APPENDIX 15-7

TELECOMMUNICATIONS IMPACT ASSESSMENT

Report

Knockshanvo Wind Farm
Telecommunications 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 Knockshanvo, Co. Clare could have on existing telecommunications operator networks.

Telecom Operator consultations (undertaken by EIAR Consultant, MKO) were originally commenced in 2020-21, when the proposed development was an 18-turbine proposal and referred to as "*Violet Hill Wind Farm*". At that time, four telecom operators raised concerns regarding their network infrastructure (2RN, Enet, ESB and Vodafone). Network analysis was then carried out by Ai Bridges to assess the possible impacts do the proposed wind farm. The network analysis findings, along with possible mitigation measures were presented to the telecom operators in 2021.

Due to various constraints, the proposed turbine layout was reduced from 18 turbines down to 9 turbines and in August 2023, Ai Bridges undertook a new round of telecom operator consultations, to reflect the new 9-turbine layout (now referred to as "*Knockshavo Wind Farm*").

During the consultation process (2023), nineteen telecom operators were contacted. At the time of writing this report, fifteen 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 field survey assessments and the consultation process, a desktop impact analysis was carried out and all of the telecommunication operator networks were analysed using radio planning \ modelling software. The results of the desktop survey analysis indicate that the proposed turbines would not impact the Telecom Operator networks (i.e. no impacts due to the proposed 9-turbine layout).

Operator	Link Description	Impact of wind farm
2RN	Licensed PTP microwave radio link from Maghera to Woodcock Hill.	No impacts. (Clearance distance of 293 m between blade-tip of nearest turbine (T01) and radio link Fresnel Zone.)
	PTP DTT off-air (UHF) radio link from Maghera to Woodcock Hill.	No impacts. (Clearance distance of 264 m between blade-tip of nearest turbine (T01) and radio link Fresnel Zone.)
Enet	Licensed PTP microwave radio link from Kilseily to ESB Killonan.	No impacts. (Clearance distance of 16 m between blade-tip of nearest turbine (T07) and radio link Fresnel Zone.)
ESB	UHF Point-to-Multipoint (PMP) radio network operating from Oatfield Mast.	No impacts. ESB have not responded with any concerns regarding the 2023 9-tubrine layout. In addition, radio network analysis indicates that there will be no impacted due to the 9-turbine layout.
	Licensed PTP radio link from Oatfield to Drumline.	
	Licensed PTP radio link from Oatfield to Parteen.	
Vodafone	Licensed PTP radio link from Oatfield to Quin.	No impacts. Vodafone have responded to consultations stating that their radio network will not be impacted by the 9-turbine layout.
	Licensed PTP radio link from Knocksis to Drumline.	

Table 1. Radio links potentially impacted by proposed wind farm.

None of the Telecommunication Operators contacted during the consultation process raised any concerns regarding telecommunications networks operating in the licence-exempt frequency bands. Also there was no impacts reported by any of the telecommunications operators operating GSM Radio Access, Mobile Broadband Data Access, Tetra or Telemetry networks.

Sections

Appendix

Section 1 - Wind Farm Site Information

1. Introduction

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

1.1 Wind Farm Site Information

The wind farm development is located in County Clare approximately 6 km northeast of Sixmilebridge. As aforementioned, in 2021, the proposed wind farm consisted of 18 turbines. The turbine layout has since been reduced down to 9 turbines. The coordinates of the turbines assessed in this report (9-Turbne Layout) are provided in Appendix A. The dimensions of the turbines assessed in this report are provided in Table 2 below.

Wind Farm	Number of Turbines	Turbine Hub Height	Turbine Rotor Diameter
Knockshanvo	9	102.5m to 110.5m	149m to 163m

Table 2. Wind Farm Turbine Details

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

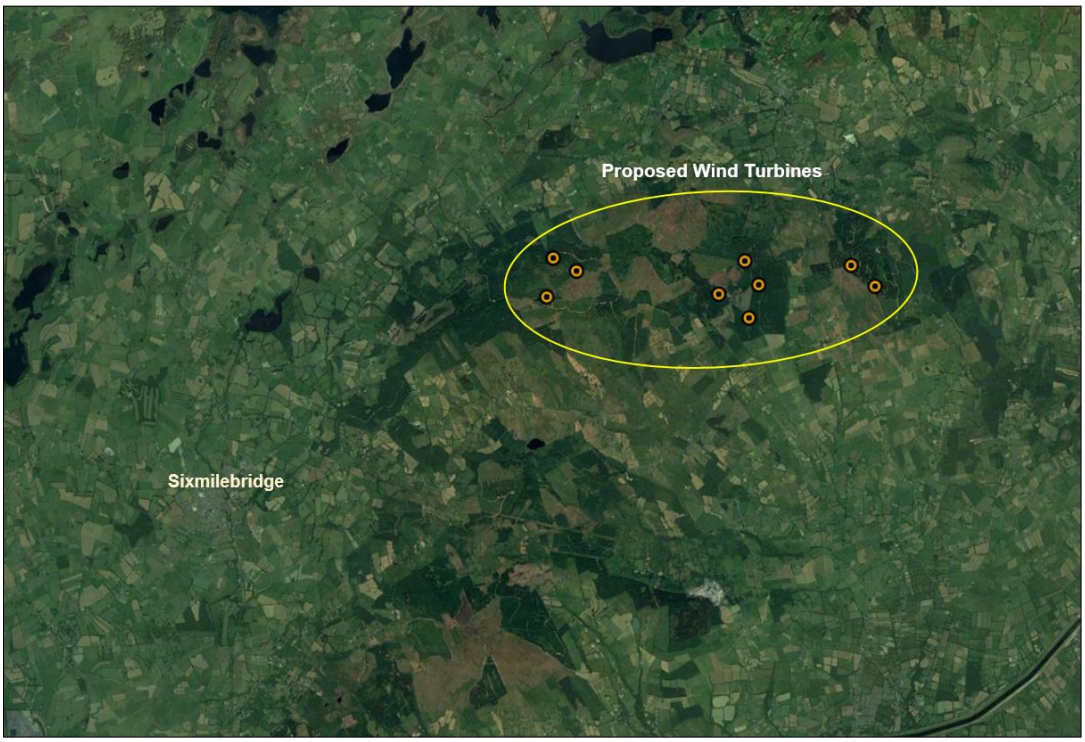


Figure 1. Location of proposed wind farm.

Section 2 - Methodology

2. Introduction

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

2.1 Methodology

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

- Telecom Operator Consultations
- Due Diligence Field Surveys conducted to verify Telecom Operator information
- Desktop Survey Network Modelling and Analysis
- Report Generation

A summary of each of these stages is provided below:

Telecom Operator Consultations

Consultations were commenced with telecom operators who were 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.

Due Diligence Field Surveys conducted to verify Telecom Operator Information

Due diligence field surveys of the telecom mast-sites identified by the Telecom Operators are undertaken. During the field surveys, antenna size, bearing and height on each of the telecom masts are surveyed and recorded.

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 at Knockshanvo. Figure 2 below shows the proposed wind turbines plotted in the radio planning tool.

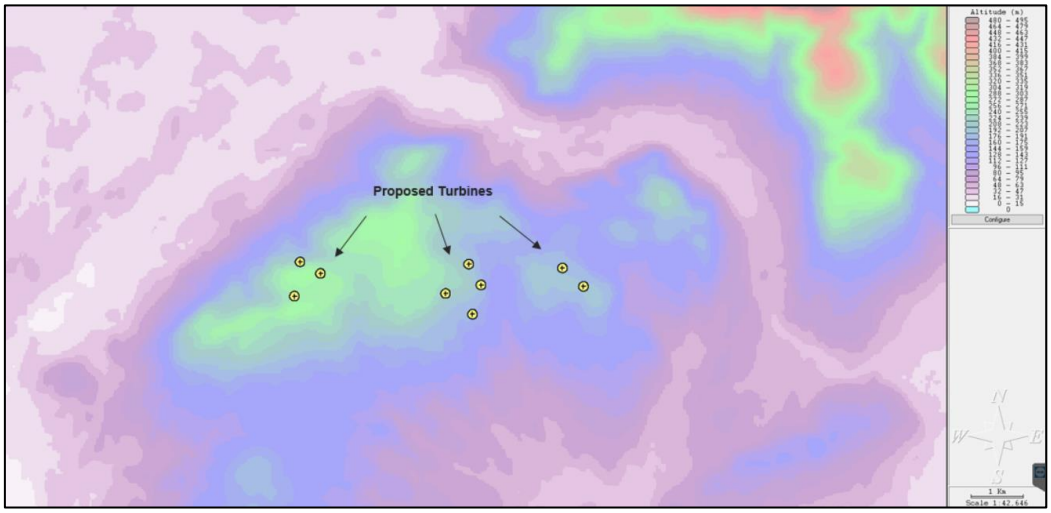


Figure 2. Proposed Wind Turbines plotted in Radio Planning Software

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 through the wind farm site modelled in radio planning software.

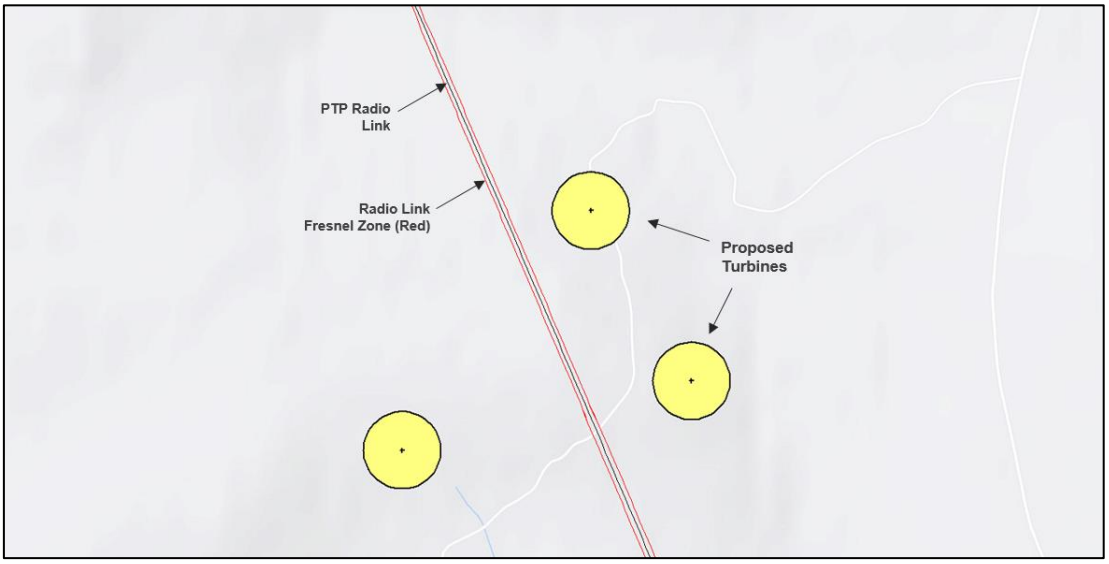


Figure 3. Example of microwave radio link crossing through the proposed wind farm site modelled in radio planning software.

Report Generation

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

Section 3 - Telecom Operator Consultations

3. Introduction

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

3.1 Telecom Operator Consultations

In 2021, Ai Bridges were notified that four Telecom Operators had informed MKO that they had concerns in relation to the original 18-turbine layout. In August 2023, to assess the new 9-turbine layout, Ai Bridges undertook a fresh round of consultations. The operators were requested to raise any concerns they may have regarding impacts to their networks due to the proposed (9-turbine) development.

Table 3 lists the telecom operators contacted by Ai Bridges (2021 & 2023) and the issues raised by the operators. The responses received from each of the Telecom Operators (2023) are provided in Sections 3.1.1 to 3.1.19. that follow.

Note: In 2021, Ai Bridges only engaged with the four telecom operators whom had raised concerns with MKO (2RN, ESB, Enet and Vodafone). The 2021 telecom operator consultations can be found in Appendix C of this report. In 2023, Ai Bridges engaged with all of the operators with telecommunications networks within the vicinity of the proposed development Knockshanvo.

ID	Operator	Telecom Operator Consultations Responses (2020/2021)	Telecom Operator Consultations Responses (2023)
1	2RN	2RN raised concerns regarding 2 x radio communications paths (Maghera to Mitchelstown and Maghera to Woodcock Hill)	2RN raised a concern regarding one licensed PTP microwave radio link and one DTT off-air (UHF) radio link.
2	Airwave	N.A.	No response. (No response expected.)
3	An Garda Síochána	N.A.	No response. (No response expected.)
4	Coimisiún na Meán (formerly the BAI)	N.A.	No issues.
5	BT Ireland	N.A.	No issues.
6	CIE/Irish Rail	N.A.	No issues.
7	Dept. of Defence	N.A.	The Department of Defence have acknowledged receipt of the consultation request and have stated that they will consult with the relevant military authorities and revert in due course. (No issues expected)
8	Eir	N.A.	No issues.
9	Enet	Enet raised concerns regarding 3 x PTP licensed microwave radio links.	Enet raised concerns regarding one licensed PTP microwave radio link.
10	ESB Networks	ESB raised concerns regarding 2 x PTP microwave radio links and 1 x PMP UHF Radio network (comprising of 10 separate UHF radio links)	No response.
11	Imagine Broadband	N.A.	No issues.
12	AirNav Ireland (formerly of the Irish Aviation Authority)	N.A.	No issues regarding radio transmission links.
13	Uisce Éireann	N.A.	No issues.
14	Clare County Council	N.A.	No response. (No issues expected.)
15	Tetra Ireland (TI)	N.A.	No issues.
16	Three Ireland	N.A.	No issues.
17	Viatel	N.A.	No issues.
18	Virgin Media	N.A.	No issues.
19	Vodafone Ireland	Vodafone raised concerns regarding 2 x PTP microwave radio links	No issues.

Table 3. Telecom Operators Consulted (2020/2021 and 2023)

3.1.1 2RN Response to Consultations (2023)

2RN provided the following email response to consultations:

> *"Just so you are aware, Turbine 01 in your map is about 370m from our off-air links between our sites at Maghera and Woodcock Hill.*
> *There is also a risk of interference to broadcast services, particularly around Baycar where the best server is Maghera, which is located behind the turbines."*

Link Name / ID	Band MHz\GHz	Link Length	Site A			Site B		
			Lat	Long	Ant Height	Lat	Long	Ant Height
MGH-WCH_6GHz	6GHz	27.8km	52.968795	-8.718379	37 m AGL	52.719662	-8.692079	17 m AGL
MGH_WCH_DTT	674MHz	27.8km	52.968795	-8.718379	161 m AGL	52.719662	-8.692079	23 m AGL

3.1.2 Airwave Response to Consultations (2023)

To date no response has been received.

3.1.3 An Garda Síochána Response to Consultations (2023)

To date no response has been received.

3.1.4 Coimisiún na Meán Response to Consultations (2023)

Coimisiún na Meán provided the following email response to consultations:

> *"Coimisiún na Meán 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."*

3.1.5 BT Ireland Response to Consultations (2023)

BT provided the following email response to consultations:

> *"BT no longer have a radio microwave network."*

3.1.6 CIE/Irish Rail Response to Consultations (2023)

CIE provided the following email response to consultations:

> *"Irish Rail have no wireless links within 5km of this proposed development."*

3.1.7 Department of Defence Response to Consultations (2023)

The Department of Defence provided the following email response to consultations:

> *"The Department of Defence wished to acknowledge receipt of your e-mail below re: Knockshanvo Wind Farm Development, Co Clare. The Department will consult with the relevant Military authorities and revert in due course."*

3.1.8 Eir Response to Consultations (2023)

Eir provided the following email response to consultations:

> *"We have no transmission links within the proposed area and it has no risk to the network."*

3.1.9 Enet Response to Consultations (2023)

Enet provided the following email response to consultations:

"The below link may be affected:"

Link Name / ID	Band MHz\GHz	Link Length	Site A			Site B		
			Lat	Long	Ant Height	Lat	Long	Ant Height
O2 O'Callaghans Mills – ESB Killonan	13GHz	19.1km	52.797167	-8.658075	15m	52.639529	-8.547088	15m

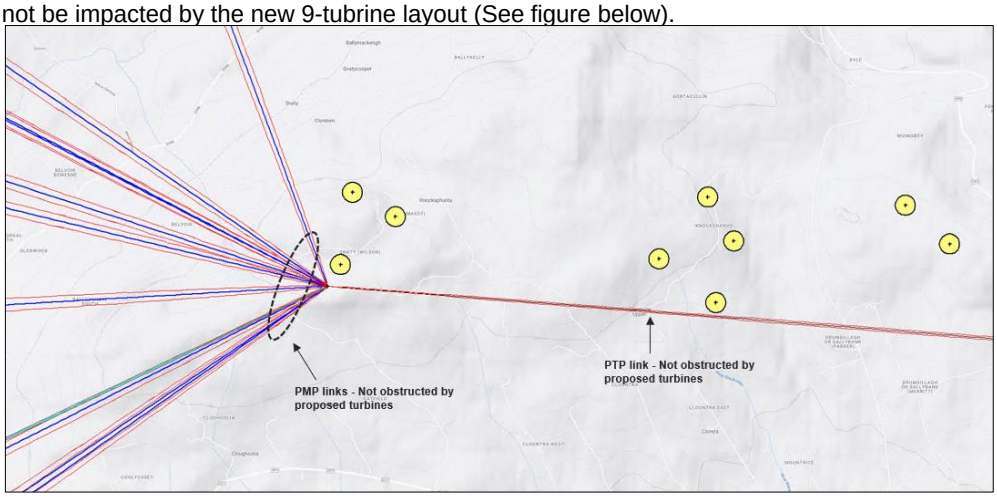
3.1.10 ESB Networks Response to Consultations (2023)

To date no response has been received.

Note: In 2021, there was correspondence with ESB (based on the original 18- turbine layout). The last response from Ai Bridges on 04/10/21 highlighted that the concerns raised by the ESB radio planning consultant (JRC) were not validated by any field surveys and did not adequately address the issues highlighted by Ai Bridges in relation to JRC's own modelling process.

Also, there was a failure to address the assumptions adopted in the JRC software modelling which did not have an industry precedent and there was no attempt to accept or adopt the mitigation measures proposed by Ai Bridges. The 2021 consultations with ESB can be found in Appendix C of this report.

In addition, network analysis of the details provided by ESB in 2021, indicate their network will not be impacted by the new 9-tubrine layout (See figure below).



3.1.11 Imagine Broadband Response to Consultations (2023)

Imagine Broadband provided the following email response to consultations:

"At present Imagine have no microwave affected by this development.
Your mail has been forwarded to our RF department. They will respond if they have any concerns."

3.1.12 AirNav Response to Consultations (2023)

AirNav provided the following email response to consultations:

> *"The proposed windfarm development falls within the coverage area of AirNav Ireland operated navigational-aids at Shannon Airport and may have an impact on the flight-calibration profiles flown as part of the associated commissioning and periodic routine flight-checks.*
>
> *AirNav Ireland requests that you contact our flight calibration contractor FCSL, to assess if any adverse effects to Shannon ILS 24 Commissioning and Routine Flight Check Profiles will occur because of this development."*

3.1.13 Uisce Éireann Response to Consultations (2023)

Uisce Éireann provided the following email response to consultations:

> *"I can confirm that Uisce Éireann have no communications links traversing the proposed study area."*

3.1.14 Clare County Council Response to Consultations (2023)

To date no response has been received.

3.1.15 Tetra Ireland (TI) Response to Consultations (2023)

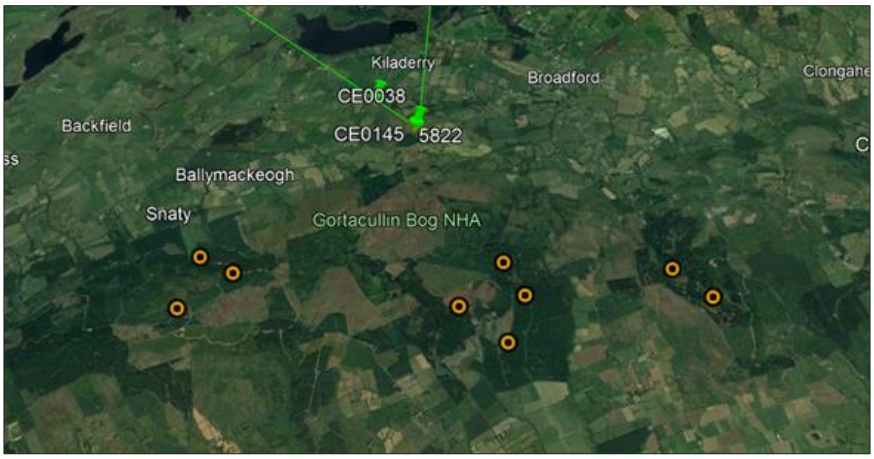
Tetra Ireland provided the following email response to consultations:

> *"We anticipate no impact from the development as proposed. Can you ensure it is also reviewed by eir."*

3.1.16 Three Ireland Response to Consultations (2023)

Three Ireland provided the following email response to consultations:

> *"I have reviewed the Proposed Wind Turbine at Knockshanvo, Co. Clare. These locations will have no impact on the Three Ireland Microwave Transmission network."*



3.1.17 Viatel Response to Consultations (2023)

Viatel provided the following email response to consultations:

> *"No impact to our wireless infrastructure."*

3.1.18 Virgin Media Response to Consultations (2023)

Virgin Media provided the following email response to consultations:

"Virgin Media Ireland do not have any links in this area."

3.1.19 Vodafone Ireland Response to Consultations (2023)

Vodafone provided the following email response to consultations:

"See screenshot below. The proposed turbine locations will not impact any Vodafone transmission."

Section 4 - Field Surveys

4. Introduction

To assess the accuracy of the network information (radio link co-ordinates, antenna heights etc.) provided by the telecom operators, field surveys of the telecom-mast sites in the vicinity of the proposed wind farm were carried out.

During the field surveys, radio antennas with bearings in the direction of the wind farm were recorded. The telecom mast-sites surveyed for this study (labelled Mast-Site A to Mast-Site D) 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.

Section 5 - Desktop Survey Analysis

5. Introduction

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

- 2RN Network
- Enet Network

Sections 5.1 to 5.2 below outline the desktop survey analysis findings* for each of the Telecom Operator networks listed above.

5.1 2RN Network Analysis

The 2RN network in the vicinity of the proposed wind farm consists of one Point-to-Point (PTP) microwave radio link and one DTT off air (UHF) radio link. The radio links are listed in Table 4 below and a Plan view of the 2RN network is shown in Figure 5.

Link ID	Operator	Link Description
1	2RN	PTP microwave (6 GHz) radio link from Maghera to Woodcock Hill
2	2RN	PTP DTT off air (UHF) radio link from Maghera to Woodcock Hill

Table 4. 2RN Radio Links requiring Analysis

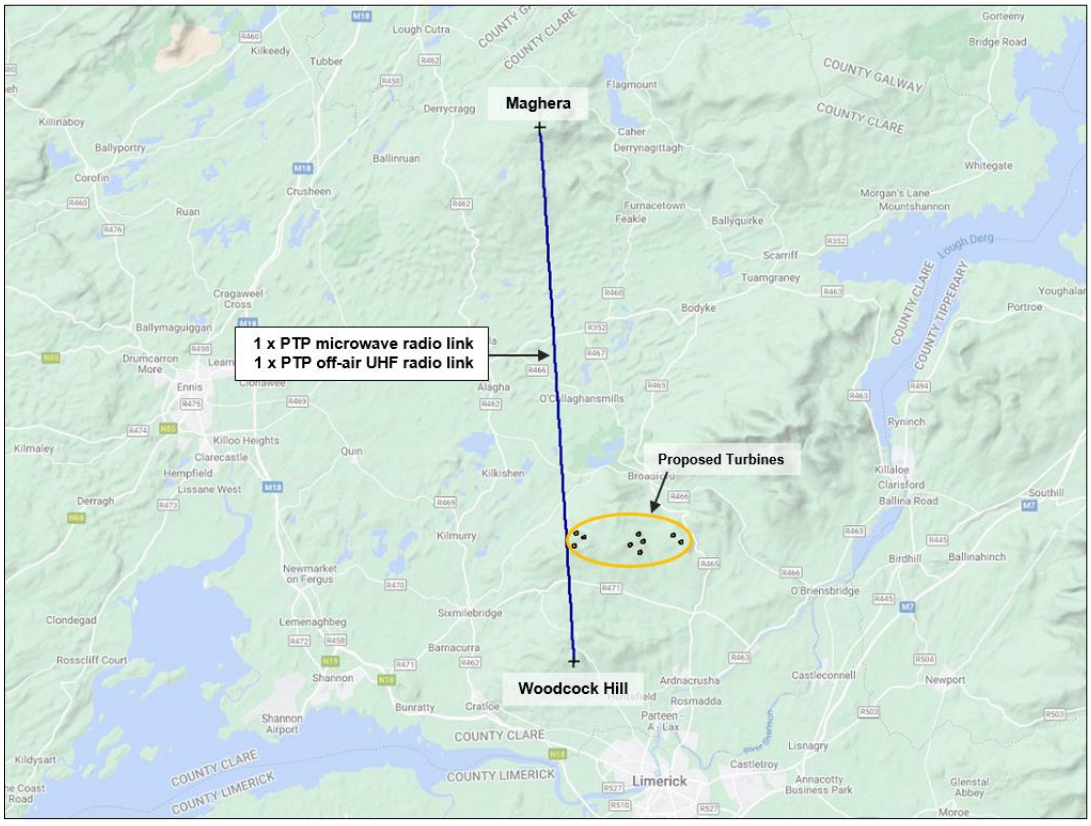


Figure 5. 2RN Network – Plan View

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

Figure 6 below shows a close-up plan view of the 2RN radio links relative to the proposed wind turbines. Desktop survey analysis indicates that there is a clearance distance of over 260 m between the blade-tip of the nearest turbine (T01) to the applicable Fresnel Zone of the radio links. At this distance, there will be no impact to the 2RN radio links.

Table 5 below provides a brief summary of the network analysis for the 2RN network in the vicinity of the proposed wind farm.

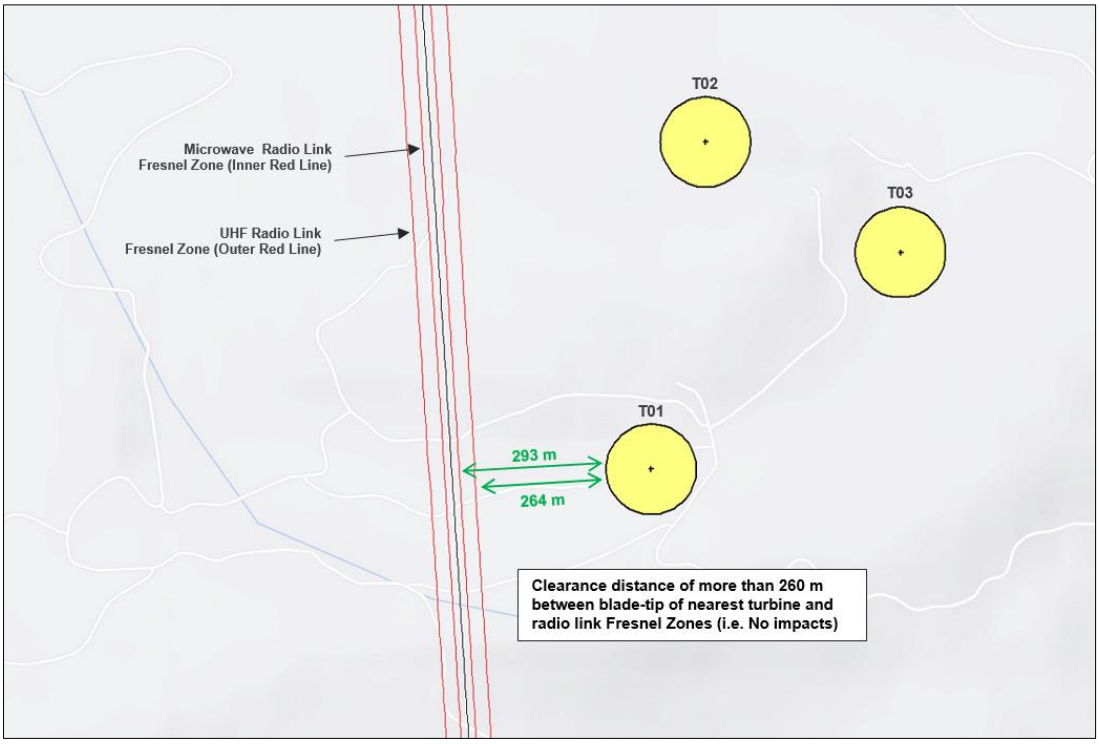


Figure 6. 2RN Network – Close-up Plan View.

Radio Link ID	Link Description	Nearest Turbine	Fresnel Zone Clearance	Wind Farm Impacts
2RN Link 1	Maghera to Woodcock Hill PTP microwave radio link (6 GHz)	T01	293 m	No Impacts.
2RN Link 2	Maghera to Woodcock Hill PTP DTT off air radio link (UHF)	T01	264 m	No Impacts.

Table 5. 2RN Network – Analysis Summary

5.2 Enet Network Analysis

The Enet 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 6 below and a Plan view of the Enet network is shown in Figure 7.

Link ID	Operator	Link Description
1	Enet	PTP microwave radio link from Kilseily to ESB Killonan

Table 6. Enet Radio Links requiring Analysis

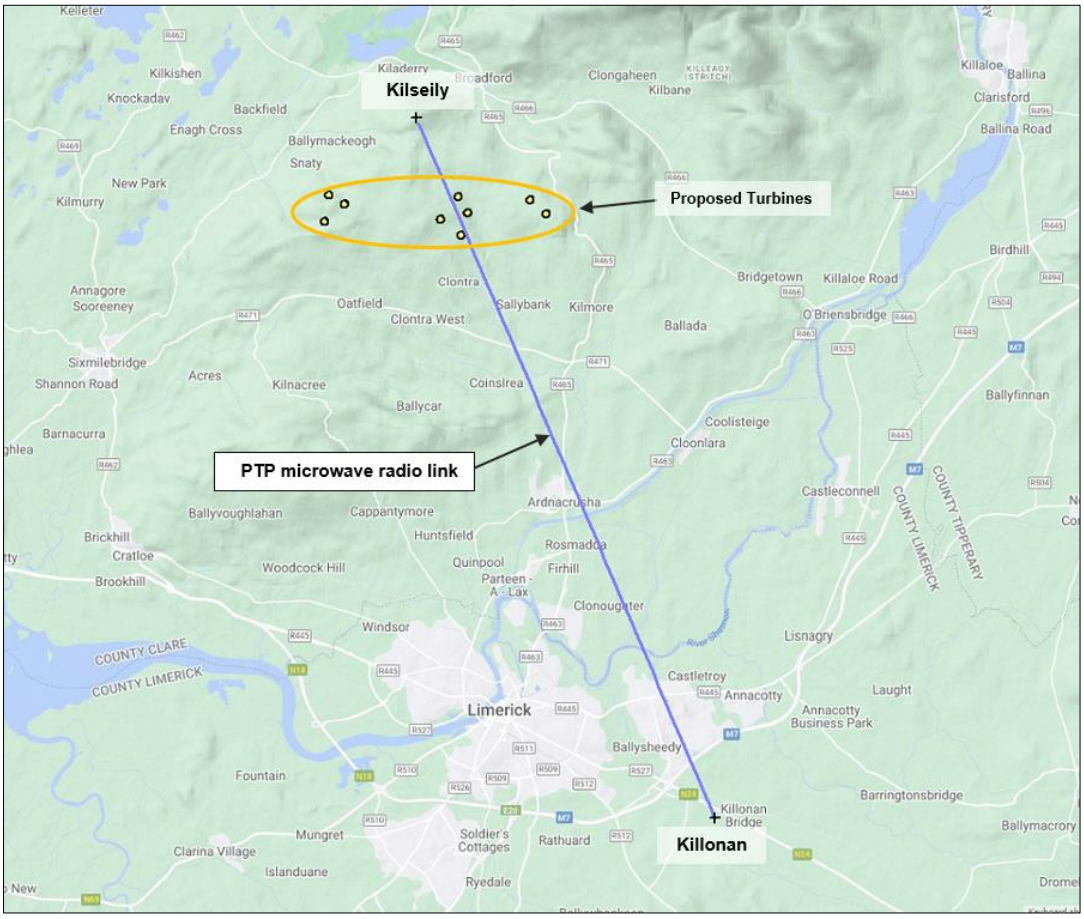


Figure 7. Enet Radio Network – Plan View

Figure 8 below shows a close-up plan view of the Enet radio link relative to the proposed wind turbines. Desktop survey analysis indicates that there is a clearance distance of 16 m between the blade-tip of the nearest turbine (T07) to the applicable Fresnel Zone of the radio link. At this distance, there will be no impact to the Enet radio link.

Table 7 below provides a brief summary of the network analysis for the Enet network in the vicinity of the proposed wind farm.

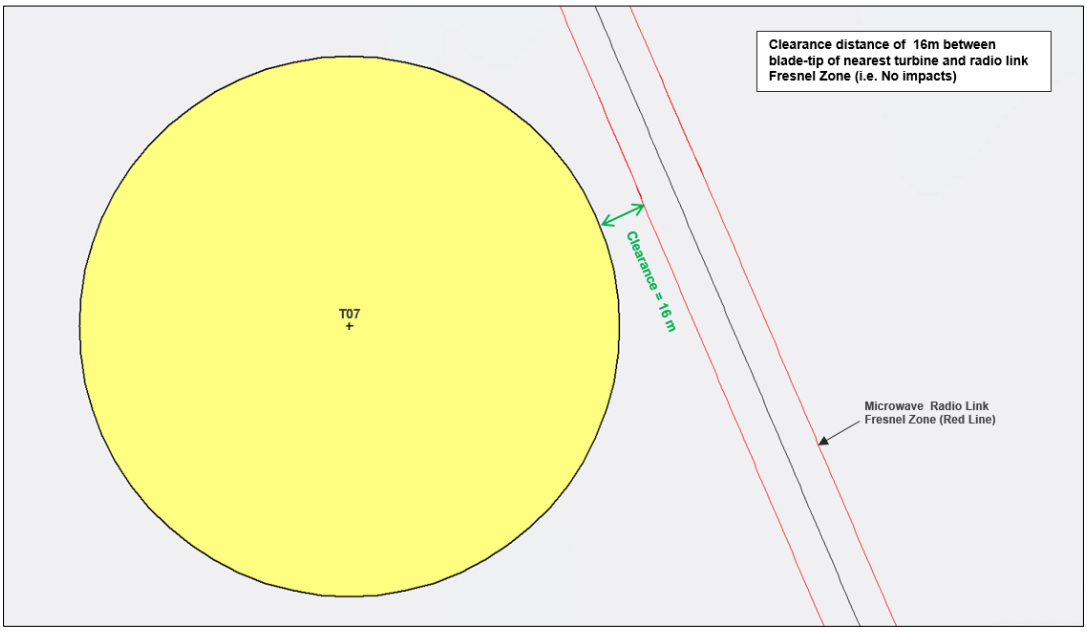


Figure 8. Enet Network – Close-up Plan View.

Radio Link ID	Link Description	Nearest Turbine	Fresnel Zone Clearance	Wind Farm Impacts
Enet Link 1	Kilseily to Killonan PTP microwave radio (13 GHz)	T07	16 m	No Impacts.

Table 7. Enet Network – Analysis Summary

Section 6 - Cumulative Impacts

6. Introduction

In this Section an assessment of the cumulative impacts of the proposed turbines at Knockshanvo is provided.

6.1 Overall Baseline

6.1.1 Current Baseline

There is are no operational wind farms in close proximity to the proposed Knockshanvo development. Consequently, there would be no cumulative impacts on telecommunications networks due to the proposed turbines at the proposed Knockshanvo development

6.1.2 Predicted Future Baseline

A planning application has been submitted to An Bord Pleanála for a new wind farm at Oatfield, Co Clare which is located adjacent to the proposed Knockshanvo development. A review of the submitted Oatfield application (Ref. Appendix E) indicates that there will no cumulative impacts due the proposed Knockshanvo development.

6.2 Assessment of Cumulative Impacts

The current and predicted future baseline conditions indicate that there will be no cumulative impacts on telecommunications networks due to the proposed turbines at Knockshanvo

6.3 Cumulative Impacts – Mitigation Measures

There will be no cumulative impacts due to the proposed development at Knockshanvo and no mitigation measures will be required.

6.4 Cumulative Impacts – Summary of Effects

There will be no cumulative impacts on telecommunications networks due to the proposed development at Knockshanvo.

6.5 Implementation of Environmental Measures

N.A. As there will be no cumulative impacts due to Knockshanvo, the implementation of environmental measures will not be required.

Environmental Measure	Responsibility for Implementation	Compliance Mechanism	Section Reference
Mitigation for cumulative impacts	N.A (No cumulative impacts)	N.A (No cumulative impacts)	6.2

Summary of environmental measures relevant to Telecommunications to be implemented

Section 7 - Conclusions

7. Conclusions

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

- Results from the telecom operator consultations and desktop survey analysis indicate that the 9-turbine layout will not impact any of the Telecom Operator radio networks.

Operator	Link Description	Impact of wind farm
2RN	Licensed PTP microwave radio link from Maghera to Woodcock Hill.	No impacts. (Clearance distance of 293 m between blade-tip of nearest turbine (T01) and radio link Fresnel Zone.)
	PTP DTT off-air (UHF) radio link from Maghera to Woodcock Hill.	No impacts. (Clearance distance of 264 m between blade-tip of nearest turbine (T01) and radio link Fresnel Zone.)
Enet	Licensed PTP microwave radio link from Kilseily to ESB Killonan.	No impacts. (Clearance distance of 16 m between blade-tip of nearest turbine (T07) and radio link Fresnel Zone.)
ESB	UHF Point-to-Multipoint (PMP) radio network operating from Oatfield Mast.	No impacts. ESB have not responded with any concerns regarding the 9-tubrine layout. In addition, radio network analysis indicates that there will be no impact to the ESB network due to the 9-turbine layout.
	Licensed PTP radio link from Oatfield to Drumline.	
	Licensed PTP radio link from Oatfield to Parteen.	
Vodafone	Licensed PTP radio link from Oatfield to Quin.	No impacts. Vodafone have responded to consultations stating that their radio network will not be impacted by the 9-turbine layout.
	Licensed PTP radio link from Knocksis to Drumline.	

Table 8. Telecom Operator Networks in vicinity of proposed Knockshanvo Wind Farm development.

- Figure 9 below has been provided to illustrate the 2RN and Enet radio links that pass near/through the proposed wind farm site (i.e. no impact by proposed 9-turbine layout.)

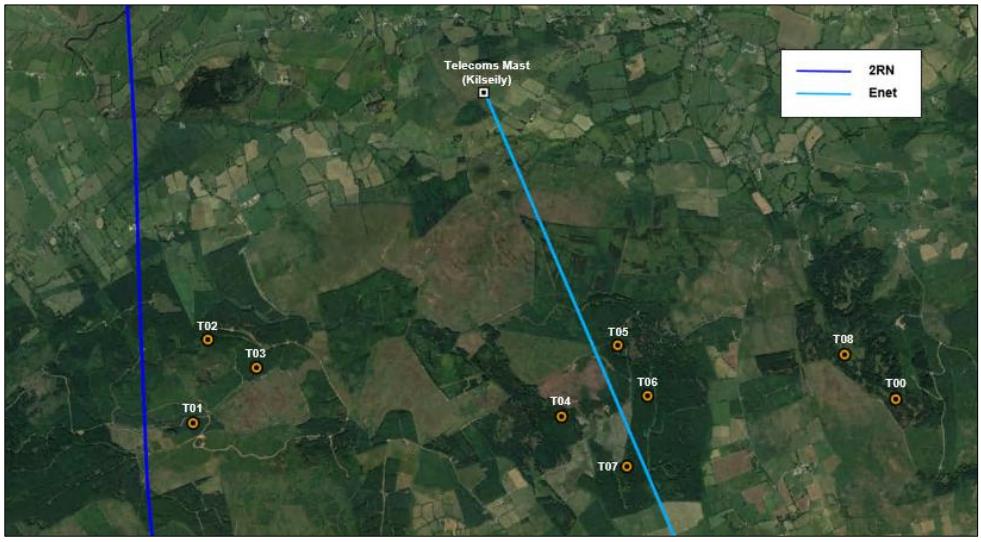


Figure 9. Telecom Operator radio links that pass near/through the proposed wind farm site.

APPENDIX A – Wind Farm Turbine Coordinates

Appendix A – Wind Farm Turbine Co-ordinates

The turbine layout considered in this Telecommunications Impact Study is provided below.

Turbine ID	Co-ordinates (WGS 84)	
	Latitude	Longitude
T01	52 46 25.63 N	8 41 31.25 W
T02	52 46 46.91 N	8 41 25.42 W
T03	52 46 39.73 N	8 41 04.49 W
T04	52 46 27.30 N	8 38 56.23 W
T05	52 46 45.51 N	8 38 32.48 W
T06	52 46 32.57 N	8 38 19.82 W
T07	52 46 14.45 N	8 38 28.56 W
T08	52 46 43.11 N	8 36 56.36 W
T09	52 46 31.70 N	8 36 34.80 W

Table 9. Wind Farm Layout - Turbine Co-ordinates (Layout Rev8 - 12/07/2023)

APPENDIX B – Field Survey Findings

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 10 below.

Figure 10. Telecom Mast-Sites shown relative to proposed Wind Farm

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

Mast-Site A (Maghera)

Telecommunications Mast-Site A is located on Maghera Mountain, Co Clare and is approximately 20 km north the proposed wind farm 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 9.

Figure 11. Mast-Site A

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

Table 10. Field Survey Summary – Mast-Site A

Mast-Site B (Kilseily)

Telecommunications Mast-Site B is located in the townland of Kilseily, Co Clare and is approximately 2 km north of the proposed wind farm 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 10.

Figure 12. Mast-Site B

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

Table 11. Field Survey Summary – Mast-Site B

Mast-Site C (Woodcock Hill)

Telecommunications Mast-Site C is located at Woodcock Hill (2RN Mast), Co Clare and is approximately 6 km south of the proposed wind farm. 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 11.

Figure 13. Mast-Site C

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

Table 12. Field Survey Summary – Mast-Site C

Mast-Site D (Killonan)

Telecommunications Mast-Site D is located at the rear of the ESB 110kV Substation at Killonan, Co Limerick and is approximately 16 km southeast of the proposed wind farm. 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 12.

Figure 14. Mast-Site D

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

Table 13. Field Survey Summary – Mast-Site D

APPENDIX C – Telecom Operator Consultations (2020-2021)

Appendix C – Telecom Operator Consultations (2020-2021)

During the original consultations with the EIAR consultant, McCarthy, Keville O'Sullivan (MKO) in 2020/21, four telecom operators raised concerns regarding telecommunications infrastructure they operate in the vicinity of Knockshanvo.

Operator	Issues raised by Operator \ Observations (2020 /2021)
2RN	Raised concerns regarding 2 x Radio Communications Paths (Maghera to Mitchelstown and Maghera to Woodcock Hill)
Enet	Raised concerns regarding 3 x PTP Microwave Radio Links
ESB	Raised concerns regarding 2 x PTP Microwave Radio Links and 1 x PMP UHF Radio network (comprising of 10 separate UHF radio links)
Vodafone Ireland	Raised concerns regarding 2 x PTP Microwave Radio Links

Table C1. Telecom Operators with network infrastructure in vicinity of proposed wind farm (from MKO Consultations – 2020/21)

Further consultation requests were subsequently sent by Ai Bridges to the relevant telecom operators. The responses received from each of the four telecom operators are provided in Sections C.1 to C.4 below.

C.1 2RN Response to Consultations

2RN provided the following email response to consultations to MKO in October 2020:

"We have two paths carrying several services that have a serious risk of interference on and near the area that you have highlighted.

1. *The DTT services from Maghera to Mitchestown Transposer Site (This passes within less than 200m of the furthest extent the windfarm) Mitchelstown covers potentially 21155 households.*

Site	*Lat.*	*Long.*	*Ant. Height AMSL (m)*	*Lowest Freq in band (MHz)*
Maghera	*52.968655°*	*-8.718119°*	*546*	*674*
Mitchelstown	*52.312990°*	*-8.306862°*	*340*	

2. *The DTT off air services from Maghera to Woodcock Hill*

Site	*Lat.*	*Long.*	*Ant. Height AMSL (m)*	*Lowest Freq in band (MHz)*
Maghera	*52.968655°*	*-8.718119°*	*546*	*674*
Woodcock Hill	*52.719770°*	*-8.692273°*	*270*	

3. *The DTT off air Services from Woodcock Hill to Maghera*

Site	*Lat.*	*Long.*	*Ant. Height AMSL (m)*	*Lowest Freq in band (MHz)*
Woodcock Hill	*52.719770°*	*-8.692273°*	*307*	*658*
Maghera	*52.968655°*	*-8.718119°*	*407*	

4. *The 6GHz Microwave link from Woodcock Hill to Maghera (This link is part of a ring that carries all of the national DTT and FM services around the country)*

Site	*Lat.*	*Long.*	*Ant. Height AMSL (m)*	*Lowest Freq in band (MHz)*
Maghera	*52.968655°*	*-8.718119°*	*411 & 421*	*6093.45*
Woodcock Hill	*52.719770°*	*-8.692273°*	*278 & 285*	

5. *The FM off air Services between Woodcock Hill and Maghera*

Site	*Lat.*	*Long.*	*Ant. Height AMSL (m)*	*Lowest Freq in band (MHz)*
Woodcock Hill	*52.719770°*	*-8.692273°*	*300*	*89.4*
Maghera	*52.968655°*	*-8.718119°*	*409*	

6. *The FM off air Services between Maghera and Woodcock Hill.*

Site	*Lat.*	*Long.*	*Ant. Height AMSL (m)*	*Lowest Freq in band (MHz)*
Maghera	*52.968655°*	*-8.718119°*	*471*	*88.8*
Woodcock Hill	*52.719770°*	*-8.692273°*	*270*	

There is also a definite risk of interference to the reception of DTT and FM services from Maghera and Woodcock Hill. We would ask that a protocol between the developer and 2rn be signed should the site go ahead.

To give you an indication of the impact to the links I have populated a kmz file with the Fresnel zones of some of the links impacted by this site.
I have also raised the height of you shape file to 180m to simulate the height of the turbines should they be installed. If we have a better idea of the location of the turbines a more detailed assessment can be made.

Please let me know if you require any more information."

10/03/21 – Consultation Response sent by Ai Bridges to 2RN

Hello Johnny,

I am following up with you in relation the proposed Violet Hill Wind Farm Development in Co. Clare. We have been requested to carry out a detailed technical assessment of the potential impact on the 2RN network.
We have been provided details of the consultations with 2RN conducted last year by the Environmental\Planning Consultants

During this consultation process 2RN communications links (UHF and FM links) operated between Maghera and Woodcock Hill were identified.

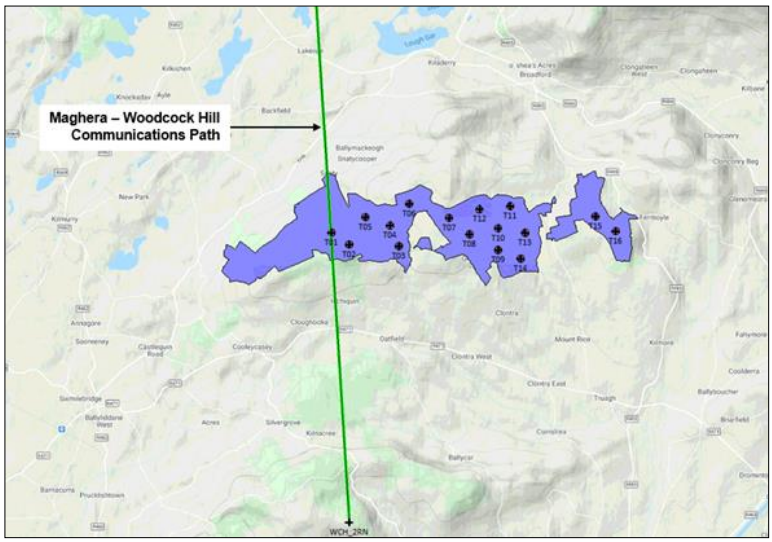
A plan view of the links below shows that both links pass over the wind farm area and that Turbine T1 will cause an impact on both links

- T1 co-ordinates : 52 46 32.04 N , 08 41 52.12 W
- Hub Height : 107.5 m
- Blade Length : 77.5 m

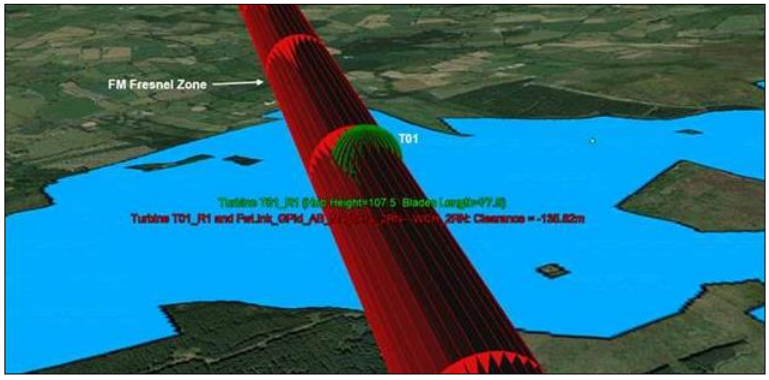
The 3D view below shows that the FM link will be impacted by T1 with an interference condition \ blockage on the link of 135.82m.

We would be grateful if you could review our analysis and confirm if our calculations are correct.

Plan View



3D View



Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

10/03/21 – 2RN Response

Hi Kevin,

Thanks for sending this on. I have reviewed the location of T1 with respect to our link path between Maghera and Woodcock Hill. I agree with your analysis that T1 is directly blocking the path. This is on the main microwave distribution path for the entire national broadcast TV and Radio networks and is essential that it is kept clear. We also require clearance to allow for backup off-air links for UHF TV and VHF FM radio as you have noted.

Grateful if you would keep me informed of any developments on this proposed development. Thanks and regards, Johnny

Johnny Evans
Head of Projects and Coverage Planning
2RN

11/03/21 – Consultation Response sent by Ai Bridges to 2RN

Hello Johnny,

We will revert to the wind farm developer and alert them to this impact on the 2RN network. Can you confirm that in the first instance that 2RN wold require that this turbine be re-located outside the 1st Fresnel zone of the FM off-air link ?

Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

11/03/21 – 2RN Response

Hi Kevin,

Yes, at the very minimum we would normally require that no turbines within the first Fresnel Zone of the FM VHF links. However, given that this link is feeding a main transmitter site providing service to Limerick city and on the main national distribution ring we would request that turbines be kept outside of the 2nd Fresnel zone, and would like some form of contingency for the potential impact of any turbines within this zone.

Thanks again and regards, Johnny

Johnny Evans
Head of Projects and Coverage Planning
2RN

11/03/21 – Consultation Response sent by Ai Bridges to 2RN

Hello Johnny,

Would you consider that an additional buffer zone of 30m between the tip of the turbine blade and the 2nd Fresnel Zone would be a sufficient contingency ?

Best Regards,
Kevin Hayes,

11/03/21 – 2RN Response

I meant that if we end up with part of a turbine a little inside the 2nd zone, then we would need to come up with a contingency plan like an alternative link path. I think with 30m buffer outside of the 2nd VHF Fresnel zone and we will be just fine and risk of interference would be very low. Regards, Johnny

Johnny Evans
Head of Projects and Coverage Planning
2RN

C.2 Enet Response to Consultations

Enet provided the following email response to consultations to MKO in October 2020:

"We have three links possibly affected:"

A-End Coordinates	*A-End Antenna Height*	*B-End Coordinates*	*B-End Antenna Height*	*Frequency*
52°47'50.00"N 8°39'29.00"W	*15m*	*52°43'5.08"N 8°52'15.12"W*	*8m*	*15GHz*
52°47'50.00"N 8°39'29.00"W	*15m*	*52°42'32.48"N 8°53'36.76"W*	*12m*	*11GHz*
52°47'50.00"N 8°39'29.00"W	*15m*	*52°38'22.19"N 8°32'49.95"W*	*15m*	*13GHz*

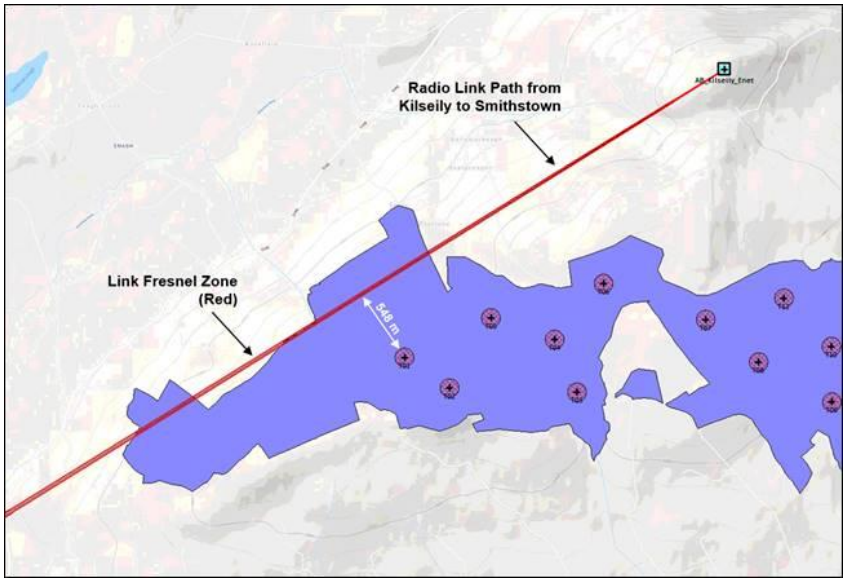
09/03/21 – Consultation Response sent by Ai Bridges to Enet

Hello Peter,

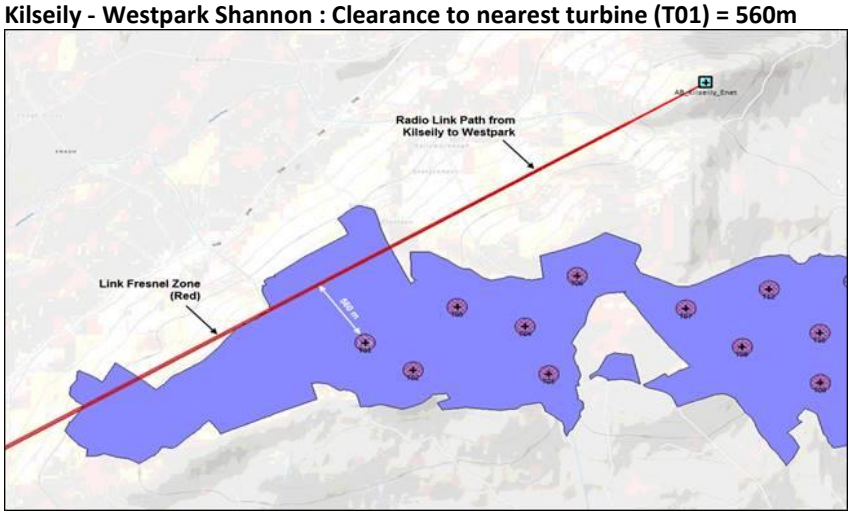
We are following up from the email in Oct 2020 below between you and MKO, the environmental consultants for the Violet Hill Wind Farm Development in Co. Clare
We have been requested to conduct a detailed analysis of the three links that you have identified during the initial consultations. We have included our details analysis below and we are seeing the loowing results
Our Network Analysis shows that the proposed turbines locations, included below, will not cause any interference on the three PTP radio links. We have inckuded a 3D analysis of the Kilseily – Kilonan link and this shows a clearance of 21.45m from the 2nd Fresnel to the tip of the nearet turbine t14.
We would be grateful if you could confirm if you are satisfied with our analysis that there will be no impacts on the links ?

Link ID	Nearest Turbine	Clearance Distance from turbine blade-tip to 2nd Fresnel (m)
Kilseily - Smithstown Shannon	T01	548
Kilseily Westpark, Shannon	T01	560
Kilseily - Kilonan	T14	21.45

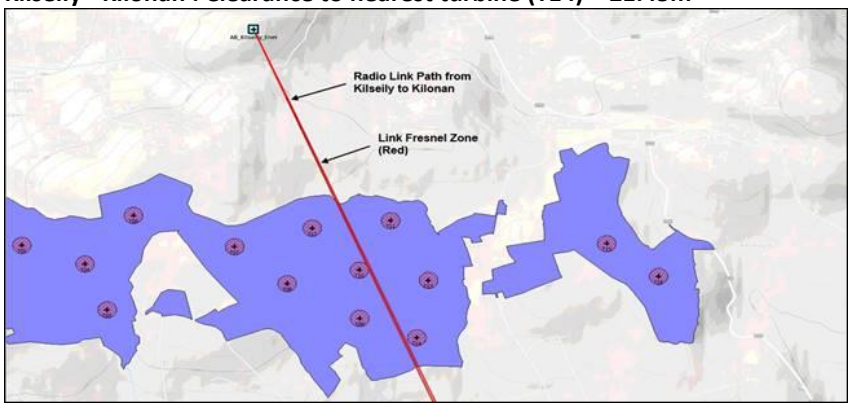
Kilseily - Smithstown Shannon : Clearance to nearest turbine (T01) = 548m

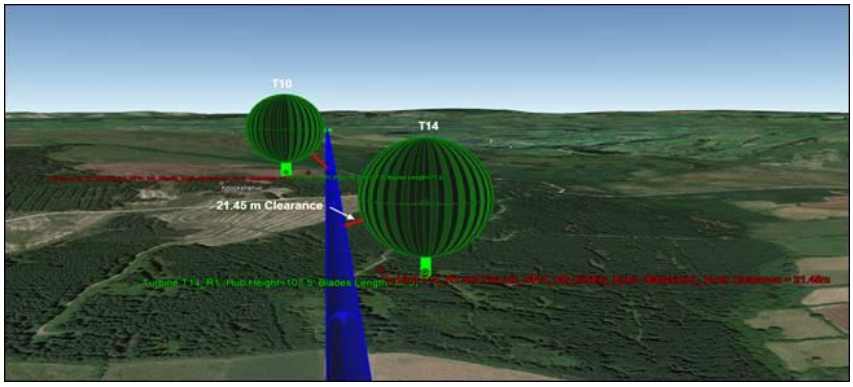


Kilseily - Westpark Shannon : Clearance to nearest turbine (T01) = 560m



Kilseily - Kilonan : Clearance to nearest turbine (T14) = 21.45m





No.	Latitude	Longitude	Height
5	52° 46' 42.695"N	8° 41' 13.507"W	57.53
4	52° 46' 36.882"N	8° 40' 45.046"W	57.53
3	52° 46' 22.661"N	8° 40' 35.044"W	57.53
7	52° 46' 42.251"N	8° 39' 37.562"W	57.52
12	52° 46' 48.037"N	8° 39' 2.623"W	57.51
11	52° 46' 50.352"N	8° 38' 27.258"W	57.5
10	52° 46' 34.982"N	8° 38' 41.429"W	57.5
9	52° 46' 19.974"N	8° 38' 41.234"W	57.5
15	52° 46' 43.241"N	8° 36' 49.886"W	57.47
16	52° 46' 33.048"N	8° 36' 26.501"W	57.46
8	52° 46' 30.782"N	8° 39' 13.941"W	57.51
13	52° 46' 31.826"N	8° 38' 10.227"W	57.49
14	52° 46' 13.948"N	8° 38' 15.458"W	57.49
2	52° 46' 23.770"N	8° 41' 31.972"W	57.54
1	52° 46' 32.041"N	8° 41' 52.121"W	57.54
6	52° 46' 51.974"N	8° 40' 23.196"W	57.53

Best Regards,
Kevin Hayes,

09/03/21 – Enet Response

Hi Kevin,

I just updated the coordinates for ESB Kilonan slightly - 52°38'22.31"N 8°32'49.49"W as they were slightly off,
Does this make much of a difference?

Thanks,
Peter

09/03/21 – Consultation Response sent by Ai Bridges to Enet

Hello Peter,

Thank you for your prompt response.
Our engineers have surveyed this mast and the original co-ordinates. And they found that the original co-ordinates were located in the filed outside the Mast compound.
Our engineers identified the correct mast co-ordinates on site, see below

Best Regards,
Kevin Hayes,

09/03/21 – Enet Response

Hi Kevin,

Thanks for checking that,
We'd obviously like more of a buffer distance but if you're satisfied our link won't be affected then we will accept this,

Best Regards,
Peter

09/03/21 – Consultation Response sent by Ai Bridges to Enet

Hello Peter,

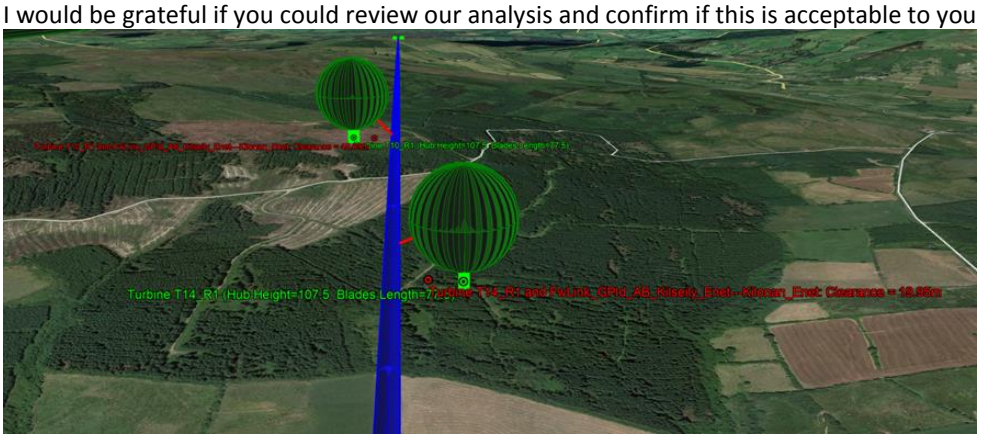
I have spoken with our engineers again and they have re-plotted the co-ordinates that you have provided and it appears that the eNet network equipment maybe located o0n the mast below i.e. identified in RED
Our engineers will re-plot the and carry out a revised analysis and we will revert to you later today

Best Regards,
Kevin Hayes,

10/03/21 – Consultation Response sent by Ai Bridges to Enet

Hello Peter,

I am following up in relation to our correspondence below . We have re-plotted based on the new co-ordinates for Kilonan and we are now seeing that the clearance from the tip of the nearest turbine T14 to the 2nd Fresnel is 19.95m i.e. reduced slightly from our initial calculations of 21.45m
Based on this clearance we would not expect there to be any impact from T14 on the Enet link from Kilseily to Kilonan.
I would be grateful if you could review our analysis and confirm if this is acceptable to you ?



Best Regards,
Kevin Hayes,

10/03/21 – Enet Response

Hi Kevin,

We'd obviously prefer more of a buffer to be 100% but if you are satisfied our link won't be affected then we will accept this,

Regards,
Peter

C.3 ESB Services Response to Consultations

ESB provided the following email response to consultations to MKO in October 2020:

> *"We have a significant amount of point to multipoint radio links and also 2 Point to Point radio links in the vicinity of the proposed Windfarm. I have plotted this links and also provided the site information for each of the links along with the heights and frequencies, please find attached report. If you require further information, please let me know.*
>
> *As this project progresses, please let us know as early as possible the coordinates of the proposed turbines which will allow us to carry out a more detailed impact analysis.*
>
> *Point to Multipoint radio Network assumed operation at 458 MHz:*
> *Highsite - Oatfield Radio site / 36m / 52.7720178 -8.6937100*
>
> *Out stations (Name/Height/Co-ordinates):*
> 1. *Spancil Hill PV / 3m / 52.862995374 -8.914414894*
> 2. *Ennis North 38kV / 10m / 52.8630980 -8.9837185*
> 3. *Corrawarrin 38kV / 6m / 52.393046 -8.96512*
> 4. *Tulla 38kV / 10m / 52.8608965 -8.7484190*
> 5. *Aughinish / 10m / 52.62509022 – 9.05109079*
> 6. *Cahircalla / 6m / 52.83054103 – 8.99197549*
> 7. *Clarecastle 38kV / 6m / 52.81157473 -8.96428549*
> 8. *Drumquin 38kV / 6m / 52.75953568 -9.03677044*
> 9. *Foynes 38kV / 12m / 52.60075827 -9.09632113*
> 10. *Rineanna 38kV / 10m / 52.71497674 -8.8805905*
>
> *Point to Point Network*
> *Link 1. Drumline 110kV to Oatfield Radio Site*
> *Drumline / 52.723679 -8.8620991 / 23m/ TX 11775MHz*
> *Oatfield RS/ 52.7720178 -8.6937100 / 25m / TX11265MHz*
>
> *Link 2. Parteen Weir to Oatfield RS /*
> *Parteen Weir / 52.761488 -8.4753191 /15m / TX 10895MHz*
> *Oatfield RS/ 52.7720178 -8.6937100 / 25m / TX11385MHz "*

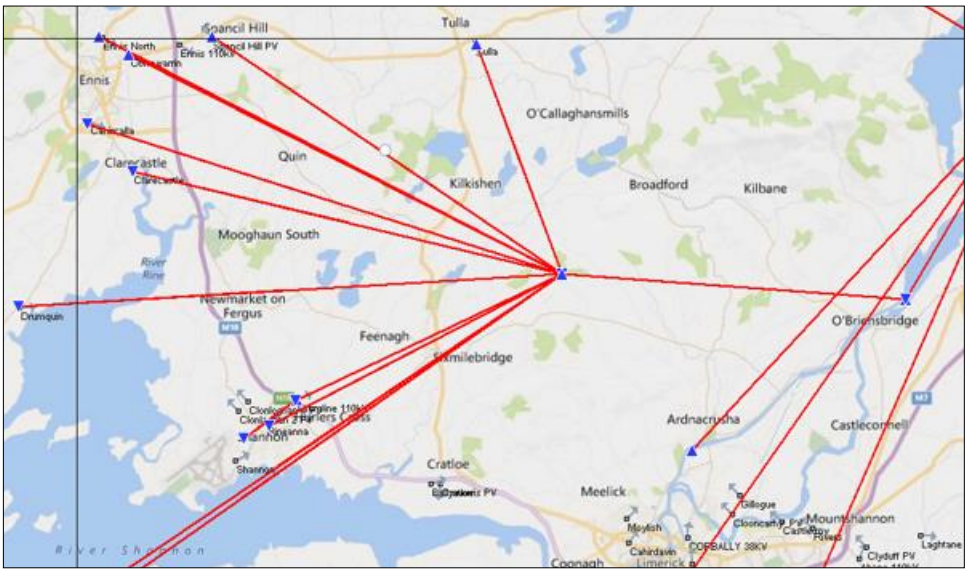


Figure 15. Graphic provided by ESB Services

19/04/21 – Consultation Response sent by Ai Bridges to ESB

Hello Myles,

I am following up with you in relation to our recent discussions regarding the Violet Hill Wind Farm. Our engineers have carried out a detailed technical analysis of the potential impacts of the proposed Violet Hill wind farm on the ESB Services telecommunications infrastructure at Oatfield mast.

In relation to the UHF PMP telemetry links our engineers have carried out a 3D modelling on all of the links and turbines. We have included the turbine co-ordinates in the email below.

Regarding the PTP link between Oatfield and Parteen Weir our analysis is showing a clearance of 44m from the nearest turbine.

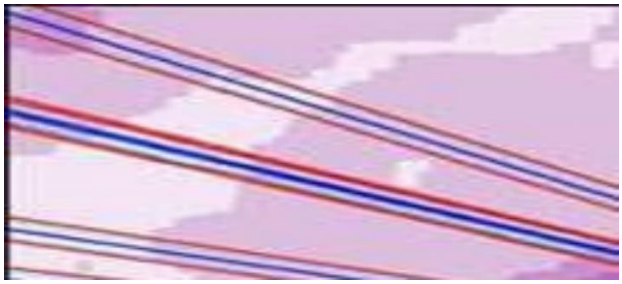
Our analysis is showing clearances that would be acceptable \ agreed clearances with mobile \ telemetry operators.

Would you be available later this week for a brief call

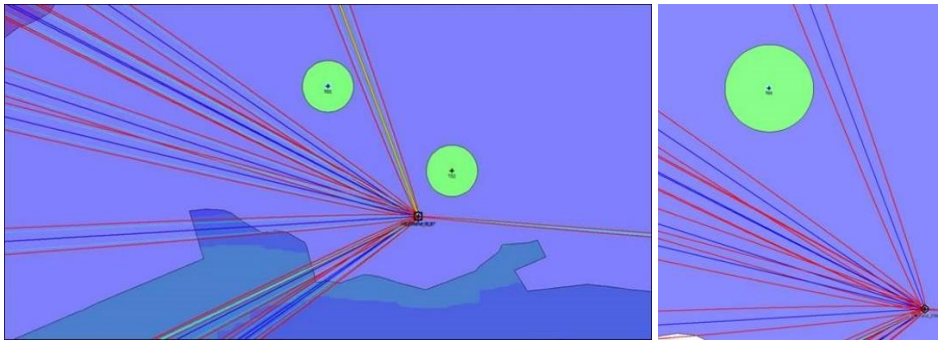
ESB – UHF PMP radio network analysis :

The nearest turbine to the ESB PMP radio network is Turbine 01. A plan view shows that T01 is the turbine that is closest to the PMP links from Outfield Mast i.e. the Tulla and Spancillhill links. A closer look at these shows that T01 is closest to the Tulla Link . A 3D analysis below shows the clearances to the links at Tulla, Spancillhill and Ennis North

1. **Plan View of the ESB Radio Network (PMP and PTP Links).**

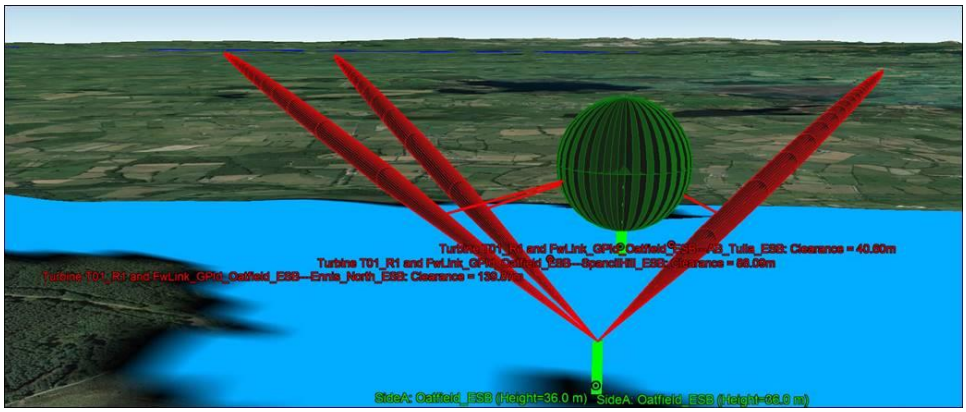


2. Close-up view of T01 relative to ESB PMP Links



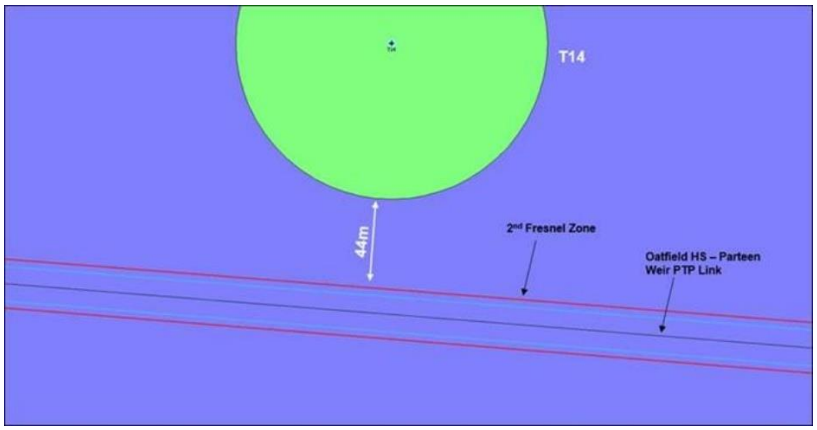
3. ESB Network - 3D Model of ESB Oatfield UHF PMP radio network

- Tulla Link Clearance : 40m
- Spancillhill Link Fresnel Clearance : 88m
- Ennis North Clearance : 139m



ESB PTP radio network :

The nearest turbine to the ESB PTP radio network is Turbine 14. There is a Clearance Distance of 44m between the turbine tip of T14 and the 2nd Fresnel zone of the Oatfield to Parteen Weir PTP radio link. This is shown below.



Turbine Co-ordinates

Name	Latitude	Longitude
1	52° 46' 32.041"N	8° 41' 52.121"W
2	52° 46' 23.770"N	8° 41' 31.972"W
3	52° 46' 22.661"N	8° 40' 35.044"W
4	52° 46' 36.882"N	8° 40' 45.046"W
5	52° 46' 42.695"N	8° 41' 13.507"W
6	52° 46' 51.974"N	8° 40' 23.196"W
7	52° 46' 42.251"N	8° 39' 37.562"W
8	52° 46' 30.782"N	8° 39' 13.941"W
9	52° 46' 19.974"N	8° 38' 41.234"W
10	52° 46' 34.982"N	8° 38' 41.429"W
11	52° 46' 50.352"N	8° 38' 27.258"W
12	52° 46' 48.037"N	8° 39' 2.623"W
13	52° 46' 31.826"N	8° 38' 10.227"W
14	52° 46' 13.948"N	8° 38' 15.458"W
15	52° 46' 43.241"N	8° 36' 49.886"W
16	52° 46' 33.048"N	8° 36' 26.501"W

23/04/21 – ESB Response

Hi Kevin,

Following up from our call the other day, I have forwarded the details of the proposed turbines to our third party radio consultants to carry out a detailed analysis of the potential impact to our operational radio network and to advise of any micrositing of necessary to ensure sufficient buffer zones are maintained.

I will let you know the outcome of the report and we can further our discussions once this has been completed. If you have any questions, please let me know.

Regards,

Myles

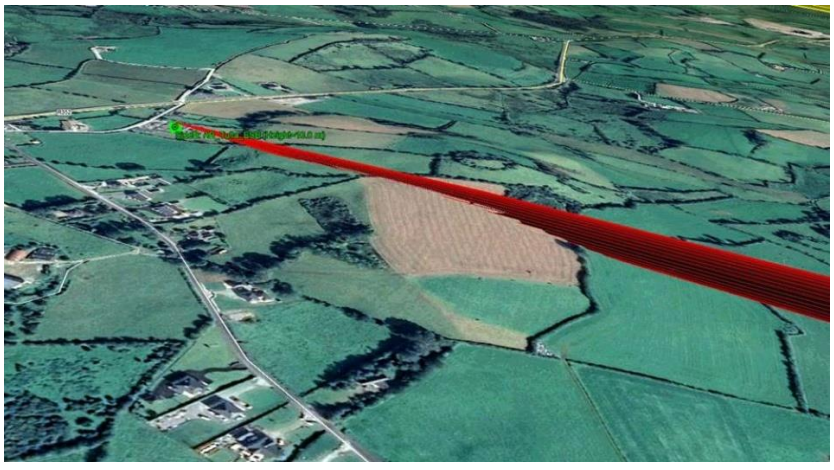
23/04/21 – Ai Bridges Response

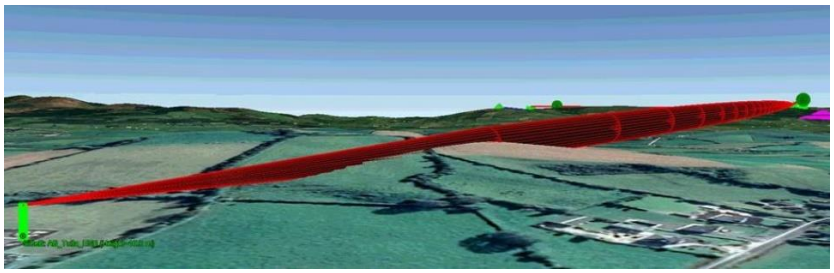
Hello Myles,

Thank you for your response below. Our engineers have carried our another detailed look at this link and they have provided another analysis below

They have taken a number of 3D plots showing the existing interference on the Tulla – Oatfield link due to "terrain blocking" . This analysis that the existing link is already severely by the terrain on the Tulla end of the link i.e. at 300m out. The final screenshot below shows that the terrain already encroaches into the critical 0.6 Fresnel zone . It can also be seen that the main boresight of this link is all blocked by terrain. On the basis that location of the proposed turbine T1 is 40m from the tip of the 2nd Fresnel Zone of the link this indicates that will be no impact from the

As discussed would it be possible that we could prepare a presentation that we would present to your Senior Management Team on MSTeams .





Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

10/09/21 – ESB Response

Note: The JRC Impact Report Referred to in the correspondence below is provided in Appendix D

Hi Kevin,

Please find attached report from JRC regarding the expected impact of the Violet hill windfarm development.

Please pay particular attention to Section 7 – Potential Mitigation.

JRC have recommended that to avoid impact to 1 microwave link, Oatfield to Parteen Weir, T14 must be agreed not to be micro-sited in a Southerly direction under any circumstance and if possible, can this be moved up to 50m in a northerly direction?

Turbines 1 and 2 have been identified as expected to impact 3 links, in particular Oatfield to Tulla 38kV and Oatfield to Corrawin 38kV. The only agreeable option for mitigation for these turbines is to move them, as recommended by JRC, outside of the 500m buffer zone.

Can you please review this and discuss the mitigation options that we have been recommended with the developer. Please advise if they agree to carry out the mitigations as suggested.

Regards,
Myles

04/10/21 – Ai Bridges Response

Hello Derek,

I am just following up from our call on Friday last. Thank you for taking the time for the call.

As discussed on our call I can confirm my availability for a call later today.

If possible I would like to address the concerns you raised in relation to interference from wind farm developments on the ESBN backbone microwave networks by focussing on the Violet Hill Wind Farm Development in East Clare, as per email below from Myles Redmond.

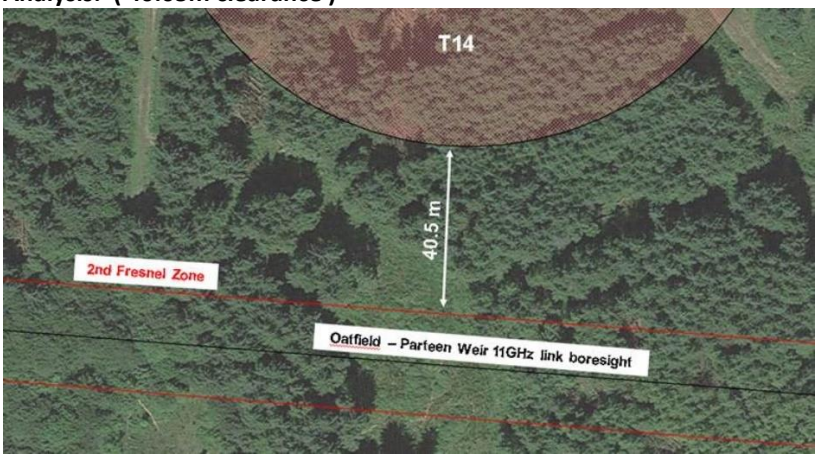
As discussed we model all microwave network links based on the same Fresnel Clearance criteria below as specified by ESB Networks consultants

- Microwave Links > 3 GHz 2nd Fresnel Zone

As per the agreed and accepted industry standard an additional 30mtr set-back clearance buffer has been applied the 2nd Fresnel zone and our engineers have modelled the closet turbine at T14 the Oatfield to Parteen Weir link based
on this standard i.e. 2nd Fresnel + 30m)

The link analysis below shows that there is no impact from the proposed location of T14. I am happy to discuss on our call later today.

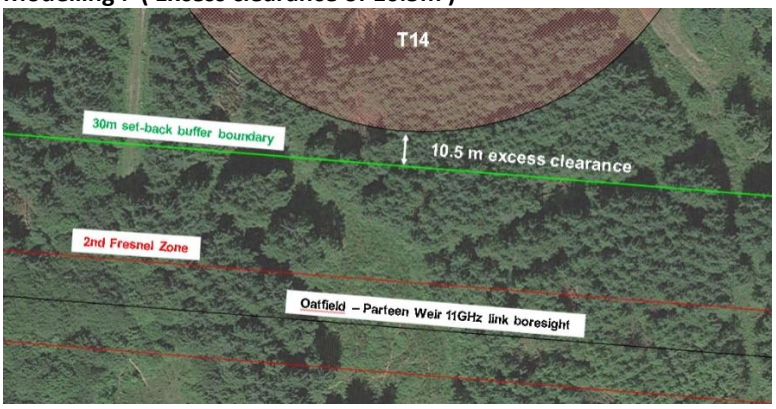
Oatfield – Parteen Weir 11GHz – Radio Link 2nd Fresnel Zone 2D Software Modelling Analysis: (40.05m clearance)



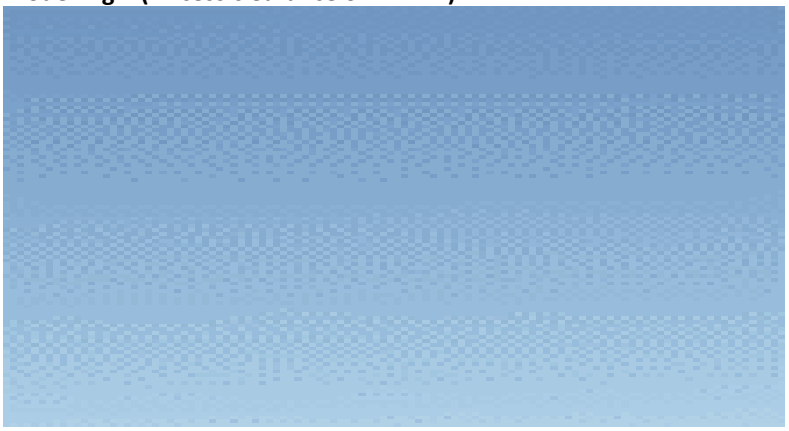
Oatfield – Parteen Weir 11GHz – Radio Link 2nd Fresnel 3D Software Modelling Analysis :

(41.12m clearance)

Oatfield – Parteen Weir 11GHz – Radio Link Set-back Buffer Boundary 2D Software Modelling : (Excess clearance of 10.5m)



Oatfield – Parteen Weir 11GHz – Radio Link Set-back Buffer Boundary 3D Software Modelling : (Excess clearance of 11.2m)



Best Regards,
Kevin Hayes,
Ai Bridges Ltd.,

C.4 Vodafone Ireland Response to Consultations

Vodafone provided the following email response to consultations to MKO in October 2020:

> *"Having analysed the location of the proposed development, I can say that the following links are in the area:*
>
> *CE034 Oatfield ESB (52.7719, -8.6928) – CE066 Quin (52.7837, -8.8532)*
>
> *CE058 Knocksis (52.8013, -8.6653) – CE066 Quin (52.7837, -8.8532)"*

Figure 16. Graphic provided by Vodafone Ireland.

11/03/21 – Consultation Response sent by Ai Bridges to Vodafone

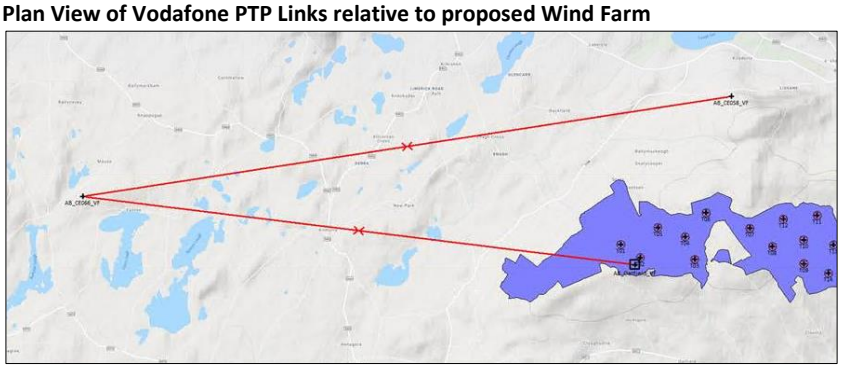
Hello Sean,

We are following up from your email correspondence with MKO in October 2020 in relation to the proposed Wind Farm Development at Violet Hill, Co. Clare.
We have been requested to conduct a detailed analysis of the two links that you have identified during the initial consultations. We have included our details analysis below.

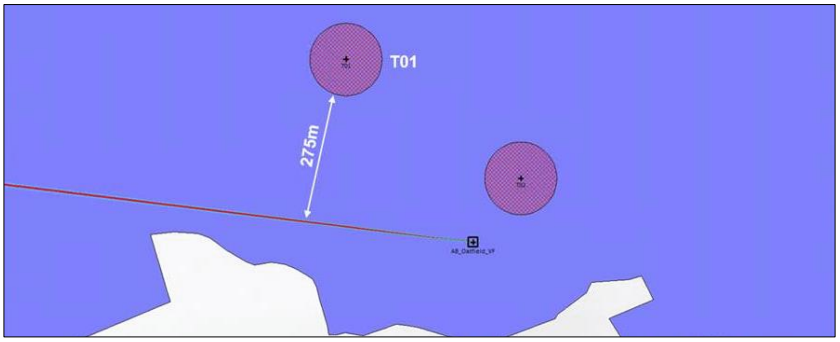
Our Network Analysis shows that the proposed turbines locations, included below, will not cause any interference to the two Vodafone PTP radio links.
We would be grateful if you could confirm if you are satisfied with our analysis that there will be no impacts on the links.

Link ID	Nearest turbine along radio link Path	Clearance Distance from turbine blade-tip to Fresnel Zone (m)
CE034 Oatfield ESB (52.7719, -8.6928) – CE066 Quin (52.7837, -8.8532)	T01	275
CE058 Knocksis (52.8013, -8.6653) – CE066 Quin (52.7837, -8.8532)	N/A (Radio link does not cross wind farm)	N/A

Plan View of Vodafone PTP Links relative to proposed Wind Farm



Close-up view of Oatfield - Quin PTP Link relative to nearest turbine along radio link path (T01)



Violet Hill Turbines Co-ordinates

No.	Latitude	Longitude
5	52° 46' 42.695"N	8° 41' 13.507"W
4	52° 46' 36.882"N	8° 40' 45.046"W
3	52° 46' 22.661"N	8° 40' 35.044"W
7	52° 46' 42.251"N	8° 39' 37.562"W
12	52° 46' 48.037"N	8° 39' 2.623"W
11	52° 46' 50.352"N	8° 38' 27.258"W
10	52° 46' 34.982"N	8° 38' 41.429"W
9	52° 46' 19.974"N	8° 38' 41.234"W
15	52° 46' 43.241"N	8° 36' 49.886"W
16	52° 46' 33.048"N	8° 36' 26.501"W
8	52° 46' 30.782"N	8° 39' 13.941"W
13	52° 46' 31.826"N	8° 38' 10.227"W
14	52° 46' 13.948"N	8° 38' 15.458"W
2	52° 46' 23.770"N	8° 41' 31.972"W
1	52° 46' 32.041"N	8° 41' 52.121"W
6	52° 46' 51.974"N	8° 40' 23.196"W

Best Regards,
David McGrath.

15/03/21 – Vodafone Response

Hi David,

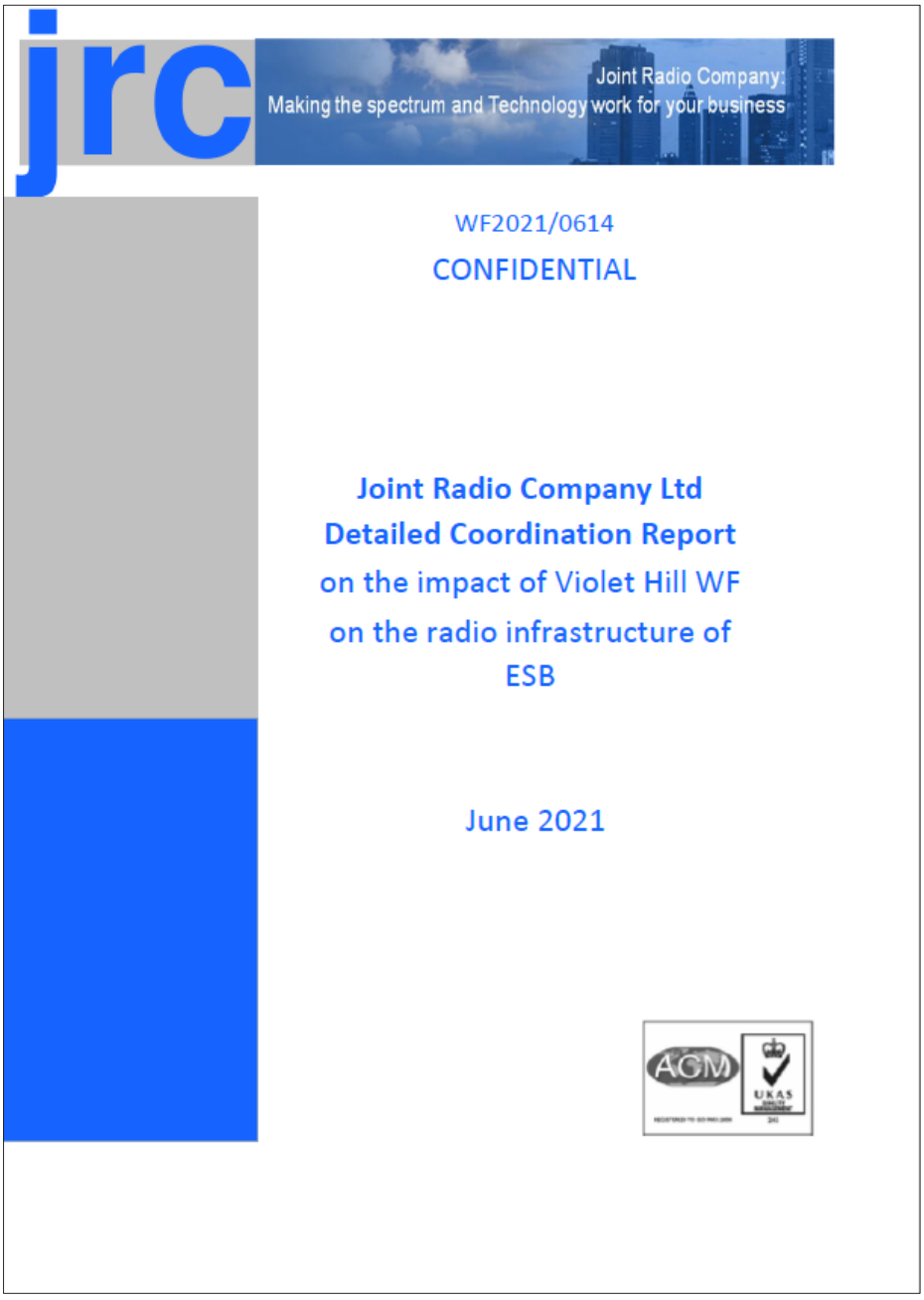
Yes, I am happy that this more than satisfies the minimum requirement on our end.

APPENDIX D – JRC Impact Report (ESB Network, June 2021)

Appendix D – JRC Impact Report (ESB Network, June 2021)

The Impact Assessment Report compiled by JRC (Joint Radio Company Ltd) is provided below.

Note: In 2021 the proposed development consisted of 16-turbines and was refers to as "*Violet Hill Wind Farm*"



Executive Summary

This report presents the results of an investigation into the effects of potential interference caused to ESB licensed radio systems by the construction of the Violet Hill Windfarm. The windfarm details are as per the email information by ESB.

We note the information supplied by AI Bridges and from that information they appear to have attempted an analysis based on Optical LOS principles without any consideration of diffraction or scatter impacts without which any analysis will be wildly optimistic in favour of the WF operator.

A summary of the detailed assessment is given in the table below.

On Initial analysis T1, T2, T5, T8 and T14 were identified as having potential impact on one or more operational links, detailed analysis quickly cleared T5 & T8 as not being a risk (based on their current notified position / size (with assumed 50m micro-siting).

T1, T2 and T14 of the proposed windfarm fail one or more criteria with respect to one or more operational links as detailed in the table below.

Although the final decision on any objection rests with the link operator, our recommendation will be to Object to this proposal if submitted for planning.

UHF Link Affected	Turbine No	Obstruction	Diffraction	Reflection/ Scattering	Comment
Oatfield to Tulla 38KV	1	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Tulla 38KV	2	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Corrawin 38KV	1	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Corrawin 38KV	2	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Foynes 38KV	1	Pass	Pass	Pass	No concern after detailed analysis
Oatfield to Foynes 38KV	2	Pass	Pass	Fail	Due to the proximity to the A end this Turbine will cause significant issues

Table 1.1: Summary of turbine assessment on potentially affected UHF links

Microwave Link Affected	Turbine NO	Obstruction	Diffraction	Reflection/ Scattering	Comment
Oatfield to Parteen Weir	14	Pass	Fail	Fail	Can be mitigated by micro-siting restrictions
Oatfield to Drumline 110KV	1	Pass	Pass	Pass	No concern after detailed analysis
Oatfield to Drumline 110KV	2	Pass	Pass	Pass	No concern after detailed analysis

Table 1.2: Summary of turbine assessment on potentially affected Microwave links

Potential mitigation solution/s have been identified to resolve the issues, but this will require relocation / micro-siting limitations on Turbines 1,2 & 14

Any changes to the proposed wind farm (other than those detailed in the mitigation section) will require a new analysis since these results will no longer apply. This analysis is correct as of the advised configuration on 19th April 2021.

Document Control

Issue	Date	Change History	Authority
0.1	10/06/21	Initial Draft	JSB
0.2	15/06/21	Initial Review	LK
0.3	15/06/21	Technical review & updates	AB/AL
1.0	15/06/21	Final Review	RL

Distribution	
Windfarm Developer	N/A
Link Operator	ESB – Myles Redmond
JRC	N:\WindFarms\WindFarms\Republic of Ireland\Violet Hill WF (ESB project)

Published by The Joint Radio Company Ltd.

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<www.jrc.co.uk/about-jrc >

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NOTICE: This report is a study of the predicted effect of the stated development on those radio systems defined in this document and shall not be used for any other purpose.

The information supplied in this document is strictly confidential and is intended for the use of the customer only. It shall not be disclosed to or used by any third party without the written permission of an authorised representative of JRC Ltd.

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Disclaimer

The assessment of the effect of windfarms on radio links is based on a combination of statistical modelling and radio propagation predictions. JRC has developed its methodology based on published documents and best practice within the industry, but the nature of radio propagation and the statistical approximations inherent in the planning tools mean that JRC cannot offer any guarantee that the effects will be exactly as predicted. However, the influence of wind turbines on UHF telemetry and microwave links is sufficiently well understood to have reasonable confidence in the predicted effects. JRC cannot be held responsible for any inaccuracies in data provided by third parties.

The use of the radio spectrum is dynamic and new radio links are being planned and installed all the time. As a result, you are advised to seek re-coordination prior to submitting a formal planning application. This will avoid the possibility of an objection being raised at that time due to any new links being assigned between the publication of this report and the finalisation of your project. Only when a windfarm proposal has been submitted for planning permission will JRC or its member companies take into account the proposal when planning new radio-based services.

If mitigation is required that involves the re-routing of link paths, then these paths will not be protected against new proposed turbine developments in the planning system until an agreement has been reached between the developer and the link operator and the links have been licensed and installed.

This report appertains only to the date of its issue and the configuration of the windfarm and radio links detailed in Sections 3 and 4 of this document. Any changes to the windfarm development after this report is issued, especially changes in the location or profile of any of the turbines, may negate the analyses that have been conducted.

Contents

1 Background

The adverse effect of Wind farms on radio propagation is relatively well understood, and several sophisticated modelling tools exist to predict the effects. The large rotating elements are a particular challenge in the radio environment.

JRC is the radio spectrum manager for the UK gas and electricity industry and is experienced in radio engineering associated with operational radio systems used by the utilities. It is therefore uniquely placed to investigate the potential impact of proposed wind farm developments. JRC is also a part of the energy sector and therefore committed to finding solutions to the problems posed by windfarms.

1.1 Radio systems affected

There are three main classes of utility operational services that might be affected by a wind farm.

Microwave fixed links: used for point-to-point communications, typically operating in frequency bands of 1.4/1.5 GHz, 6 GHz, 7.5 GHz, 10/11GHz, 13/14 GHz, 23 GHz, 26 GHz, 38 GHz and 58 GHz and employing a variety of digital modulation techniques.

Scanning Telemetry and Telecontrol links: used for point to multi-point communications in accordance with OfW49 in the UHF 450-470 MHz band and 140 MHz band.

Private Mobile Radio (PMR): for communications with mobile and hand-held radios. For the electricity industry, these systems usually operate around 140 MHz and employ MPT1327 or DMR trunking protocols. JRC do not coordinate wind turbines with PMR systems except when the turbine is very close (<500m) to the Transmitter site.

JRC uses a simple buffer coordination zone to initially determine which radio links may be impacted by the wind farm.

Radio Link Frequency	Buffer distance for coordination
Below 1 GHz	1000m
Above 1 GHz	500m

Table 1.1 : Initial coordination buffer distances

To the rear of the link, where a directional antenna is in use, the buffer distance is halved.

1.2 Mechanisms by which wind farms may affect radio transmissions

The effects of wind turbines on radio transmissions can be described under three main headings:

Obstruction: Where the wind farm is physically obstructing the direct radio path, attenuating the received signal.

Diffraction: Where a wind farm, although not directly obstructing the radio signal causes interference patterns to be generated (Fresnel Zone Interference).

Reflection/Scattering: Where the radio waves are reflected or scattered by the wind farm and interfere with the wanted signal.

Wind turbines pose problems for radio transmissions as the turbines tend to occupy the high ground also used by the radio infrastructure, and their size implies that they offer radio interference paths that may be superior to the designed radio path profile.

The sensitivity of a particular radio service to interference will depend on the radio parameters, including the frequency, modulation and the polarisation of the radio signal.

The severity of the effect on radio signals will depend on the construction of the turbine including the height, blade size, construction material, blade rotation, the pitch of the turbine blades, the yaw of the turbine nacelle and moisture retention or icing of the turbine blades.

2 Scope

It was agreed that JRC will undertake the following activities to assess the impact of the proposed Violet Hill wind farm.

- To undertake a detailed study and survey into the existing radio communication infrastructure within the area of the wind farm to confirm the parameters for the services operated by ESB.
- To review the theoretical analysis of the impact of the proposed wind turbine position on the licensed radio systems.
- This report was undertaken using information supplied by ESB.

3 Proposed windfarm development

Turbine No.	Lat	Long	Hub Height (m)	Rotor Diameter (m)	Tip Height (m)
1	52° 46' 32.041"N	8° 41' 52.121"W	90	45	135
2	52° 46' 23.770"N	8° 41' 31.972"W	90	45	135
3	52° 46' 22.661"N	8° 40' 35.044"W	90	45	135
4	52° 46' 36.882"N	8° 40' 45.046"W	90	45	135
5	52° 46' 42.695"N	8° 41' 13.507"W	90	45	135
6	52° 46' 51.974"N	8° 40' 23.196"W	90	45	135
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8	52° 46' 30.782"N	8° 39' 13.941"W	90	45	135
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10	52° 46' 34.982"N	8° 38' 41.429"W	90	45	135
11	52° 46' 50.352"N	8° 38' 27.258"W	90	45	135
12	52° 46' 48.037"N	8° 39' 2.623"W	90	45	135
13	52° 46' 31.826"N	8° 38' 10.227"W	90	45	135
14	52° 46' 13.948"N	8° 38' 15.458"W	90	45	135
15	52° 46' 43.241"N	8° 36' 49.886"W	90	45	135
16	52° 46' 33.048"N	8° 36' 26.501"W	90	45	135

Table 3.1 : Wind farm parameters

Development parameters used for the analysis is as per the information by ESB. Any modifications from these details will require a new analysis.

4 Affected radio links.

ESB operates one or more UHF telemetry links and one or more microwave links within the coordination zone. The end point of these links has been verified by JRC.

Site A Name	Link Type	Site A Easting	Site A Northing	Site B Name	Site B Easting	Site B Northing
OATFIELD RS HS1	UHF / SCADA	153229	169183	TULLA 38KV	149647	179116
OATFIELD RS HS1	UHF / SCADA	153229	169183	CORRAWARRIN	134997	178798
OATFIELD RS HS1	UHF / SCADA	153229	169183	FOYNES 38KV	125766	150462
OATFIELD RS HS1	Microwave	153229	169183	Parteen Weir	167965	167902
OATFIELD RS HS1	Microwave	153229	169183	Drumline 110KV	141807	163937

Table 4.1 : Radio Link Parameters

The proposed wind turbine layout and the relationship to the affected radio links can be seen in the following diagram,

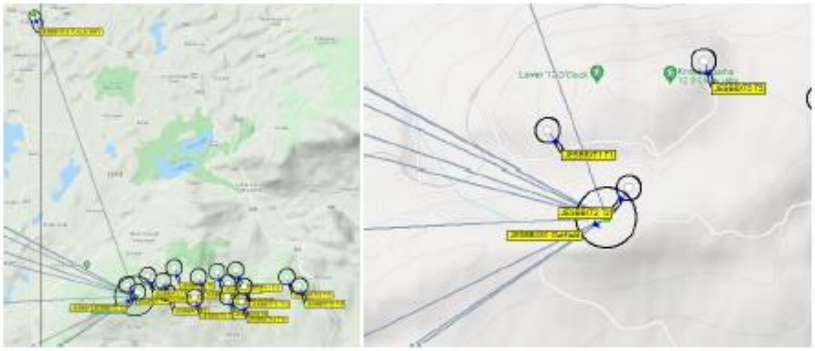

Figure 4-1 : Radio Link and Turbine Location

A larger version of this appears in Appendix A: Disposition of the turbine in relation to ESB link infrastructure

5 Impact Assessment Methodology

5.1 Calculation Method

The analysis of the potential impact of the proposed wind farm follows the methods set out in the JRC paper "Calculation of The Clearance Zone" [1]. A full explanation of this method can be found in on the JRC web site https://www.jrc.co.uk/what-we-do/wind-farms .
When protecting link availability approaching 99.9%, the wind turbine must be profiled in the worst case, i.e. with maximum horizontal profile, maximum radar cross section, maximum Doppler shift, etc. It is accepted that all of these conditions will not be fulfilled at all times, and in practice may only be for a small percentage of time, but the total tolerance for loss of service to such a link is no more than 0.1% of the time.

JRC employs a number of tools to complete the wind farm assessment:

- An in-house tool developed within MapInfo is used for identifying the potentially affected links and their location relative to the proposed turbines
- ATDI's HTZ radio planning tool to calculate the predicted path loss for the link path and for the path between the link ends and the turbine. HTZ is integrated with the 20m terrain dataset and 20m (for the Island of Ireland) clutter datasets and building data where available and uses ITU-R P.525 and P.526 with Delta Bullington diffraction propagation algorithms.
The JRC method calculates both the diffraction clearance and reflection / scattering clearance required to protect the link from interference.

5.2 Diffraction Clearance zone calculation.

The Diffraction Clearance assessment used by JRC is that the no part of the windfarm turbine should encroach on the appropriate Fresnel clearance zone given in Table 5.1 : Fresnel Clearance Zones.

Frequency	Clearance criteria
UHF	60% of the 1st Fresnel zone
1 to 3 GHz	1st Fresnel zone
Microwave Links > 3 GHz	2nd Fresnel zone

Table 5.1 : Fresnel Clearance Zones

A buffer zone is added to the diffraction clearance to allow for location uncertainty of the link ends and turbine construction. This buffer zone varies from 25m to 150m depending on the accuracy of the link locations. An additional allowance is also added for turbine micro-siting which can vary from 100m to 25m depending on the information provided. These buffer figures may be reduced if a JRC site survey is undertaken.
To complement the basic clearance, the 3D diffraction clearance can be visualised using the MapInfo tool.

5.3 UHF Telemetry links Reflection / Scattering interference method.

HTZ is used to predict the path loss from the link transmitter to the turbine and then from the turbine to the receive end of the link. The field strength from this reflected path is compared to the measured and predicted field strength on the direct link. Where predicted, the links are calculated in accordance with OFW49 in the UK or the appropriate system for other countries unless the link is already known to be degraded, in which case the measured signal strength is used where available.

The wanted to unwanted ratio is calculated according to the JRC method detailed in the paper "Calculation of The Clearance Zone" [1].

If the reflection angle is less than 90 degrees, it is calculated assuming worst case micro siting and uncertainty buffer (towards the link) for forward scatter.

For yagi antennas at the outstation, a standard mask is used to determine antenna response. For nonstandard antennas, then the impact is assessed using both the standard mask and using the bespoke antenna pattern to determine the impact.

6 Results

A summary results of the detailed analysis can be seen in the table below:

UHF Link Affected	Turbine NO	Obstruction	Diffraction	Reflection/ Scattering	Comment
Oatfield to Tulla 38KV	1	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Tulla 38KV	2	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Corrawin 38KV	1	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Corrawin 38KV	2	Fail	Fail	Fail	Due to the proximity to the A end this Turbine will cause significant issues
Oatfield to Foynes 38KV	1	Pass	Pass	Pass	No concern after detailed analysis
Oatfield to Foynes 38KV	2	Pass	Pass	Fail	Due to the proximity to the A end this Turbine will cause significant issues

Table 6.1 : JRC Calculation Results

7 Potential Mitigation

Turbines 1 & 2

Turbines 1 & 2 are very close to the Oatfield Radio site, and it is impossible to provide any mitigation for these turbines in the stated positions, the only solution to avoid interference to the existing UHF links would be for the two turbines to be moved outside the 500m buffer zone around the Oatfield Radio site and the link paths as detailed in the diagram below.

Effectively this would entail moving the turbines North, Northeast or due South of their current positions rather than southeast due to potential impact on the Microwave link to Parteen Weir.

Whilst we have detailed the impact on the UHF links between Oatfield, Tulla, Corrawarrin and Foynes it is entirely possible for there to be intermittent impact on some of the other UHF links due to the proximity of these turbines to the base station site.

Oatfield to Parteen Wier Microwave Link

This link which currently fails on W/U by some 6.9dB below the required threshold in particular respect to T14 could pass if there was a limitation of 10m micro-siting applied to T14 (particularly in a southerly direction toward the link) therefore a wider micro-siting allowance can apply in the Northerly direction.

Equally moving T14 north by greater than 50m would allow this one to pass the Threshold with normal 50m micro-siting allowance.

Either of these two solutions would allow the link to coexist with T14 now exceeding the required W/U threshold by some 7.6dB

8 References

[1] "Calculation of the Clearance Zone". Peter Swan, et al. Version 3.1, September 2009, Joint Radio Company Ltd.

[2] "Fixed-link wind-turbine exclusion zone method". Dr. David Bacon. Version 1.1, 28 October 2002, UK Radiocommunications Agency (now part of Ofcom).

[3] Ofcom Independent Report on RF Measurement Assessment of Potential Wind Farm Interference to Fixed Links and Scanning Telemetry Devices, published in March 2009.

NOTE: More information on how JRC assesses Wind Energy Developments and links to other reference documents can be found on the JRC Web Site: http://www.jrc.co.uk/wind-farms

9 Appendix A: Disposition of the turbine in relation to ESB link infrastructure

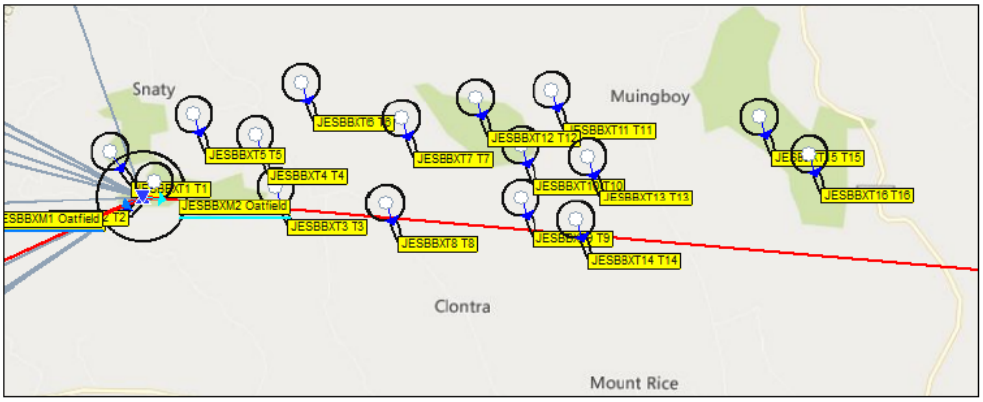

Figure 9-1 : Turbine locations with respect to ESB Links

10 Appendix B: Path Profiles and Analysis

10.1 UHF Point to Multi Point telemetry links

10.1.1 Link Oatfield RS HS1 to Tulla 38KV Station

There is a single scanner connected to a single omnidirectional antenna at Oatfield RS.

There is a single vertically polarised 12 element Yagi antenna in use at the existing Tulla 38KV Substation.

The worst case (B-A) radio path analysis for the link can be seen in the following diagram Figure 10-2.

10.1.1.1 Overview of impact from proposed Turbines / WF installation

The impact of T1 and T2 on this link is significant as shown by the combined 16dB below the required threshold of 38dB for normal operation in accordance with the established JRC methodology for measuring WF interference on UHF and microwave link.

T 5 has minimal impact and on its own passes (just) and is not considered in the final result.

It can be seen from the Reflected Ray diagrams (below) that the main concern is the proximity of turbines 1 & 2 to the A end of the links at Oatfield RS thus the only possible mitigation is to move them outside the minimal buffer of 500m from the base station and associated links – See diagram in mitigation section.

10.1.1.2 Diffraction clearance (Fresnel interference)

For links below 1 GHz; the criterion used is that no part of a turbine should enter area defined by 60% of first Fresnel zone of the link.

To this is added a buffer zone to allow for location inaccuracy of the link ends and turbine construction and ellipsoid conversion anomalies; in this instance JRC has used 15m.

An allowance for micro-siting must be included. As we have no specified value from the developer, we have assumed the typical value of 50m.

The three-dimensional clearance is assessed for all the turbines against each link and can be seen in the figures below:

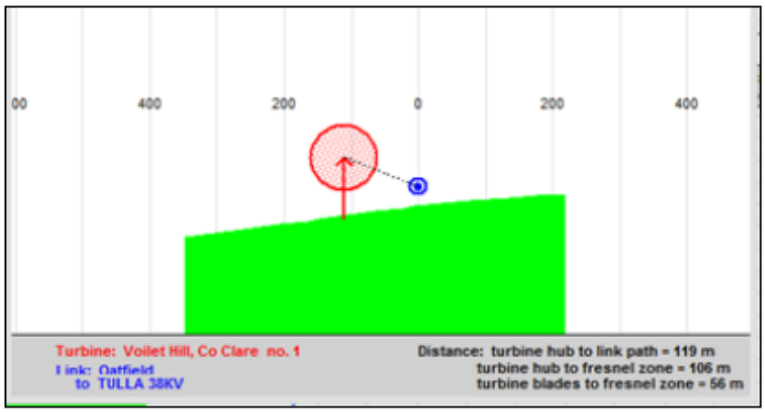

Figure 10-1: 'Basic' three-dimensional clearance for Turbine 1

(Not including buffer or micro-site).

The required clearance between turbine tip and Fresnel zone is 100m therefore as can be seen in the figure above and in the results table, Turbine 1 Fails the diffraction clearance assessment.

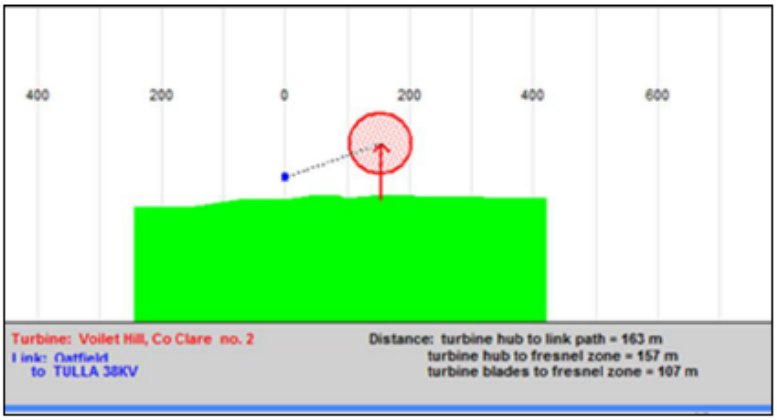

Figure 10-2: 'Basic' three-dimensional clearance for Turbine 2

(Not including buffer or micro-site).

The required clearance between turbine tip and Fresnel zone is 100m therefore as can be seen in the figure above and in the results table, Turbine 2 Fails the diffraction clearance assessment.

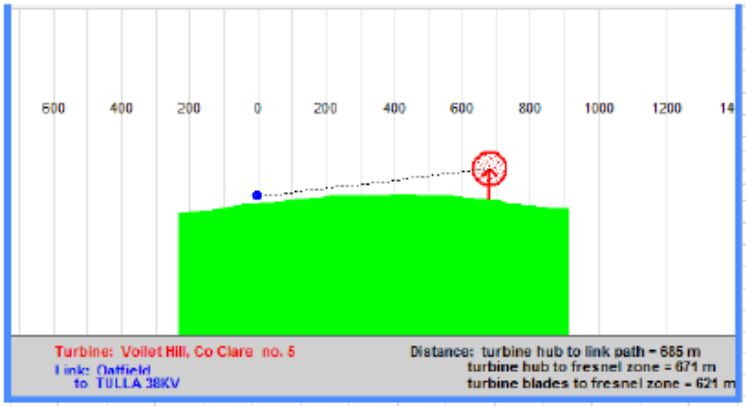

Figure 10-3: 'Basic' three-dimensional clearance for Turbine 5
(Not including buffer or micro-site).

The required clearance between turbine tip and Fresnel zone is 100m therefore as can be seen in the figure above and in the results table, Turbine 5 Passes the diffraction clearance assessment.

10.1.1.3 UHF Telemetry links Reflection/Scattering interference.

The existing links operate in the 460 MHz band. The turbines when added should therefore not reduce the W/U ratio of the link below the JRC threshold of 38dB.

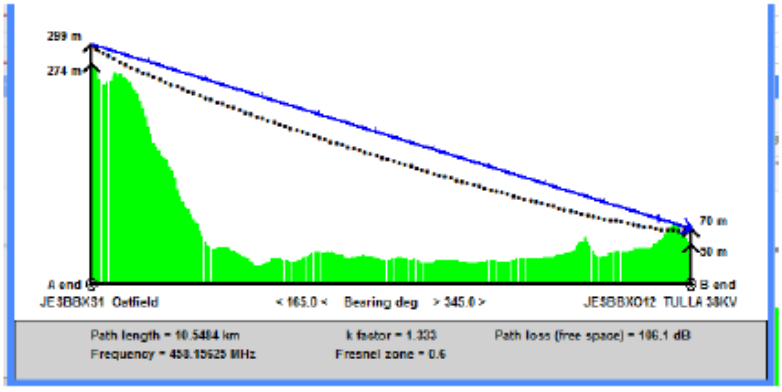

Figure 10-4 : Radio path analysis B-A

As can be seen from the profile above, the link path is partially obstructed.

The predicted path loss is 115.4dB, Since the link path is partially obstructed, predicted loss rather than free space loss has been used for the main path.

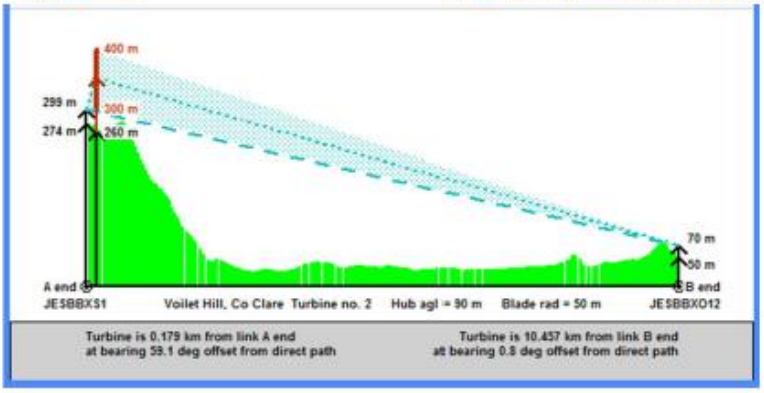

Figure 10-5 : Basic radio reflection diagram for Turbine 1

Turbine 1 has a slightly obstructed path to the link path therefore, predicted loss is used in the initial Wanted to Unwanted calculation

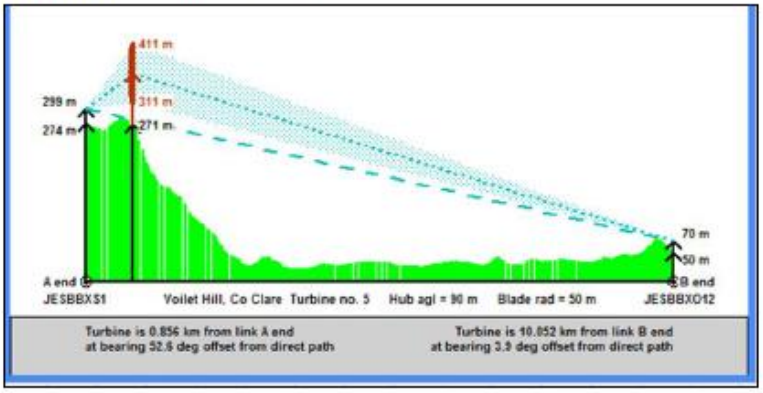

Figure.10-6 : Basic radio reflection diagram for Turbine 2.

Turbine 2 has a slightly obstructed path to the link path therefore, predicted loss is used in the initial Wanted to Unwanted calculation

10.1.1.4 W/U Result

JRC W/U Power Sum including antenna discrimination & scatter Threshold = 38			
All Turbines	21.8	Selected turbines	21.9
Above Threshold	-16.2	Above Threshold	-16.1

10.1.2 Link Oatfield RS HS1 to Corrawarrin 38KV Station

There is a single scanner connected to a single omnidirectional antenna at Oatfield RS.

There is a single vertically polarised 12 element Yagi antenna in use at the existing Corrawarrin 38KV Substation.

The worst case (B-A) radio path analysis for the link can be seen in the following diagram Figure 10-2.

10.1.2.1 Overview of impact from proposed Turbines / WF installation

Although not a direct obstruction the impact of T1 on this link is significant as shown by the combined 1.1dB below the Required threshold of 38dB for normal operation in accordance with the established JRC methodology for measuring WF interference on UHF and microwave link.

T 2 has minimal impact and on its own passes (just) and is not considered in the final result.

It can be seen from the Reflected Ray diagrams (left) that the main concern is the proximity of turbines 1 & 2 to the A end of the links at Oatfield RS thus the only possible mitigation is to move them outside the minimal buffer of 500m from the base station and associated links – See diagram in mitigation section.

10.1.2.2 Diffraction clearance (Fresnel interference)

For links below 1 GHz; the criterion used is that no part of a turbine should enter area defined by 60% of first Fresnel zone of the link.

To this is added a buffer zone to allow for location inaccuracy of the link ends and turbine construction and ellipsoid conversion anomalies; in this instance JRC has used 15m.

An allowance for micro-siting must be included. As we have no specified value from the developer, we have assumed the typical value of 50m.

The three-dimensional clearance is assessed for all the turbines against each link and can be seen in the figures below:

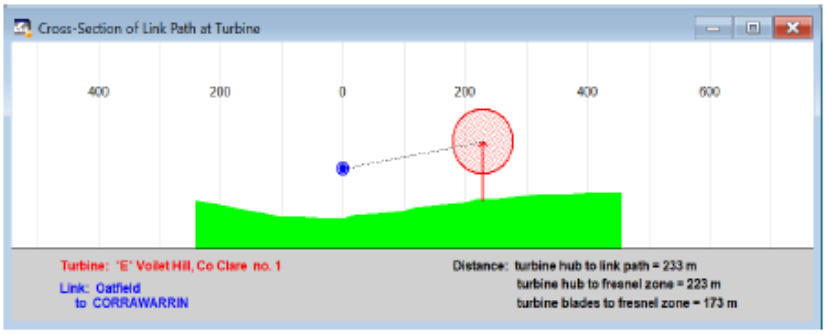

Figure 10-7: 'Basic' three-dimensional clearance for Turbine 1

(Not including buffer or micro-site).

The required clearance between turbine tip and Fresnel zone is 100m therefore as can be seen in the figure above and in the results table, Turbine 1 Passes the diffraction clearance assessment.

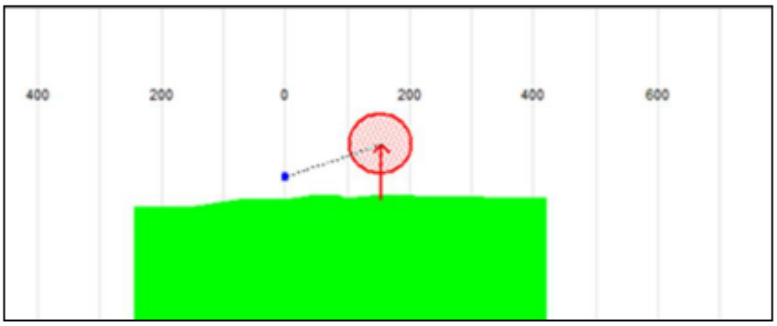

Figure 10-8: 'Basic' three-dimensional clearance for Turbine 2
(Not including buffer or micro-site).

The required clearance between turbine tip and Fresnel zone is 100m therefore as can be seen in the figure above and in the results table, Turbine 2 Passes the diffraction clearance assessment.

10.1.2.3 UHF Telemetry links Reflection/Scattering interference.

The existing links operate in the 460 MHz band. The turbines when added should therefore not reduce the W/U ratio of the link below the JRC threshold of 38dB.

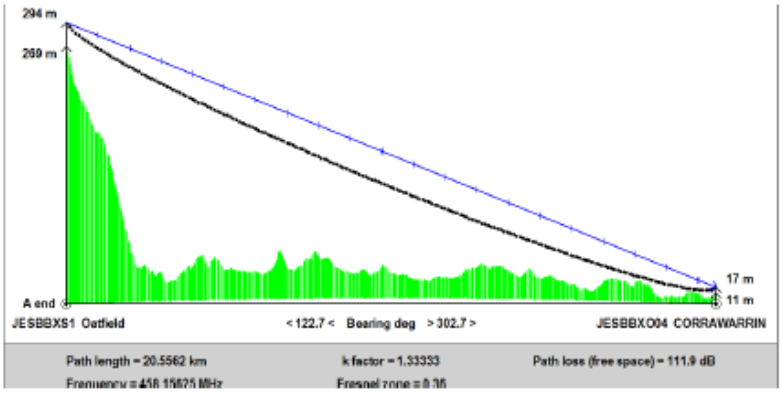

Figure 10-9 : Radio path analysis B-A

As can be seen from the profile above, the link path is partially obstructed.

The predicted path loss is 140.7dB, Since the link path is partially obstructed, predicted loss rather than free space loss has been used for the main path.

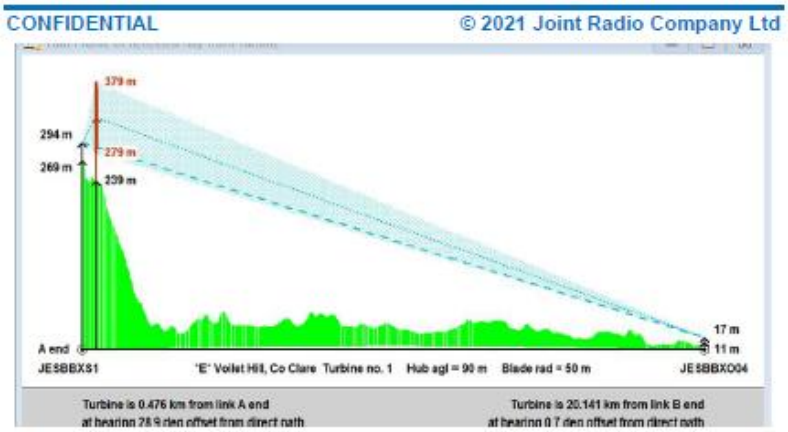

Figure 10-10 : Basic radio reflection diagram for Turbine 1

Turbine 1 has a slightly obstructed path to the link path therefore, predicted loss is used in the initial Wanted to Unwanted calculation

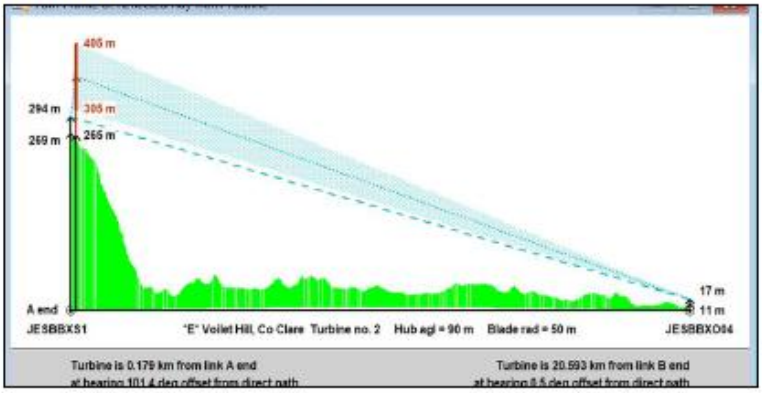

Figure.10-11 : Basic radio reflection diagram for Turbine 2.

Turbine 2 has a slightly obstructed path to the link path therefore, predicted loss is used in the initial Wanted to Unwanted calculation

10.1.2.4 W/U Result

JRC W/U Power Sum including antenna discrimination & scatter			
All Turbines	27.3	Selected turbines	27.9
Above Threshold	-10.7	Above Threshold	-10.1

10.1.3 Link Oatfield RS HS1 to Foynes 38KV Station

There is a single scanner connected to a single omnidirectional antenna at Oatfield RS.

There is a single vertically polarised 12 element Yagi antenna in use at the existing Foynes 38KV Substation.

The worst case (B-A) radio path analysis for the link can be seen in the following diagram Figure 10-2.

10.1.3.1 Overview of impact from proposed Turbines / WF installation

Although not a direct obstruction the impact of T1 on this link is significant as shown by the combined 1.1dB below the Required threshold of 38dB for normal operation in accordance with the established JRC methodology for measuring WF interference on UHF and microwave link.

T 2 has minimal impact and on its own passes (just) and is not considered in the final result.

It can be seen from the Reflected Ray diagrams (left) that the main concern is the proximity of turbines 1 & 2 to the A end of the links at Oatfield RS thus the only possible mitigation is to move them outside the minimal buffer of 500m from the base station and associated links – See diagram in mitigation section.

10.1.3.2 Diffraction clearance (Fresnel interference)

For links below 1 GHz; the criterion used is that no part of a turbine should enter area defined by 60% of first Fresnel zone of the link.

To this is added a buffer zone to allow for location inaccuracy of the link ends and turbine construction and ellipsoid conversion anomalies; in this instance JRC has used 15m.

An allowance for micro-siting must be included. As we have no specified value from the developer, we have assumed the typical value of 50m.

The three-dimensional clearance is assessed for all the turbines against each link and can be seen in the figures below:

As all the Turbines under consideration are behind the A End from the perspective of the B end there is no issue with Diffraction for this link but there are issues with Reflection / Scatter – see the next section

10.1.3.3 UHF Telemetry links Reflection/Scattering interference.

The existing links operate in the 460 MHz band. The turbines when added should therefore not reduce the W/U ratio of the link below the JRC threshold of 38dB.

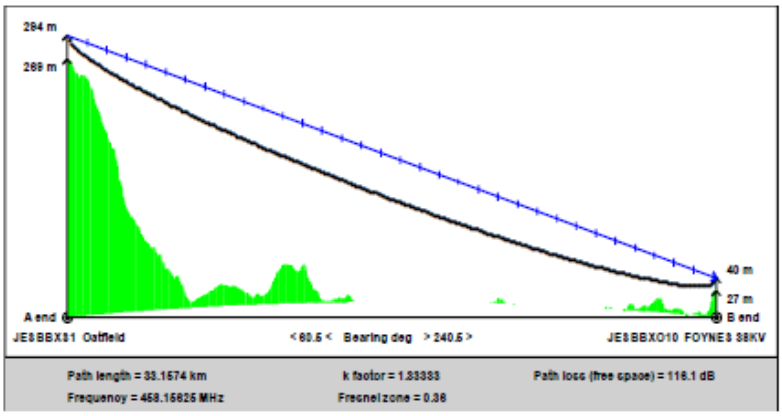

Figure 10-12 : Radio path analysis B-A

As can be seen from the profile above, the link path is partially obstructed.

The predicted path loss is 116.2dB, Since the link path is partially obstructed, predicted loss rather than free space loss has been used for the main path.

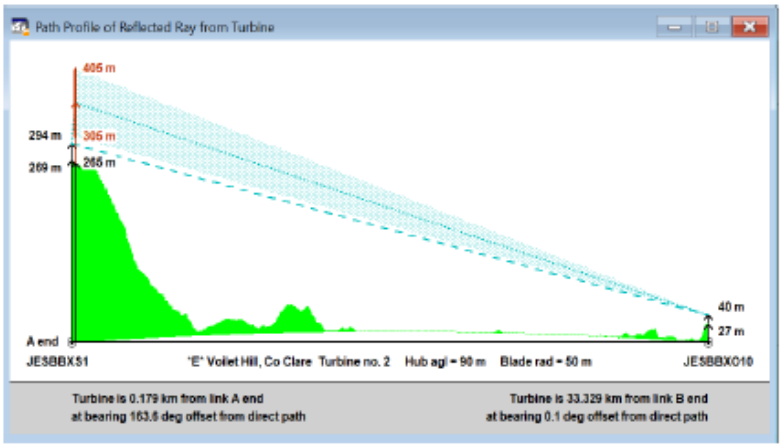

Figure 10-13 : Basic radio reflection diagram for Turbine 1

Turbine 1 has a slightly obstructed path to the link path therefore, predicted loss is used in the initial Wanted to Unwanted calculation

10.1.3.4 W/U Result

JRC W/U Power Sum including antenna discrimination & scatter			
All Turbines	27.2	Selected turbines	27.4
Above Threshold	-10.8	Above Threshold	-10.6

10.2 Microwave Point to point links

10.2.1 Link Oatfield RS HS1 to Parteen Weir

This link is a high capacity 10/11GHz microwave link with a VHLPX6-11W Antenna at the Oatfield end and a VHLPX3-11W at the Parteen Weir End

10.2.1.1 Overview of impact from proposed Turbines / WF installation

It can be seen in the results that the main issue here is the impact of T14, T 2 contributes a very minor amount whilst passing on its own account (although it cannot remain in that position due to the impact on the UHF links from Oatfield).

The main factor leading to the result is from the potential for T14 to migrate south due to micro-siting allowances thus by limiting the micro-siting to the south to 10m or less or by relocating the proposed position more than 50m north this Turbine can happily co-exist with the microwave link.

In appendix C are two sets of results indicating the difference if the micro-siting allowance is limited or the Site moved more than 50m North.

10.2.1.2 Diffraction clearance (Fresnel interference)

For links above 3 GHz; the criterion used by the JRC and agreed by the industry is that no part of a turbine should enter area defined by the second Fresnel zone of the link.

To this is added a buffer zone to allow for location inaccuracy of the link ends and turbine construction and ellipsoid conversion anomalies; in this instance JRC has used 50 m.

An allowance for micro-siting must be included. The developer indicated 50 m. Where the developer advises no micro-siting, JRC use 10m as minimum value even for absolute positions.

The three-dimensional clearance is assessed for all the turbines against each link and can be seen in the figures below:

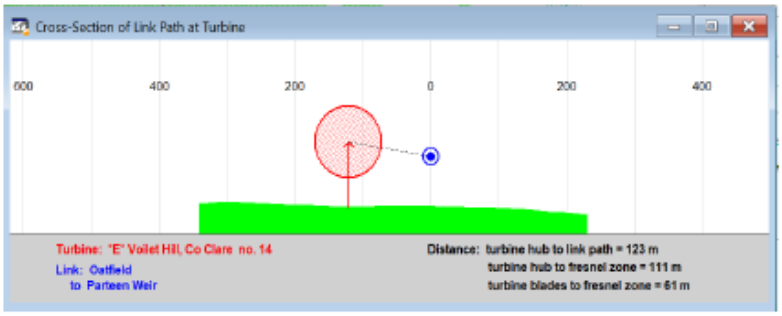

Figure 10-14: 'Basic' three-dimensional clearance for Turbine 14

(Not including buffer or micro-site).

The required clearance between turbine tip and Fresnel zone is 100m therefore as can be seen in the figure above and in the results table, Turbine 14 Fails the diffraction clearance assessment (due to micro-siting allowance).

10.2.1.3 UHF Telemetry links Reflection/Scattering interference.

The existing links operate in the 10/11GHz band. The turbines when added should therefore not reduce the W/U ratio of the link below the JRC threshold of 45dB.

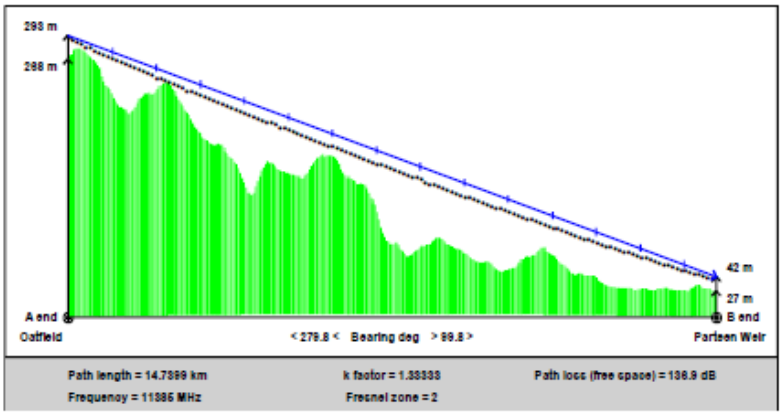

Figure 10-15 : Radio path analysis B-A

The free space path loss is 136.9dB, Since the link path is not obstructed free space loss has been used for the main path.

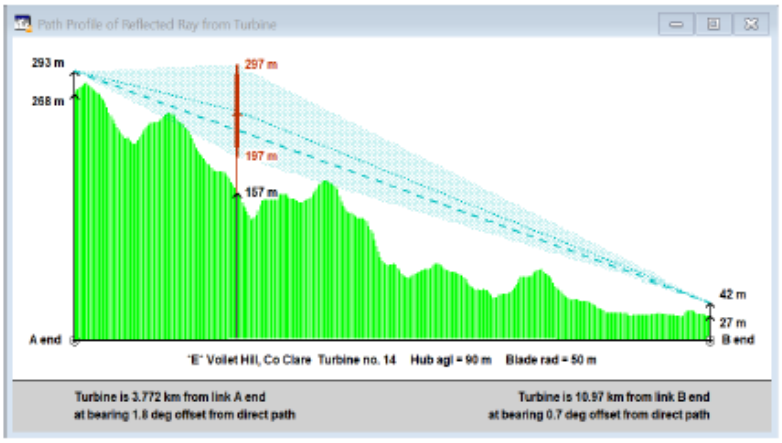

Figure 10-16 : Basic radio reflection diagram for Turbine 14

Turbine 14 has a clear Los to both end of the link thus Free space loss is used in the initial Wanted to Unwanted calculation

10.2.1.4 W/U Result

Result with existing proposed location for T14

JRC W/U Power Sum including antenna discrimination & scatter			
All Turbines	40.8	Selected turbines	41.1
Above Threshold	-4.2	Above Threshold	-3.9

Result with micro-siting limitation of 10M or less

JRC W/U Power Sum including antenna discrimination & scatter			
All Turbines	45.5	Selected turbines	46.6
Above Threshold	4.3	Above Threshold	7.6

11 Appendix C: Calculation Results for turbines against Links

UHF Link Oatfield RS HS1 to Tulla 38KV Stn Detailed Calculations

A-End antenna: Omnidirectional B-End Antenna: 12 element VP Yagi

Link ID	WF Name	Turbine No	Micro siting (MS)	Link Buffer (LB)	Basic Clearances		Loss above Free Space Path			Antenna Discrimination Modifiers		Basic W/U Ratio (no scatter)		Include Turbine in Calc?	Scatter Modifiers		HTZ Predicted Path Loss		Modified JRC W/U Ratio (with scatter)
					Basic	Plus MS & LB	Link A to B	Link End A to	Turbine to Link End B	A End	B End	Bacon (inc ant dist)	JRC (inc. ant dist)		Forward	Back	Link End A to Turbine	Turbine to Link End B	JRC
Tulla 38KV	Violet Hill	1	50	50	50.8	-49.2	9.22	0.14	6.91	0.00	0.00	35.6	33.40	Y	9.80	0.00	79.4	112.7	23.6
	Violet Hill	2	50		98.7	-1.3		0.02	6.30	0.00	0.00	27.4	24.50	Y	0.00	2.34	70.8	112.4	26.8
	Violet Hill	3	50		619.4	519.4		-0.17	6.74	0.00	-0.07	40.7	38.06	N	0.00	0.00	84.2	112.5	38.1

Link Oatfield RS HS1 to Tulla 38KV Stn Results –

Basic JRC W/U Power Sum including antenna discrimination Threshold = 38			
All Turbines	23.8	Selected Turbines	24
Above Threshold	-14.2	Above Threshold	-14

JRC W/U Power Sum including antenna discrimination & scatter Threshold = 38			
All Turbines	21.8	Selected turbines	21.9
Above Threshold	-16.2	Above Threshold	-16.1

Microwave Link Oatfield RS HS1 to Parteen Weir Detailed Calculations – Before Mitigation

A-End antenna: VHLPX6-11W B-End Antenna: VHLPX3-11W

Link ID	WF Name	Turbine No	Micro siting (MS)	Link Buffer (LB)	Basic Clearances		Loss above Free Space Path			Antenna Discrimination Modifiers		Basic W/U Ratio (no scatter)		Include Turbine in Calc?	Scatter Modifiers		HTZ Predicted Path Loss		Modified JRC W/U Ratio (with scatter)
					Basic	Plus MS & LB	Link A to B	Link End A to	Turbine to Link End	A End	B End	Bacon (inc ant dist)	JRC (inc. ant dist)		Forward	Back	Link End A to Turbine	Turbine to Link End B	JRC
Parteen Weir	Violet Hill	14	50	50	59.4	-40.6	0	0.00	0.00	0.00	-0.62	-0.05	38.1	Y	0.00	3.00	0.0	0.0	41.1
	Violet Hill	2	50		84.3	-15.7		0.00	0.00	0.00	-40.00	-0.05	52.6	Y	0.00	2.36	0.0	0.0	55.0

Microwave Link Oatfield RS HS1 to Parteen Weir Results – Before Mitigation

Basic JRC W/U Power Sum including antenna discrimination Threshold = 45			
All Turbines	37.9	Selected Turbines	38.1
Above Threshold	-7.1	Above Threshold	-6.9

JRC W/U Power Sum including antenna discrimination & scatter Threshold = 45			
All Turbines	40.8	Selected turbines	41.1
Above Threshold	-4.2	Above Threshold	-3.9

Microwave Link Oatfield RS HS1 to Parteen Weir Detailed Calculations – After Mitigation
A-End antenna: VHLPX6-11W B-End Antenna: VHLPX3-11W

Link ID	WF Name	Turbine No	Micro sitting (MS)	Link Buffer (LB)	Basic Clearances		Loss above Free Space Path			Antenna Discrimination Modifiers		Basic W/U Ratio (no scatter)		Include Turbine in Calc?	Scatter Modifiers		HTZ Predicted Path Loss		Modified JRC W/U Ratio (with scatter)
					Basic	Plus MS & LB	Link A to B	Link End A to Turbine	Turbine to Link End B	A End	B End	Bacon (inc. ant disc)	JRC (inc. ant disc)		Forward	Back	Link End A to Turbine	Turbine to Link End B	JRC
Parteen Weir	Violet Hill	14	10	50	59.4	-0.6	0.00	0.00	0.00	-9.01	-0.19	46.6	46.65	Y	0.00	6.00	0.0	0.0	52.6

Microwave Link Oatfield RS HS1 to Parteen Weir Results – After Mitigation

Basic JRC W/U Power Sum including antenna discrimination Threshold = 45			
All Turbines	45.5	Selected Turbines	46.6
Above Threshold	0.5	Above Threshold	1.6

JRC W/U Power Sum including antenna discrimination & scatter Threshold = 45			
All Turbines	49.3	Selected turbines	52.6
Above Threshold	4.3	Above Threshold	7.6

APPENDIX E – Review of Cumulative Impacts

Appendix E – Review of Cumulative Impacts

There is are no operational wind farms in close proximity to the proposed Knockshanvo development. Consequently, there would be no cumulative impacts on telecommunications networks due to the proposed turbines at Knockshanvo.

However, it should be noted that a planning application* has been submitted to An Bord Pleanála for a new wind farm at Oatfield, Co Clare which is located adjacent to the proposed Knockshanvo development. In the Telecommunications Impact Assessment that was submitted with the planning application, one microwave radio link was identified as being potentially impacted by the Oatfield turbines. The radio link potentially impacted is a link from ESB Killonan to Kilseily (O'Callaghans Mills). To mitigate for the potentially impacted radio link, it has been proposed to re-route the radio link to Kilseily from an alternative POP site (i.e. from Drumline). The proposed radio link is shown in Figure E1 below.

Figure E1. Proposed turbines at Oatfield and Knockshanvo shown relative to microwave radio link from Drumline to Kilseily

In the event that a radio link from Drumline to Kilseily is commissioned (to mitigate for the impacts of the Oatfield wind farm development), the radio link would be over 450 m from the nearest of the proposed Knockshanvo turbines. At this distance there would be no impacts due the proposed Knockshanvo wind farm development.

Review Summary

There would be no cumulative impacts on telecommunications networks due to the proposed wind turbines at Knockshanvo

** The Oatfield wind farm planning application submitted to An Bord Pleanála is publicly available and can be viewed online via the following URL*: *https://oatfieldplanning.ie/environmental-impact-assessment-report*