Media microwave radio link relative to the proposed wind farm site. Desktop survey analysis indicates that the PTP radio link is over 2 km from the nearest of the proposed turbines. At this distance there will be no impact to the radio link due to the wind farm development.

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Figure 28. Virgin Media Network – Close-up Plan View

Table 17 below provides a brief summary of the 3D radio link interference analysis for the closest turbines to the Virgin Media radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
Virgin Media Link 1	Lanesborough N.S. to Sliabh Bawn	T02	> 100 m	No impacts

Table 17. Virgin Media Network – Analysis Summary

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5.8 Vodafone Ireland Network Analysis

The Vodafone Ireland network in the vicinity of the proposed wind farm consists of four Pointto-Point (PTP) microwave radio links. The radio links are listed in Table 18 below and a Plan View of the Vodafone network is shown in Figure 29.

Link ID	Operator	Link Description
1	Vodafone	PTP microwave radio link from Woodlawn to Garrycam
2	Vodafone	PTP microwave radio link from Bord na Móna Mount Dillon to Ballyfeeny
3	Vodafone	PTP microwave radio link from Lanesborough to Ballyfeeny
4	Vodafone	PTP microwave radio link from Cornadowagh to Garrycam

Table 18. Vodafone Ireland Radio Links requiring Analysis



Figure 29. Vodafone Ireland Radio Network - Plan View

Figure 30 below shows a Close-up view of the Vodafone microwave radio links relative to the proposed wind turbines. The plan view indicates that Turbine T01 would be relatively near the Vodafone radio link from Bord na Móna Mount Dillon to Ballyfeeny.



Figure 30. Vodafone Ireland Network – Close-up Plan View.
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To further assess the potential impact of the turbines, the radio links have been modelled in 3D and the Clearance Distances between the Fresnel Zone(s) of the links and the blade-tip of the nearest turbines have been calculated. A 3D view of the microwave radio links relative to the proposed turbines is shown below in Figure 31.

The results of the 3D analysis indicate that the proposed turbines do not obstruct the Fresnel Zones of the radio links and there would be no impact due to the wind farm development.



Figure 31. Vodafone Network – 3D View.

Table 19 below provides a brief summary of the 3D radio link interference analysis for the closest turbines to the Vodafone radio links that traverse the proposed wind farm. A detailed analysis showing the clearance distances from the radio link Fresnel Zones (0.6F1, F2 and F2) to the blade-tip of each of the proposed turbines can be found in Appendix C.

Radio Link ID	Link Description	Nearest Turbine(s)	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Wind Farm Impacts
Vodafone Link 1	Woodlawn to Garrycam	T10	> 100 m	No impacts
Vodafone Link 2	Mount Dillon to Ballyfeeny	T01	46.1 m	No impacts
Vodafone Link 3	Lanesborough to Ballyfeeny	T04	> 100 m	No impacts
Vodafone Link 4	Cornadowagh to Garrycam	T20	> 100 m	No impacts

Table 19. Vodafone Network – Analysis Summary

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Section 6 - Conclusions

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6. Conclusions

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

- Results from the telecom operator consultations and desktop survey analysis indicate that there are nineteen radio links in the vicinity of the proposed development. These radio links are below listed in Table 20.

Operator	Radio Link Description	Nearest Turbine	Fresnel Zone (F2) Clearance Distance to Blade-tip of Turbine.	Impact of Wind Farm
Enet	Cairn Hill to Fermoyle N.S.	T08	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Enet	Sliabh Bawn to Aughine CC.	T05	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Eir	Barnacor to Garrycam	T01	60.6 m	No Impacts. (Subject to Final Turbine Layout).
Eir	Woodlawn to Garrycam	T10	> 100 m	No Impacts.
Eir	Emoe Cross to Garrycam	T13	9.2 m	No Impacts. (Subject to Final Turbine Layout).
Eir	Cornadowagh to Garrycam	T20	> 100 m	No Impacts. (Subject to Final Turbine Layout).
ESB	Garrycam to Roscommon (UHF Radio)	T13	32.5 m (0.6F1 Fresnel Zone used for UHF radio links)	No Impacts. (Subject to Final Turbine Layout).
ESB	Garrycam to Aghamore (UHF Radio)	T08	> 100 m (0.6F1 Fresnel Zone used for UHF radio links)	No Impacts. (Subject to Final Turbine Layout).
Imagine Broadband	Barnacor to Cairn Hill.	T06	27.6 m	No Impacts. (Subject to Final Turbine Layout).
2RN	Cairn Hill to Maghera.	T14	> 100 m	No Impacts. (Subject to Final Turbine Layout).
2RN	Cairn Hill to Coolderry (#1)	T18	23.7 m	No Impacts. (Subject to Final Turbine Layout).
2RN	Cairn Hill to Coolderry (#2)	T18	28.1 m	No Impacts. (Subject to Final Turbine Layout).
Three Ireland	Lanesborough to Sliabh Bawn	T02	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Three Ireland	Garrycam to Sliabh Bawn	T05	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Virgin Media	Lanesborough N.S. to Sliabh Bawn	T02	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Vodafone	Woodlawn to Garrycam	T10	> 100 m	No Impacts.
Vodafone	BnM Mount Dillon to Ballyfeeny.	T01	46.1 m	No Impacts. (Subject to Final Turbine Layout).

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Vodafone	Lanesborough to Ballyfeeny.	T04	> 100 m	No Impacts. (Subject to Final Turbine Layout).
Vodafone	Cornadowagh to Garrycam.	T20	> 100 m	No Impacts. (Subject to Final Turbine Layout).

Table 20	Padio Links	in vicinit	v of pro	nosod wind	lform
Table 20.			γοι ριο	posed wind	I I al III

- 3D analysis indicates that there would be a clearance condition between the blade-tip of T13 and the 0.6F1 Fresnel Zone of ESB Link 1 (Garrycam Roscommon). However, if it is a requirement that the 2nd Fresnel Zone of the radio link should also be obstruction-free, this could be achieved by relocating the UHF antenna at Roscommon Substation. This mitigation measure is described in Section 5.3 of this report.
- Figure 32 has been provided to illustrate the telecommunications links that cross over the proposed wind farm site. Desktop Survey analysis indicate that these radio links will not be impacted by the proposed wind farm development, (subject to final turbine layout and turbine dimensions).



Figure 32. Telecom Operator radio links crossing over proposed wind farm.

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APPENDIX A – Wind Farm Turbine Coordinates

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Appendix A – Wind Farm Turbine Co-ordinates

The turbine co-ordinates used in this Impact Assessment report are shown below in Table 21.

	Co-ordinates (WGS 84)				
שו	Latitude	Longitude			
T01	53.676465	-7.936019			
T02	53.679092	-7.942726			
T03	53.686097	-7.945030			
T04	53.691126	-7.950448			
T05	53.694078	-7.940417			
T06	53.688428	-7.933368			
T07	53.683187	-7.930861			
T08	53.666327	-7.917273			
т09	53.664386	-7.909400			
T10	53.662457	-7.901463			
T11	53.646120	-7.902776			
T12	53.644313	-7.896766			
T13	53.652775	-7.899035			
T14	53.642504	-7.912346			
T15	53.638472	-7.910361			
T16	53.629694	-7.876278			
T17	53.633539	-7.879731			
T18	53.626836	-7.870878			
T19	53.624352	-7.863759			
T20	53.627111	-7.851542			
T21	53.631807	-7.859603			
T22	53.636897	-7.850993			

Table 21. Wind Farm Turbine Co-ordinates

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APPENDIX B – Field Survey Findings

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Appendix B – Field Survey Findings

The telecom mast-sites surveyed for this Telecoms Impact Study are shown relative to the proposed wind farm site in Figure 33 below.



Figure 33. Telecom Mast-Sites shown relative to proposed wind farm.

The findings from the field surveys of each of the mast-sites are presented below.

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Mast-Site A (Cairn Hill)

Telecommunications Mast-Site A is located at Cairn Hill, Co Longford and is located approximately 19 km northeast of the proposed wind farm development site. A photo of the mast at this location is shown in the figure below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 22.



Figure 34. Mast A

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast A	Enet, 2RN, Imagine

Table 22. Field Survey Summary – Mast A

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Mast-Site B (Sliabh Bawn)

Telecommunications Mast-Site B is located at Sliabh Bawn, Co Roscommon and is approximately 7 km northwest of the proposed wind farm development site. A photo of the mast at this location is shown in the figure below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 23.



Figure 35. Mast B

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

Table 23. Field Survey Summary – Mast B

AiBridges Total Broadband Solutions	Procedure: 001	Rev: 3.0
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Mast-Site C (Ballyfeeny)

Telecommunications Mast-Site C is located in the townland of Ballyfeeny, Co Roscommon and is approximately 10 km north of the proposed wind farm development site. A photo of the mast at this location is shown in the figure below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 24.



Figure 36. Mast C

Mast ID	Telecom operators with radio links in direction of proposed wind farm	
Mast C	Vodafone	



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Mast-Site D (Aughine Community Centre)

Telecommunications Mast-Site D is located in the village of Aughine and is approximately 7 km east of the proposed wind farm development site. A photo of the mast-structure at this location is shown in the figure below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 25.



Figure 37. Mast D

Mast ID	Telecom operators with radio links in direction of proposed wind farm	
Mast D	Enet	



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Mast-Site E (Fermoyle National School)

Telecommunications Mast-Site E is located at Fermoyle National School which is approximately 5 km west of the proposed wind farm development site. A photo of the mast-structure at this location is shown in the figure below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 26.



Figure 38. Mast E

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast E	Enet



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Mast-Site F (Garrycam)

Telecommunications Mast-Site F is located in the townland of Garrycam and is approximately 19 km east of the proposed wind farm development site. A photo of the mast-structures at this location is shown in the figure below.

The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 27.



Figure 39. Mast-Site F

Mast ID	Telecom operators with radio links in direction of proposed wind farm	
Mast F1	Vodafone Ireland, Eir, ESB	
Mast F2	Three Ireland, Eir	

Table 27. Field Survey Summary – Mast F

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Mast-Site G (Coolderry)

Telecommunications Mast-Site G is located in the townland of Coolderry and is approximately 37 km southwest of the proposed wind farm development site.

A photo of the mast at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 28.



Figure 40. Mast G

Mast ID	Telecom operators with radio links in direction of proposed wind farm	
Mast G	2RN	

Table 28. Field Survey Summary – Mast G

AiBridges Total Broadband Solutions	Procedure: 001	Rev: 3.0
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Mast-Site H (Cornadowagh)

Telecommunications Mast-Site H is located in the townland of Cornadowagh and is approximately 5 km southwest of the proposed wind farm development site.

A photo of the mast-structure at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 29.



Figure 41. Mast H

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast H	Eir, Vodafone Ireland

Table 29. Field Survey Summary – Mast H

AiBridges Total Broadband Solutions	Procedure: 001	Rev: 3.0
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Mast-Site I (Bord na Mona, Mount Dillon)

Telecommunications Mast-Site I is located at the Bord na Mona site at Mount Dillon and is located within the proposed wind farm development site.

A photo of the mast-structure at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 30.



Figure 42. Mast I

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast I	Vodafone Ireland



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Mast-Site J (Lanesborough)

Telecommunications Mast-Site J is located in Lanesborough and is located within 1 km of the proposed wind farm development site.

A photo of the mast at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 31.



Figure 43. Mast J

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast J	Vodafone, Three Ireland



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Mast-Site K (Barnacor, Lanesborough)

Telecommunications Mast-Site K is located in the townland of Barnacor and is located within the proposed wind farm development site.

A photo of the mast at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 32.



Figure 44. Mast K

Mast ID	Telecom operators with radio links in direction of proposed wind farm	
Mast K	Imagine Broadband, Eir	

Table 32. Field Survey Summary – Mast K

AiBridges Total Broadband Solutions	Procedure: 001	Rev: 3.0
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Mast-Site L (Emoe Cross)

Telecommunications Mast-Site L is located in the townland of Emoe Cross and is approximately 14 km west of the proposed wind farm development site.

A photo of the mast-structure at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 33.



Figure 45. Mast L

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast L	Eir

Table 33. Field Survey Summary – Mast L

AiBridges Total Broadband Solutions	Procedure: 001	Rev: 3.0
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Mast-Site M (Roscommon Substation)

Telecommunications Mast-Site M is located at the Roscommon ESB Substation and is approximately 16 km west of the proposed wind farm development site.

A photo of the mast-structure at this location is shown in the figure below. The Telecom Operators who have radio links operating from this mast-site in the direction of the wind farm are listed in Table 34.



Figure 46. Mast M

Mast ID	Telecom operators with radio links in direction of proposed wind farm
Mast M	ESB

Table 34. Field Survey Summary – Mast M

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APPENDIX C – Radio Link Clearance Calculations Results

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Appendix C – Radio Link Clearance Calculations Results

The Radio Link Clearance Calculations Results for each of the Telecom Operators with radio links in the vicinity of the proposed wind farm are presented below (i.e. Enet, Eir, Imagine Broadband, 2RN Three Ireland and Vodafone).

Clearance Calculations - Enet Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Enet Link 1 (Cairn Hill to Fermoyle National School)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08*	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

Enet Link 1 - Cairn Hill to Fermoyle National School

* Nearest turbine to radio link.

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Enet Link 2 - Sliabh Bawn to Aughine Community Centre

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Enet Link 2 (Sliabh Bawn to Aughine Community Centre)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05*	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Clearance Calculations - Eir Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

Eir Link 1 - Barnacor to Garrycam

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Eir Link 1 (Barnacor to Garrycam)			
	0.6F1	F1	F2	
T01*	64.34 m	63.03 m	60.61 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Eir Link 2 - Woodlawn to Garrycam

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Eir Link 2 (Woodlawn to Garrycam)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10*	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Eir Link 3 - Emoe Cross to Garrycam

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Eir Link 3 (Emoe Cross to Garrycam)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13*	17.13 m	14.35 m	9.24 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Eir Link 4 - Cornadowagh to Garrycam

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Eir Link 4 (Cornadowagh to Garrycam)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20*	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Clearance Calculations - ESB Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

ESB Link 1 – Garrycam to Roscommon

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip ESB Link 1 (Garrycam to Roscommon)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13*	32.53 m	17.4 m	-10.41 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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ESB Link 2 – Garrycam to Aghamore

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip ESB Link 2 (Garrycam to Aghamore)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08*	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Clearance Calculations – Imagine Broadband Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

Imagine Link 1 - Barnacor, L	anesborough to C	airn Hill
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Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Imagine Link 1 (Barnacor, Lanesborough to Cairn Hill)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06*	32.09 m	30.5 m	27.57 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Clearance Calculations – 2RN Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

2RN Link 1 - Cairn Hill to Maghera

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip 2RN Link 1 (Cairn Hill to Maghera)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14*	> 100 m (195.51 m)	> 100 m (175.05 m)	> 100 m (137.4 m)	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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2RN Link 2 - Cairn Hill to Coolderry (#1)

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip 2RN Link 2 (Cairn Hill to Coolderry (#1))			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18*	40.68 m	34.65 m	23.7 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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2RN Link 3 - Cairn Hill to Coolderry (#2)

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip 2RN Link 3 (Cairn Hill to Coolderry (#2))			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14*	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18*	45.1 m	39.11 m	28.1 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Clearance Calculations – Three Ireland Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

Three Ireland Link 1 - Lanesborough to Sliabh Bawn

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Three Ireland Link 1 (Lanesborough to Sliabh Bawn)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02*	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Three Ireland Link 2 - Garrycam to Sliabh Bawn

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Three Ireland Link 1 (Garrycam to Sliabh Bawn)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05*	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	
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Clearance Calculations – Virgin Media Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

Virgin Media Link 1 – Lanesborough N.S. to Sliabh Bawn

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Virgin Media Link 1 (Lanesborough N.S. to Sliabh Bawn)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02*	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Clearance Calculations – Vodafone Network

The Clearance Distances from the Radio Link Fresnel Zones (0.6F1, F1 and F2) to each of the proposed turbines have been calculated and are presented below.

Vodafone Link 1 - Woodlawn to Garrycam

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Vodafone Link 1 (Woodlawn to Garrycam)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10*	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Vodafone Link 2 - Bord na Móna Mount Dillon to Ballyfeeny

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Vodafone Link2 (Bord na Móna Mount Dillon to Ballyfeeny)		
	0.6F1	F1	F2
T01*	48.7 m	47.79 m	46.11 m
T02	> 100 m	> 100 m	> 100 m
T03	78.06 m	76.71 m	74.23 m
T04	> 100 m	> 100 m	> 100 m
T05	> 100 m	> 100 m	> 100 m
T06	> 100 m	> 100 m	> 100 m
T07	> 100 m	> 100 m	> 100 m
T08	> 100 m	> 100 m	> 100 m
T09	> 100 m	> 100 m	> 100 m
T10	> 100 m	> 100 m	> 100 m
T11	> 100 m	> 100 m	> 100 m
T12	> 100 m	> 100 m	> 100 m
T13	> 100 m	> 100 m	> 100 m
T14	> 100 m	> 100 m	> 100 m
T15	> 100 m	> 100 m	> 100 m
T16	> 100 m	> 100 m	> 100 m
T17	> 100 m	> 100 m	> 100 m
T18	> 100 m	> 100 m	> 100 m
T19	> 100 m	> 100 m	> 100 m
T20	> 100 m	> 100 m	> 100 m
T21	> 100 m	> 100 m	> 100 m
T22	> 100 m	> 100 m	> 100 m

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Vodafone Link 3 - Lanesborough to Ballyfeeny

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Vodafone Link 3 (Lanesborough to Ballyfeeny)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04*	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	

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Vodafone Link 4 - Cornadowagh to Garrycam

Turbine ID	Clearance Distance from Radio Link Fresnel Zone to Turbine Blade-tip Vodafone Link 4 (Cornadowagh to Garrycam)			
	0.6F1	F1	F2	
T01	> 100 m	> 100 m	> 100 m	
T02	> 100 m	> 100 m	> 100 m	
T03	> 100 m	> 100 m	> 100 m	
T04	> 100 m	> 100 m	> 100 m	
T05	> 100 m	> 100 m	> 100 m	
T06	> 100 m	> 100 m	> 100 m	
T07	> 100 m	> 100 m	> 100 m	
T08	> 100 m	> 100 m	> 100 m	
T09	> 100 m	> 100 m	> 100 m	
T10	> 100 m	> 100 m	> 100 m	
T11	> 100 m	> 100 m	> 100 m	
T12	> 100 m	> 100 m	> 100 m	
T13	> 100 m	> 100 m	> 100 m	
T14	> 100 m	> 100 m	> 100 m	
T15	> 100 m	> 100 m	> 100 m	
T16	> 100 m	> 100 m	> 100 m	
T17	> 100 m	> 100 m	> 100 m	
T18	> 100 m	> 100 m	> 100 m	
T19	> 100 m	> 100 m	> 100 m	
T20*	> 100 m	> 100 m	> 100 m	
T21	> 100 m	> 100 m	> 100 m	
T22	> 100 m	> 100 m	> 100 m	