

Laurclavagh Renewable Energy Development Response to ACP FI reply from MKPO, Galway

Planning Reference: 319307

Date for Submission: 9th January 2026

[Note: Comments in black are FI queries from ACP, Comments in blue are MKO responses, Comments in green are taken from MKO references, Comments in red with yellow highlights are from Martin Lavelle]

Response to Further Information Laurclavagh Renewable Energy Development

Item 1. Roads and Traffic (EIAR)

Roads Summary:

1. Inadequacy of N83-L61461 junction on Sight grounds, Width grounds & Safety grounds for access & turning movements.
2. Grossly inadequate access safety from private house at end of slip road.
3. Trespass on setback area of private house
4. Trespass on lands for grid connection
5. Inadequate sweptpath submission not showing 2-way HGV traffic, proposed hedge cutting, overhang and oversail areas

1.1

The N83-L61461 junction layout as outlined in submitted plans, the traffic management plan and in your response to submissions do not appear to be consistent with the existing onsite arrangement. The existing junction layout appears to display restricted sightlines in both northerly and southerly directions onto the N83. Given the application details submitted to date and the existing junction layout, consultation should take place with the planning authority in order to clarify the status of the existing junction layout.

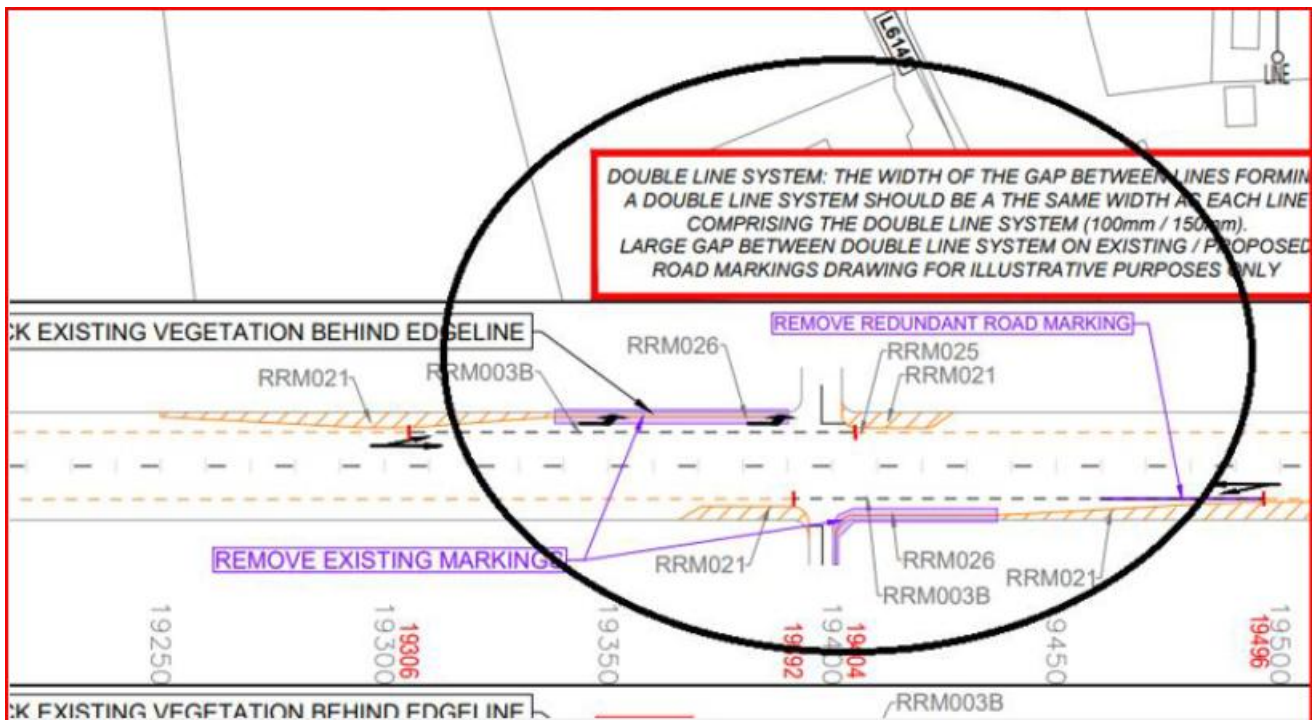
In agreement with the Commissions observations, it is noted that the road markings on the L61461 minor arm approach to the junction with the N83 have changed in the interim period from when the EIAR was prepared up to the point when the submissions were being responded to. It is considered that the 2 different layouts have little impact on the Proposed Project. As stated in the EIAR, temporary traffic management measures are proposed at this location as mitigation during the critical construction period. A description of the 2 junction configurations is as follows; Layout 1 - In place during the preparation of the EIAR – Stop line extended to carriageway edge to maximise visibility splays for traffic accessing the N83. This configuration is as described in the EIAR, and in the Response to Observations Received Report, with the relevant information now included in the EIAR Addendum. The layout is provided in Appendix 2 Addendum Planning Drawings of this RFI is shown in plan in Figure FI1 in Appendix 15-5 of the Report, with the key points to note for this layout as follows. The hard shoulder is discontinued to the north of the junction by means of yellow hatching and to the south before the commencement of the left turn lane that provides access from the N83 onto the L61461. This permits the STOP line to be located adjacent to the carriageway edge, as opposed to the nearside edge of the hard shoulder, and the x-distance for the visibility splays to be measured from the edge of carriageway, as is shown for this layout in Figure FI2 in Appendix 15-5 of the Report. As shown, for this arrangement the full 3m x 215m visibility splays, as are required for a 100 kph speed limit, are available (Reference Geometric Design of Junctions, DN-GEO-03060, TII, May 2023). It is noted that this junction layout with an extended stop line exists at various other junctions on the N83 in close proximity to the N83 / L61461 junction.

This current configuration of the road markings on the L61461 approach to the N83, which is in place at present (August 2025), is illustrated in Figure FI3 in Appendix 15-5 of the Report. The recently implemented changes to the

junction markings have been implemented without any alterations to the boundary walls running parallel to the N83, and as a result, there are significant restrictions to the visibility splays for drivers accessing the N83 from the L61461, as are shown in Figure F14 in Appendix 15-5 of the Report. Measured from a minimum setback of 2.4m as permitted as a relaxation in TII Guidelines, as a result of the boundary walls now constraining visibility splays, a maximum of 35m is available to the north, and just 20m to the south. Consultation with Galway County Council As requested by An Coimisiún Pleanála, Galway County Council was consulted in order to establish the reason for the recent change to the junction design and to establish if there were any further long term alterations proposed for the N83 / L61461 junction. A record of the emailed consultations is as follows; Galway County Councils Road Section (Robert Landon) – An email was issued on 18/07/25 requesting clarification with regards the recent changes to the N83 / L61461 junction and clarification of future plans for the junction. A response was received from Robert Landon on 22/07/25 stating that he was unaware of the issues relating to the junction and suggested that we contact the Area Engineers Office. Galway County Council Tuam Local Area Engineers Office (John Coyle / Tom Regan) – The same email was issued to Galway County Councils Tuam Local Area Office (John Coyle) on 24/07/25. An email response was received (Tom Regan) on the same day indicating that the Local Area Office would not deal with issues associated with the N83 / L61461 junction as it is on a National Road. It was suggested that contact be made with the Galway County Council National Road Project Office. Galway County Council National Road Project Office (Maire McGrath) – An email was issued to the National Road Project Office (NRPO) on 24/07/25 with a response received from Steven Lally of the NRPO on 07/08/25 stating that TII, through the Donegal NRDO (which looks after signing & road marking) appointed consultants to review the N83 route. As part of that review the location of the STOP line on the L61461 approach to the junction with the N83 was relocated from that shown in Configuration 1, to Configuration 2, as discussed above. A snapshot of the N83 Route Delineation Design drawing provided by Galway County Councils NRPO is inserted as Figure F15 below.

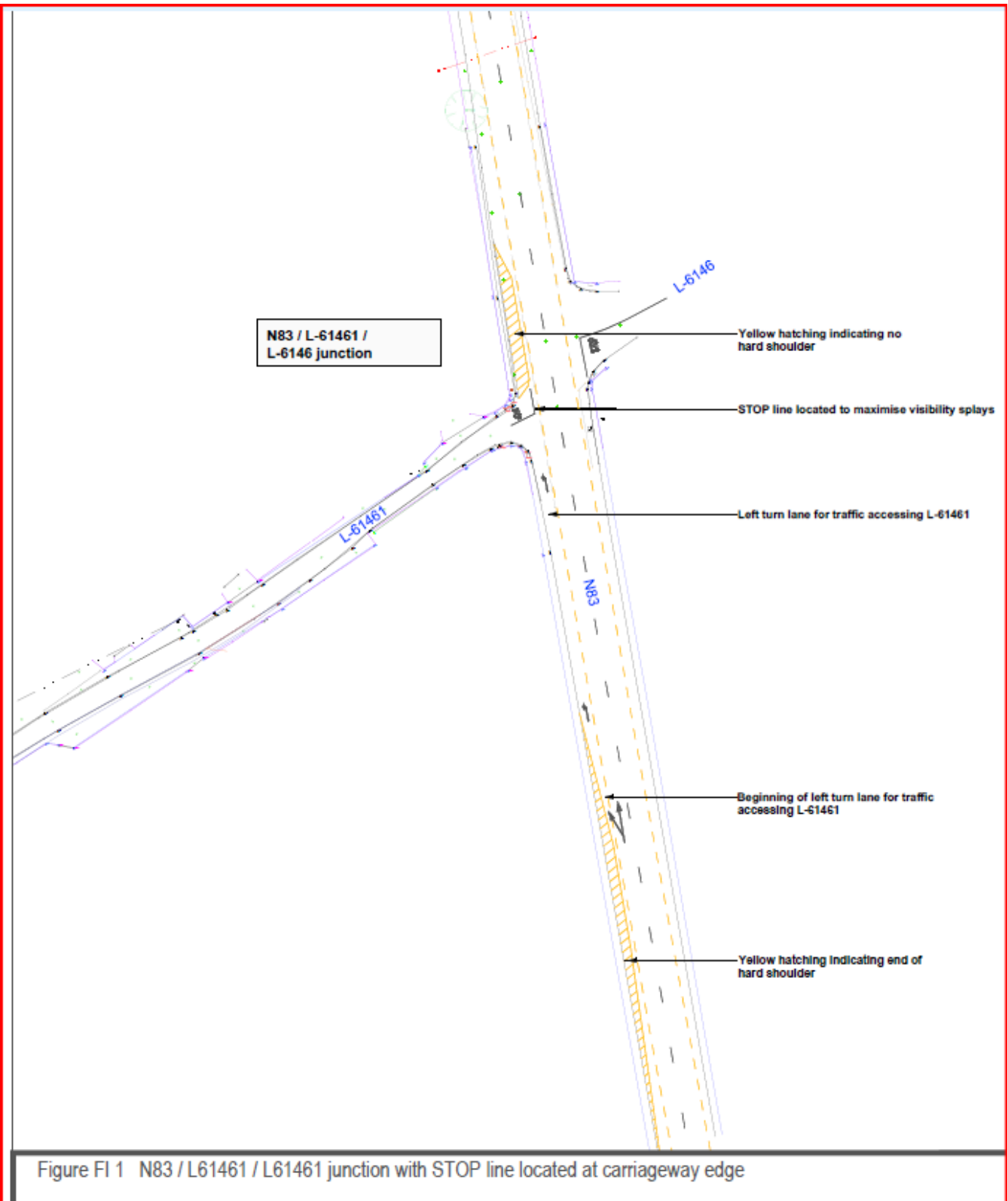
It is confirmed that there have been minor alterations made to the layout of the N83 / L61461 junction between the time of the preparation of the EIAR for the Proposed Project, and the date of the preparation of the Response to Observations Received Report, and the preparation of the response to issues raised by the Commission, presented in this report. The changes were implemented by the Donegal NRDO on behalf of TII, and it is confirmed that there are no further changes proposed. It is noted that the recent change to the junction layout, which includes the relocation of the stop line back to the nearside edge of the hard shoulder, does not include a setback of the boundary walls along the N83, which results in visibility for drivers accessing the N83 from the L61461 now being severely constrained. It is also noted, however, that this recently implemented design has been designed and implemented by Donegal NRDO / TII and its consultants, and is therefore accepted by the Applicant.

Figure F15 Extract of N83 / L61461 junction with STOP line re-located to nearside of hard-shoulder.

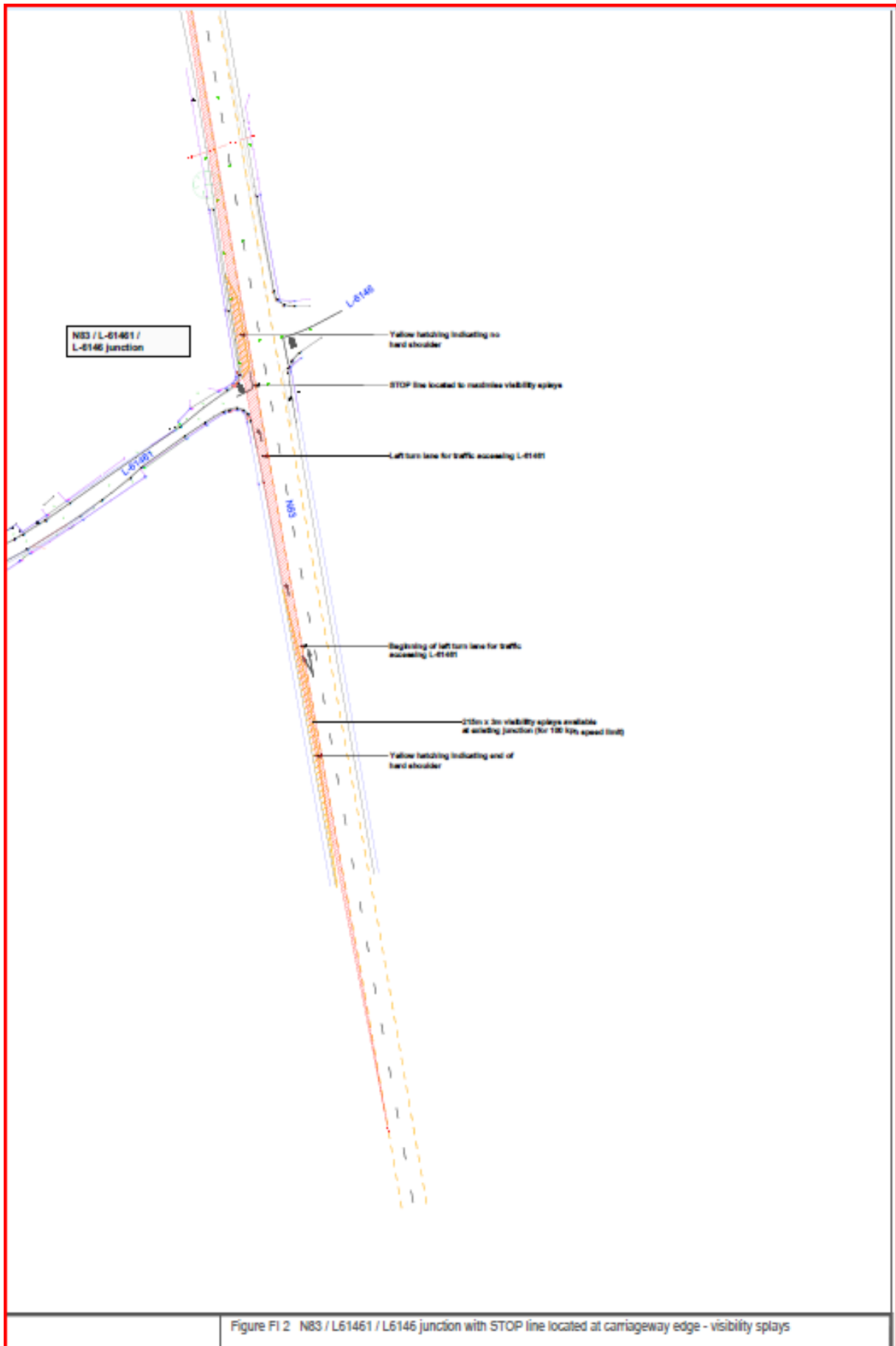


It was confirmed by Galway County Councils NRPO that there are no additional long term plans for further alterations to the N83 / L61461 junction.

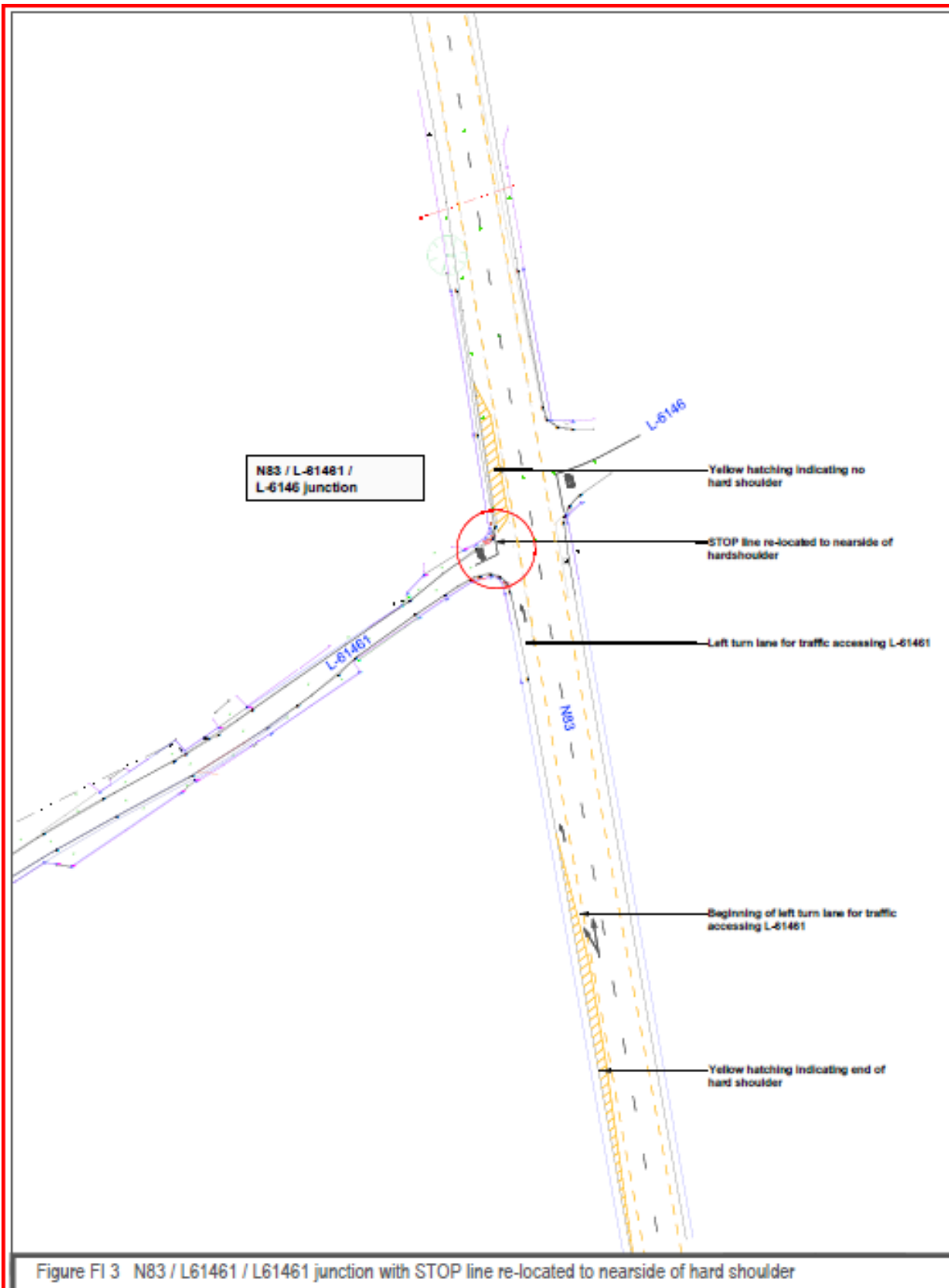
Summary of consultation with Galway County Council in relation to the layout of the N83 / L61461 junction



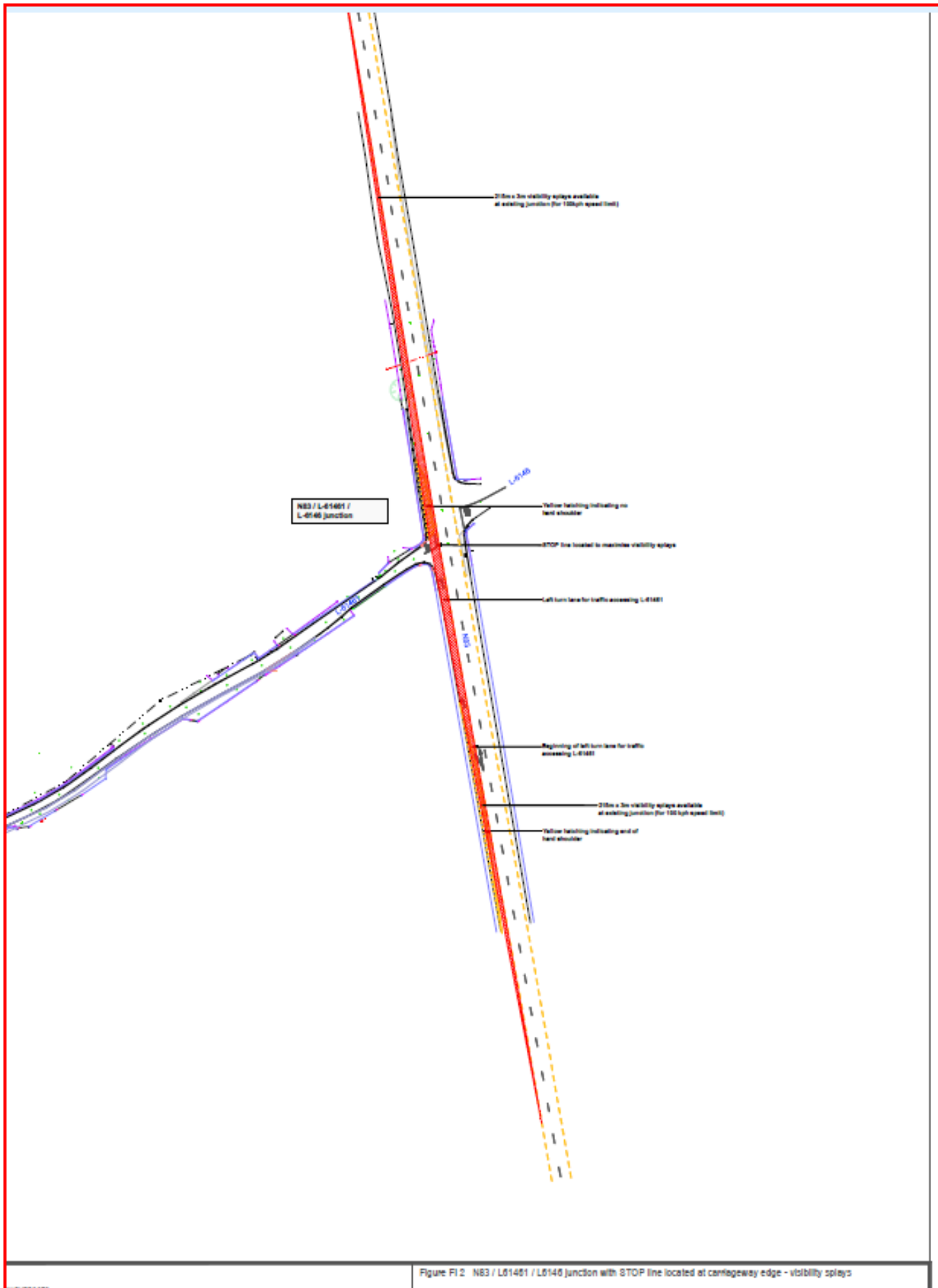
This layout does not comply with TII Standards

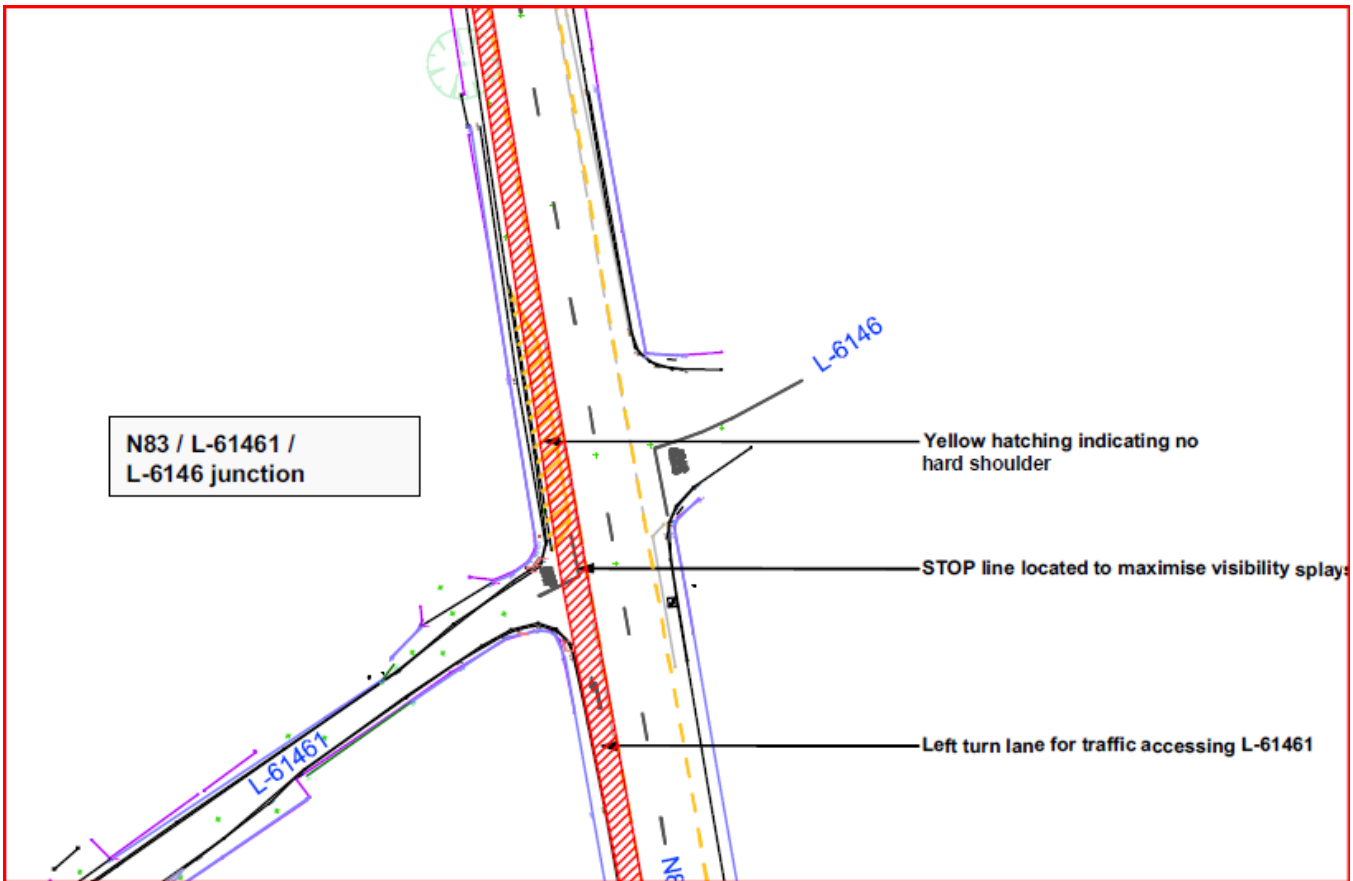


This layout does not comply with TII Standards



This layout does comply with TII Standards TII as National Roads Authority updated all existing junctions to reflect their adopted Standards for National Roads. This contract included the N83 Stop lines & hatched markings. The Stop lines & hatched markings at the N83/L61461 reflect the Standards.





This layout does not comply with TII Standards

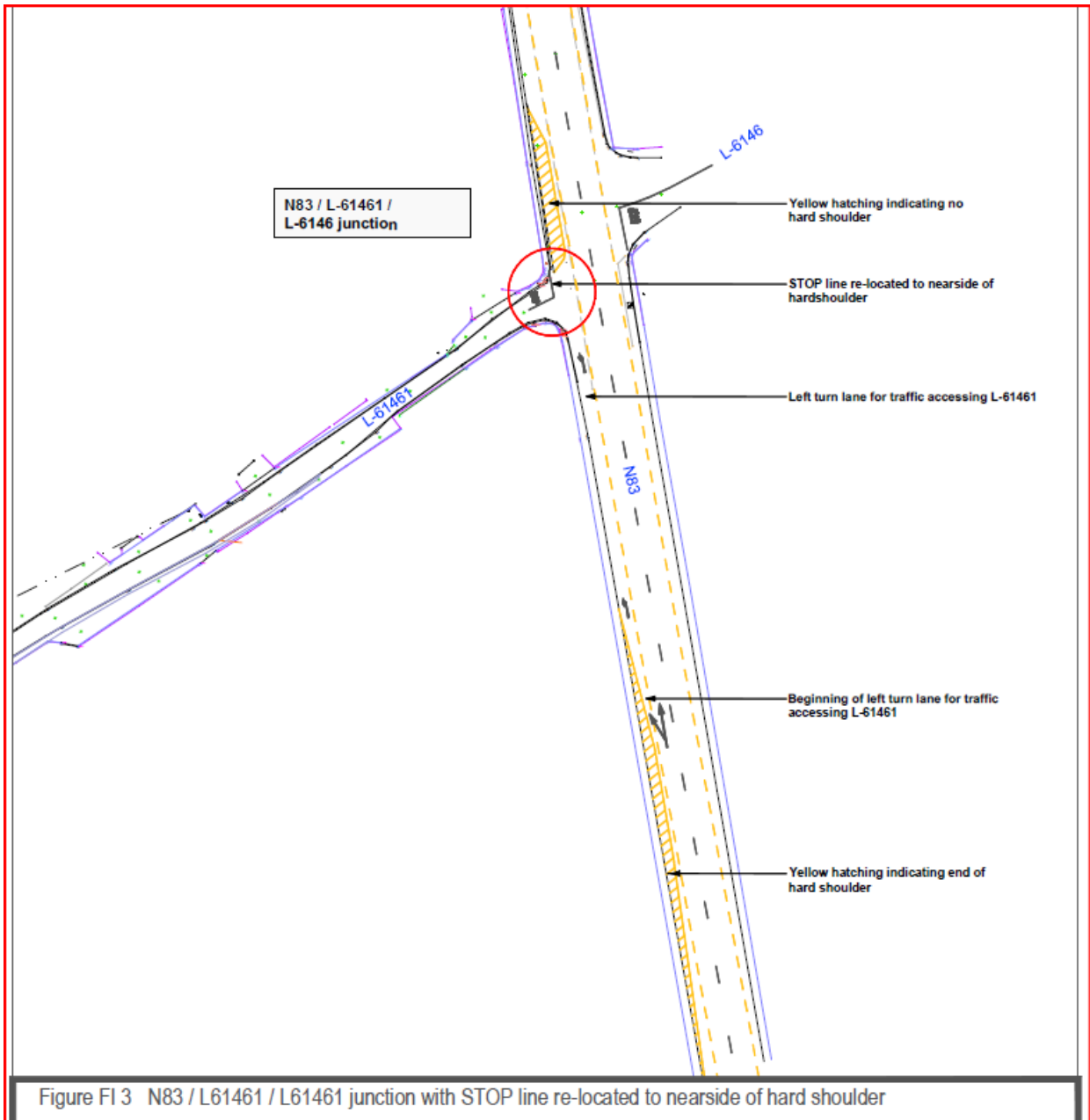
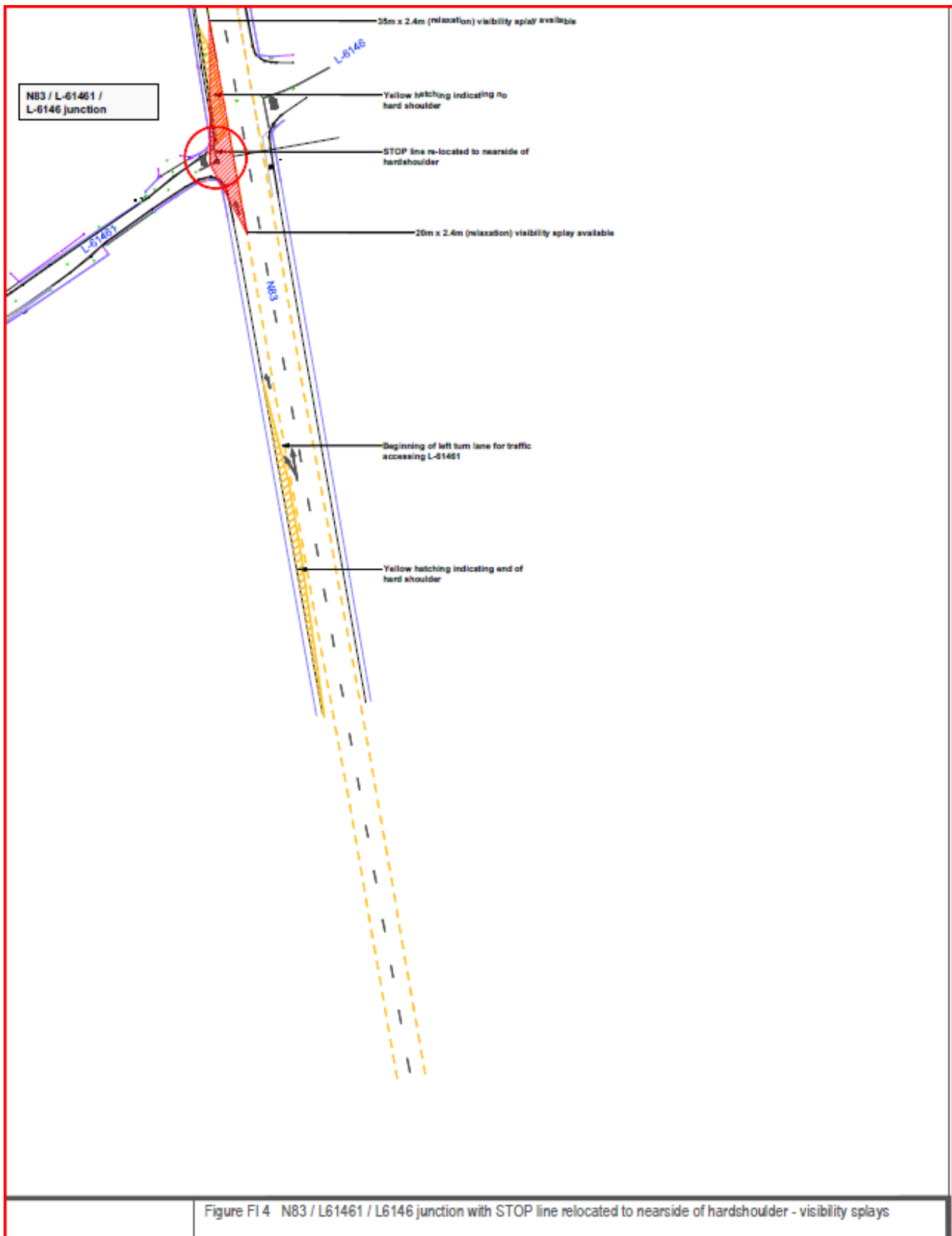


Figure FI 3 N83 / L61461 / L61461 junction with STOP line re-located to nearside of hard shoulder



Note that the X distance should be 3m – 9m for Stop line control and not 2.4m. This crossroad is not a simple junction & no request for a relaxation from TII is indicated for a 2.4m X distance. This 3m minimum requirement reduces the Sight Distance Triangle to a lot lower than 35m & 20m. This is obviously why the Road Safety Auditor omitted mention of the junction issues. These SDT distances constitute a hazard to all traffic with rere-end shunts, head-on collisions and side-swipe accidents. It would constitute gross negligence to grant Planning Approval for such a proposal.

Table 5.4 'x' Distances on the minor road for visibility measurements

Major road use	Minor road use	Standard	'x' Distance(m)
All roads	All junctions and accesses, Stop control	Desirable Minimum	3.0
All roads	Cycle Route	Desirable Minimum	4.0
National roads	Simple Junctions, Stop control	Relaxation	2.4*
Regional & Local Roads	All junctions and accesses, Yield control (where there are no relaxations associated with the junction layout)	Desirable Minimum	Max. 9.0
Regional & Local Roads	Accesses, Lightly trafficked	Relaxation	2.0
All roads	All junctions and accesses	Desirable Maximum	9.0

Note that the Applicant fails to provide the 85%ile speed, the Forward Sight Distance Triangle, A vertical profile of the Sight Distance Triangle for 1.05m object height as required by the Galway County Development Plan. In order to get a Relaxation for an X-distance to 2.4m, an Applicant has to apply to TII for same & there is no evidence in application of same.

Note no details are provided for kerb radii of >13m to facilitate turning movements as per DN-GEO-03060 - May 2023: Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions) indicates Radii at site entrances & require kerb radii of >13m.

“5.6.4 Corner Radii

It is recommended that the minimum circular corner radius at simple junctions in rural areas where no provision is made for HGVs should be 10m. Where there is frequent use by large commercial vehicles (e.g. near a quarry or industry frequently accessed by large vehicles), the minimum circular corner radius shall be as follows:

- a) For vehicles entering the minor road, the corner radii shall be 13m followed by a 1:10 taper for a distance of 25m measured along the line of the minor road from the nearside edge of the major road.*
- b) For vehicles entering the major road from the minor road, the corner radii shall be 13m followed by a 1:10 taper for 25m measured along the line of the major road from the corner line of the minor road.”*





Inadequate width at N83 junction determines queuing on the N83 to turn right.





Note kerb radii at junction of 13m not available. Note inability to facilitate 2-way traffic on L61461. Note no right-turning lane on N83 from north. Thus queuing on the N83 for right turning onto the L61461 will occur and it is necessary to indicate Forward Sight Distances for Southbound traffic to these queuing vehicles from the centre of the N83 Southbound lane at a distance of 215m & compliance at 1.05m vertical profile.

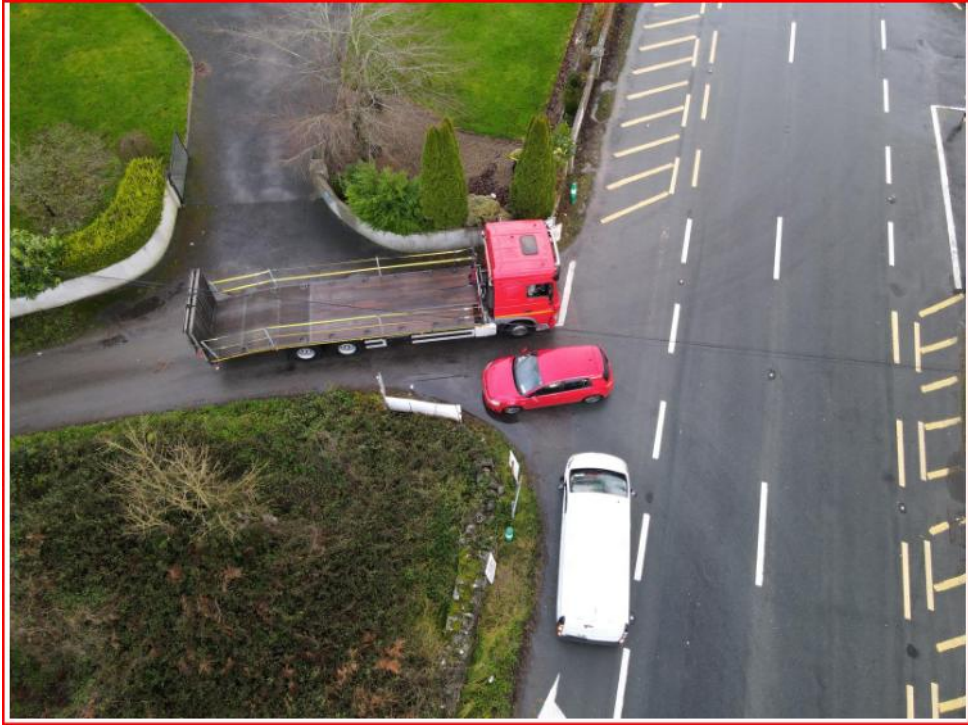


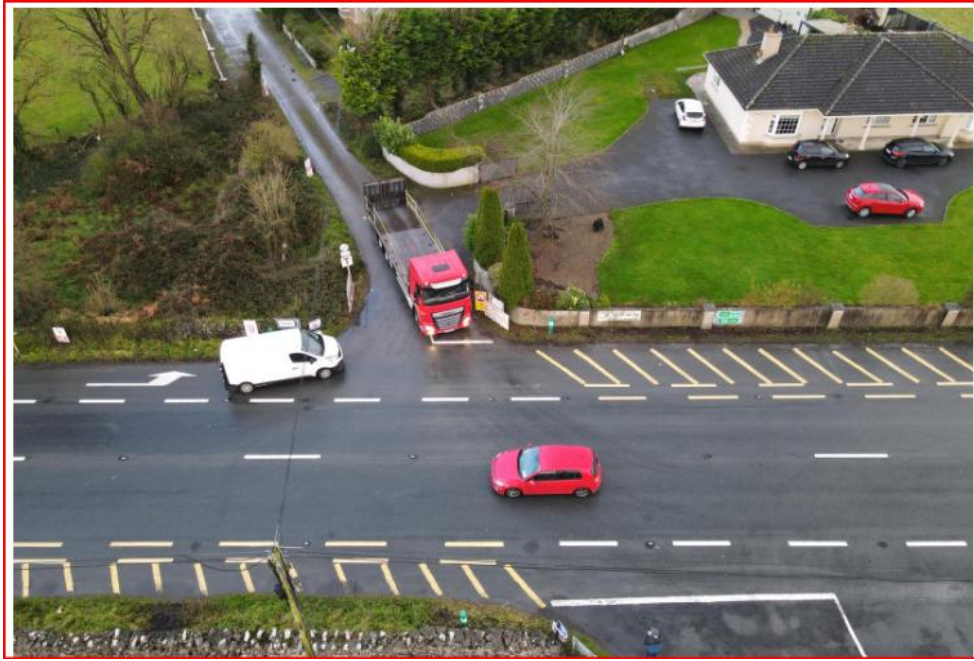




Note that absence of kerb radii determines that HGV turning movement has to cross lane to contraflow lane to turn left.





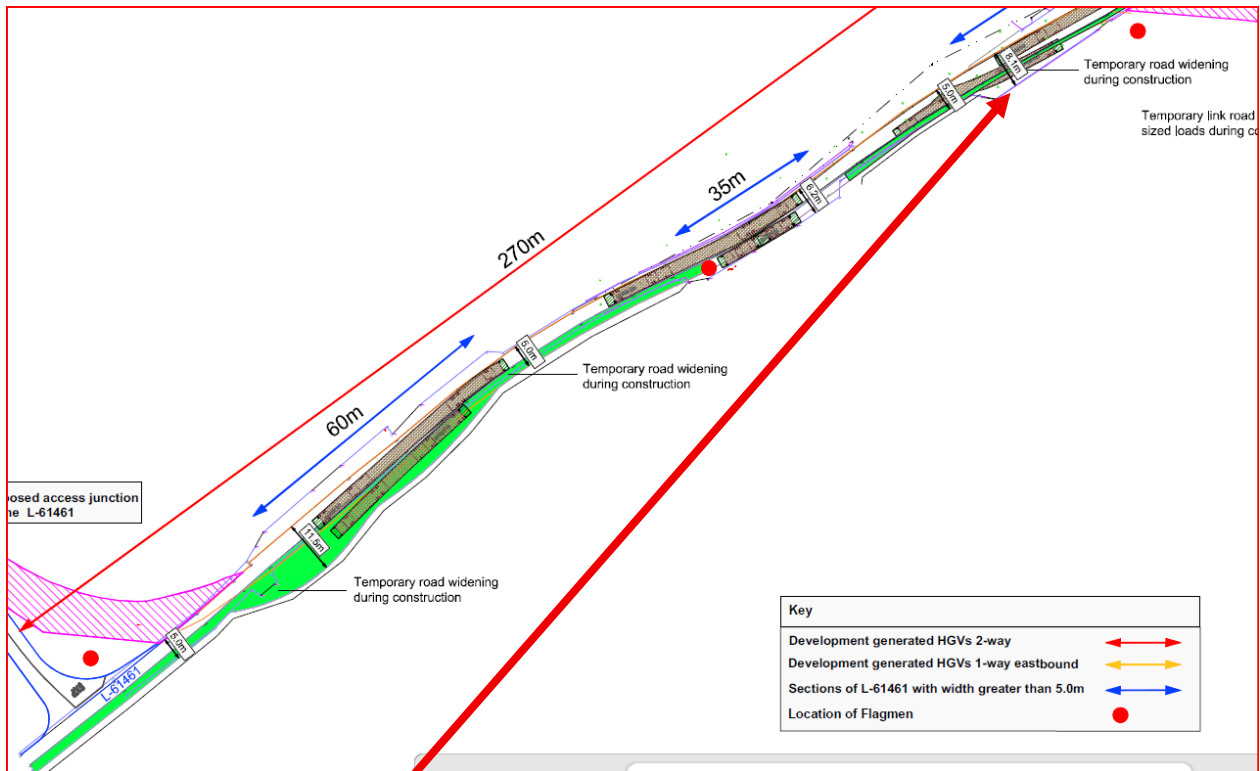




Note this photograph of 26/11/2025 shows Stop line at inside of carriageway edge from L-61461 on Western side of N83 facing Galway. There is no Sight Distance Triangle compliance of 215m @ 3m from this Stop line.



Note this photograph of 26/11/2025 shows Stop line at inside of carriageway edge from L-6146 on Eastern side of N83 facing Galway



Note there is no evidence that these lands are in the ownership/control of the Applicant. The owner objected to such usage on his property in the original file.

The land acquisition agreements for the Clonberne Windfarm 320089-24 are now being contested in the High Court between the developer & funder, where the funder has requested repayment of his €1.8million investment as the land agreements have expired. The Applicant for Laurclavagh has not included copies of the land agreements with the application. It would seem that those agreements were for 7-years and have expired.

15.3A: ADDENDUM STAGE 1 ROAD SAFETY AUDIT

Item 1.7 raised by the Commission states the following;

“The details outlined on material assets in your response to submissions including the management of HGV trips on the L-61461, swept path analysis, new temporary access roads access and egress restrictions, and items raised 1.1, 1.2, 1.4 & 1.5 above should be included in an updated Road Safety Audit for the construction stage. This should be outlined by way of an addendum to the EIAR.”

Following a discussion with the independent Road Safety Auditors (Trafficco Ltd) it was considered that rather than update the existing Road Safety Audit, each of the issues raised may be addressed separately as part of the addendum. Similar to the format of a Road Safety Audit the response to the safety issues raised in the submissions and by the Commission are prepared by the Applicant, with a further comment provided by the Road Safety Auditors. The issues and the responses are set out below

This response is rubbish. The initial submission from the Applicant in their Road Safety Audit ignored the road safety issue at the L-61461/L-6146 crossroad with the N83, & the effects of the slip road on an existing access, This Audit should have analysed this location for potential head-on, rear-end shunts & side-swipe collisions on a heavily trafficked (c10,890 AADT) & high-speed (100kph) roadway. Traffic of c1,000 vehicles per hour translates into 16.6vehicles per minute & 0.28 per second or 1vehicle every 3 seconds. The traffic generated by the development will not be able to access the N83. The submission below indicates 70 staff cars arrive in morning peak hour with a further 17 arrivals & exits for deliveries. This indicates traffic movement of 104vehicles & the reverse in the evening with 70 staff cars exiting the site plus 17 arrivals & exits for deliveries to a total of 104 movements.

The response from the Applicant, again ignores the issue. Using loose English & software doesn't get over this issue.

The TII Standard for junctions (Figure 5.24) from a minor road is included below & the Stop-line is shown at 600mm back from the inside of the hard shoulder edge. Suggesting that the moving of the Stop line out to the carriageway edge is a solution creates criminal negligence as trucks/vehicles do not have side lights that would identify them to N83 approaching vehicles. A cross hatched area is not visible at night-time. It is obvious that the writer of the Road Safety Audit chose to ignore this issue as any competent Auditor would identify the unsuitability of the junction. This is somewhat similar to the Gort Biogas [Appeal reference no. ABP-320207-24] entrance decision by the Supreme Court, where road safety was remitted back to ACP for reconsideration.

The Applicant should have purchased the required land to comply with the Sight Distance Triangle requirements & kerb radii before lodging this Application.

Issue 1 – Updated Audit to respond to Item 1.1 raised by the Commission- The N83 / L-61461 junction layout as outlined in submitted plans, the traffic management plan and in your response to submissions do not appear to be consistent with the existing onsite arrangement. The existing junction layout appears to display restricted sightlines in both northerly and southerly directions onto the N83. Given the application details submitted to date and the existing junction layout, consultation should take place with the planning authority in order to clarify the status of the existing junction layout.

Applicants Response – The 2 different junction layouts are discussed in detail in the Responses to ABP Issues Report, including Figures FI1 to FI4 in Appendix 15-5 of the Report. In summary the previous layout at the N83 / L-61461 junction included the STOP line of the minor arm of the junction being located adjacent to the carriageway edge, as opposed to the nearside edge of the hard shoulder, which permitted the full 3.0m x 215m visibility splays required for a 100 kph speed limit to be available. The junction layout has since been revised to include the relocation of the STOP line to be in line with the nearside of the hard shoulder. The recently implemented changes to the junction markings have been implemented without any alterations to the boundary walls running parallel to the N83, and as a result, there are significant restrictions to the visibility splays for drivers accessing the N83 from the L61461, as are shown in Figure FI4 of the in Appendix 15-5 of the Report. **Measured from a minimum setback of 2.4m as permitted as a relaxation in TII Guidelines, as a result of the boundary walls now constraining visibility splays, a maximum of 35m is available to the north, and 20m to the south.**

This is not correct. The minimum X distance requirement is 3m. If a relaxation was envisaged, the applicant should have requested it from TII & provided evidence of their approval, but didn't do so. The Y distance should be a minimum 213m & not 35/20m.

The recent design changes at the N83 / L61461 junction were designed and implemented by a Local Authority Roads Design Office on behalf of TII.

TII design, manage & administer their contracts through Local Authority Design Offices. TII pay all of the costs for the Local Authority Design Offices as their agents.

The design of the changes including any implications relating to road safety are therefore the responsibility of these organisations.

TII is responsible for all designs on National Roads.

No design changes are proposed at this location as part of the Proposed Project. Temporary traffic management measures proposed during the various stages of the construction are discussed under Issue 1.2.2 of this report above.

Auditor Comment – I have reviewed ABP's item 1.7, the Designer's response and the road drawings which have been revised following the issue of our road safety audit.

All items raised in the road safety audit appear to have been suitably addressed within the revised site layout drawings.

The items raised have not been addressed.

In my opinion, the design changes fall under the heading of 'design development' and are unlikely to pose any further road safety risks (other than those raised within our audit).

This constitutes gross negligence.

On this basis, I do not see any need to revisit or update the road safety audit.

Road Safety Audit Team Leader- Traffico

Issue 2 – Updated Audit to respond to Item 1.2 raised by the Commission- You are requested to submit a revised site layout plan at an appropriate scale indicating clear sightline triangles at the required standard including at the N83 / L-61461 junction. This shall clearly dimension the extent of proposed boundary walls to be set back adjoining the L61461 and adjoining the N83. Sightlines at all entrances and junctions should meet required standards.

Applicants Response – As set out above, there are no design changes proposed at the N83 / L-61461 junction as part of the Proposed Project.

Auditor Comment – Refer to our response to Issue 1 herein.

This constitutes gross negligence.

Issue 3 – Updated Audit to respond to Item 1.4 raised by the Commission- Site layout plans should be revised to clearly detail the width of L-61461 and its proposed widened areas, at an increased scale, taking into account the width of 2 number passing HGVs.

Applicants Response – It is considered that the proposed road widening and passing opportunities, as set out in Figure F16 of the Appendix 15-6 of the Report and discussed in detail under Issue 5 below provide adequate passing opportunities for all vehicle types to pass. The onsite safety will be significantly enhanced with the implementation of the proposed complimentary traffic management measures, including supervision and co-ordination provided by site staff and warning signs.

Auditor Comment – Refer to our response to Issue 1 herein.

The aerial photographs above indicate the inadequacy of passing opportunities on the L61461.

Issue 4 – Updated Audit to respond to Item 1.5 raised by the Commission- The site layout plans should be revised to detail existing junction layouts at the N83 – local roads.

Applicants Response – There are no design changes to the N83 / L-61461 junction proposed as part of the Proposed Project. The revised junction layout recently implemented by TII is the responsibility of Galway County Council and TII. As the Applicant is not responsible for the recent changes and no further changes are proposed we have no further comment on this issue.

Auditor Comment – Refer to our response to Issue 1 herein.

This constitutes gross negligence. The absence of X & Y distance requirements & the kerb radii requirements dictate that this junction is totally unsuitable & dangerous.

Issues 5 – Updated Audit relating to the details outlined on material assets in your response to submissions including the management of HGV trips on the L61461, swept path analysis, new temporary access roads access and egress restrictions.

Applicants Response – The above issues were raised as part of a Submission prepared by the Roads and Transportation Section of Galway County Council and relate to concerns in relation to the carrying capacity and safety of the road network. The main concerns raised related to the following:

- Safety concerns relating to speed on N83, the multiplicity of entrances on N83, the impact on visibility splays at the N83 / L61461 junction
- Deficiencies in RSA relating to HGV's requirements to use both lanes on N83 and lack of consideration for N83 / L-61461 junction

- Concerns about road widening and facilitation of HGV movements at some locations
- Proposal would endanger public safety by reason of traffic hazard and would contravene DM Standard 28

While we have not seen the internal report received from the Roads & Transportation section of Galway County Council, the key concerns stated in the planner's report based on a combination of issues raised under Section 16. Carrying Capacity and Safety of Road Network, and 18.1 Report from the Roads & Transport Engineer are set out below.

GCC Topic Heading - Safety concerns relating to speed on N83, the multiplicity of entrances on N83, the impact on visibility splays at the N83 / L61461 junction

GCC issue 1- Significant safety concerns are raised regarding traffic safety aspect of the proposed development. The Road Section note that having regard to road speed travelled by users (100 kph speed limit) and the multiplicity of other permitted entrances opening onto the N83 within close vicinity of the new proposed development construction vehicular entrance, the existing local tertiary (L-61461) access point onto the N83 will be deemed to be impaired owing to the restricted visibility due to the new temporary road link for construction vehicles on the N83.

Applicants response- Speed limit on the N83 – It is acknowledged that the existing speed limit on this section of the N83 in the proximity of the junction with the L-61461 is 100 kph. Should the Proposed Project proceed, in order to assist with providing the safest environment for background and development generated traffic on the N83 and the L-61461, an important element of the traffic management measures that should be considered, would be a temporary reduction of the speed limit on this section of the N83 from 100 kph to 60 kph. This would be a temporary measure for the duration of the construction phase only. It is also acknowledged that this would require to be implemented by Galway Council and approved by TII, but it remains a proposed component of the TMP proposed for the construction phase of the proposed project.

Auditor Comment – Refer to our response to Issue 1 herein.

The applicant has not submitted any application to either Galway County Council or TII for a speedlimit change. Speedlimit byelaws are under the control of the Elected Members of Galway County Council & approval cannot be assumed. Irrespective of speedlimits, the actual 85% speed on the N83 won't change.

GCC issue 2- Further to the above the applicant has not satisfactorily demonstrated that the N83 / L61461 junction has sufficient sightlines in both northerly and southerly directions to support this level of usage.

Applicants response- The appropriate response to this issue raised by GCC is the responses provided to Items 1.1 and 1.2 of the FI Response Document. Rather than repeating these please refer to these responses in that report.

Auditor Comment – Refer to our response to Issue 1 herein.

This is not correct. The minimum X distance requirement is 3m. If a relaxation was envisaged, the applicant should have requested it from TII & provided evidence of their approval, but didn't do so. The Y distance should be a minimum 213m & not 35/20m.

GCC issues 3- It is considered the remedial works required to provide the aforementioned visibility sightlines from the temporary entrance of the site would constitute removal of trees / vegetation, in conjunction with generating overlapping visibility splays between the multiplicity of adjacent entrances.

Applicants response- As set out in the response to GCC issue 2 above, it is not proposed to undertake any additional works at the N83 / L61461 junction as provided to ABP Items 1.1 and 1.2 of the FI Response Document.

With respect to GCC's comment regarding "overlapping visibility splays between the multiplicity of adjacent entrances" the following points are made;

- There are no visibility splays required at the proposed left turn access onto the proposed temporary link road proposed between the N83 and the L-61461 for the construction period. This is because it is not intended that there will be an access onto the N83 at this location, but will provide for deliveries turning left off the N83 travelling to the site only. It is mentioned in the EIAR that the cement mixers exiting the site on the 7 days that the turbine foundations

are poured may exit the site onto the N83 via the temporary link road. While it was intended that this would be done using temporary traffic management measures for the 7 days, including flagmen and signs, based on the assessment provided in Section 1.2.2 above, it is not considered this to be necessary, and this is now not being proposed.

- In the case that the comment regarding “overlapping visibility splays between the multiplicity of adjacent entrances” is in relation to the potential for development generated HGV vehicles turning left into the temporary link to impact on the visibility splay for traffic exiting the existing L-61461, it is noted that existing northbound traffic on the N83 travelling in the left turn lane currently has significantly greater impact on visibility splays for this traffic. It is also noted that with the current location of the stop line on the L-61461 approach to the junction, recently set back by TII to the nearside of the hardshoulder, visibility for traffic accessing the N83 looking south is restricted to 20m, which is does not reach the proposed temporary left turn lane.

Auditor Comment – Refer to our response to Issue 1 herein.

This is not correct. The minimum X distance requirement is 3m. If a relaxation was envisaged, the applicant should have requested it from TII & provided evidence of their approval, but didn't do so. The entrance to the first house after the proposed link road connection to the L61461 would have zero sight distance to the east. This entrance has been totally ignored. The removal of trees at this junction has not been assessed under the Habitats Directive

GCC Topic Heading - Deficiencies in RSA relating to HGV's requirements to use both lanes on N83 and lack of consideration for N83 / L-61461 junction

GCC issues 4- Furthermore, concerns are also raised with regards to deficiencies in the Road Safety Audit in terms of consideration of swept path analysis which simulates HGV requirements to use both lanes on the N83, and ignores completely consideration of the junction of the L-61461 and the N83 and is deficient in this regard.

Applicants response- The swept path requirements for the abnormal loads carrying the blade and the tower sections of the turbine are shown at the proposed temporary access off the N83 in Figures 15-13 and 15-14 of the EIAR respectively. While the figures show that the vehicles transporting the blade will require the blade tip to extend into the southbound lane of the N83, the delivery of all abnormal loads will be made to the site with an escort provided by An Garda Siochana, (as detailed throughout the EIAR and first referenced in Section 15.1.4.1.) and the haulage company, that will provide transient traffic management measures for the convoys (1 per night on 22 nights) along the turbine delivery route.

The swept path for a standard large articulated HGV making a right turning movement from the L-61461 onto the N83 is shown in Figure 15-15 of the EIAR. This movement is as per an existing situation for vehicles exiting the L-61461 onto the N83 and does not show a vehicle travelling on both lanes of the N83. It is noted that no additional HGV movements making the left turn onto the N83 at this location will be generated by the Proposed Project.

With respect to the N83 / L-61461 junction in general, it is acknowledged that the frequency of traffic movements will increase through this junction during the construction of the Proposed Project, as is detailed in EIAR with further details set out in Section 1.2.2 above. As all inbound HGVs will use the proposed temporary access off the N83 it is forecast that a maximum of 3 additional HGV movements in one hour will exit the L-61461 onto the N83 at this location on the 227 days that general construction will take place. In mitigation, these movements will be made, with the co-operation of Galway County Council and TII, in a tightly controlled traffic managed environment, with the additional HGV movements released through the existing narrow 70m section of the L-61461 by flagmen that will be in place at either end.

It is our view that the above points do not represent deficiencies in the Road Safety Audit but are simply not issues that raised concern for the Audit Team, for the reasons described above.

Auditor Comment – Refer to our response to Issue 1 herein.

This suggests that traffic proposing to enter the L61461 will be queued on the N83 in both lanes & over an extended distance on account of the inadequate kerb radii. On a high trafficked/high speed road, this constitutes a major traffic hazard. See aerial photos above.

GCC Topic Heading - Concerns about road widening and facilitation of HGV movements at some locations

GCC issues 5 - Difficulty in achieving road widening is also highlighted as a concern. From a site visit the proposed widening of the road to facilitate simultaneous HGV/ Truck/ Tractor & Trailer contra flow movements will be difficult to achieve in some locations.

Applicants response - This issue is considered in detail in the additional information provided for the TMP included in section 1.2.2 above.

Auditor Comment – Refer to our response to Issue 1 herein.

This is not true. The Applicant proposes to use private property, without consent, for passing bays.

GCC Topic Heading - Proposal would endanger public safety by reason of traffic hazard and would contravene DM Standard 28

GCC issues 6- If permitted as proposed, the development would endanger public safety by reason of traffic hazard, obstruction of road users, or otherwise, would contravene materially in safeguarding the capacity and safety of roads and DM Standard 28 contained in the Galway County Development Plan 2022-2028 and therefore would be contrary to the proper planning and sustainable development of the area.

Applicants response- Based on the information provided in Section 15 of the EIAR, the Stage 1 Road Safety Audit, the FIR Document, the Stand Alone N83 / L-61461 / L-61461 Traffic and Transport Assessment), and this EIAR Addendum Report, the Applicant respectfully disputes this statement. Each of the points raised by Galway County Council have been carefully considered and robustly addressed and it is demonstrated that each point raised has either already been addressed in the EIAR submitted with the application, or has been addressed in the responses set out in the additional documents listed.

This is untrue. None of the issues raised have been addressed.

Auditor Comment – Refer to our response to Issue 1 herein.

15.1.10 Road Safety

At the Applicants request, Traffico Road Safety Engineering Consultants Ltd were commissioned to undertake a Stage 1 Road Safety Audit for the access arrangements for the Proposed Wind Farm site, in accordance with GE-STY-01024 Road Safety Audit Guidelines, TII, December 2017. The Stage 1 Road Safety Audit Report is included as Appendix 15-3 of the EIAR.

As documented in the Audit Report, the Audit Team identified 3 potential Problems. For each Problem identified the Design Team are required to provide a response, as documented in Appendix A, Road Safety Audit Feedback Form of the Stage 1 Road Safety Audit Report. The 3 problems identified, together with the Design Teams response and whether the response was accepted by the Audit Team are set out below.

Problem 2.1 – Space for opposing HGVs to pass on section of the L-61461 to be used by construction traffic

– The Audit Team state; **It's likely that in some locations, space will be limited for two opposing HGVs to pass each other on the L-61461. This could lead to opposition type conflicts or lengthy (and risky) reversing manoeuvres.** The Audit Team recommends that appropriate measures should be set in place as part of the Construction Traffic Management Plan to manage the risks associated with opposing HGV conflicts on the L-61461.

The Design Team Response is as follows- It is proposed that that the approx. 270m section of the L61461 between the temporary road and the proposed access junction will have a minimum width of 5m, which will be sufficient for many of the construction vehicles to pass when moving slowly. A traffic management plan is also proposed as part of the EIAR to manage traffic volumes and minimise the potential for opposing HGVs to meet on this section of the L-61461. It is noted that site staff (Flagmen) will be on-site at all times during the construction phase to manage traffic construction traffic.

This is untrue. The existing L61461 does not have a 5m width. In order to get such a width, it involves trespass on private lands without permission.

Problem 2.2 – Errant drivers entering works / over-run area at temporary link between N83 and L61461

- The Audit Team state: The opening of the over-run area for abnormal loads and construction traffic could create driver confusion, leading to errant drivers (i.e. the general public) accessing the wind farm construction site in error. The Audit Team recommends that access to the over-run area should be managed appropriately whilst being used for construction traffic to avoid errant drivers entering the works. Access points should be closed when not required by construction traffic. The Design Team Response is as follows- The default for the temporary over-run area connecting the N83 to the L-61461 will be that it will be closed to all traffic by means of gates / fencing. During times when this area is being used for construction traffic the access at both ends will be managed at all times by means of signing and site staff (Flagmen), and during the delivery of the abnormally sized loads, by Garda escort vehicles. On completion of the construction phase the temporary road will be permanently closed with boundary fencing.

Problem 2.3 – Sightline for drivers looking right obscured-

The Audit Team state: Visibility looking to the right for drivers leaving the construction site may be partially obscured by foliage within the adjacent field boundary. This is likely to increase the risk of a side impact type collision on the Local Road L-61461. The Audit Team recommends that sightlines at the wind farm access should be maximised by cutting back and maintaining all boundary foliage falling within the envelope of visibility.

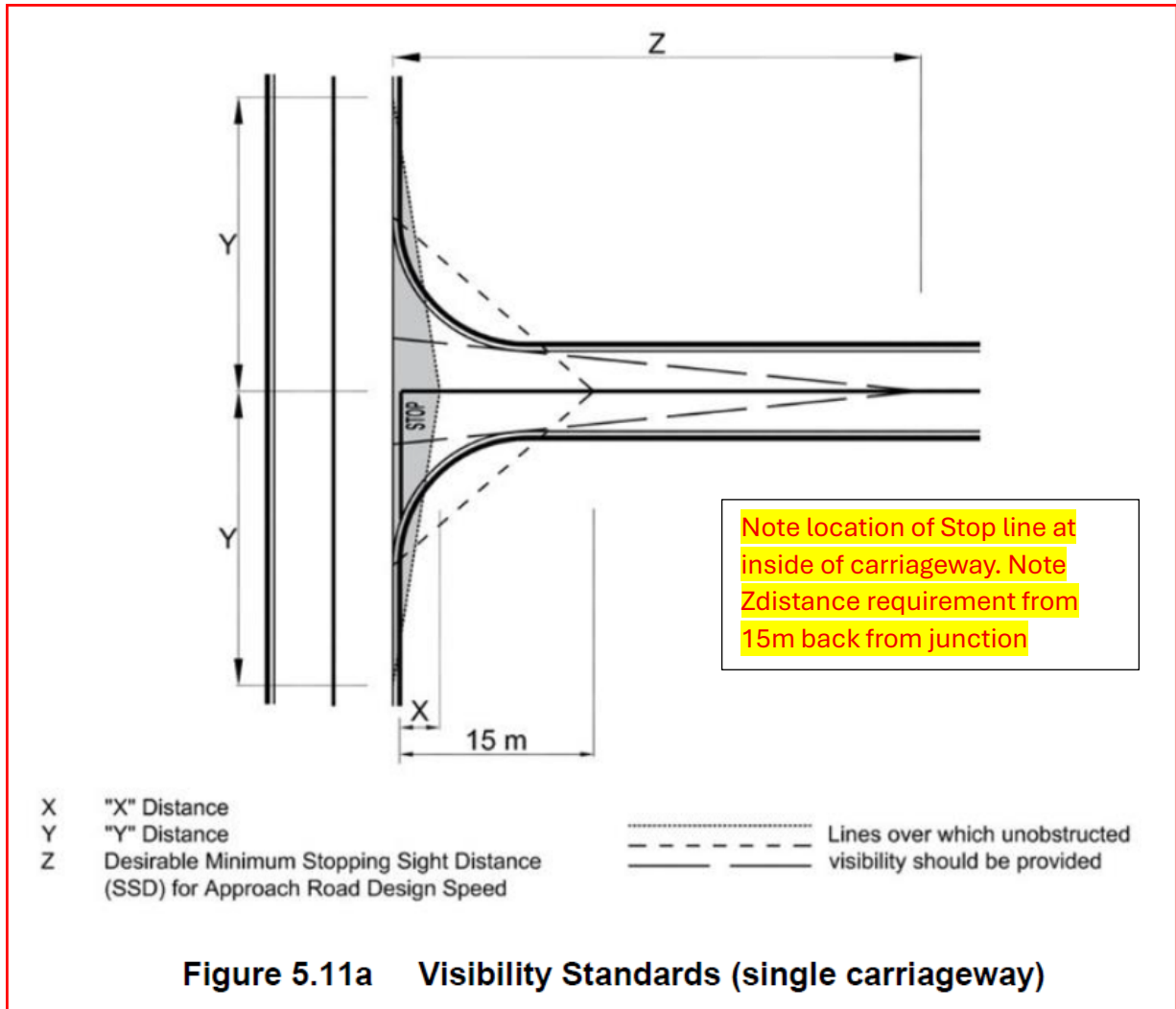
The Design Team Response is as follows-

It is confirmed that the appropriate visibility splays as shown in Figure 15-17 of the EIAR will be kept clear of all obstruction during the construction, operational and decommissioning stages of the Proposed Project.

Summary of Stage 1 Road Safety Audit-

The Audit Team raised 3 potential road safety problems. The Design Team agreed with each problem and each recommendation suggested by the Audit Team and provided a detailed solution describing each mitigation measure proposed. It is confirmed that each solution was to the satisfaction of the RSA Team Leader. It is noted that the final column in the RSA Feedback form is blank in each case, as it is understood from TII that this column is for instances where alternative solutions to those recommended by the Audit Team are proposed.

Problem Reference (Section 2)	Designer Response Section			Audit Team Response Section
	Problem Accepted (yes / no)	Recommended Measure Accepted (yes / no)	Alternative Measures or Comments	Alternative Measures Accepted (yes / no)
2.1	Yes	Yes	It is proposed that that the approx. 270m section of the L-61461 between the proposed link road and the proposed access junction will have a minimum width of 5m, which will be sufficient for many of the construction vehicles to pass when moving slowly. A traffic management plan is also proposed as part of the EIAR to manage traffic volumes and minimise the potential for opposing HGVs to meet on this section of the L-61461. It is noted that site staff (Flagmen) will be on-site at all times during the construction phase to manage traffic construction traffic.	
2.2	Yes	Yes	The default for the temporary over-run area connecting the N83 to the L-61461 will be that it will be closed to all traffic by means of gates / fencing. During times when this area is being used for construction traffic the access at both ends will be managed at all times by means of signing and site staff (Flagmen), and during the delivery of the abnormally sized loads, by Garda escort vehicles. On completion of the construction phase the link road will be permanently closed with boundary fencing.	
2.3	Yes	Yes	It is confirmed that the appropriate visibility splays as shown in Figure 15-17 of the EIAR will be kept clear of all obstruction during the construction, operational and decommissioning stages of the Proposed Project.	



The distance back along the minor road or direct access from which the full visibility is measured is known as the 'x' distance. It is measured back along the centreline of the minor road or direct access from the continuation of the line of the nearside edge of the paved surface (including hard strip or hard shoulder) of the major road. The 'x' distances on the minor road for visibility measurements shall be as defined in Table 5.4. In difficult circumstances the 'x' distance may be taken as a Relaxation as provided in Table 5.4.

From the point "x" metres back from the major road a driver approaching the junction along the minor road shall be able to see clearly points to the left and right on the nearer edge of the major road running carriageway at a distance given in Table 5.5, measured from its intersection with the centreline of the minor road. This is called the 'y' distance and is defined in Figure 5.11a and 5.11b.

Table 5.4 'x' Distances on the minor road for visibility measurements

Major road use	Minor road use	Standard	'x' Distance(m)
All roads	All junctions and accesses, Stop control	Desirable Minimum	3.0
All roads	Cycle Route	Desirable Minimum	4.0
National roads	Simple Junctions, Stop control	Relaxation	2.4*
Regional & Local Roads	All junctions and accesses, Yield control (where there are no relaxations associated with the junction layout)	Desirable Minimum	Max. 9.0
Regional & Local Roads	Accesses, Lightly trafficked	Relaxation	2.0
All roads	All junctions and accesses	Desirable Maximum	9.0

From the point "x" metres back from the major road a driver approaching the junction along the minor road shall be able to see clearly points to the left and right on the nearer edge of the major road running carriageway at a distance given in Table 5.5, measured from its intersection with the centreline of the minor road. This is called the 'y' distance and is defined in Figure 5.11a and 5.11b.

Table 5.5 'y' Visibility distances from the minor road

Design Speed of major road(km/h)	'y' Distance(m)
42	50
50	70
60	90
70	120
85	160
100	215
120	295

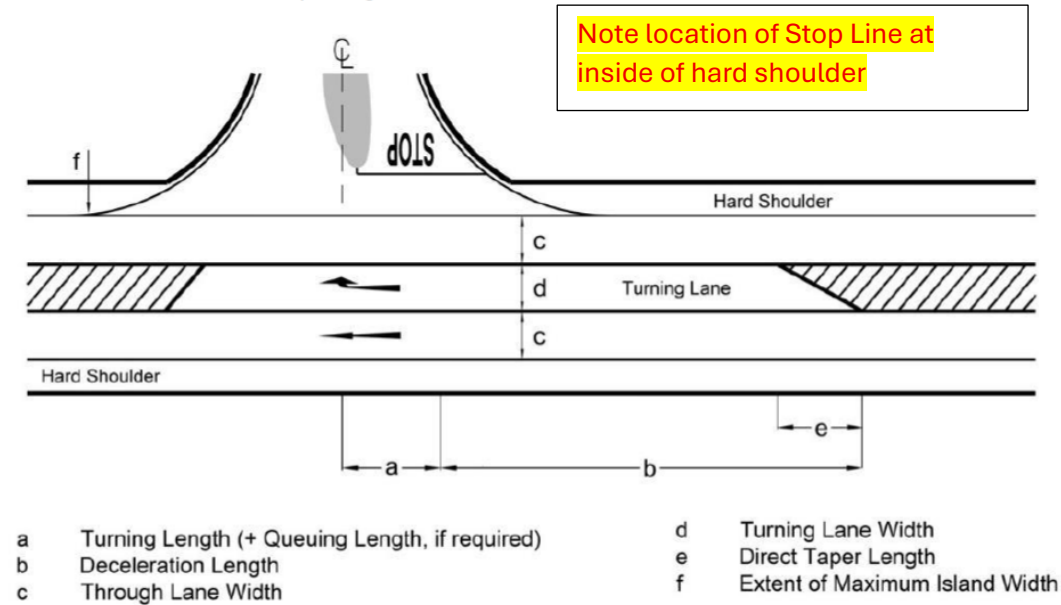
On national roads the full 'y' distance must be achieved to the high object 1.05m. No vertical section is provided to indicate availability of this 1.05m requirement.

5.6.9 Design of Ghost Island Junctions

5.6.9.1 Turning Length

The turning length is provided to allow long vehicles to position themselves correctly for the right turn off the major road. The turning length shall be 10m long irrespective of the design speed or gradient, measured from the centreline of the minor road as shown in Figure 5.18.

Where capacity calculations indicate that for significant periods of time there will be vehicles queuing to turn right from the major road, the turning length shall have a queuing length added to it as a reservoir to accommodate queuing vehicles.



5.9.3 Stop Line

In accordance with the Traffic Signs Manual, the edge of the stop line nearest to the major road shall not be closer than 0.6m to the line of the back of the paved area of the major road including any hard shoulder or hard strip (see Figure 5.24).

TII Publications
Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions)

DN-GEO-03060
May 2023

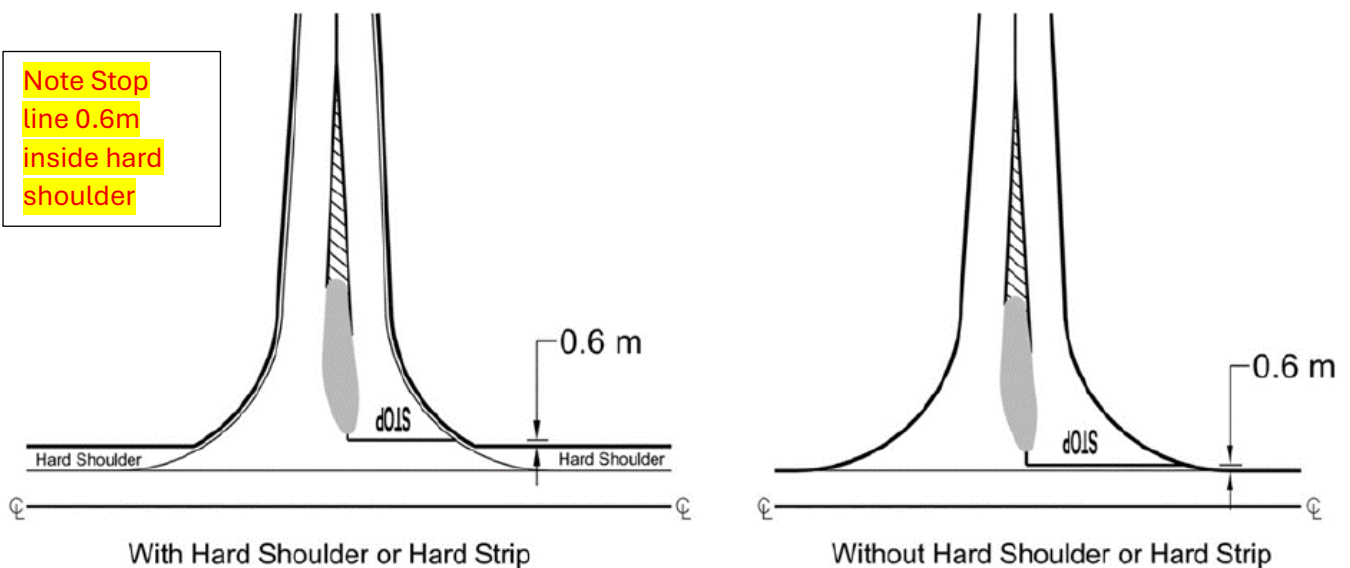
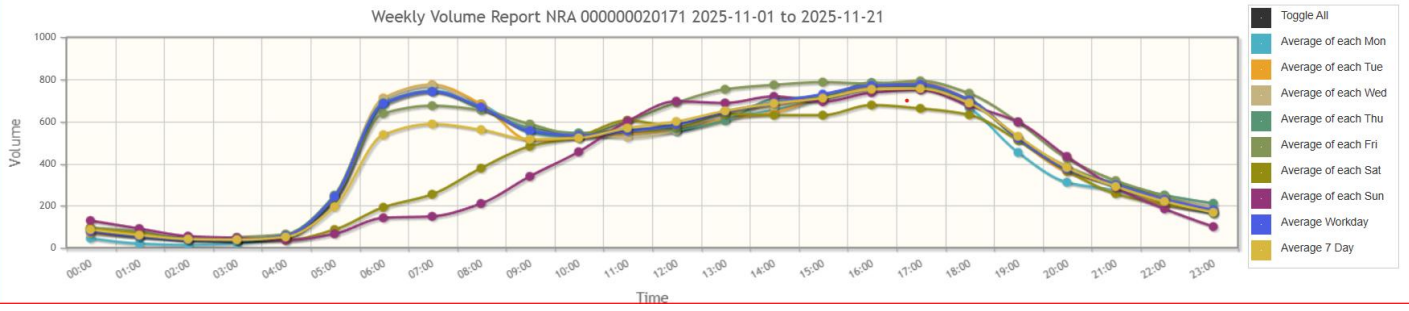
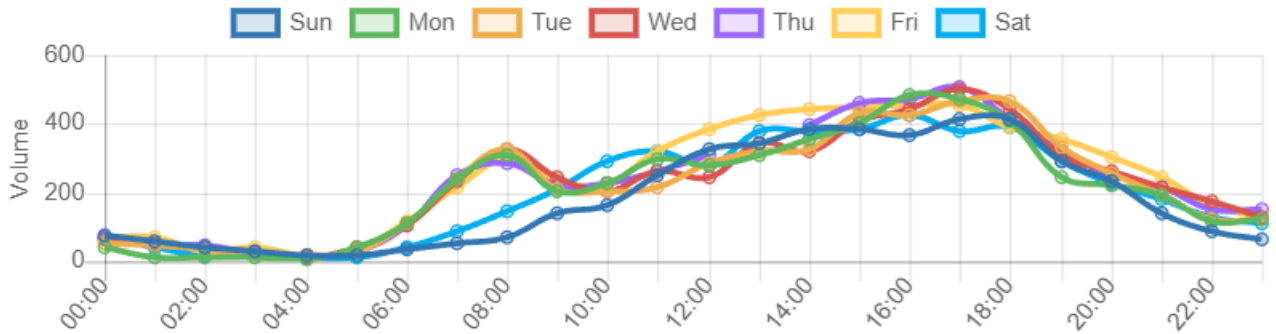


Figure 5.24 Priority Junction Stop Line with and without Hard Shoulder or Hard Strips

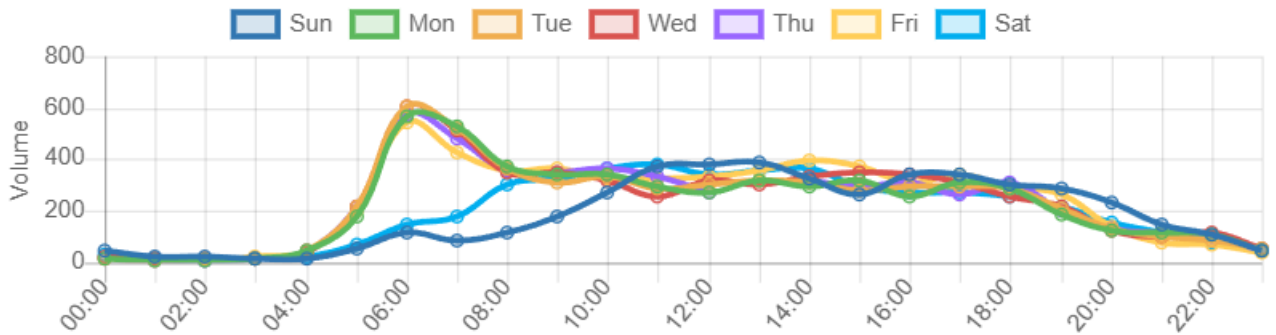
Weekly Volume Report NRA 00000020171 2025-11-01 to 2025-11-21

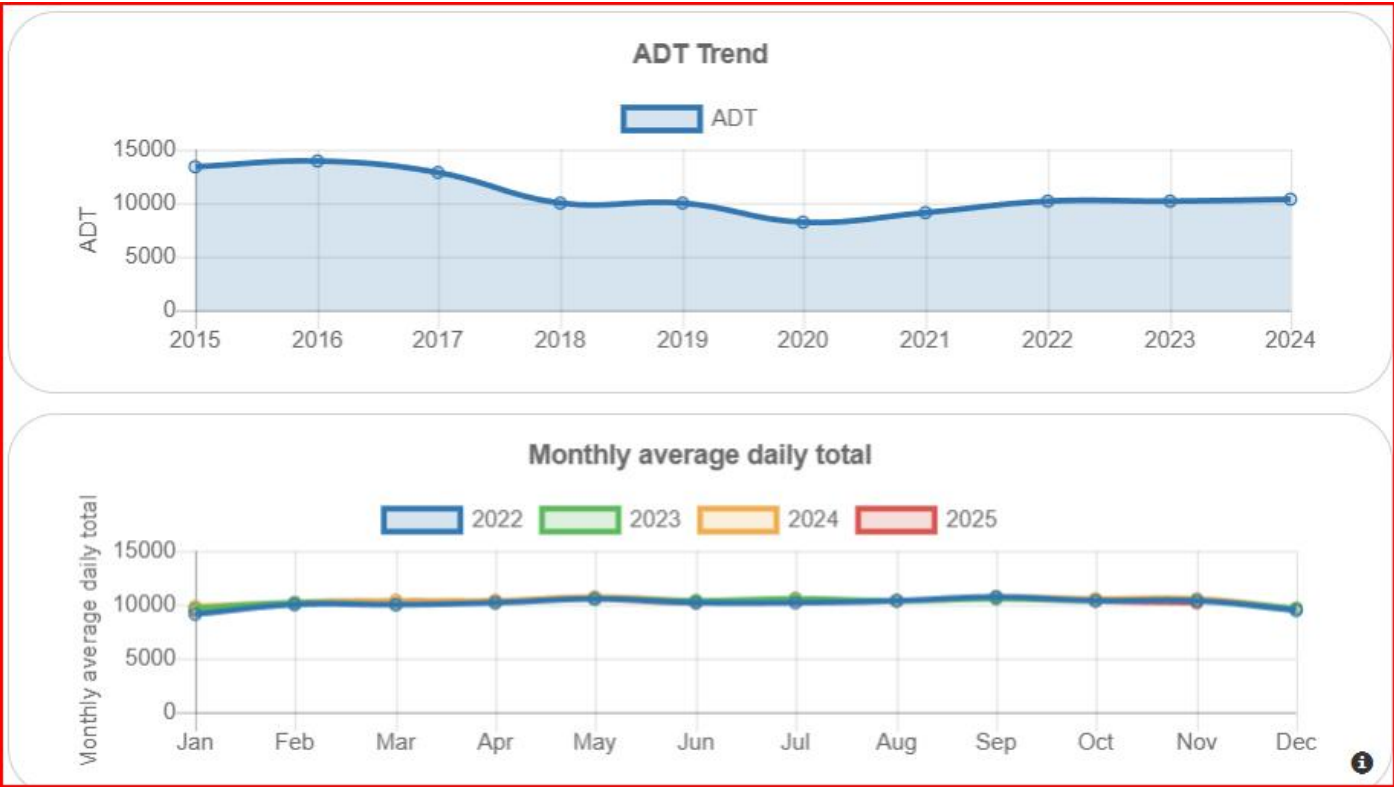


Daily Volume (North)



Daily Volume (South)





Note decrease in traffic from c15,000AADT to 10,000AADT since opening of the M17 Motorway.

Weekly Traffic Count

61,923

7-day Average Traffic Count

10,321

Weekday Average Traffic Count

10,890

Vehicle Classification 2025

1. Motorbike		0.15%
Motorbikes		
2. Car		85.27%
Passenger cars		
3. LGV		10.15%
Light goods vehicles		
4. Bus		1.19%
Buses or coaches		
5. HGV		1.75%
Heavy goods vehicles		
6. Articulated HGV		0.86%
Articulated heavy goods vehicles		
7. Caravan		0.63%
Vehicles pulling caravans		

Traffic Statistics by Direction			
Direction	Weekday average total traffic	7-day average traffic	Weekly traffic total
North	5,404	5,142	30,850
South	5,486	5,179	31,073

Appendix 5 Standalone Traffic and Transport Impact Assessment Laurclavagh Renewable Energy Development. N83 / L61461 / L6146 JUNCTION

3 Base Year 2023 and Construction Year 2028 Traffic Flows at the N83 / L61461 / L-6146 Junction

3.1 Observed 2023 traffic flows

A 24 hour classified traffic count was undertaken at the N83 / L-61461 / L-6146 junction by Traffinomics Ltd, a specialist traffic survey company. The survey was undertaken on Tuesday 21st November 2023. The observed counts are shown in terms of passenger equivalent car units (pcus) in Figure 2, with the main points to note as follows;

- The AM peak hour was observed to be 07:00 to 08:00, and the PM peak hour 16:00 to 17:00.
- On the N83 a maximum 2-way hourly flow of 880 pcus was observed to the south of the L61461 during the AM peak hour.
- Existing traffic volumes on the L61461 which leads to the site were observed to be very light with a 2-way flow of 4 pcus observed during both the AM and PM peak hours.
- Existing traffic volumes on the L6146 which forms the 4th arm of the junction are slightly heavier with a 2-way flow of 34 pcus observed during the AM peak hour and 50 pcus during the PM peak hour. These traffic counts were adopted as base flows for the purpose of the junction capacity tests discussed in Section 5 of this report. A full listing of the traffic counts is provided in Appendix A.

Note that a 24-hour traffic count without 85th percentile effective speeds is not in compliance with County Development Plan requirements. A 24-hour count for a submitted Strategic Infrastructure Development is not acceptable. It should cover a 14-day period as a minimum.

4 Proposed Project Traffic Generation and Assignment at the N83 / L61461 / L-6146 junction

A detailed breakdown of the trip generations during the various construction periods and once the Proposed Project is operational is provided in Sections 15.1.4.2 of the EIAR and the EIAR Addendum Report. While these details are not restated in this report, the maximum number of additional traffic movements that may be generated by the Proposed Project through the N83 / L61461 / L6146 junction are as follows;

4.1 During Construction

Construction staff travelling to and from the site – As set out in the EIAR it is estimated that a maximum of 70 site staff will be employed on the wind farms site, although it is likely that approximately 20 will be on site at anyone time. Site staff will typically arrive on-site before deliveries are made to site and leave the site once deliveries are complete. A maximum staff trip generation is based on the following;

- All 70 staff arrive on site during the AM peak hour and all leave the site during the PM peak hour,
- All staff drive on their own generating one car trip per staff member. Based on the above and an assumption that 50% of staff will travel from the direction of Tuam and 50% from the direction of Galway, the additional trips that will

be generated through the junction are shown in Figure 4. For this scenario an additional 75 pcus will travel through the junction during the AM and PM peak hours.

AM peak hour To site = 70 pcus, From site = 0 pcus, 2-way = 70 pcus

PM peak hour To site = 0 pcus, From site = 70 pcus, 2-way = 70 pcus

Deliveries during the 8 days of concrete foundation pours – Again, as set out in the EIAR the maximum number of HGV that will travel to and from the site will occur on the 8 days that the concrete foundations are poured, when 7 concrete mixers or (based on a pcu value of 2.4) 17 pcus will travel to and from the site per hour. As described in the EIAR, all HGV trips will travel to and from the site from the direction of Galway, with and total of 34 pcus travelling through the junction, as shown in Figure 5.

AM peak hour To site = 17 pcus, From site = 17 pcus, 2-way = 34 pcus

PM peak hour To site = 17 pcus, From site = 17 pcus, 2-way = 34 pcus

1.2

You are requested to submit a revised site layout plan at an appropriate scale indicating clear sightline triangles at the required standard including at the N83 & L61461 junction. This shall clearly dimension the extent of proposed boundary walls to be set back adjoining the L61461 and adjoining the N83. Sightlines at all entrances and junctions should meet required standards.

It is not proposed to implement any permanent changes to the existing N83 / L61461 junction as part of the Proposed Project. The justification for this is set out below. The traffic generated by the Proposed Project that will pass through the N83 / L61461 junction, together with the proposed traffic management measures proposed as mitigation are set out in Sections 15.1.4 and 15.1.12.5.2 of the EIAR, with further information relating to traffic management measures provided in Section 15.1.12.5.2 of the Report, and summarised as follows; Construction period During the 8 days when concrete foundations will be poured, all concrete mixers accessing the site will turn left off the N83 onto the temporary access link joining the N83 to the L61461 proposed as part of the development and will not travel through the existing N83 / L61461 junction. All cement mixers leaving the site will exit the L61461 onto the N83 at the existing junction, with the assistance of the comprehensive set of temporary traffic management measures set out in 15.1.12.5.2 of the EIAR (including traffic signs, proposed temporary reduction in speed limit, the presence of construction staff, temporary introduction of bollards on the centreline of the N83). For 227 days when general construction materials will be delivered to the site, and for a further 8 days when smaller turbine components will be delivered to the site using standard HGVs, the same traffic management measures described previously will be in place, that is, all HGV movements will turn left off the N83 onto the L61461 onto the temporary access link, and when leaving the site will exit the L61461 onto the N83 with the assistance of the same set of traffic management measures. For these days the temporary traffic management measures set out in the EIAR will provide mitigation against the temporary increase in traffic volumes that will pass through the junction, and the existing constraints in visibility splays at the existing junction. These measures will also be in place to facilitate the arrivals and departures of all construction staff traffic (maximum 35 cars to and from the site per day) during the full 18 month construction delivery period. On the 22 nights when the large turbine components will be delivered to the site the 3 abnormally sized loads will access the proposed temporary link road between the N83 and the L61461 to access and exit the site. All deliveries made by abnormally sized vehicles will be accompanied by an escort provided by An Garda Siochana who will provide transient traffic management measures, which will mitigate against the visibility constraints at this location. It is set out in the EIAR and summarised above that for all days during the construction phase of the Proposed Project, during which traffic volumes passing through the N83 / L-61461 junction will be increased, temporary traffic management measures will be in place as temporary mitigation measures. Operational stage Once operational it is anticipated that there will be 1-2 maintenance staff on site on any given day, typically generating 1 car/lgv trip, or 2 movements per day. With a total of 98 movements forecast on the L61461 by the proposed construction year of 2028, it is considered that the long term impacts of the additional 2 daily trips that will pass through the N83 / L-61461 junction will be imperceptible during the operational stage. It is considered that this minor increase in the additional trips will be accommodated by the junction layout that has recently been modified by Donegal NRDO / TII. Conclusion Based on the above, it is considered that the scale of the permanent increase in traffic volumes that will be generated during the operational stage of the Proposed Project does not justify a requirement for the Applicant to implement junction improvements at the N83 / L-61461 junction which has recently been altered by TII. The applicant would, however, be approachable to making a proportional contribution to any improvements to the junction that may be considered by Galway County Council / TII.

Note that the Applicant does not intend to implement any permanent changes to the existing N83 / L61461 junction & does not intend to comply with the RFI. Thus, they recognise the inadequate sight distance triangles from the L-61461 to the N83, but propose to ignore the overwhelming road safety issues. Note that he ignores the sight distance requirements for the entrance to the house at the slip road junction on the L61461.

15.1.4 Proposed Project and Traffic Generation

15.1.4.1 Proposed Access Junctions

While the design of the junctions that will provide access to the Proposed Wind Farm is discussed in Sections 15.1.9, a summary of the proposed access junctions is provided below. Temporary Road between N83 and L-61461 It is proposed that a temporary road will be constructed linking the N83 to the L-61461 at a location approximately 80m south of the existing N83 / L-61461 junction. This link will facilitate the delivery of the turbine components, which will be accompanied by a Garda escort, and the access of all standard HGV deliveries to the Proposed Wind Farm site, which will be controlled by on traffic management measures and flagmen. On the 8 days that the concrete foundations are poured this link will also be used for these vehicles to exit the site. All other HGV movements will exit the Site via the existing L61461 / N83 junction. All staff vehicles will use the existing N83 / L-61461 junction. Once the construction of the Proposed Project is complete the temporary road will be closed by means of fencing and the land and existing boundary treatments re-instated. The proposed link will only be re-opened for the replacement of turbine components. Construction and Operational Entrance off the L-61461 The construction and operational entrance will be off the L-61461, approximately 370m west of the N83. This entrance will be established for construction traffic and construction staff access and will be retained during the life of the Proposed Project for operational phase access. On completion of the construction phase, the Site entrance will be reduced in size and gated for security.

15.1.4.2 Development Trip Generation –

During Construction For the purpose of assessing the effects of traffic generated during the construction of the Proposed Project, the construction phase is in the following stages. Stage 1 – Proposed Project construction: groundworks, construction of temporary construction compounds, turbine foundations, met mast foundations, onsite 110kV substation, internal electrical cabling and construction of the Proposed Grid Connection underground cable route. Stage 2 – Wind turbine component delivery and construction. For the purpose of the traffic impact assessment, projections based on trip generation data collected from other wind farm construction projects regarding the numbers of trips per quantum of material, the number of turbine component parts based on 8 turbines, the length of the construction phase and work periods etc. were made to inform the assessment. These projections allow for assessment using the precautionary principle but should not be inferred as prescriptive limitations to the construction phase. There are numerous variables which can affect a construction project programme, including weather. 15-17

The construction phase of the Proposed Project will be carried out in accordance with the CEMP, included as Appendix 4-5 of this EIAR, which will be agreed, where required, with the relevant Local Authority. The traffic generation estimates set out in the following paragraphs is based on a total construction period of 18-24 months. The shortest potential construction phase duration of 18 months was assumed for the construction of the Proposed Project in order to test a precautionary scenario. The shortest construction period will give rise to higher volumes of construction traffic using the public road network at any one time. For assessment purposes a standard 255 working days per annum was adopted equating to 383 working days for over an 18-month construction period. The total number of deliveries made to the Proposed Project site during that period are shown in Table 15-7. It is estimated that a total of 9,707 deliveries by truck or standard articulated HGVs will be made to the Site during this period. The numbers of deliveries made to the Site is further split in Table 15-7 between materials delivered for the construction of the Proposed Wind Farm and materials delivered for the construction of the Proposed Grid Connection, As discussed further below.

15.1.4.2.1 Stage 1 – Site Preparation and Groundworks

For assessment purposes, this stage of the Proposed Project construction, which includes the site preparation and ground works, construction of temporary construction compounds, turbine foundations, met mast foundations, and internal electrical cabling is assumed to last approximately 11 months (235 days), during which a total of 7,265 deliveries will be made to the site. During this construction phase there will be two distinct types of days with respect to trip generation. A total of 8 days will be used to pour the 8 concrete wind turbine foundations. Foundations will likely be poured one per day, with circa 80 concrete loads required for each turbine delivered to the Proposed Wind Farm over a 12-hour period, resulting in 7 HGV trips to and from the Site per hour. On the remaining 227 working days for this stage other general materials will be delivered to the Proposed Wind Farm site. The estimated additional daily traffic generated on the road network during these days are shown in Tables 15-8 and 15-9. The figures show that on the 8 days that concrete will be delivered to the Site, an additional 384 two-way PCUs will be added to the network (comprising 80 two-way HGV trips with 2.4 PCUs per movement), as shown in Table 15-8. Similarly, on the 227 days

when other materials will be delivered to the Site, traffic volumes on the local network will increase by an average of 140 PCUs, as set out in Table 15-9.

15.1.4.2.2 Stage 1 – Proposed Grid Connection

This stage of the Proposed Project construction, includes works related to the construction of the Proposed Grid Connection, including, construction of the temporary construction compound, the onsite 110kV substation and the underground cable route. The construction of the of the Proposed Grid Connection is discussed further in Section 15.1.7 of the EIAR. It is forecast that the construction of the Proposed Grid Connection and associated works will take 118 working days during which a total of 2,442 HGV trips will travel to and from the site, as shown in Table 15-7. Similarly, on the 118 days when deliveries for the Proposed Grid Connection and associated works will be delivered to the site, traffic volumes generated by deliveries on the local network will increase by an average of 99 PCUs, as set out in Table 15-10.

15.1.4.2.3 Stage 2 – Turbine Construction

During the turbine construction stage, including delivery and assembly, there will be deliveries to the Proposed Wind Farm site made by abnormally large vehicles, referred to in this section as extended artics, transporting the component parts of the turbines (nacelles, blades and towers). There will also be deliveries made by standard large HGVs, transporting cables, tools and smaller component parts. The types of load and associated numbers of trips made to the Proposed Wind Farm site during the turbine construction period are shown in Table 15-11, which summarises that a total of 64 trips will be made to and from the Site by extended artics, with a further 32 trips made by standard large articulated HGVs.

For the purposes of this assessment, it is assumed that the turbine delivery element will progress at the rate of 3 extended artic trips made by convoy to the Proposed Wind Farm on 5 days per week, which is a common delivery frequency for large turbine components from the port of entry to the site. This will result in this stage taking 22 days spread over a 5-week period with all deliveries made during the night. The actual trip number will be determined following consultations with An Garda Síochána. On a further two days per week, lasting for approximately 4 weeks, the remaining equipment required during this phase will be delivered to the Proposed Wind Farm site. The additional traffic movements for these two types of days are summarised in Tables 15-12 and 15-13. In Table 15-12 a PCU equivalent value of 10 was allocated to each extended artic movement, resulting in an additional 60 PCUs on the study network on these 22 days, while an additional 19.2 PCUs are forecast to be on the network on 8 other days, as shown in Table 15-13, during the turbine construction phase.

Construction Employee Traffic During the construction of the Proposed Project, it is estimated that 100 jobs will be created. Of this total it is estimated that up to 70 staff members will be employed at any one time during the site preparation and groundworks stage of construction, reducing to a maximum of 45 staff at any one time during the turbine construction stage. If a precautionary scenario is assumed that all staff will travel to / from the Site by car, at an average of 2 persons per car, then a total of 70 PCU movements (each trip is two way) will be added to the network during the groundworks stage (Stage 1) of the Proposed Project, reducing to 45 PCU trips during the turbine construction stage (Stage 2).

15.1.4.3 Development Trip Generation –

During Operation It is estimated that the Proposed Wind Farm will be unmanned once operational and will be remotely monitored. The only traffic associated with the operational phase of the Proposed Wind Farm will be from maintenance personnel. While there will be no scheduled trips required for the Proposed Grid Connection underground cabling, maintenance may be required, although this will occur rarely generating a modest number of trips. It is estimated that the traffic volumes that will be generated by the Proposed Wind Farm once it is operational will be minimal, with an estimated 1-2 staff employed on the Proposed Wind Farm site at any time. The impact on the network of these trips during the operational stage is discussed in Section 15.1.12

15.1.4.4 Development Trip Generation –

During Decommissioning Traffic generation to the Proposed Wind Farm site during decommissioning will be similar but significantly less than the trip generation estimates presented for the construction phase presented above. This is because much of the materials brought into the Proposed Wind Farm during construction will be left in-situ during the decommissioning stage. There will be no traffic generation as a result of the Proposed Grid Connection as it will not be decommissioned.

15.1.12.5.2: Mitigation Measures

During the Construction Stage The successful completion of the Proposed Project will require significant coordination and planning and a comprehensive set of mitigation measures will be put in place before and during the construction stage of the Proposed Project, in order to minimise the effects of the additional traffic generated by the Proposed Project.

A detailed Traffic Management Plan (TMP), included as Appendix 15-2 of this EIAR, will be finalised and confirmatory detailed provisions in respect of traffic management agreed with the road's authority and An Garda Síochána prior to construction works commencing.

Traffic management measures for the local road network between the existing N83 and the proposed access junction on the L-61461 will include the following. It is proposed that a temporary road will be constructed linking the N83 to the L-61461 commencing at a location on the N83 at a point approximately 80m south of the existing N83 / L-61461 junction. The proposed temporary road connects into the L61461 at a point approximately 70m west of the N83 / L-61461 junction. The proposed temporary road will facilitate the delivery of the turbine components, which will be accompanied by a Garda escort, and the access of all standard HGV deliveries to the Proposed Wind Farm site. On the 8 days that the concrete foundations are poured the temporary road will also be used for these vehicles to exit the site. All other HGV movements will exit the Site via the existing L61461 / N83 junction. All staff vehicles will use the existing N83 / L-61461 junction.

The default for the temporary road connecting the N83 to the L-61461 will be that it is closed to all traffic by means of temporary gates / fencing / traffic barriers. During times when this area is being used for construction traffic the access at both ends will be opened and will be managed at all times by means of signing and site staff (Flagmen), and during the delivery of the abnormally sized loads, by Garda escort vehicles. On completion of the construction phase the temporary road will be permanently closed with boundary fencing re-instated. The temporary road will only be re-established in the unlikely event of the replacement of large turbine component parts during the operational phase.

While the details of the traffic management measures will be developed in detail and submitted for agreement with Galway County Council prior to the construction of the Proposed Project, they will include the following measures,

- **An application to Galway County Council for the temporary reduction of the speed limit on the N83 from 100 km/h to 80 km/h during the construction phase of the Proposed Project, as discussed in principle with Galway County Council during preplanning discussions.**

Why has this not been submitted in advance of application?

- Similar in relation to the section of the L-61461 between the N83 and the proposed site access junction approximately 280m to the west for a temporary reduction in the speed limit from 80 km/h to 60 km/h (the default speed limit for this road could already be reduced from 80kmh to 60kmh under proposed government guidelines).
- Introduction of signage on northbound and southbound approached to the existing L61461 and the temporary link of warning of approaching construction site (TMS Traffic Signs WK001).

Why has this not been submitted in advance of application?

Signage on the N83 northbound indicating the temporary construction access approaching on the left (TMS traffic Sign WK052) and similar on southbound lane indication the temporary link approaching on the right (TMS Traffic Signs WK053).

Why has this not been submitted in advance of application?

- Signage on the N83 northbound and southbound approaches to temporary access of Flagmen (TMS traffic Sign WK061).

Why has this not been submitted in advance of application?

- It is also proposed that temporary signage indicating the overtaking is not permitted during the construction phase (TMS traffic Sign RUS 014). These may be introduced with temporary bollards on the centreline of the N83.

Why has this not been submitted in advance of application?

- It is proposed that the temporary speed limit of 80 km/h is indicated on this section of the N83 using Variable Message Signs in order to maximise conspicuity.

Why has this not been submitted in advance of application?

- Similarly, temporary signage will be introduced on the L-61461, including signage on eastbound and westbound approaches to the proposed temporary link (TMS Traffic Signs WK001), signage indicating the temporary construction access approaching on the L-61461 (TMS traffic Signs WK052 and WK053), signage on the L-61461 warning of the presence of Flagmen (TMS traffic Sign WK061).
- A temporary 60 km/h speed limit signs will also be introduced on the L-61461 (if not already established as the default speed limit).

The detailed TMP will also include the following measures: Traffic Management Coordinator – a competent Traffic Management Co-ordinator will be appointed for the duration of the construction of the Proposed Project and this person will be the main point of contact for all matters relating to traffic management.

Delivery Programme – a programme of deliveries will be submitted to Galway County Council and other relevant authorities in advance of deliveries of turbine components to the Proposed Wind Farm site.

Information to locals – Locals in the area will be informed of any upcoming traffic related matters e.g. delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Contract Project Co-ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided.

A Pre and Post Construction Condition Survey – A pre-condition survey of roads associated with the Proposed Project will be carried out prior to construction commencement to record the condition of the road. A post construction survey will be carried out after works are completed. Where required the timing of these surveys will be agreed with the local authority.

Liaison with the relevant local authorities- Liaison with the relevant local authorities including the roads sections of local authorities that the delivery routes traverse, and An Garda Síochána, during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required.

Implementation of temporary alterations to road network at critical junctions – At locations where required highlighted in Section 15.1.9. Identification of delivery routes – These routes will be agreed and adhered to by all contractors. Travel plan for construction workers to Site– A travel plan for construction staff, which will include the identification of a routes to / from the Site and identification of parking areas will be implemented by the main contractor.

Temporary traffic signs – As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the temporary access linking the N83 and L-61461 and the access junction on the L-61461.

All measures will be in accordance with the “Traffic Signs Manual, Section 8 – Temporary Traffic Measures and Signs for Road Works” (DoT now DoTT&S) and “Guidance for the Control and Management of Traffic at Roadworks” (DoTT&S). Construction staff (flagman) will be present at key junctions during peak delivery times.

Delivery times of large turbine components- The management plan will include the delivery of large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.

Diversion routes during the construction of the Proposed Grid Connection Underground Cabling Route – As set out in Section 15.1.7 of this EIAR.

Additional measures - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including sweeping / cleaning of local roads as required. Re-instatement works- All road surfaces and boundaries will be re-instated to predevelopment condition, as agreed with the local authority engineers.

15.1.9 Abnormal Load Route Assessment

A route assessment was undertaken covering the proposed turbine delivery route, with the route and assessment locations shown in Figure 15-2a.

Galway Port is the proposed point of arrival for the large turbine components for the Proposed Wind Farm. The port is a well-established point of arrival for wind turbine components of similar scale into the State on a regular basis, as is the road network between the port and the national road network.

A swept path analysis was undertaken using Autotrack in order to establish the locations where the wind turbine transporter vehicles will be accommodated, and the locations where some form of remedial measure may be required.

It is noted that a dry run involving a vehicle adapted to replicate the geometry of the extended transport vehicles will be undertaken over the entire turbine delivery route prior to the construction stage of the Proposed Wind Farm.

Location 1 – R339 signalised junction at Thermo King

The swept path analysis undertaken for this junction is shown for the blade and tower transporters in Figures 15-6 and 15-7 respectively. The swept path analysis undertaken for this location shows that both vehicles will be accommodated.

Location 2 – R336 Tuam Road junction at Trappers Inn

The swept path analysis undertaken for this junction is shown for the blade and tower transporters in Figures 15-8 and 15-9 respectively. Similarly, the swept path analysis undertaken for this location shows that both vehicles will be accommodated at this existing junction.

Location 3 – N17 / N6 Bothar na dTreabh junctions

The swept path analysis undertaken for this junction is shown for the blade and tower transporters in Figures 15-10 and 15-11 respectively. At this junction the TDR passes straight through the junction with the swept path analysis demonstrating that both vehicles will be accommodated.

It is noted that vehicles of a similar size to those tested for the Proposed Project have been observed by the project team negotiating Locations 1 to 3 during the delivery phase for previously constructed wind farms.

Location 4 – N83 / L-61461, proposed temporary access for abnormally sized loads and standard HGV's during construction phase

The proposed temporary access for the abnormally sized loads is shown in Figure 15-12. The temporary access for the abnormally sized loads connects the N83 at a point approximately 80m south of the L-61461 junction, to a point on the L-61461 approximately 70m to the west of the junction with the N83. This access will be opened temporarily only on the nights that the abnormally sized vehicle convoys deliver to the Proposed Wind Farm site escorted by An Garda Síochána and staff provided by the haulage company, and during the construction period, when standard HGV's will be permitted to turn left onto the temporary road under strict traffic management conditions set out in the Traffic Management Plan included as Appendix 15-2. It is also noted that concrete mixers will exit via this temporary access on the 8 days that the concrete foundations are poured. On the completion of the construction phase this location will

be fenced off and re-instated to its original state and will be opened only for the purpose of replacing large turbine component parts.

The autotrack assessment shown in Figures 15-13 and 15-14 demonstrates that the temporary access proposed between the N83 and the L-61461 will accommodate the turning requirements of the blade and tower transport vehicles. A swept path for a standard HGV using the proposed access road and exiting via the existing L-61461 junction is shown in Figure 15-15.

Note the Autotrack assessment should have included the full route & not two pitch points for the abnormal loads. It should have included 2-way sweptpath for HGV's on the L61461.

Similarly, it should have included a structural assessment of the Clare River Bridge in Claregalway for knife edge loads from heavy vehicles involving abnormal lengths (Blades) & weights (Nacelle). This bridge was recently extended after the 2009 flooding & design loading would have been available.

Location 5 – Proposed access junction off the L-61461 for all traffic during construction and operation

It is proposed to construct a new general construction traffic and operational maintenance access off the L-61461, as shown in Figure 15-16. This access is situated on the northern side of the L-61461 approximately 370m to the west of the N83.

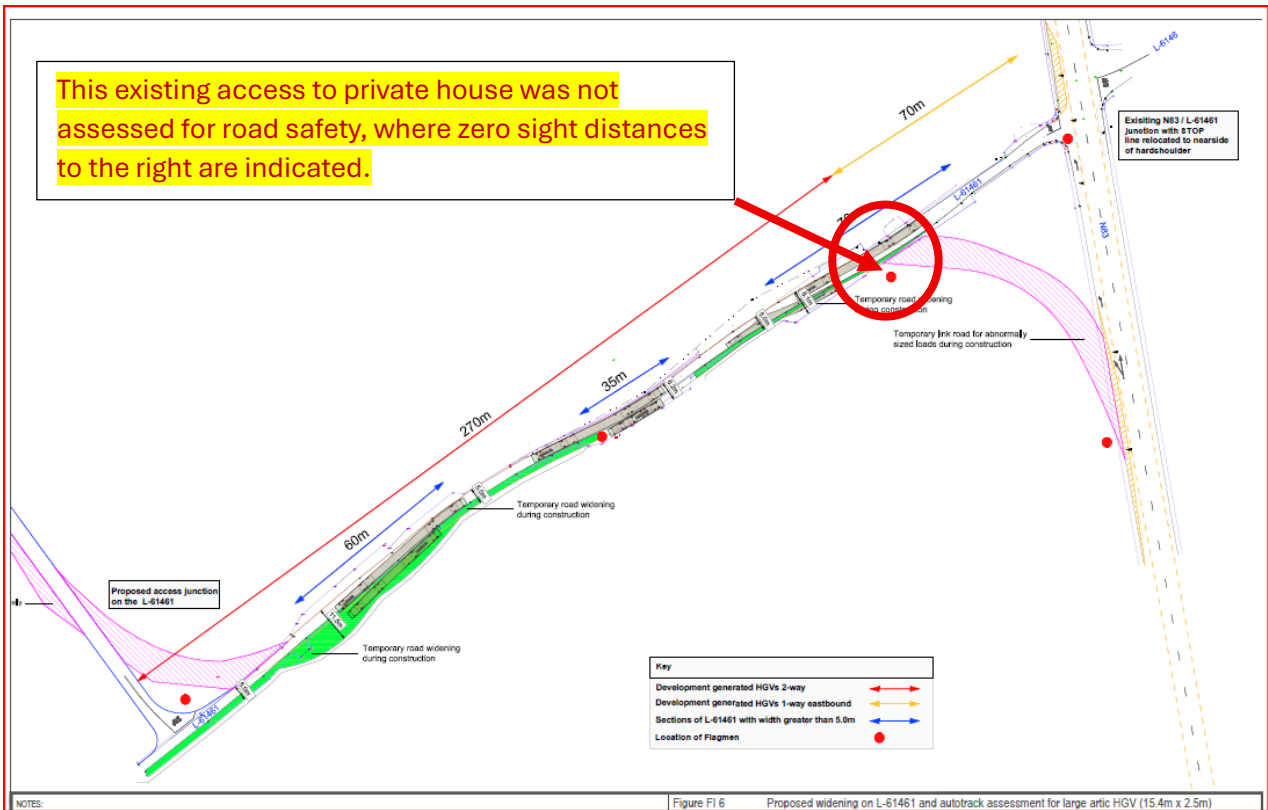
The junction has a radius of 13m on the eastern corner to provide for standard HGVs, in accordance with TII guidelines Geometric Design of Junctions (DN-GEO-03060). Visibility splays that will be kept clear during the construction and operational stages of the Proposed Project are shown in Figure 15-17. Splays of 90m at a setback of 2.4m will be provided which is appropriate for a 60 km/h operational speed as set out in the Galway County Development Plan 2022-2028, Chapter 15 Development Management Standards, Table 15-3.

The autotrack assessment shown in Figures 15-18 and 15-19 demonstrates that the proposed junction off the L-61461 will accommodate the turning requirements of the blade and tower transport vehicles.

The proposed access off the L-61461 will be gated and closed at all times with the exception of when it is in use during the construction and operational stages of the Proposed Wind Farm.

Connections with Internal Access Roads

There are various locations where the Proposed Wind Farm internal access road crosses existing local farm access roads. During the construction phase these locations will be attended by site staff and existing farm access retained at all times. On the completion of the construction phase, the Proposed Wind Farm access road will be gated at either side of these locations, and priority retained for farm access at all times.



Note these lands coloured green involve private lands & are not in the ownership or control of the applicant

15.1.6.4 Effect on Junctions – During Construction

The junction most affected on the delivery route will be the junction between the N83 and the L-61461 which leads to the Proposed Wind Farm site access junction. As set out above, the N83 is forecast to operate over link capacity adjacent to the L-61461 (as shown in Table 15-26) and the traffic volumes on the L-61461 (Link 3) are forecast to increase by 399.8% during the 8 days that the foundations are poured (see Table 15-19) and by 209.6% during the general groundworks and construction period (see Table 15-20). For this reason a detailed junction capacity test was undertaken for the N83 / L61461 junction and is included as Appendix 15-3.

Junction capacity tests were undertaken using the industry standard junction simulation software PICADY, which permits the capacity of any junction to be assessed with respect to existing or forecast traffic movements and volumes for a given time period. The capacity for each movement possible at the junction being assessed is determined from geometric data input into the program with the output used in the assessment as follows:

- Queue – This is the average queue forecast for each movement and is useful to ensure that queues will not interfere with adjacent junctions.
- Degree of Saturation or Ratio of Flow to Capacity (% Sat or RFC) – As suggested, this offers a measure of the amount of available capacity being utilised for each of capacity, in accordance with TII requirements. Delay – Output in minutes, this gives an indication of the forecast average delay during the time period modelled for each movement.

15.1.6.4.1 Scenarios Modelled

The greatest effect in terms of traffic will be experienced during peak hours when, during peak construction periods, approximately 70 workers (35 cars) will pass through it. It is assumed that deliveries of materials to the Proposed Wind Farm site will take place during the day after the workers have arrived, and before they leave at the end of the day and will therefore not occur at the same time.

15.1.6.4.2 N83 / L-61461 Junction Capacity Test Results – Proposed Project

The AM and PM peak hour traffic flows for the base year 2028 and the proposed construction year of 2028 are shown in Figures 15-5a and 15-5b respectively. The additional traffic movements that are forecast to be generated by construction workers are shown in Figure 15-5c, with proposed construction year 2028 traffic flows including the additional construction traffic shown in Figure 15-5d. The results of the junction capacity tests are shown in Table 15-27 and show that the additional car trips passing through the junction will have a slight effect on the operation of the junction, increasing the maximum ratio of flow to capacity (RFC) at the junction from 5.05.5% to 8.6% during the AM peak hour, and from 4.4% to 16.4% for the movement affected during the PM peak hour. The assessment shows that the junction is forecast to operate well within the acceptable limit of 85% as specified by TII in the Traffic and Transport Assessment Guidelines.

15.1.6.4.3 Effect on Junctions – During Operation

As discussed in Section 15.1.12 it is forecast that once operational, the Proposed Wind Farm is expected to generate 1 to 2 trips per day for maintenance purposes. It is therefore concluded that the Proposed Wind Farm will have an imperceptible effect on the local network once constructed.

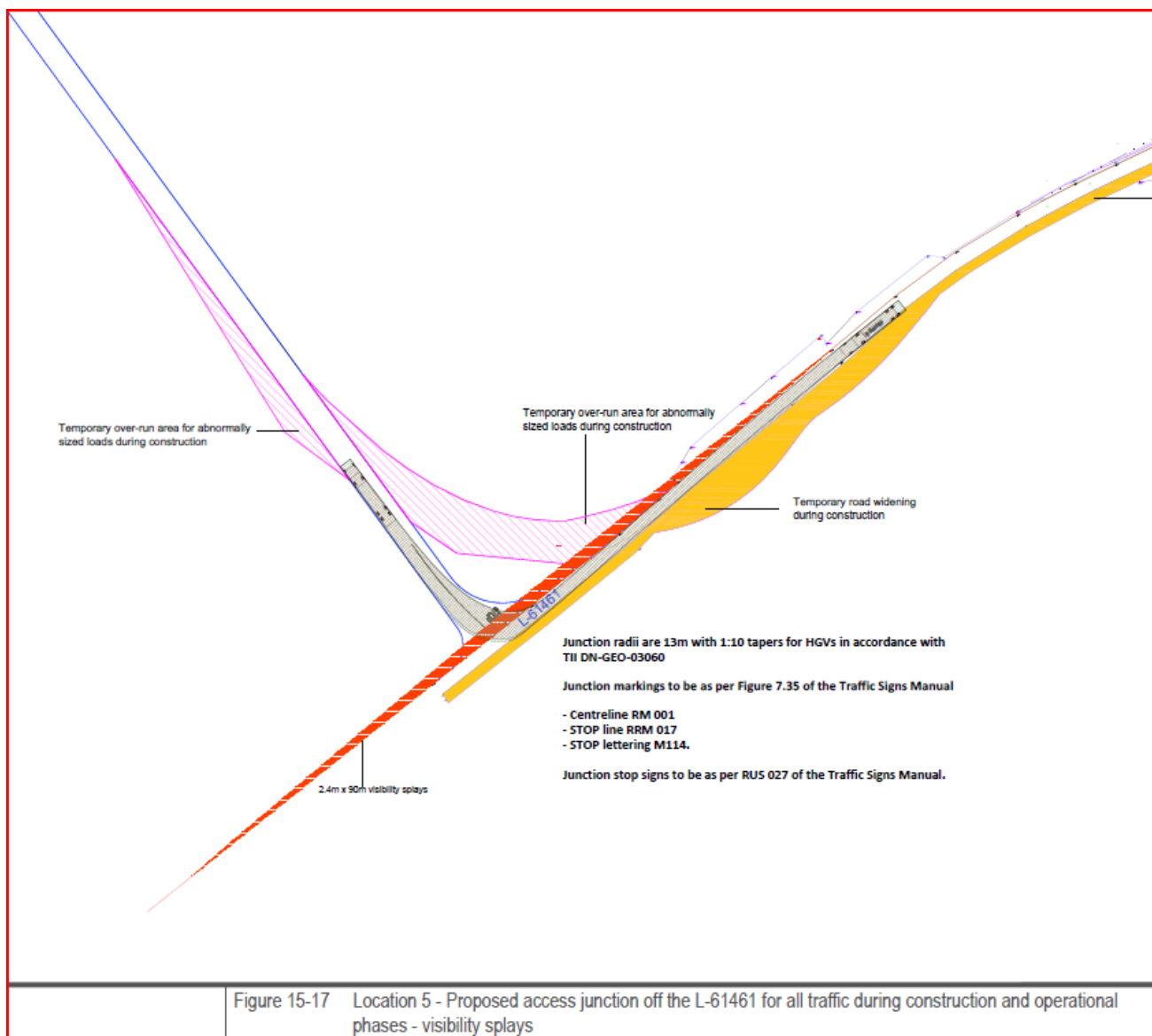


Figure 15-17 Location 5 - Proposed access junction off the L-61461 for all traffic during construction and operational phases - visibility splays

Note Landowner consents to “Temporary road widening during construction” without landowner consents.

Junction Analysis Procedure

Date: _____
Project: _____
Location: _____

Data Collection	Classification and Name	AADT		Design Speed (Km/h)	Posted Speed (Km/h)
		Current Year ()	Design Year ()		
Major road					
Intersecting Road					
Junction Type	New <input type="checkbox"/>		Existing <input type="checkbox"/>		
Site Visit	Yes: _____	No: _____	Date of Site Visit (if applicable): _____		
Functional Characteristics	Part 1 (General Information for all Intersections)				
Collision Analysis					
Access Requirements (Including ATU Requirements and Level of Usage)					
Access Control					
Future Development					
Vehicle Design Type (Include any Special Design Vehicle Details)					
% HGV's					
	Part 2 (Specific Information for More Detailed Analysis)				
Junction Layout & Turning Movement Diagram	<i>Include Layout with all approaches clearly labelled. Direction of flow and flow ratios to be clearly identified. Worked example included in Appendix D to this document.</i>				
Notable Constraints due to Upstream/Downstream Junction	Yes: _____	No: _____	Notes: _____		
Proposed Improvements to Other Roads (that would impact the traffic movement at this location)					
Geometric Characteristics					
Road Geometry on all approaches	To be attached in an appendix to this document.				
Is design compliant with the standards	Yes: _____				
Desirable Stopping Sight Distances			Achievable Stopping Sight Distances		
Mainline Horizontal Curvature					
Profile gradient on mainline	_____ %	Intersecting Roadway	_____ %		
Other Characteristics					
Traffic Management Measures					
Impact on Utilities					
Impact on Right of Way					
Recommendation of Type of Junction Treatment based on Functional, Geometric and Other Characteristics					
Scope of Modelling Required	Local Junction Modelling <input type="checkbox"/>		Micro-simulation Modelling <input type="checkbox"/>		
Designer: _____	Date: _____				
Approved: _____	Date: _____				

Figure 4.3 Junction Analysis Procedure Form

Worked example included in Appendix D.

Note this Junction analysis was not conducted for the N83/L-6146/L-61461 cross road.

1.3

If required, submit any letter(s) of consent from any adjoining landowner consenting to set back their property in order to achieve sight distances where current sight distance y-splay traverses through adjoining third party boundary.

As set out in the response to Item 1.2 above, **it is not proposed to provide any improvements to the N83 / L61461 junction as part of the Proposed Project.** The proposed mitigation measures outlined in response to the above point ensures that no improvements are necessary during either the construction or operational stages of the Proposed Project. As above, a contribution would be considered for any junction improvement works that may be considered by Galway County Council / TII.

Note that the Applicant identifies Sight Distance Triangles of 35m & 20m [Y] from 2.4m [X] distance, where 215m from 3m is required by TII & Galway County Council & Applicant states that no improvements are necessary.

The Sight Distance Triangle for the house entrance immediately after the proposed slip road from the N83 to the L61461 is zero.

1.4

Site layout plans should be revised to clearly detail the width of L-61461 and its proposed widened areas, at an increased scale, taking into account the width of 2 number passing HGVs.

The proposed temporary widening of the L-61461 is shown in Figure F16 to a scale of 1:1000 in provided as Appendix 2 Addendum Planning Drawings of this RFI Document at the appropriate scale. The figure shows the sections proposed for road widening, road widths at selected locations, and also a swept path analysis for a large articulated HGV (15.4m long by 2.5m wide). A detailed assessment of the operation of the 340m section of the L-61461 between N83 and the proposed site access junction was provided in Section 2.11 Traffic / Road Safety of the Response to Observations Received Report which is included as Section 15.1.12.5.2 of the Report. Figure F16 clearly demonstrates that the proposed widening measures will facilitate the passing of HGVs.

Note the Applicant does not have landowner consents to such widening & such widening would involve trespass. See response at 1.6 below.

1.5

The site layout plans should be revised to detail existing junction layouts at the N83 local roads.

All figures in the EIAR and those included in the Appendix, showing the layout of the N83 / L61461 junction have been updated to include the revised road markings with the STOP line on the L-61461 approach relocated to the nearside of the hard shoulder, and are provided as Appendix 2 Addendum Planning Drawings of this RFI Document. This is addressed in Section 15.1.9 of the Report.

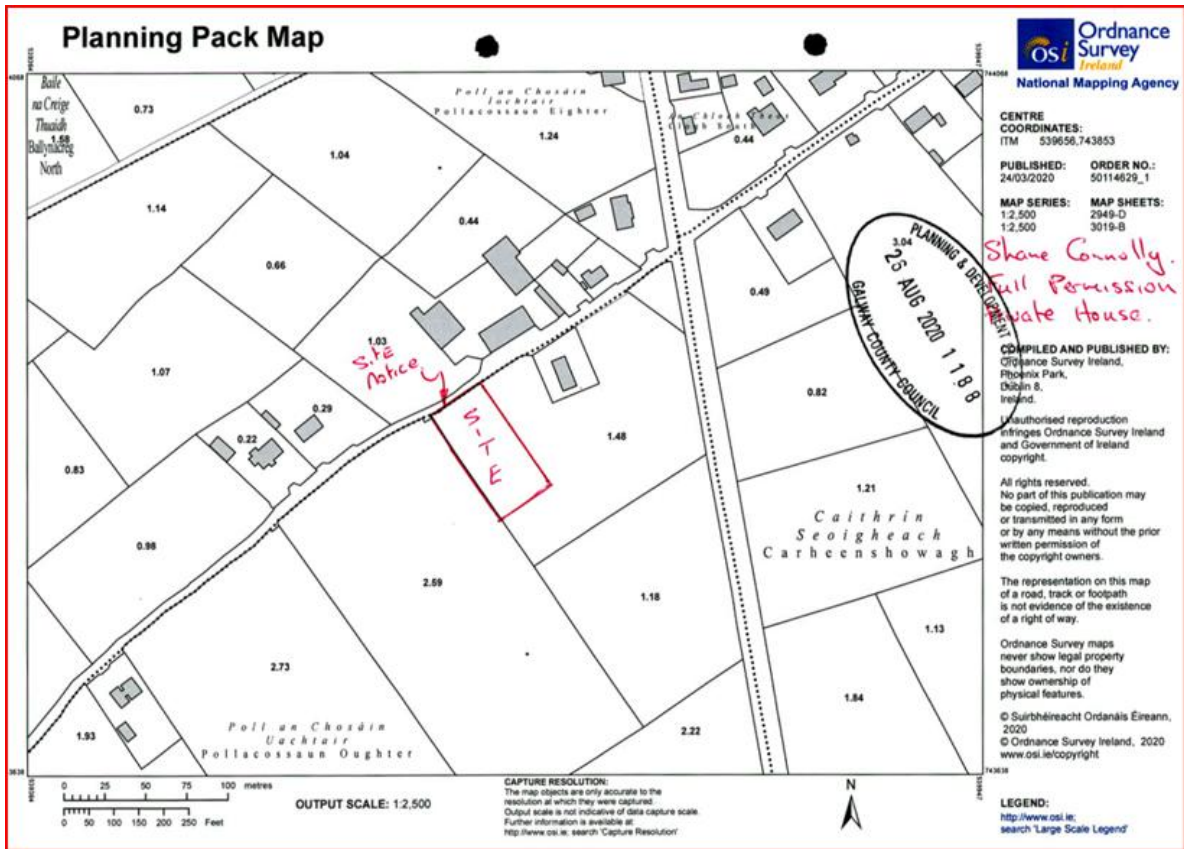
1.6

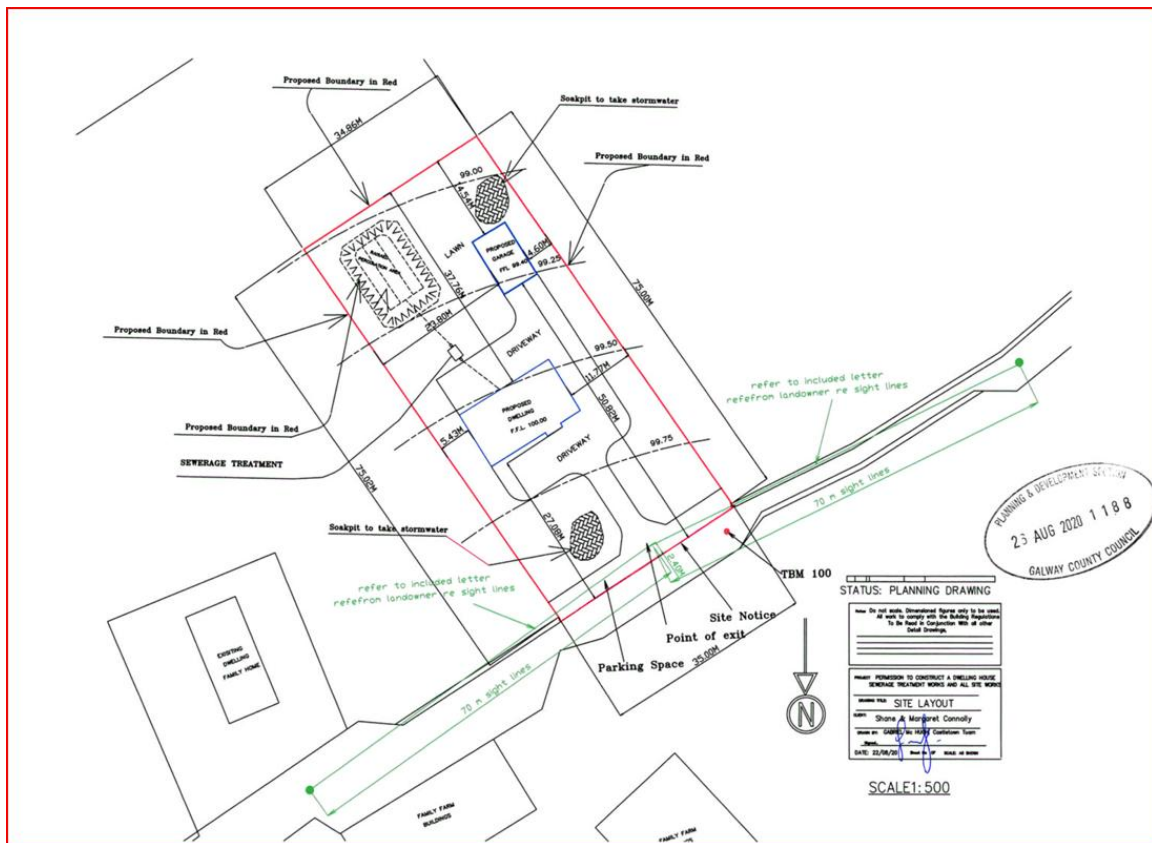
The proposed wind farm development would appear to adjoin/encroach onto third party lands adjoining the L61461, with existing dwellings not delineated on the site layout plans at this location. You are requested to provide clarification on same, and submit relevant consents if/where applicable, with plans revised to detail existing dwellings.

The red line boundary of the Proposed Development that was included in the initial submission encroaches on third party lands at Folio GY133807F which is adjoining the L61461. Subsequently, the red line boundary has been amended to no longer include any third party lands where consent has not been obtained. It should be noted that the planning permission granted for the property referred to in GCC Pl. Ref. 20/1188 states that:

“A 3 metre deep set back shall be provided immediately adjoining the edge of the margin of the roadway for the entirety of the site frontage. This space shall be cleared, graded, levelled and surfaced to a standard suitable for use as off-road parking to the satisfaction of the Area Engineer and Planning Authority.”

It is assumed that the above works have been carried out in accordance with the conditions of planning permission outlined above by Galway County Council. All relevant planning and drainage drawings have been updated to show the updated red line boundary and any proposed road widening works. Please refer to Appendix 2 for these updated drawings.





4. A 3 metre deep set back shall be provided immediately adjoining the edge of the margin of the roadway for the entirety of the site frontage. This space shall be cleared, graded, levelled and surfaced to a standard suitable for use as **off-road parking** to the satisfaction of the Area Engineer and Planning Authority.

REASON: In the interests of road safety.

Note the setdown area is for "off road parking" at the front of a household in a planning approval & is for the householder. It is not part of the public road & is not in the charge of Galway County Council. The Council do not maintain the area. It is not available to another applicant save with the consent of the owner. Using such an area without consent is trespass as per Dromada v Cremins High Court Case attached below. Without getting such consent the applicant included the lands & coloured red but not in the ownership/control of the Applicant.

Any condition in relation to the proposed access over private lands is limited under Section 34(4) to lands which are under the control of & are owned by the Applicant, & the lands are not so owned, and where the imposition of conditions/mitigation measures over the full extent of the route cannot be the subject matter of condition where mitigation measures relate to these lands as the said lands do not fall within the jurisdiction conferred by Section 34(4).

Article 221(2)(g) provides that where the Applicant is not the legal owner of the land or structure concerned the written consent of the owner to make the application is required. The application proposes works across lands where no consent of the owners of these lands has been submitted notwithstanding the requirements of Article 22(2)(g) of the Planning and Development Regulations. The only exception to this obligation is where the Applicant is a Statutory Undertaker which on the face of the documentation submitted does not fall within this exception and where therefore it is necessary where the development is not being carried out by a Statutory Undertaker that the written consent of the landowner be submitted and accordingly, the application does not comply with the requirements of Article 22(2)(g) of the Planning and Development Regulations.

There is no evidence or no basis to disapply the default provision in respect of works being located in lands where the written consent of the said owner of the lands is required, and where there is no evidence of a type that complies with the obligations under Article 22(2)(g)(ii) on the face of the documentation and specifically, there is no statutory undertaker that has been identified nor could be identified which complies with the requirements such as to disapply

the obligation to furnish the said written consent which is required as a mandatory obligation under the said regulations.

A citizen cannot be unilaterally deprived of his property rights having regard to Constitutional Provisions in Article 43 & Article 40.3 unless through due course of law.

1.7

The details outlined on material assets in your response to submissions including the management of HGV trips on the L-61461, swept path analysis, new temporary access roads access and egress restrictions, and items raised in items 1.1, 1.2, 1.4 & 1.5 above should be included in an updated Road Safety Audit for the construction stage. This should be outlined by way of an addendum to the EIA.

This issue is addressed in a joint response prepared by the Applicant and the Independent Road Safety Auditors (Trafficco Ltd) and is included. This is included as Appendix 15-3a of the EIA Addendum Report.

This response is nothing short of disgraceful. It seems as if the Road Safety Auditor was fully aware of the dangerous situation being proposed and choose not to respond. No other conclusion is possible. Using loose English to try and confuse ACP is not acceptable. TII Standards are just that & ignoring them is unforgiveable & has to lead to refusal.

1.8

A Traffic and Transport Impact Assessment for the N83-L61461 junction encompassing the N83, L61461 and L6146 should be submitted as a standalone document.

The standalone Traffic and Transport Assessment for the N83 / L61461 / L61461 junction is included as Appendix 5 of this RFI. It is noted that all key conclusions with respect to the capacity of the junction are consistent with those presented in Section 15.1.6.4 of the EIAR.

Appendix 5-Standalone Traffic and Transport Impact Assessment

Laurclavagh Renewable Energy Development – N83 / L61461 / L6146 junction, Co Galway – Traffic and Transport Assessment

A 24 hour classified traffic count was undertaken at the N83 / L-61461 / L-6146 junction by Traffinomics Ltd, a specialist traffic survey company. The survey was undertaken on Tuesday 21st November 2023. The observed counts are shown in terms of passenger equivalent car units (pcus) in Figure 2,

This 24-hour classified traffic count is not provided in this Traffic and Transport assessment. Nor is Figure 2 included. Again, a message is being given to ACP.

1.9

Details of the junction capacity test referenced as included as Appendix 15-3 of the EIAR should be submitted.

Due to a typographical error in Chapter 15 Material Assets, it was incorrectly stated the junction capacity test was included as Appendix 15-3 of the EIAR. A detailed junction capacity test was undertaken for the N83 / L61461 junction and was included in Section 15.1.6.4.2 of Chapter 15 of the EIAR. It is noted that this information is now also provided in the Standalone Traffic and Transport Assessment included as Appendix 5 of this RFI Document. It is noted that this information is now also provided in the Standalone Traffic and Transport Assessment included as Appendix 5 of the EIAR Addendum Report. In summary the assessment presents additional details of the junction capacity assessment undertaken for the construction stage of the Proposed Project at the N83 / L-61461 / L-6146 junction, updated to take account of the reduced visibility on the L-61461 junction. A sensitivity test is also presented based on an extreme precautionary scenario of all construction staff and the maximum number of HGVs for a concrete foundation pour passing through the junction at the same time. The junction was determined to operate within capacity for this scenario.

1.10

TII outline the proposals to lay the grid cable in the N83 national road reservation has a potential to impact on road authorities and TII in undertaking future maintenance and improvement requirements, and there also may be additional cost implications to improvements and maintenance resulting from the presence of high voltage cabling. Please outline if joint bays can be accommodated within the N83 carriageway, and their locations should be clearly outlined.

The Planning Drawings (included in the Planning Pack) are relevant to S37E Application for the Proposed Wind Farm only. Drawings of the Proposed Grid Connection assessed are included in Appendix 4.8: Grid Connection Infrastructure of the EIAR to facilitate ACP to complete a robust EIA of the Proposed Project. Joint bays located in roadways are common features of large scale renewable energy projects in Ireland. 21 no. joint bays are proposed along the Proposed Grid Connection underground cabling route, approximately 600 to 800 metres apart or as otherwise required by ESB/Eirgrid and electrical requirements. Joint Bays are a crucial part of undergrounding electricity networks, facilitating connections for both Eirgrid and ESB Networks between renewable energy projects and the national grid. They are often located under public roads and are required to be informed by the TII "Specification of Road Works" and other ESB functional specifications. Appendix 4-8 Grid Connection Infrastructure provides details of the proposed locations on joint bays in the public roadway along the Proposed Grid Connection underground cabling route. The final location of all joint bays will be detailed in a separate Planning Application for the Proposed Grid Connection infrastructure, under S.182 of the Act, which will also take into account any observations which TII and other relevant stakeholder may provide.

The last sentence requested an outline if joint bays can be accommodated within the N83 carriageway and their locations should be clearly outlined. The Applicant does not answer this question.

The proposed grid connection is coloured red on planning application as if in the ownership/control of the Applicant. However, the lands are not & they are private lands & no consent exists to their use for cable laying. The attached Caselaw *Dromada v Cremins* determines trespass in such a situation. ACP cannot facilitate trespass.

The Irish Constitution protects Property Rights as does the European Convention on Human Rights Protocols 1 & 8.

Any condition in relation to the proposed grid connection or access over private lands is limited under Section 34(4) to lands which are under the control of & are owned by the Applicant, & the lands are not so owned, and where the imposition of conditions/mitigation measures over the full extent of the route provided for grid connection works cannot be the subject matter of condition where mitigation measures relate to these lands as the said lands do not fall within the jurisdiction conferred by Section 34(4).

Article 221(2)(g) provides that where the Applicant is not the legal owner of the land or structure concerned the written consent of the owner to make the application is required. The application proposes works across lands where no consent of the owners of these lands has been submitted notwithstanding the requirements of Article 22(2)(g) of the Planning and Development Regulations. The only exception to this obligation is where the Applicant is a Statutory Undertaker which on the face of the documentation submitted does not fall within this exception and where therefore it is necessary where the development is not being carried out by a Statutory Undertaker that the written consent of the landowner be submitted and accordingly, the application does not comply with the requirements of Article 22(2)(g) of the Planning and Development Regulations.

There is no evidence or no basis to disapply the default provision in respect of the grid connection works where the said grid connection is being located in lands where the written consent of the said owner of the lands is required, and where there is no evidence of a type that complies with the obligations under Article 22(2)(g)(ii) on the face of the documentation and specifically, there is no statutory undertaker that has been identified nor could be identified which complies with the requirements such as to disapply the obligation to furnish the said written consent which is required as a mandatory obligation under the said regulations.

The Proposed Grid Connection underground cabling route measures approximately 14.3km, of which approx. 12km is located within the public road corridor.

The route of the grid connection with joint boxes extends over an approximate **14.3km** distance, of which approximately 12 is located within the public road corridor but is not located entirely within the public road but includes lands which lie outside the public road, and within margins of the public road, and in order for the said exemption to apply the total extent of the grid connection must either be exclusively in the public road and comply with Article 22(2)(g)(ii) or be on private land where the written consent of the landowner is required, but the said provisions may not be combined so as to adopt a provision in respect of part of the scheme and its disapplication in respect of other parts of the scheme.

A ground investigation survey was not provided by the applicant to establish the existing condition of the road and to inform the most appropriate form of reinstatement.

A Ground Penetrating Radar (GPR) survey of all services was not provided to identify clashes with high pressure water mains, MD fibre optic cables etc with letters of consent from Éireann, EIR, NBI etc where clashes require proposed 38KV power cable ducting to be beneath these existing services and still achieve the minimum depth as per the 'Interim Guidance' from DoT and RMO.

A GIS survey of all installed ducting, joint pits and any underground ancillary equipment or pits along the cable ducting route on Local/National routes should have been carried out. The GIS survey should have been to ITM coordinates.

Detailed design drawings over the full extent of the proposed grid connection route should have been provided and should have clearly demonstrate how the proposed works would have impacted existing services in the public road. Additionally, detailed cross section drawings showing trench depths required should have been provided so as not to affect existing services.

A structural assessment of all structures to be crossed should have been submitted in accordance with TII Publications AM STR-06048 to verify that they can sustain an 'Exceptional Abnormal Loads' load safely.

Details in plan of the location of the proposed wheel wash and chute outwash facilities are not provided.

A citizen cannot be unilaterally deprived of his property rights having regard to Constitutional Provisions in Article 43 & Article 40.3 unless through due course of law.

RECEIVED: 29/09/2022

THE EFFECT OF DISTANCE ON MAGNETIC FIELDS

Both AC and DC technologies produce magnetic fields and both decrease with distance as you move away from the line or cable. See graph below:

AC LINES AND CABLES

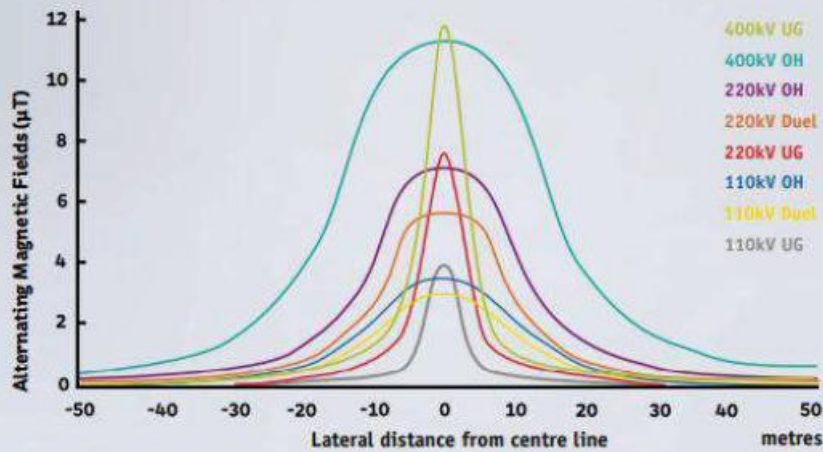


Figure C illustrates the magnetic field from overhead AC lines operating in Ireland. The field strength decreases with distance. The fields from these AC lines are far below the 1998 ICNIRP Guidelines for exposure to AC magnetic fields ($100\mu\text{T}$). In 2010 ICNIRP updated its ELF-EMF guidelines, which included the recommendation for a $200\mu\text{T}$ reference level for exposure for the general public, but these have not yet been adopted by the European Union.

Note this Figure indicates the distance relationship effects from AC & DC Magnetic fields. Many houses along the proposed grid route are within these 30m distances of cables. These magnetic effects cause health issues. This is not addressed in application.

Summary of Ornithology issues:

1. References to Percival 2003 relate to a totally different scale of windfarm from late 1980's to 2000 (see below). Note the vast majority of Turbines in his papers are Medium (500kw) to small (<500kw). Using this data for 7Mw turbines is nonsense. None of the collision data is relevant for this application. And then we don't know the separation distances between turbines in Percival references, while the separation distances in this application do not conform with WEG2006 & Draft WEG2019 for downwind issues. The corresponding ignoring of the sensitivity areas assessment from Percival 2003 is manipulation of the application.
2. In addition to the assessment of effects provided under EIAR, further analysis of the potential for disturbance and displacement effects on Annex I species within the zone of influence of the proposed development arising from repetitive disturbance, and associated potential for heightened risks of nest failure occurring during the construction, operational and decommissioning phases of the proposed development, both by themselves and in combination, and their potential by reason of their nature, frequency or duration to have the potential to override any potential habituation behaviours this species may exhibit to repeated disturbance events within construction and operational settings leading to nest failure. Where following this assessment, likely significant effects are identified, appropriate mitigation measures should have been considered.
3. It is noted that descriptions of mitigation measures under EIAR that the risk of an identified Annex I raptor species & others collision is likely to be highest when inexperienced young birds are initially fledged and engaging in flight practice and that real time monitoring of the breeding location through the breeding season is proposed as mitigation. This issue is not considered.

Item 2. Ornithology (EIAR & NIS)

2.1

In relation to the methodology for potential bird mortality and the acceptability of same, the Department of Housing, Local Government and Heritage consider that both the Ornithology chapter of the EIAR and the NIS do not accurately use the methodology outlined to determine the significance of the potential bird mortality caused by collisions with the proposed turbines. It is outlined that the EIAR and NIS make reference to the methodology outlined by Percival (2003) for determining the magnitude and significance of an effect on a given population (e.g. High = < 20% population remains, Negligible = < 1% population lost), and according to Percival (2003), the magnitude of impact on a species population as a result of collisions, would be negligible if the estimated mortality does not increase the natural mortality rate of the population by 1%. It is outlined however, Percival (2003) states that 'one issue in this process concerns the precise area or bird population against which the degree of impact should be judged, and for protected SPAs this is usually quite straightforward, comprising simply the populations for which that site has been designated'. The Department outline the EIAR and NIS only make reference to national and county populations even when connectivity with Lough Corrib SPA has been identified in the reports. It is outlined for example, the reports establish potential connectivity between the proposed development and the Lough Corrib SPA in relation to potential collision mortality impacts on breeding Black-headed Gulls, which are a qualifying interest of the SPA, however, these impacts are then contextualised in terms of county population and not the SPA population as would be the case if the Percival (2003) methodology was used correctly. So instead of an increase of 0.26% mortality in relation to quoted county population there would be a 0.8% increase in mortality in relation to the SPA population. This change, while still resulting in an increase of mortality below 1%, may be important in relation to the assessment of in-combination effects with other wind farms with potential connectivity to the Lough Corrib SPA. While the details set out in your response to the submissions are noted, having regard to the observations of the Department Of Housing, Local Government and Heritage, to enable a determination of the significance of the potential bird mortality caused by collisions with the proposed turbines on all relevant bird species, from both an individual project and cumulative perspective, collision risk impacts should be clearly contextualised in terms of the county and the SPA population, utilising the Percival (2003) methodology, as per the Departments observation.

An Coimisiún Pleanála (ACP) issued a further information request that makes specific reference to the 2024 submission of the Department. As the submission by the Department is central to the further information request, it is summarised in the following paragraphs. It is noted that a response to this 2024 submission was submitted on the 9th

of August 2024. ACP note this response to submissions. This response has been prepared by Principal Ornithologist, Padraig Cregg (B.Sc., M.Sc.) with assistance from Senior Ornithologist Donnacha Woods (B.Sc., M.Sc.) of MKO, both of whom are suitably qualified, competent, professional ornithologists with extensive experience in completing avifaunal assessments and are competent experts for the purpose of the preparation of this response. The Department's key concern (from the 2024 submission) related to the potential for an important cumulative collision risk for the Special Conservation Interest population of breeding black-headed gulls from the nearby Lough Corrib SPA. The Department criticised the methodology used in the Ornithology Chapter of the EIAR and the NIS to assess bird mortality from turbine collisions. They argue that both reports inaccurately apply Percival's (2003)¹ methodology for assessing the significance of potential bird fatalities. Percival suggests that an impact is negligible if it does not exceed a 1% increase in natural mortality rate, emphasising the importance of correctly defining the affected bird population. The relevant text includes the following worked example, which illustrates their position: "For example, the reports establish potential connectivity between the Proposed Development and the Lough Corrib SPA in relation to potential collision however, these impacts are then contextualised in terms of the county population and not the SPA population as would be the case if Percival (2003) methodology was used correctly. So instead of an increase of 0.26% mortality in relation to quoted county population, there would be a 0.8% increase in mortality in relation to the SPA population. This change, while still resulting in an increase in mortality below 1% may be important in relation to the assessment of in-combination effects with other wind farms with potential connectivity to the Lough Corrib SPA."

In summary, the Department highlights how the choice of reference population can impact the outcome of the impact assessment. In the present case, they are primarily concerned with the cumulative impact assessment for black-headed gulls. In the 2024 response to submissions, there was first a discussion of the choice of black-headed gull reference population for the collision risk impact assessment, followed by the cumulative assessment of collision risk. In the 2025 request for further information from ACP, they request the following: "To enable a determination of the significance of the potential bird mortality caused by collisions with proposed turbines on all relevant bird species, from both an individual project and cumulative perspective, collision risk impact should be clearly contextualised in terms of the county and the SPA population, utilising the Percival (2003) methodology, as per the Departments observation." The "relevant bird species" mentioned in the ACP FI request is taken to mean any key ornithological receptor as per **Section 7.4.2** of the EIAR where that species is also named as a SCI for an SPA with potential connectivity to the site. This is taken to be the case due to the requirement to contextualise "in terms of the county and the SPA population". An example species would be black-headed gull. As this species was discussed at length in the 2024 response to submissions, it is not discussed further here. There are only two other species that fit this description: golden plover and hen harrier. For golden plover, the choice of reference population for the collision risk impact assessment was first discussed followed by the cumulative assessment of collision risk. Collision risk is then discussed for hen harrier. Please see the **Section 7.5 of the EIAR Addendum** for detailed discussion. Bird surveying has been ongoing at the Proposed Wind Farm site from October 2023 to March 2025 (data presented in **Section 7.3.7.1** of the EIAR Addendum and **Appendix 7-2a and 7-4a**). The results of these most recent surveys and the previously reported surveys have been combined to inform an updated collision risk assessment. Please see EIAR Addendum **Appendix 7-6a** for details. The results of this revised collision risk assessment informs this response. Additional information has been provided for relevant species in **Sections 7.5.2.1, 7.5.2.2 and 7.5.2.7 of the Report**.

Additional information has been provided for relevant species in **Sections 6.1.1.1.5, and 8.1.3.2** of the Revised NIS.

Please see Section 8.2.5.3 of the EIAR for a summary of Percival (2003) guidance.

Note, The Percival 2003 analyses involved wind turbines of a far smaller size. Comparing that period in time to 2025 sizes is irrelevant & not scientific.

Birds and windfarms

Table 1. Bird-windfarm collision studies: summary of findings.

Species group	Sites studied	Windfarm size	Turbine type	Exposure to collision risk	Incidence of collision	Population effect
Divers	Burgar Hill ^{1,2}	S	S/M	M	Nil	No
Cormorants	Buffalo Ridge ³	VL	M	L	Nil	No
	Blyth ^{4,5}	S	S	L	VS	No
Swans	Yukon ⁶	S	S	S	Nil	No
	Urk ⁷	M	S	M/L	VS	No
Geese	Buffalo Ridge ³	VL	M	L	Nil	No
	Klondike ⁹	M	M	M	S	No
	Kreekrak ¹²	S	S	M	S	No
	Gotland ¹⁰	L	M	L	Nil	No
Ducks	Urk ⁷	M	S	M	Nil	No
	Blyth ^{4,5}	S	S	L	S	No
	Buffalo Ridge ³	VL	M	L	VS	No
	San Gorgonio ¹¹	VL	S	-	VS	No
Eagles, vultures, hawks	Kreekrak ¹²	S	S	L	M	No
	Altamont ^{11,13}	VL	S	L	S	Likely
	Tehachapi ¹¹	VL	S	-	VS	Possible
	San Gorgonio ¹¹	VL	S	-	VS	No
	Tarifa ^{14,16}	VL	S	L	VS	Possible
Harriers	Navarre ¹⁵	VL	M	L	S	Possible
	Buffalo Ridge ³	VL	M	M	Nil	No
	Altamont ^{11,13}	VL	S	L	VS	No
Falcons	Foot Creek Rim ⁸	L	M	-	VS	No
	Altamont ^{11,13}	VL	S	L	S	Possible
	Burgar Hill ¹	S	S	S	VS	No
	Novar ¹⁷	M	M	M	VS	No
	Tehachapi ¹¹	VL	S	-	VS	No
Upland gamebirds	Tarifa ^{14,16}	VL	S	L	VS	Possible
	Buffalo Ridge ³	VL	M	S	VS	No
	Novar ¹⁷	M	M	S	VS	No
	Tehachapi ¹¹	VL	S	-	VS	No
Owls	Altamont ^{11,13}	VL	S	L	VS	Possible
	San Gorgonio ¹¹	VL	S	-	VS	No
	Tehachapi ¹¹	VL	S	-	VS	Possible
Waders	Kreekrak ¹²	S	S	L	S	No
	Gotland ²¹	L	M	L	VS	No
	Blyth ^{4,5}	S	S	M/L	VS	No
	Oosterbierum ¹⁸	M	S	M/L	VS	No
	Ovenden Moor ¹⁹	M	S	L	VS	No
Gulls	Buffalo Ridge ³	VL	M	L	VS	No
	Blyth ^{4,5}	S	S	L	M	No
	Kreekrak ¹²	S	S	L	M	No
	Zeebrugge ²⁰	M	S/M	L	L	Possible
Terns	Buffalo Ridge ³	VL	M	L	Nil	No
	Zeebrugge ²⁰	M	S/M	L	M	Possible
	Blyth ^{4,5}	S	S	M	Nil	No
Passerines	Blyth ^{4,5}	S	S	M/L	Nil	No
	Buffalo Ridge ³	VL	M	L	M	No
	Oosterbierum ¹⁸	M	S	L	L	No

KEY

Sources: 1. Meek *et al.* 1993; 2. Haworth 2002; 3. Johnson *et al.* 2000; 4. Still *et al.* 1995; 5. Painter *et al.* 1999; 6. Mossop 1998; 7. Winkelman 1989; 8. Young *et al.* 2003; 9. Johnson *et al.* 2003; 10. Percival 1998b; 11. Erickson *et al.* 2001; 12. Masters *et al.* 1995, 1996; 13. Thelander *et al.* 2003; 14. SEO/BirdLife 1995; 15. Lekuona 2001; 16. Janss 2000; 17. Bioscan 2001; 18. Winkelman 1992a; 19. EAS 1997; 20. Everaert *et al.* 2002; 21. Percival 2000.

Windfarm size: VL = very large (>200 turbines); L = large (50-200 turbines); M = medium (10-50 turbines); S = small (<10 turbines).

Turbine type: L = large (>1.5 MW); M = medium (500 KW-1.5 MW); S = small (<500 KW).

Exposure to collision risk (based on number of flights at rotor height in proximity to turbines per year): L = large (>10,000); M = medium (1,000-10,000); S = small (<1,000).

Incidence of collision: L = large (>10/turbine/yr); M = medium (1-10/turbine/yr); S = small (0.1-1/turbine/yr); VS = very small (<0.1/turbine/yr).

Population effect: determined on the basis of the total numbers killed in relation to the population dynamics.

Note Turbine type definitions of Large >1.5Mw, Medium 500 -1.5Mw, Small <500Mw. Not one turbine type listed as Large & the majority listed as Small.

Note the vast majority of Turbines are Medium (500kw) to small (<500kw). Using this data for 7Mw turbines is nonsense. None of the collision data is relevant for this application. And then we don't know the separation distances between turbines in Percival references.

Table 2. Bird-windfarm disturbance studies: summary of findings.

Species group	Sites studied	Habitat	Windfarm size	Turbine type	Disturbance distance
Cormorant	Blyth ¹	Coastal	S	S	None *
Swans	Urk ³	Farmland and coastal	M	S	None (Bewick's), 300 m (Whooper)
Geese	Germany ^{4,5}	Farmland	M	S/M	Up to 600 m
	Urk ³	Farmland and coastal	M	S	None
	Denmark ⁶	Farmland	L	M	1-200 m
	Gotland ⁷	Coastal marsh	L	M	0-25 m
	Toronto ⁸	Parkland	S	M	None
Ducks	Tuno Knob ⁹	Offshore	M	M	None
	Utgrunden ¹⁰	Offshore	S	L	None
	Urk ³	Coastal	M	S	Up to 300 m
Raptors	Bryn Tytli ¹⁶	Upland moor	M	S	None
	Altamont ¹⁷	Grassland	VL	S	None
Waders: breeding	Ovenden Moor ¹¹	Upland moor	M	S	None
	Various UK sites ¹²	Upland	S/M	S/M	None
	Gotland ²²	Coastal and farmland	L	M	None
	Oosterbierum ¹⁵	Lowland farmland	S	S	Up to 300 m
Waders: non-breeding	Germany ¹³	Lowland farmland	S/M	S/M	Up to 200 m
	Blyth ¹	Coastal	S	S	None
	Tjaereborg ²	Farmland	S	M	800 m
	Zeebrugge ¹⁴	Coastal	M	S/M	Up to 250 m
Gulls	Oosterbierum ¹⁵	Farmland	M	S	500 m
	Tjaereborg ²	Farmland	S	M	800 m
Terns	Blyth ¹	Coastal	S	S	None
	Zeebrugge ¹⁴	Coastal	M	S/M	None
Passerines	Blyth ¹	Coastal	S	S	None
	Various UK sites ¹²	Upland	S/M	S/M	None
	Buffalo Ridge ¹⁸	Grassland	VL	M	1-200 m
	Bryn Tytli ¹⁶	Upland moor	M	S	None
	Burgar Hill ²⁰	Upland moor	S	S	None
Novar ^{21,23}	Upland moor	M	M	None	

KEY

Sources: 1. Still *et al.* 1995; 2. Pedersen and Poulsen 1991; 3. Winkelman 1989; 4. Kowalik & Borbach-Jaene 2001; 5. Kruckenberg & Jaene 1999; 6. Larsen & Madsen 2000; 7. Percival 1998a; 8. James 2003; 9. Guillemette *et al.* 1998, 1999; 10. Pettersson & Stalin 2003; 11. Bullen Consultants 2002; 12. Thomas 1999; 13. Ketzenberg *et al.* 2002; 14. Everaert *et al.* 2002; 15. Winkelman 1992b; 16. Green 1995; 17. Thelander *et al.* 2003; 18. Leddy *et al.* 1999; 19. Phillips 1994; 20. Meek *et al.* 1993; 21. Bioscan 2001; 22. Percival & Percival 1998; 23. Percival 2002.

Windfarm size: VL = very large (>200 turbines); L = large (50-200 turbines); M = medium (10-50 turbines); S = small (<10 turbines).

Turbine type: L = large (>1.5 MW); M = medium (500 KW-1.5 MW); S = small (<500 KW)

Disturbance distance: 'None' indicates no significant disturbance effect, * disturbance noted during construction but not operation.

Note the vast majority of Turbines are Medium (500kw) to small (<500kw). Using this data for 7Mw turbines is nonsense. And then we don't know the separation distances between turbines.

Basically, an Applicant cannot use historic science from a period of different turbine sizes, unknown spacing between turbines to predict current situation

Table 1. Studies of collision rates of birds and wind turbines.

Site	Habitat	Species present	Size of wind farm	Collision rate per turbine per year	Species colliding	Source
Altamont, California	Ranch land	Raptors	VL	0.05	Raptors, inc. Golden Eagle	Orloff and Flannery 1992, 1996
"	"	"	"	0.06	Continuing mortality of raptors, inc. golden eagle	Thelander and Rugge 2000
US sites (review)	Various	Various	Mixed	2.2 (0.03 for raptors)	Various	Erickson <i>et al</i> 2001
Tarifa, S. Spain	Coastal hills	Raptors, storks and many other migrants	VL	0.34	Raptors, inc. Griffon Vulture	SEO/ BirdLife 1995
"	"	Raptors	"	0.03	Griffon vulture and short-toed eagle	Janss 1998
Navarre, Spain	Inland hills	Various, inc. raptors, pigeons, passerines	VL	0.34 ¹	Griffon vulture (62%), smaller nos of other spp.	Lekuona 2001
Burgar Hill, Orkney	Coastal moorland	Upland species inc. divers and raptors	S	0.15	Gulls, Peregrine (1)	Meek <i>et al.</i> 1993
Haverigg, Cumbria	Coastal grassland	Golden plover, gulls	S	0	None	SGS Environment 1994
Blyth, Northumberland	Coastal shoreline	Cormorant, eider, purple sandpiper, gulls, migrants	S	1.34	Mainly gulls, Eider	Still <i>et al.</i> 1995
"	"	"	"	2.52	Mainly gulls, less eider in later years	Painter <i>et al.</i> 1999
Zeebrugge, Belgium	Coastal shoreline	Mostly gulls, terns, passerine migrants.	M	11-29 ²	>90% gulls, also few terns, raptors, passerines	Everaert <i>et al</i> 2002.
Bryn Tyfli, Wales	Upland moorland	Upland species, inc. red kite and	M	0	None	Tyler 1995
Cemmaes, Wales	Upland moorland	peregrine Upland species	M	0.04	Snipe (1)	Dulas 1995
Urk, Netherlands	Coastal – on dyke wall	Waterfowl, inc. geese, Bewick's swans, migrants	M	1.7	Gulls, waders, other waterfowl (no geese or Bewick's Swans), migrants	Winkelman 1989
Oosterbierum, Netherlands	Coastal – on dyke wall	Migrants, waterfowl	M	1.8	Waterfowl, kestrel, woodpigeon, passerines.	Winkelman 1992a
Kreekrak, Netherlands	Coastal – on dyke wall	Waterfowl, inc. geese	S	3.4	Gulls, waders, Brent Goose (1), other waterfowl	Musters <i>et al.</i> 1996
Ovenden Moor, south Pennines	Upland moorland	Upland species, inc. golden plover and curlew	M	0.04	Golden plover (1), curlew (1)	EAS 1997
Novar	Upland moorland	Upland species	M	0.08	Red grouse (3) and kestrel (2)	Bioscan 2001
Tjaereborg, Denmark	Coastal grassland	Waterfowl, mainly waders and gulls	S	3.0	Gulls, Mallard, Moorhen, passerines	Pedersen and Poulsen 1991
Näsudden, Gotland, Sweden	Coastal marsh and arable	Waterfowl inc. geese and breeding waders, migrants	L	0.7	Redshank (1)	Percival 1998
Utgrunden	Offshore	Eiders	S	0	None	Petterson and Stalin 2003

VL=very large (>200 turbines); L=large (50-200 turbines); M=medium (10-50 turbines); S=small (<10 turbines).

¹ – for this study the raw collision rates are given, as the reported correction factors were very high indeed (with less than 10% of collisions reportedly being found).

² – this study included high correction factors (detecting only 11% of collisions).

Table 2. Studies of possible disturbance effects of wind farms on bird distribution.

Site	Habitat	Species present/ studied	Number of turbines	Species significantly affected	Distance affected	Source
Tjaereborg, Denmark	Coastal grassland	Waterfowl, mainly waders and gulls	S	Lapwing, Golden Plover, gulls	Max 800m. Breeding lapwing up to 300m	Pedersen and Poulsen 1991
Urk, Netherlands	Coastal – on dyke wall	Waterfowl, inc. geese, Bewick's and whooper swans	M	Whooper Swan, Pochard, Goldeneye.	Max 300m.	Winkelman 1989
Oosterbierum, Netherlands	Coastal – on dyke wall	Waterfowl	M	Waders, gulls and Mallard	Max 500m. No effect on breeding waders	Winkelman 1992b
Vejle, Denmark	Farmland	Pink-footed geese	L	Pink-footed geese	1-200m	Larsen and Madsen 2001
Westermarsch, Germany	Farmland	Barnacle geese	M	Barnacle geese	Max 600m.	Kowalik and Borbach-Jaene 2001
Burgar Hill, Orkney	Coastal moorland	Upland species inc. divers and raptors	S	Red-throated Diver	Human disturbance during initial construction only	Meek <i>et al.</i> 1993; Haworth 2002
Haverigg, Cumbria	Coastal grassland	Golden plover, gulls	S	None		SGS Environment 1994
Blyth, Northumberland	Coastal shoreline	Cormorant, eider, purple sandpiper, gulls	S	None		Still <i>et al.</i> 1995
Bryn Tylli, Wales	Upland moorland	Upland species, inc. red kite and peregrine	M	None		Phillips 1994; Green 1995.
Cemmaes, Wales	Upland moorland	Upland species	M	None		Dulas 1995
Carno, Wales	Upland moorland	Upland species	L	None		Williams and Young 1997; Young 1999
Ovenden Moor, NW England	Upland moorland	Upland moorland, inc. golden	M	None		Bullen Consultants 2002

Windy Standard, SW Scotland	Upland moorland	plover and curlew Upland species	M	None		Hawker 1997
Nasudden, Gotland, Sweden	Coastal marsh and arable	Waterfowl inc. barnacle geese and breeding waders	L	None		Percival 1998; Percival and Percival 1998
Various UK sites	Upland	Upland species, inc. lapwing, curlew, skylark and meadow pipit	M	None		Thomas 1999
Tunø Knob, Denmark	Offshore	Eider, Common Scoter	M	None, other than minor flight route changes		Guillemette <i>et al.</i> 1998, 1999; Tulp <i>et al.</i> 1999
Zeebrugge, Belgium	Coastal shoreline	Waterfowl	M	Mostly wildfowl and waders	Up to 300m	Everaert <i>et al.</i> 2002
Novar	Upland moorland	Upland species	M	None		Bioscan 2001; Percival 2003
Utgrunden	Offshore	Long-tailed duck	S	None		Petterson and Stalin 2003

VL=very large (>200 turbines); L=large (50-200 turbines); M=medium (10-50 turbines); S=small (<10 turbines)

EVALUATING SENSITIVITY (PERCIVAL)

The sensitivity of a species can be defined as its ecological importance and nature conservation interest at the site being assessed. This is determined by a number of factors, including:

- whether the species is on Annex 1 of the EC Birds Directive
- whether the species is ecologically sensitive: this includes larger birds of prey and rare breeding birds (including divers, common scoter, hen harrier, golden eagle, red-necked phalarope, roseate tern and chough).
- whether the site contains species at nationally important numbers (>1% of Irish population)
- whether the site contains species at regionally important numbers (>1% of regional population, with the region usually taken as the county)
- whether the species is subject to special conservation measures, eg as red or amber species on the BirdWatch Ireland's (Newton *et al.* 1999) list of Birds of Conservation Concern.

The sensitivity is further affected by any nature conservation designations in the area.

The determination of sensitivity needs to take into account whether a species contributes to the overall objectives of the designation (including whether the species is notified as a qualifying feature of the site), and specifically for internationally important Special Protection Areas (SPA), it needs to consider whether the species contributes to the overall integrity of the site. The determination of sensitivity is summarised in Table 3.

Table 3: Determination of Sensitivity

SENSITIVITY	DETERMINING FACTOR
VERY HIGH	Species that form the cited interest of SPAs and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.
HIGH	Species that contribute to the integrity of an SPA but which are not cited as species for which the site is designated. <i>Ecologically sensitive species including the following: divers, common scoter, hen harrier, golden eagle, rednecked phalarope, roseate tern and chough.</i> <i>Species present in nationally important numbers (>1% Irish population)</i>
MEDIUM	<i>Species on Annex 1 of the EC Birds Directive</i> <i>Species present in regionally important numbers (>1% regional (county) population)</i> <i>Other species on BirdWatch Ireland's red list of Birds of Conservation Concern</i>
LOW	<i>Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.</i>

DETERMINING THE MAGNITUDE OF POSSIBLE IMPACTS

Once the species/populations in the wind farm area have evaluated in terms of their sensitivity, the next step is to determine the magnitude of the possible impacts that may occur on those species/populations. The methodology addresses this issue by quantifying the effect as far as possible, and expressing the size of that effect in relation to the existing baseline conditions (see Table 4).

One issue in this process concerns the precise area or bird population against which the degree of impact should be judged. For protected SPAs this is usually quite straightforward, comprising simply the populations for which that site has been designated. It is less clear-cut where such protected sites are not involved. The methodology states "the test of significance of an impact will be whether the wind farm impact is causing a significant change to the population, its range or distribution." A key point in the assessment is whether the development results in a loss of potential for the site to support its current bird populations. Generally an area wider than the wind farm needs to be considered to allow a balanced view of any displacement effects. A smallscale (e.g. 0-1km) displacement to an adjacent area may have little or no ecological consequence, in which case the magnitude would be low. However, if the displacement were over a wider area (e.g. >5km) then it may be more appropriate to regard the impact as medium or high. Another important consideration here is the availability of alternative habitat. Even small-scale displacement may be important if no such alternatives exist and the development results in a local population decline.

A suggested zone of 5km within the wind farm site for making this assessment is suggested in the methodology, though it should be noted that this is only a suggestion and not a definitive position. In some cases it may be more

appropriate to consider a local ecological unit if its extent is of a suitable scale, e.g. an island (actual or habitat). The populations of each important species at the wind farm within this zone should be estimated using the best available data on bird densities and habitat availability. These populations then constitute the baseline against which the magnitude of any predicted effects should be judged.

Table 4: Determination of Magnitude of Effects

MAGNITUDE	DESCRIPTION
VERY HIGH	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. <i>Guide: < 20% of population / habitat remains</i>
HIGH	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. <i>Guide: 20-80% of population/ habitat lost</i>
MEDIUM	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. <i>Guide: 5-20% of population/ habitat lost</i>
LOW	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre development circumstances/patterns. <i>Guide: 1-5% of population/ habitat lost</i>
NEGLIGIBLE	Very slight change from baseline condition. Change barely distinguishable, approximating to the “no change” situation. <i>Guide: < 1% population/ habitat lost</i>

There are three main ways in which a wind farm development could affect bird populations: (i) direct habitat loss to the development, (ii) collision and (iii) disturbance (construction and operational phases). Each is considered in turn below.

Direct Habitat Loss

This impact comprises the loss of habitat that would result from the take by the turbine bases, access tracks, grid connection cabling and any other associated construction.

Assessment of the impact in relation to ornithological interests should involve quantifying the area of each habitat that would be lost (using information from the baseline habitat survey). The magnitude of this effect can then be determined in relation to the proportion of each habitat available that will be lost, in the context of the wind farm site itself and the surrounding ranges of any key bird species present.

In some circumstances it is also possible that there may be indirect loss of habitat, and this should be considered too. An example of how this might occur would be on peatland habitats, where construction activity may affect the site’s hydrology and have an impact over a much greater area. Appropriate environmental management systems/ mitigation measures should be put in place to ensure that such effects are avoided as much as possible – indeed such impacts could constitute significant ecological impacts in their own right if such practice is not followed.

Collision Risk

Birds flying at the same height as the wind turbine rotor blades within the wind farm area will be at some risk of colliding with those blades. Mechanistic models to predict the theoretical numbers of birds that would collide with wind turbines in the absence of any avoiding behaviour have been developed by Tucker (1996) and Band (2001). The Band model has developed this in a simple spreadsheet form and is available from SNH (from bill.band@snh.gov.uk), and is the method recommended here. Full details are given in Band (2001) and the model is summarised in Percival *et al.* (1999).

In terms of using the model in the assessment process, the main consideration is the required data input. This is the reason why it is necessary to collect detailed field data on the flight activity of important species in and around the wind farm site being assessed.

These include:

1. Numbers of flights per year through wind farm at rotor height
2. Bird flight speed

3. Size of bird (length and wingspan)

4. Size and rotational speed of wind turbine rotor.

Data for points 2-3 should usually be available from published sources (e.g. Campbell and Lack, 1985, and Cramp 1998), though it may be necessary in some cases to quantify flight speeds at the site in relation, for example, to wind conditions, where published data are sparse. Data for point 4 would be readily available from wind turbine manufacturers. **[Not provided by Applicant]**

Where a range of different specification turbines are being considered the assessment should be carried out on a worst-case basis.

The mechanistic model produces an estimate for the number of collision likely to occur in the absence of any avoiding behaviour being exhibited by the birds. In reality birds do not just fly around at random but will usually avoid structures in their flight path, so an account of this avoidance needs to be taken in the assessment. It is likely that this will have greatest level of uncertainty in whole of this collision risk assessment process, as it is difficult to quantify. Numerous collision studies have been carried out at existing wind farms, generally reporting only low levels of collision but sometimes have included important species (Percival 2000). In order to estimate avoidance rate, these collision studies ideally need also to have measured the bird flight rate through the wind farm before and after construction. The basic principle of this calculation is straightforward.

The predicted number of collisions without avoidance should be calculated using the Band model, the actual number of collisions measured, and then avoidance rate is calculated as:

Avoidance rate = 1 - observed/predicted number of collisions.

It is important that account is taken in any collision studies of the collision victims that may have been missed through removal of corpses by scavengers or birds falling into habitats in which recovery of the corpses is more difficult. In many cases precise estimation of collision (and hence avoidance) rate has proved difficult simply because the frequency of collision is so low. As a result of these issues and the need for bird flight rates, there are few examples where it is possible to obtain a firm value for avoidance.

There is an urgent need for studies to determine avoidance rates more precisely. New technologies to achieve this are currently being developed, including the use of infra-red video cameras to monitor collisions, but these have not yet provided more definitive estimates of collision rates.

Many collision risk assessments therefore need to be on the basis of a 'reasonable worst case' approach, i.e. what could possibly happen, not what would be totally unrealistic.

The assessment of the magnitude of the impact needs to take into account the additional uncertainties that this approach involves. The most likely outcome should be estimated but the likely bounds of that estimate should also be presented and considered in the determination of magnitude. Simulation modelling, e.g. using Monte Carlo methods, may be useful in some circumstances. If the uncertainty in the possible avoidance rates is high, then the analyses should be presented acknowledging that uncertainty. This could be achieved by presenting graphs of the range of possible avoidance rates plotted against the predicted collision rate, so that the effect on the collision predictions of the uncertainty could be illustrated.

The general principle should be to use the worst case avoidance rate for the most closely related taxonomic group, but also to consider the effects of weather conditions and local topography (and the consequences of those effects) that could potentially also affect the avoidance rate.

The collision risk modelling approach also allows the question to be tackled from another direction, to determine the level of avoidance required in order to result in different magnitude impacts, and then assess likelihood that this may occur. This can be useful to demonstrate the degree of difference between what might actually happen and what would need to happen in order for a significant impact to occur.

This approach can be used to predict the likelihood of collision impact, but can also demonstrate the process of risk minimisation during the wind farm design, whereby different layouts can be assessed in relation to the collision risk that they pose.

Whilst the numbers of likely collisions is an important part of predicting the magnitude of any impacts, it is not the only part. The impact of such collisions at the population level can be very different between different species. Differences in life-history strategies are likely to reflect differences in vulnerability to any additional mortality that may result from collisions with wind turbines, and hence the magnitude of the impact. Many populations may be unaffected by a small level of additional mortality, but there are some where even this could result in a significant population decline (Morrison *et al.* 1998).

Species with high adult survival rate and low breeding rate may be more susceptible to population impacts, as they would be less able to replace any losses. Similarly species that were unable to compensate for any losses incurred, for

example by increased survival or breeding rate (i.e. populations regulated in a density- independent way) would be more susceptible. It is therefore recommended that the magnitude of the predicted collision rate should be determined in the context of the background mortality rate for that species (obtained, for example, from Cramp 1998). A ‘negligible’ magnitude impact would, for example, be predicted if the collision mortality was to represent an increase of less than 1% on the background mortality rate.

Population Viability Analysis models may be useful in exploring this further, where such models or at least the data on which to base such models exist. These could potentially identify levels of mortality at which statistically and biologically significant impacts could be detected.

In many cases it may be that the politically acceptable number of collisions is considerably lower than that at which significant biological impacts would occur on the population. For some species of particular conservation importance it may be that ‘acceptability threshold’ would be better set at a lower level - in some cases perhaps even just a single collision - and look at likelihood of that occurring.

Disturbance

The presence of wind turbines at a site could potentially deter some birds from using that site and its surrounds, effectively resulting in a disturbance impact. In addition during the construction phase of the project the human presence on the site will often be much increased on the baseline conditions, adding further to potential disturbance effects.

Such disturbance would only have a real ecological impact if it resulted in reduced resource use by the birds (i.e. it directly causes resource under-utilisation and hence a reduction in carrying capacity; see Gill *et al.* 1996b). It is also important to consider the likely ecological consequences of any disturbance effect. Displacement may occur but if there were ample alternative habitat to accommodate the displaced birds it may actually be inconsequential. It is also important in determining the likely magnitude of any disturbance impact to decide on the size of the potential disturbance zone (or sizes, given that it is likely to be greater during construction). If important bird populations may be affected, it may be possible to mitigate this by temporal avoidance, restricting potentially disturbing activities to periods when the important bird populations are not using the site.

Reasonable worst-case potential disturbance distances would be 300m during the breeding season and 800m at other times of year, based on observations from existing wind farms (Gill *et al.* 1996a, Percival 2000, Langston and Pullan 2002). However, for species with larger home ranges, there is also the potential to affect birds breeding at considerably greater distances, for example through partial loss of their foraging range. It is important to determine the populations that could be affected by appropriate field survey and collation of existing data. These worst reasonable case distances could then be reduced where there is robust evidence that effects in similar situations affect a rather smaller area. In the offshore environment, where the scale of impact is currently less well-studied than in terrestrial habitats (Percival 2001), it may be appropriate to use larger potential disturbance distances (e.g. 1-2km), particularly where important bird populations may be affected of species that have not been studied elsewhere. As with the assessment of collision risk, this approach can also be applied in the wind farm design process to examine different possible layouts in order to minimise the possible impacts.

DETERMINATION OF SIGNIFICANCE

The assessments of magnitude and sensitivity lastly need to be brought together in order to determine the significance of the potential impact, and hence their acceptability in a planning context. The methodology achieves this by cross-tabulating the magnitude and sensitivity, using Table 5 below, to give a prediction of the significance of each potential impact.

Table 5. Significance matrix: combining magnitude and sensitivity to assess significance

SIGNIFICANCE	Sensitivity				
		Very high	High	Medium	Low
Magnitude	Very high	Very high	Very high	High	Medium
	High	Very high	Very high	Medium	Low
	Medium	Very high	High	Low	Very low
	Low	Medium	Low	Low	Very low
	Negligible	Low	Very low	Very low	Very low

This significance should then be used to determine whether a predicted impact is acceptable or not. The methodology suggests the following interpretation of the significance ratings:

Very low and **low** should not normally be of concern, though normal design care should be exercised to minimise impacts.

Very high and **high** represent a highly significant impact on bird populations and would warrant refusal of a planning proposal.

Medium represents a potentially significant impact that requires careful individual assessment. Such an impact could warrant planning refusal, but it may be of a scale that can be resolved by revised design or appropriate mitigation. In complex or particularly sensitive situations, it may be appropriate to look at a range of possible magnitude effects and make the final assessment on this basis, taking into account the various uncertainties in the available data.

FURTHER APPLICATIONS

Mitigation measures

In circumstances where significant impacts are predicted, or where they may be possible, it may be possible to undertake mitigation measures to offset any adverse effects. Full consideration should be given to habitat enhancement and other measures that could ensure that the development results in a local conservation gain rather than any adverse impact.

The methodology can also be very useful in the wind farm design process. Where significant impacts are predicted it may be possible to re-design the proposed wind farm to avoid the features of particular conservation importance. The methodology provides a way in which the benefits of such re-design can be assessed and demonstrate the benefits of the new layout.

Measures that deliver enhancement to the local bird populations can be a very useful way to manage the uncertainties in the assessment process. There will inevitably be a degree of uncertainty in the predictions of wind farm impacts on birds. An effective way to deal with this would be to put enhancement measures in place that would provide a benefit over and above the predicted adverse effect. This assessment methodology provides a way in which those benefits can be evaluated and the balance between possible adverse and beneficial effects determined.

Table 1. Studies of collision rates between birds and wind turbines.

Site	Habitat	Species present	Number of turbines	Collision rate per turbine per year	Species colliding	Source
Altamont, California	Ranch land	Raptors	7,000	0.06	Raptors, inc. Golden Eagle	Orloff & Flannery 1992, 1996
Tarifa, S Spain	Coastal hills	Raptors, storks and many other migrants	90	0.34	Raptors, inc. Griffon Vulture	SEO/ BirdLife 1995
Burgar Hill, Orkney	Coastal moorland	Upland species inc. divers and raptors	3	0.15	Gulls, Peregrine (1)	Meek <i>et al.</i> 1993
Haverigg, Cumbria	Coastal grassland	Golden Plover, gulls	5	0	None	SGS Environment 1994
Blyth, Northumberland	Coastal shoreline	Cormorant, Eider, Purple Sandpiper, gulls, migrants	9	1.34	Mainly gulls, Eider	Still <i>et al.</i> 1995
Bryn Tytli, Wales	Upland moorland	Upland species, inc. Red Kite and Peregrine	22	0	None	Tyler 1995
Cemmaes, Wales	Upland moorland	Upland species	24	0.04	Snipe (1)	Dulas 1995
Urk, Netherlands	Coastal – on dyke wall	Waterfowl, inc. geese, Bewick's Swan, migrants	25	1.7	Gulls, waders, other waterfowl (no geese or Bewick's), migrants	Winkelman 1989
Oosterbierum, Netherlands	Coastal – on dyke wall	Migrants, waterfowl	18	1.8	Waterfowl, Kestrel, Woodpigeon, passerines	Winkelman 1992a
Kreekrak, Netherlands	Coastal – on dyke wall	Waterfowl, inc. geese	5	3.4	Gulls, waders, Brent Goose (1), other waterfowl	Musters <i>et al.</i> 1996
Ovenden Moor, south Pennines	Upland moorland	Upland species, inc. Golden Plover and Curlew	23	0.04	Golden Plover (1), Curlew (1)	EAS 1997
Tjaereborg, Denmark	Coastal grassland	Waterfowl, mainly waders and gulls	1	3.0	Gulls, Mallard, Moorhen, passerines	Pedersen & Poulsen 1991
Näsudden, Gotland, Sweden	Coastal marsh and arable	Waterfowl, inc. geese and breeding waders, migrants	70	0.7	Redshank (1)	Own data

Site	Habitat	Species present	Number of turbines	Species significantly affected	Distance affected	Source
Tjaereborg, Denmark	Coastal grassland	Waterfowl, mainly waders and gulls	1	Lapwing, Golden Plover, gulls	Max 800m; breeding Lapwing up to 300m	Pedersen & Poulsen 1991
Urk, Netherlands	Coastal – on dyke wall	Waterfowl, inc. geese, Bewick's and Whooper Swans	25	Whooper Swan, Pochard, Goldeneye	Max 300m	Winkelman 1989
Oosterbierum, Netherlands	Coastal – on dyke wall	Waterfowl	25	Waders, gulls and Mallard	Max 500m; no effect on breeding waders	Winkelman 1992b
Burgar Hill, Orkney	Coastal moorland	Upland species, inc. divers and raptors	3	Red-throated Diver		Meek <i>et al.</i> 1993
Haverigg, Cumbria	Coastal grassland	Golden Plover, gulls	5	None		SGS Environment 1994
Blyth, Northumberland	Coastal shoreline	Cormorant, Eider, Purple Sandpiper, gulls	9	None		Still <i>et al.</i> 1995
Bryn Tytli, Wales	Upland moorland	Upland species, inc. Red Kite and Peregrine	22	None		Phillips 1994, Green 1995
Cemmaes, Wales	Upland moorland	Upland species	24	None		Dulas 1995
Carno, Wales	Upland moorland	Upland species	56	None		Williams & Young 1997
Ovenden Moor, north-west England	Upland moorland	Upland species, inc. Golden Plover and Curlew	23	None (Golden Plover nos increased)		EAS 1997
Windy Standard, south-west Scotland	Upland moorland	Upland species	36	None		Hawker 1997
Näsudden, Gotland, Sweden	Coastal marsh and arable	Waterfowl, inc. geese and breeding waders	70	None		Own data – see below
Tunø Knob, Denmark	Offshore	Eider, Common Scoter	10	None		Guillemette <i>et al.</i> 1998, 99

Note that none of Percival's papers have been subject to SEA or peer reviews and have no relevance to present day infrastructure or legislation. They are a review of historic papers using information from the late 1980's -1990's, when turbines were much smaller & probably separated by large distances. There is no information in relation to checks & balances (peer reviews) in relation to those historic papers.

Table 1 Model input values are largely unchanged, the key updates are the recorded seconds at possible collision height (PCH), number of survey seconds and bird availability. Please refer to the EIAR Appendix 7-6 for further discussion on model inputs.

Species	Model	Period	Updated PCH sec. (Total)
Golden Plover	Random	October to April	194,136
Hen Harrier	Random	September to March	30
Peregrine Falcon	Random	All	917
Whooper Swan	Random	Winter	3,225
Black-headed Gull	Random	Winter	20,740
Black-headed Gull	Random	Breeding	10,447
Common Gull	Random	Winter	90,296
Lesser Black-backed Gull	Random	Winter	25,724
Lesser Black-backed Gull	Random	Breeding	60,225
Kestrel	Random	All	10,056
Lapwing	Random	Winter	4,029
Snipe	Random	Winter	3,912
Buzzard	Random	All	16,861
Sparrowhawk	Random	All	410

Updated Population Estimate for Wintering Lesser black-backed gull

Lesser black-backed gull are an SCI species for Lough Mask SPA however, given the large separation distance between the Proposed Wind Farm and Lough Mask and the proximity of Lough Corrib (3.7km), it is more likely that the birds observed at the Proposed Wind Farm are associated with Lough Corrib. Lesser black-backed gull is not an SCI species for Lough Corrib; however, it does support a population of wintering birds.

The national population of lesser black-backed gull is estimated to be 11,842 for the Republic of Ireland (ROI) (Lewis et al. (2019a)) Therefore, a regularly occurring population of 118 birds is required for classification as National Importance. There are no published figures for the County Galway wintering population of lesser black-backed gull. Using the distribution of lesser black-backed gull across Ireland from the wintering bird atlas1 (2007-2011) the County population of lesser black-backed gull is estimated to be 592 birds. Taking a precautionary approach and using the above as a guide; a regularly occurring population of five birds is required for classification of County Importance.

Lesser black-backed gull were observed within, or partially within, the Proposed Wind Farm on 23 occasions during the winter season. The maximum number of birds recorded within the Proposed Wind Farm from the winter seasons surveyed was 6 birds. Thus, this species is considered to be a population of County Importance.

The predicted number of transits per year and the collision risk is presented in Table 2, along with the final predicted number of collisions per year. Note that for birds that both flap and glide, the average collision risk percentage between flapping and gliding is taken.

Species	Survey Period	Model	Transits	Collision Risk			Collision Rate			One Bird Collision
				flapping	gliding	overall	without avoidance	avoidance factor	with avoidance	
Black-headed Gull	Winter	random	1190.6	4.89%	4.7%	4.79%	57.05	98%	1.141	1 year
Black-headed Gull	Breeding	random	843.5	4.89%	4.7%	4.79%	40.42	98%	0.808	1 year
Common Gull	Winter	random	5791.4	4.99%	4.75%	4.87%	282.19	98%	5.644	<1 year
Golden Plover	October to April	random	18042.8	4.22%	no gliding flight	4.22%	762.27	99.6%	3.049	<1 year
Hen Harrier	September to March	random	1	5.79%	5.69%	5.74%	0.06	99%	0.001	1683 years
Lesser Black-backed Gull	Winter	random	1477.1	5.75%	5.52%	5.64%	83.28	98%	1.666	1 years
Lesser Black-backed Gull	Breeding	random	4856.2	5.75%	5.52%	5.64%	273.8	98%	5.476	<1 year
Peregrine Falcon	All	random	55.1	5.14%	4.97%	5.06%	2.79	98%	0.056	18 years
Whooper Swan	Winter	random	279	7.51%	no gliding flight	7.51%	20.96	99.5%	0.105	10 years
Kestrel	All	random	506.2	4.89%	4.8%	4.85%	24.54	95%	1.227	1 year
Lapwing	Winter	random	251.6	4.54%	no gliding flight	4.54%	11.44	98%	0.229	4 years
Snipe	Winter	random	328.7	4.05%	no gliding flight	4.05%	13.31	98%	0.266	4 years
Buzzard	All	random	973.6	5.58%	5.41%	5.5%	53.52	98%	1.07	1 year
Sparrowhawk	All	random	20.2	4.85%	4.79%	4.82%	0.97	98%	0.019	51 years

Table 3 below provides a comparison of the collision risk model as outlined in the EIA as lodged, compared to the updated collision risk model which includes the most up to date survey data (from April 2020 to March 2022 and April 2023 to March 2025). The impact assessment for each species listed in the table below is provided in Section 7.5.2 of the EIA as lodged. The effect of the collision mortality from the Wind Farm Site was assessed in relation to the county population and the background mortality for each species. The percentage increase in background mortality as outlined in the EIA, as lodged, and updated increase in background mortality are presented in Table 3 below. This change is then assessed to establish if there is a significant change in the collision risk impact for each species.

Table 3 Comparison of Results

Species	Survey Period	Collision Risk (April 2020 – March 2022; April 2023 – September 2023) (birds per year)	Updated Collision Risk (April 2020 – March 2022; April 2023 – March 2025) (birds per year)	Difference (birds per year)	Change in Background Mortality (Original → Updated Collision Risk)	Change to Impact Assessment
Golden Plover	October to April	0.787	3.049	+2.262	0.07% → 0.23%	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Hen Harrier	September to March	0.001	0.001	0	No change	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Peregrine Falcon	All	0.034	0.056	+0.022	0.5% → 0.9%	No significant change (very low (Percival, 2003)/long-term imperceptible negative (EPA, 2022))
Whooper Swan	Winter	0.051	0.105	+0.054	0.02% → 0.04%	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Black-headed Gull	Winter	1.103	1.141	+0.038	No change	No significant change (very low (Percival, 2003)/long-term imperceptible negative (EPA, 2022))
Black-headed Gull	Breeding	0.501	0.808	+0.307	0.26% → 0.4%	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Common Gull	Winter	5.837	5.644	-0.193	2.3% → 2.2%	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Lesser Black-backed Gull	Winter	0.198	1.666	+1.468	3.7% → 3.1%	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Lesser Black-backed Gull	Breeding	2.681	5.476	+2.795	3.9% → 7.9%	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Kestrel	All	0.968	1.227	+0.259	0.5% → 0.7%	No significant change (very low (Percival, 2003)/long-term imperceptible negative (EPA, 2022))
Lapwing	Winter	0.234	0.229	-0.005	No change	No significant change (very low (Percival, 2003)/long-term imperceptible negative (EPA, 2022))
Snipe	Winter	0.037	0.266	+0.229	0.03% → 0.87%	No significant change (very low (Percival, 2003)/long-term imperceptible negative (EPA, 2022))
Buzzard	All	0.575	1.07	+0.495	NA	No significant change (low (Percival, 2003)/long-term slight negative (EPA, 2022))
Sparrowhawk	All	0.009	0.019	+0.01	NA	No significant change (very low (Percival, 2003)/long-term imperceptible negative (EPA, 2022))

7.3.7.1 Golden Plover

Survey	Total number of records	Average and peak count per observation	Activity of note
Vantage Point Surveys	26	34 (125)	The majority of observations comprised birds travelling, circling and foraging. There were seven observations of birds dropping to the ground within 500m of the Proposed Wind Farm site, comprising flock sizes of between 2 - 82 birds.
Winter Walkover Surveys	9	21 (42)	There were seven observations of between 1 and 42 birds recorded travelling and calling over the Proposed Wind Farm site and an additional two observations recorded utilizing habitats on Proposed Wind Farm site
Waterbird Distribution and	2	33 (60)	There were two observations of birds flying between 5.7km and 8km from the Proposed Wind Farm site.

Abundance Surveys			
Incidental Records	9	58 (200)	The majority of observations were of flocks in flight over the Proposed Wind Farm site with one observation landing in a field within 700m of the Proposed Wind Farm site.

7.5.2

7.5.2.1 Effects on Key Ornithological Receptors during Construction and Operation

Golden Plover (Winter)

This text provides additional information on golden plover collision risk. Golden Plover Choice of Reference Population

To identify the relevant reference population, the key question that needs to be answered is where were the golden plover that were recorded onsite coming from and what population does that associate them with, i.e. the Lough Corrib SPA alone or the wider county population that includes the SPA. Why this is important when considering collision risk is outlined as follows.

A collision risk impact assessment is informed by the predicted number of collisions, however, a meaningful impact assessment cannot be undertaken with the predicted number of collisions alone. Context is needed. For example, one predicted collision for a population of one would be catastrophic whereas the same number of collisions is less important for a large population. In deciding what is an appropriate reference population for the impact assessment, a key consideration is whether the birds encountered onsite are part of a discrete local population or a larger population present throughout (suitable habitat) in the wider surroundings. Several other factors are typically considered, such as the behaviour of the species in question (are they a wide-ranging species), their habitat preference, whether the habitat is abundant and whether there is connectivity within the habitat. A relevant section in the impact assessment guidance produced by Percival (2003) outlines how “one issue in this process concerns the precise area or bird population against which the degree of impact should be judged. For protected SPAs this is usually quite straightforward, comprising simply the populations for which that site has been designated”. However, there is a requirement to consider what proportion of the individuals recorded onsite are associated with the SPA if the proposed wind farm is located outside the SPA, e.g. all, some or none.

As stated in the NIS and Chapter 7 of the EIAR there is potential connectivity between the golden plover encountered at the Proposed Wind Farm site and the Lough Corrib SPA population. The question is, whether all golden plover encountered within the Proposed Wind Farm site were associated with the SPA or were they part of the larger county population (that includes the SPA). The NIS and EIAR's position is that the birds encountered at the site include birds from the SPA and birds from the wider county population. The rationale for this position is in line with Percival (2003) guidance (please see EIAR Chapter 7 Section 7.2.5 for guidance summary) and is as follows:

There are wintering golden plover in the county that are not associated with the Lough Corrib SPA, as evidenced by the results from the Irish Wetland Bird Survey (I-WeBS), for which golden plover have been recorded at 20 additional sites in the county outside of Lough Corrib SPA (as detailed in Section 7.4.1.1 of the EIAR as submitted).

Wintering golden plover is a mobile and widespread species (as per the Bird Atlas 2009-11) that utilises widespread habitat types (e.g. agricultural grassland) throughout much of Ireland (including Co Galway). It is, therefore, unlikely the birds encountered at the Proposed Wind Farm site form part of a distinct local population and reasonable to conclude that there is some exchange of individuals in suitable habitat within the county. Furthermore, the species is particularly abundant during the winter season in the western midlands of Ireland, including the east Co. Galway region (as per the Bird Atlas 2009-11).

There is also the potential for foraging golden plover from the Lough Corrib SPA to visit the Proposed Wind Farm site. The maximum foraging range of wintering golden plover is 12km (Gillings and Fuller, 1999). The Proposed Wind Farm site does not adjoin the Lough Corrib SPA, but it is within foraging range: the separation distance is ~3.6km. There is abundant suitable habitat (e.g. agricultural grassland) throughout Galway, particularly to the east of Lough Corrib. There is nothing unique about the agricultural grassland within the Proposed Wind Farm site, it is, therefore, reasonable to assume that the occurrence of golden plover within the grassland of the Proposed Wind Farm site is indicative of similar occurrences throughout similar habitats in other areas of the county. Particularly in the abundant agricultural grassland to the east of Lough Corrib. There is no barrier to connectivity within this (largely contiguous) suitable habitat, it is therefore reasonable to assume that there is an exchange of individuals within the county.

The evidence of waterbird distribution and abundance surveys shows golden plover to be numerous in the wider surroundings of the Proposed Wind Farm site. Please see EIAR Appendix 7-4 Table 7-4-2 and associated figure 7.4.2). Birds were recorded in Lough Corrib but also within the network of wetland/turloughs and grassland sites to the north of the Proposed Wind Farm site, including Lough Hackett, Belclare Turlough, Turloughnaroy and Bohercull Turlough. It should be noted that the birds encountered at these wetland sites are likely only a fraction of the birds that are present in grassland habitats in the wider surroundings of the Proposed Wind Farm site³⁰. This is due to the foraging ecology of wintering golden plover that favours agricultural grasslands and other terrestrial habitats when foraging.

In summary, it is considered that the balance of evidence strongly suggests that at most only some of the golden plover recorded within the Proposed Wind Farm site are associated with the Lough Corrib SPA wintering population for which the site is designated. As stated in the EIAR, the birds encountered at the Proposed Wind Farm site are part of the larger county population that includes the SPA. It therefore follows that only a portion of the predicted collisions are associated with the SPA population.

Golden Plover Revised Collision Risk Assessment

A revised collision risk assessment was undertaken that incorporates data from a further 1.5 years of bird surveys. There is no significant change to the impact assessment conclusion from the revised collision risk assessment for wintering golden plover at the county level (i.e. low (Percival, 2003)/longterm slight negative (EPA, 2022)- see EIAR Addendum Appendix 7-5a for further detail).

As outlined in detail above, the best available evidence strongly suggests that the birds encountered at the Proposed Wind Farm site are part of the larger county population that includes the SPA. That is to say, only a portion of the birds encountered at the Proposed Wind Farm site are likely associated with the SPA. Notwithstanding this, consideration has been given to the potential collision risk for the SPA population alone.

As a first step, it was necessary to assume the falsehood that all golden plover encountered at the Proposed Wind Farm site and the associated collision risk are associated with the SPA population alone. To undertake the analysis, the predicted rate of collisions at the Proposed Wind Farm site (3 birds) was considered in the context of the Lough Corrib SPA population³¹ (2,088) alone. Using this figure as the reference population, the predicted collisions at the Proposed Wind Farm site (as per EIAR Addendum Appendix 7-5a) would increase the annual mortality rate of the SPA population by 0.54% (this is a negligible collision rate). However, as previously discussed, the actual increase in mortality for the SPA population is highly likely to be considerably less than this, as only a portion of the golden plover recorded onsite are likely associated with the SPA. Therefore, no significant collision risk effects or adverse effects are predicted for the Lough Corrib SPA population of golden plover.

The above serves to further corroborate the finding of no significant collision risk effects for wintering golden plover as provided in the EIAR as lodged and no adverse effect for the golden plover of the Lough Corrib SPA. Notwithstanding this, a comprehensive suite of commencement/pre-construction and operational phase monitoring is proposed in Appendix 7-7 of the EIAR. The proposed monitoring programme was not proposed in response to any identified significant effect but rather as a best practice measure (SNH, 2009). The monitoring is comprehensive and considered entirely adequate in this regard. The monitoring results will be reported to the Planning Authority following each monitoring year and will include recommendations that may inform additional mitigation or adaptation if required.

7.5.2.2 Hen Harrier (Winter)

This section provides additional information on hen harrier collision risk. The collision risk from the revised collision risk assessment has been calculated at a rate of 0.001 collisions per year, or one bird every 1,683 years. That is to say, no collisions are predicted to occur over the 30- year life-time of the Proposed Project. It therefore follows that no significant collision risk effects are predicted for either the Lough Corrib SPA or the county population. It further follows that if there are no collisions predicted to occur during the 30- year life-time of the Proposed Project, such a low rate of predicted collisions (effectively zero) could not contribute to a significant cumulative effect. Therefore, no significant collision risk effects are predicted from either an individual project or a cumulative perspective.

No reference to 7.5.2.7 in report

6.1.1.1.5 Common Gull (Breeding)

As evidenced by a comprehensive suite of surveys, common gull were effectively absent from the Proposed Wind Farm site during the breeding season. In four years of vantage point surveying, a single bird on a single occasion was recorded during the breeding season. Owing to this extremely low rate of occurrence within the Proposed Wind Farm site, it is concluded that the breeding population of the SCI species is not using the Proposed Wind Farm site and that there is no potential for adverse effect to the species via collision risk.

8.1.3.2 Other Wind Farms within SCI foraging range of Lough Corrib SPA

In response to the RFI, a cumulative impact assessment of the Proposed Project in-combination with other wind farm projects within 18.5km of Lough Corrib SPA has been undertaken. This has been undertaken in order to ascertain whether other wind farm projects are likely to result in effects in SCI populations of the SPA (black-headed gull and golden plover, as recorded during ornithological surveys of the Proposed Wind Farm site). The chosen geographical boundary was 18.5km given that this is the furthest foraging distance of the species within the SPA (i.e breeding black headed gull).

8.1.3.2.1 Hen harrier

The collision risk for hen harrier has been calculated at a rate of 0.001 collisions per year. That is to say, no collisions are predicted to occur over the 30- year life-time of the Proposed Wind Farm. It therefore follows that no adverse collision risk effects are predicted for either the Lough Corrib SPA or the county population. It further follows that if there are no collisions predicted to occur during the 30- year life-time of the Proposed Wind Farm, such a low rate of predicted collisions (effectively zero) could not contribute to an adverse cumulative effect. Therefore, no adverse collision risk effects are predicted from either an individual project or a cumulative perspective.

8.1.3.2.2 Common Gull Breeding population

As outlined in the Lough Corrib SPA site-specific conservation objectives, there is a population of 137 pairs of common gull breeding on the lough²⁸. Primarily in the mid and upper parts of the lough. However, as evidenced by a comprehensive suite of surveys, these birds only very rarely visit the Proposed Wind Farm site. In four years of vantage point surveying, a single bird on a single occasion was recorded during the breeding season. Owing to this extremely low rate of occurrence within the Proposed Wind Farm site, no significant collision risk is predicted for common gulls during the breeding season and no adverse effect is predicted for the Lough Corrib SPA population. Therefore, no adverse collision risk effects are predicted from either an individual project or a cumulative perspective.

Wintering population (non- SCI)

The collision risk for wintering common gull is not predicted to result in adverse effects for the breeding common gull population that is an SCI for the Lough Corrib SPA based on the following rationale:

- The common gull encountered at the Proposed Wind Farm site during the winter are unlikely to be the same birds that breed within the Lough Corrib SPA. During the winter, much of the Irish breeding population leaves Ireland and there is a large influx of common gull into Ireland from continental Europe (Vernon J. D. R. 1969²⁹ and Hutchinson C.D. 1989³⁰).
- Likely, the common gulls that were encountered at the Proposed Wind Farm site are immigrant individuals wintering in Ireland. Common gull is considerably more numerous during the winter (non-breeding season) than during the breeding season. As outlined in Article 12 reporting, there are nearly five times more common gulls in the winter months. Article 12 reporting further states that the reported winter population is likely an underestimate. This broader abundance during the winter months likely explains how the species could be effectively absent from the Proposed Wind Farm site in the breeding season but present in the winter months.

In summary, no adverse collision risk effects are predicted for the breeding common gulls of the Lough Corrib SPA. Therefore it cannot contribute to a cumulative effect in this regard.

8.1.3.2.3 Black-headed Gull Breeding SCI population

There is abundant suitable habitat for the SCI species (e.g. turloughs and agricultural grassland) throughout Galway, particularly to the east of Lough Corrib. However, within this habitat, there is a very low density of turbines. This area included two single turbines (Montiagh and Summerfield, discussed in the section above) at the southern end of the Lough Corrib and the proposed Shancloon Wind Farm (Newspaper notice issued- ACP 317307). At such low densities of turbines, significant rates of collisions are unlikely. The rationale for this assessment is as follows.

- The two single turbines are not located particularly close to Lough Corrib, owing to their scale and distance from the breeding colonies of black-headed gull in the Upper Basin (as set out in the site-specific conservation objectives³¹), impacts are predicted to be effectively zero.
- There are no reports yet on the proposed Shancloon Wind Farm planning file. However, if it is assumed (for the purposes of the cumulative assessment) that there is a similar rate of collisions at that wind farm as the Proposed Wind Farm (i.e. 0.8 collisions annually) predicted impacts would remain negligible. That is, if the rates of collisions were 0.8 and 0.8 respectively for each development per year it would mean that the combined losses would increase the annual mortality of the county population (c.1,960) by 0.82%. The predicted collision risk is negligible as per Percival (2003) criteria. As only a portion of the predicted collisions are likely to be associated with the SPA population, no adverse effects are predicted.
- While the 1% increase in background mortality referenced in Percival (2003) is often set as the threshold for judging significance it is likely quite conservative. The threshold likely originates from a hunting threshold set by the European Commission (and referenced in EC, 2008)³² and was not intended to indicate that all increases in mortality above 1% were significant. Among other reasons, the threshold was set at 1% by the European Commission because such losses are so low that they are within the margin of error from a mathematical point of view in population dynamics modelling studies. This further limits the potential for significant cumulative collision risk effects to result or adverse effects on the SPA population of blackheaded gulls.

The west side of Lough Corrib has a much higher density of turbines than the east. These turbines are concentrated in the forestry and blanket bog to the west of Oughterard, Co. Galway. These wind farms include Knockranny Wind Farm

(Permitted), Lettergunnet Wind Farm, Letterpeak Wind Farm, Knockalough Wind Farm, Ardderroo Wind Farm and the Galway Wind Park. None of these wind farms identified black-headed gulls as key ornithological receptors owing among other reasons to their very low rate of occurrence. For example, their EIS/EIARs include the following information:

- On Ardderroo Wind Farm (ACP Ref. 303086), in two years of surveying, black-headed gulls were recorded on a single occasion on or near the site.
- On Knockalough Wind Farm (PI Ref. 16/1211) no black-headed gulls were recorded.
- On Knockranny Wind Farm (PI Ref.13/829, Alterations proposed under PI Ref. 23/225) no black-headed gulls were recorded.
- On Lettergunnet and Letterpeak Wind Farms (LGLP) (PI ref. 10/1214 & 10/1225) Wind Farm no black-headed gulls were recorded.

Knock South Wind Farm (09/1326) is located still further to the west of the above wind farms in blanket bog and no black-headed gulls were recorded. There are no other wind farms with the potential to significantly impact this species within 18.5km of the SPA.

As these wind farms do not occur in habitats that are likely to be visited by this species in large numbers or with any regularity no significant collision risk is predicted. Collision rates are likely to be so low for this species on these sites as to be effectively zero.

In summary, following a review of wind farms within 18.5km of the SPA, there is no potential for cumulative adverse effect on the black-headed gulls of the Lough Corrib SPA.

Wintering population (Non- SCI)

The collision risk for wintering black-headed gull is not predicted to result in adverse effects for the breeding black-headed gull population that is an SCI for the Lough Corrib SPA based on the following rationale:

- Likely a majority of the black-headed gulls that were encountered at the Proposed Wind Farm site are immigrant individuals wintering in Ireland. Black-headed gull is considerably more numerous during the winter (non-breeding season) than during the breeding season. As outlined in Article 12 reporting, there are 2.5 times more black-headed gulls in the winter months. Article 12 reporting further states that the reported winter population is likely an underestimate.

In summary, no adverse collision risk effects are predicted for the breeding black-headed gulls of the Lough Corrib SPA. Therefore it cannot contribute to a cumulative effect in this regard.

8.1.3.2.4 Golden Plover

To undertake the cumulative assessment of collision risk for golden plover from the Lough Corrib SPA it is first necessary to identify where the SCI species is likely to encounter turbines. As outlined in the SPA Conservation Objectives the golden plover from the site forage in terrestrial habitats. During the winter season, foraging birds can travel 12km (Gillings and Fuller, 1999). Therefore, turbines that occur in suitable terrestrial habitats within the foraging range are most likely to be encountered. A review of wind farms within 12km of the SPA was undertaken. There is abundant suitable habitat (e.g. agricultural grassland) throughout Galway, particularly to the east of Lough Corrib. However, within this habitat there is a very low density of turbines. This area included two single turbines (Montiagh and Summerfield) at the southern end of the Lough Corrib and the proposed Shancloon Wind Farm (Newspaper notice issued- ACP 317307). Shancloon Wind Farm is approximately 12km from the Lough Corrib SPA. At such low densities of turbines, significant rates of collisions are unlikely.

The rationale for this assessment is as follows.

- The two single turbines are not located particularly close to Lough Corrib, owing to their scale and distance from the SPA, impacts are predicted to be effectively zero.
- There are no reports yet on the proposed Shancloon Wind Farm planning file and as it is c.12km from the Lough Corrib SPA is at the outer edge of sites with potential connectivity to the SPA. If it is assumed (for the purposes of the cumulative assessment) that there is a similar rate of collisions at that wind farm as the

Proposed Wind Farm, predicted impacts would remain negligible. That is, if the rates of collisions were 3.049 and 3.049 respectively for each development per year it would mean that the combined losses would increase the annual mortality of the county population (c.4,423) by 0.51%. The predicted collision risk is negligible as per Percival (2003) criteria. As only a portion of the predicted collisions are likely to be associated with the SPA population, no adverse effects are predicted.

- While the 1% increase in background mortality referenced in Percival (2003) is often set as the threshold for judging significance, it is likely quite conservative. The threshold likely originates from a hunting threshold set by the European Commission (and referenced in EC, 2008)³³ and was not intended to indicate that all increases in mortality above 1% were significant. Among other reasons, the threshold was set at 1% by the European Commission because such losses are so low that they are within the margin of error from a mathematical point of view in population dynamics modelling studies. This context further limits the potential for significant cumulative collision risk effects to result or adverse effects on the SPA population of golden plover.

The west side of Lough Corrib has a much higher density of turbines than the east. These turbines are concentrated in the forestry and blanket bog to the west of Oughterard, Co. Galway. These wind farms are within the potential foraging range (c.12km) of the Lough Corrib SPA and include Knockranny Wind Farm (Permitted), Lettergunnet Wind Farm, Letterpeak Wind Farm, Knockalough Wind Farm, Ardderroo Wind Farm and the Galway Wind Park. Knockranny Wind Farm, Ardderroo Wind Farm, Lettergunnet Wind Farm and Letterpeak Wind Farm identified golden plover as key ornithological receptors.

Their EIS/EIARs include the following information:

- The Ardderroo Wind Farm (ABP Ref. 303086) is sited in a conifer plantation with very little suitable open habitat for golden plover. In two years of vantage point surveying golden plover were recorded on five occasions, although no flights were onsite. Collision risk was assessed to be effectively zero.
- On Knockranny Wind Farm (PI Ref.13/829, Alterations proposed under PI Ref. 23/225) golden plover were recorded during surveys however the potential for collisions was considered to be low.
- On Lettergunnet and Letterpeak Wind Farms (LGLP) (PI ref. 10/1214 & 10/1225) only small numbers of wintering golden plover were recorded. No significant collision risk was predicted.

There are no other wind farms with the potential to significantly impact this species within 12km of the SPA.

As these wind farms do not occur in habitats that are likely to be visited by this species in large numbers or with any regularity, (e.g. agricultural grassland) no significant collision risk is predicted. Collision rates are likely to be so low for this species on these sites as to be effectively zero.

In summary, following a review of wind farms within 12km of the Lough Corrib SPA, there is no potential for adverse cumulative collision risk effects on golden plover.

6.2.2.1.6. Proposed Grid Connection: [Dealt with above.]

Along the Proposed Grid Connection underground cabling route, there are 4 no. surface water crossing points. The 2 no. primary crossings exist along existing bridges over the River Clare and a smaller tributary of the River Clare, while there are a further 2 no. crossings further east at small streams along a local road. The proposed Grid Connection underground cabling will be emplaced along the road carriageway, therefore no instream works will occur. However, the works have the potential to adversely affect the River Clare within Lough Corrib SAC along the Proposed Grid Connection underground cabling route. The cabling route will cross the River Clare via Horizontal Direction Drilling (HDD).

The crossing under the M17 motorway is not located near a watercourse, with the nearest river being the Sulleen river located 350m east of the crossing, with no small streams or ditches located near the crossing point. As such, the M17 crossing is not considered sensitive in terms of potential effects on the hydrological/hydrogeological environment, given the lack of any surface water connections and distances involved to nearby watercourses.

The existing water crossings along the Proposed Grid Connection will be crossed according to the following methodologies set out in Table 6-1 below:

Table 6-1 Proposed Grid Connection Water Crossing Methodologies

<i>Watercourse Crossing Reference No.</i>	<i>Watercourse Type</i>	<i>Watercourse Crossing Type</i>
<i>WC1</i>	<i>Double concrete pipe crossing</i>	<i>Crossing using standard trefoil formation</i>
<i>WC2</i>	<i>Clearspan Bridge (River Clare)</i>	<i>Horizontal Directional Drilling</i>
<i>WC3</i>	<i>Stone-Arch Bridge</i>	<i>Flatbed Formation over bridges/culverts</i>
<i>WC4</i>	<i>Concrete Pipe</i>	<i>Crossing using standard trefoil formation</i>

Proposed Mitigation Measures

Wind Farm Site

The key mitigation measures typically employed during the construction phase of Wind Farms is the avoidance of sensitive aquatic areas where possible, by application of suitable buffer zones (i.e. 50m to main watercourses, and 10m to main drains). At the Proposed Wind Farm site, the nearest surface watercourse is situated 2.6km away. Therefore, self-imposed buffer zones are not required at the site.

Spoil management areas for removed soil/subsoil will be localised to 4 no. spoil management areas and will be designed and constructed with the minimal amount of surface area exposed. In these spoil management areas, the vegetative top-soil layer will be removed and re-instated or reseeded directly after construction, allowing for re-vegetation which will mitigate against erosion.

Grid Connection underground cabling route

More than 95% of the underground electrical cabling connection route is >50m from any nearby watercourse, sections within 50m of the route are confined to existing watercourse crossings at bridges. It is proposed to limit any works in any areas located within 50m of any watercourse/waterbody including the stockpiling of excavated soils and subsoils.

No in-stream works are required at any of these crossings, however due to the proximity of the streams to the construction work at the crossing locations, there is a potential for surface water quality impacts during trench excavation work. Mitigation measures are outlined below.

A constraint/buffer zone will be maintained for all crossing locations where possible. In addition, measures which are outlined below will be implemented to ensure that silt laden or contaminated surface water runoff from the excavation work does not discharge directly to the watercourse.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively.

The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface watercourses; and,
- Avoid the entry of suspended sediment from earthworks into watercourses.

Mitigation by Avoidance:

- A key mitigation measure adopted during the design phase is the avoidance of infrastructure close to surface water features across the Proposed Wind Farm site. The Proposed Wind Farm site is significantly distal from any surface water course, the nearest being the Ballinduff stream located 2.6km west of the site.

The Proposed Grid Connection underground cabling route crosses over 4 no. watercourses. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively.

The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface watercourses (again, absent from the Wind Farm site); Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, by allowing all surface water/recent rainfall to infiltrate to ground at the Proposed Wind Farm site.

Maintenance of Wind Turbine Blades and Microplastic Emission: How to Mitigate Environmental Risks. Leon Mishnaevsky Jr. *Wind Energy*, 2025; 28:e70072. <https://doi.org/10.1002/we.70072>

Blade repair can be needed as early as 1–2 years after the wind turbine installation and can be required quite often, every 2 years. This repair frequency and high costs apparently mean that the technology should be drastically improved.

Maintenance and repair of wind turbine blades include typically the following steps: finding damage, assessing the degree and type of the damage, designing the repair scheme, removing the damaged region and surface preparation, fabricating repairing parts, and attaching it, inspection. The steps where any plastic particle emission can be expected are removal of the damaged region (typically, by grinding), surface preparation (grinding), bonding, and finally surface polishing.

Different repair procedures are applied to wind turbine blades, depending on specific conditions and blade damage mechanisms. According to the estimations from [2], the most common blade damage mechanism is the leading edge erosion. While it is a minor damage of the blade and not so spectacular as blade collapses (which are widely reported in newspapers), erosion repair constitutes 90% of all blade damages requiring repair. The costs for repair of minor blade damage (erosion) are also 12 times higher than those of structural failure. Moreover, structural blade repair requires a blade replacement or factory repair, while the surface erosion can be repaired onsite, thus adding to the risk of onsite plastic emission.

Using the data of wind turbine service companies, it was determined that the volume of emitted particles due to erosion is about 75g per year per blade for onshore wind turbines.

Thus, all of these emitted particles fall onto the surrounding lands & are pollutants to the food & drinking water chain.

Mitigation by Design:

- Source controls:
 - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
 - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.
 - In-Line controls:

o Interceptor drains, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

Treatment systems:

o Silt-buster system or equivalent.

Silt Fences Silt fencing will be emplaced downgradient of turbines, to prevent any runoff of sediment laden water. Silt fences are effective at removing heavy settleable solids. Inspection and maintenance of these structures will be carried out during construction phase. They will remain in place throughout the entire construction phase. Silt fences will also be emplaced along the Proposed Grid Connection underground cabling route during the construction phase. A double layer of silt fencing will be emplaced where the Proposed Grid Connection is near sensitive areas (i.e. watercourse crossing over River Clare).

On the apparent failure of silt fences to protect freshwater ecosystems from sedimentation: A call for improvements in science, technology, training and compliance monitoring S.J. Cooke, J.M. Chapman. J.C. Vermaire. *Journal of Environmental Management* 164 (2015) 67e73. <http://dx.doi.org/10.1016/j.jenvman.2015.08.033> 0301-4797/© 2015

In the face of development activities, regulatory bodies have enacted policies (see Mertes, 1989; Alsharif, 2010) in an attempt to reduce the input of sediment into aquatic systems given that it has been long (see Ellis, 1936) and widely accepted that such inputs are deleterious to environmental quality and aquatic biodiversity (e.g., Ryan, 1991; Wood and Armitage, 1997; Bilotta and Brazier, 2008; Chapman et al., 2014). Accompanying such policies is a suite of tools (or best practices) that are available to practitioners known as silt or sediment controls. By far the most common and visible is the silt fence (Kouwen, 1990). One doesn't have to venture far in developed countries to see them deployed adjacent to most construction activities that have the potential to mobilize sediment. **Although presumably used with good intentions, there is surprisingly little research that evaluates the effectiveness of silt fences and the factors that modulate success when properly installed and maintained.** What constitutes "proper" installation and maintenance is unclear, especially given regional- and site-level variation in precipitation, slope, soil characteristics, etc. We presented a candid critique of silt fences. Our goal was not to dismiss silt fences as a potentially useful tool. Instead, we question how they are being used and call for better science as well as better training for those that install, maintain and inspect such devices, as well as more rigorous compliance monitoring. From our perspective, the jury is still out regarding the effectiveness of silt fences with many opportunities (as we outlined here) to improve the science and practice of sediment control via silt fences. Quite simply, with insufficient literature/data to conduct a systematic review and meta-analysis on the utility of silt fences for protecting aquatic ecosystems from sedimentation, their widespread use is not consistent with an evidence-based approach to environmental management (Sutherland et al., 2004).

Silt Bags

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through. The discharge from the silt bags will be directed to the settlement ponds, where the water will be allowed to naturally infiltrate to ground.

Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the Proposed Wind Farm site will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the Site to direct proposed construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction **but do not provide any quantitative rainfall estimates**;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. **Less useful than general forecasts as only available on a provincial scale**;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours **but does not account for possible heavy localised events**;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes.
- **Radar images are not predictive**; and,
- Consultancy Service: Met Eireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works should be suspended if forecasting suggests either of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures should be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from Spoil Storage Areas It is proposed that excavated subsoil will be used for landscaping throughout the Site and any excess will be accommodated at 4 no. spoil management areas across the Proposed Wind Farm site.

Proposed surface water quality protection measures regarding the spoil storage areas are as follows:

- During the initial emplacement of spoil at the storage area, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the enclosure.
- Drainage from the storage areas will be directed to settlement ponds as required or will overflow through controlled overflow pipes.
- Discharge from the storage areas will be intermittent and will depend on preceding rainfall amounts.
- Once the storage areas have been seeded and vegetation is established the risk to downstream surface water is significantly reduced.

Therefore, at each stage of the spoil storage area development the above mitigation measures will be deployed to ensure protection of downstream water quality. Mitigation for watercourse crossings along the Proposed Grid Connection underground cabling route

Prior to the commencement of cable trenching or crossing works the following measures will apply:

- No in-stream works are proposed, however the drilling works will be done over a dry period, and if works occur outside the months of July to September (as required by IFI for in-stream works) the Applicant will be cognisant of the salmon spawning season, and will inform the IFI);
- The crossing works area will be clearly marked out with fencing or flagging tape to avoid unnecessary disturbance;

- There will be no storage of material / equipment or overnight parking of machinery inside the hydrological buffer zone;
- The area around the batching, pumping and recycling plant will be bunded using terram (as it will clog) and sandbags in order to contain any spillages; Drilling fluid returns will be contained within a sealed tank / sump to prevent migration from the works area;
- Spills of drilling fluid will be cleaned up immediately and contained in an adequately sized skip before been taken off-site;
- Daily monitoring of the compound works area, the water treatment and pumping system and the percolation area will be completed by a suitably qualified person during the construction phase.

All necessary preventative measures will be implemented to ensure no entrained sediment, or deleterious matter is discharged to the watercourse, In the event that works are giving rise to sediment or deleterious matter discharging to watercourses, the ECoW or supervising hydrologist will stop all works. The source of the sediment, or deleterious matter will be identified and additional drainage measures will be installed in advance of works recommencing.

Timing of Site Construction Works

Construction of the Wind Farm site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of the commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at infiltration outfall points or within the short drainage channels, that may decrease the effectiveness of the drainage feature, will be removed.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQs should be undertaken at drainage outfall locations, and specifically following heavy rainfall events. The inspections will include ensuring that all surface water is infiltrating to ground as per the Drainage Design, with no surface water runoff from the Wind Farm site.

Residual adverse effects:

Once the above listed mitigation measures are implemented, there will be no potential for residual adverse effects on water quality of European Sites as a result of earthworks and entrainment of suspended solids.

6.2.2.1.2 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in the death of aquatic organisms.

The pathways for the rapid transport of any potential spilt chemicals are limited at this site, due to the absence of any surface water drainage routes (rivers, streams etc). The primary pathway is through infiltration through the subsoil and bedrock and eventually reaching the underlying groundwater aquifer.

The potential release of hydrocarbons can occur during the works within the Proposed Wind Farm site and during works along the Proposed Grid Connection underground cabling route. As stated previously, the Proposed Wind Farm site does not directly interact with any surface watercourses. There are 4 no. surface watercourse crossings along the Proposed Grid Connection underground cabling route.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the Proposed Wind Farm site and along the Proposed Grid Connection underground cabling route are as follows: Minimal refuelling or maintenance of construction vehicles or plant will take place on site.

Off-site refuelling will occur at a controlled fuelling station;

- On site re-fuelling of machinery will be carried out using a double skinned refuelling truck.
 - o A refuelling truck will be used to refuel construction equipment used on site.
 - o The refuelling truck will also carry fuel absorbent material and pads in the event of any accidental spillages.
 - o The fuel truck will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site.
 - o Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Onsite refuelling will be carried out by trained personnel only;
- Fuels stored on site will be minimised. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- Surface water runoff from temporary construction compounds will be collected and drained via silt traps and hydrocarbon interceptors prior to recharge to ground;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;

Residual adverse effects: Once the above listed mitigation measures are implemented, there will be no potential for residual adverse effects on water quality of European Sites as a result of hydrocarbon pollution.

6.2.2.1.3 Release of Cement-Based Products

6.2.2.1.4 Potential Effects on Surface Water and topographically downgradient Surface Water bodies

6.2.2.1.5 Groundwater and Surface Water Contamination from Wastewater Disposal

6.2.2.1.6 Hydrogeological Impacts Potential Effects on Groundwater Flows and Levels due to alteration of recharge (including activation of potential karst)

Proposed Wind Farm

Proposed Wind Farm Groundwater flow within a recognised karst environment is difficult to fully quantify without significant datasets, as spatial variations in the degree of karstification can alter the permeability and transmissivity (essentially the volume of groundwater flowing through a particular unit of rock) by orders of magnitude. For the Proposed Wind Farm site, a comprehensive site investigation dataset has been accrued between 2021-2023. The collated site investigation dataset for the Site has not identified any significant karst features within the underlying bedrock, following 230m of drilling within the bedrock, along with an extensive data from trial pitting in these areas.

Groundwater bearing bedrock formations (aquifers) were encountered between 19.5 – 41mbgl at the Proposed Wind Farm site, within the 3 no. deep groundwater monitoring wells. No water bearing formations were recorded during the drilling of the 10-10.5m deep rotary core boreholes. The data from the rotary core drilling shows that the bedrock is generally medium hard to hard Limestone. The inflow of groundwater into the monitoring wells was encountered at depths >20m, and data from the GWS wells indicates groundwater strikes were similarly deep within the Limestone aquifer. There were no groundwater strikes recorded during the drilling of the 10 no. rotary core boreholes drilled across the Proposed Wind Farm site. The ~20m of competent Limestone bedrock below the Proposed Wind Farm site does not contain any evidence of karst flow systems. Groundwater levels have been monitored extensively.

Groundwater levels within the Proposed Wind Farm site are below the formation levels for the proposed turbine foundations. Groundwater levels in the deep water bearing aquifers (>20m depth) occasionally rise to near ground levels, however unless an excavation penetrates these deep aquifers this will not be observed in the overlying hard, competent limestone. As the proposed excavations are shallow in nature (typically 3-4m), groundwater strikes will not

occur (as evidenced from the drilling of RC01-RC09 and RC-11) and as such the excavations will remain relatively dry (apart from managing rainfall). Groundwater levels may be affected by any change in recharge within a groundwater catchment. A reduction in recharge, which would be accompanied by an increase in surface water drainage, would clearly reduce the volume of water infiltrating to the bedrock aquifers and therefore lead to a reduction in groundwater levels. The drainage management design of the Proposed Wind Farm site has been optimised to ensure the volume of rainfall infiltrating through the subsoils to the groundwater aquifer will not change.

Proposed Grid Connection [Response above]

Changes in the permeability of the ground along the Proposed Grid Connection underground cabling route can impact on groundwater recharge to the underlying aquifer. As the cable trench will be shallow (~1.3m) and within an existing road carriageway, the trench will be excavated within the soil/subsoil layer. Following the excavation of the trench, the cable will be laid and the soil/subsoil removed will be backfilled within the excavation (in the same order as it was removed). As such, the overall permeability of the ground along the Proposed Grid Connection route will not be altered to a significant degree. Where tarmacadam or other hardstanding is removed, this will be reinstated and as such the permeability will not change as a result of the Proposed Grid Connection underground cabling route.

Mitigation by Avoidance- Groundwater Flows: Proposed Wind Farm

The construction of the turbines, met mast, access roads and other ancillary features of the Proposed Project could impact groundwater flows within the Proposed Wind Farm site, if a particular pathway e.g. karst conduit, existed near the development, however based on all the available site investigation data no reasonable pathways have been identified. The identification and avoidance of any potential karst features has been a key aim of the intrusive and extrusive site investigations, through iterative geophysical surveys, drilling and trial pit excavations and is considered to be the most rational method of mitigating against effecting flow paths, by avoiding any potential karst areas.

The Site data outlined within Section 9.3.7.2 and 9.3.7.3 (Appendix 2) provides sufficient scientific data to say, with a high degree of certainty, that the construction of the turbine foundations, met mast, site access roads, substation and other relatively near surface constructs, will not interact with or alter the existing groundwater recharge, and underlying groundwater flow, regimes.

Proposed Grid Connection [Response above]

The Proposed Grid Connection underground cabling route will be routed along an existing road carriageway. The trench will for the cabling will be excavated to a depth of 1.3m and the soil/subsoil removed will be backfilled in place. As such there will be no significant change in the permeability of the lands occupied by the grid connection.

Mitigation by Design- Groundwater Levels:

As mentioned above, the critical driver of groundwater levels and the potential to affect them is through groundwater recharge. The drainage design of the Proposed Wind Farm site has been designed to mimic the existing hydrological regime within the Site, whereby surface water runoff pathways are generally short and rainfall readily percolates to ground. The drainage design incorporates check dams to reduce velocities, and level spreaders to allow water to infiltrate to ground. The net effect of the drainage design will be that all rainfall falling within the Proposed Wind Farm site will remain on the Site and infiltrate to ground and will not exit the Site as runoff to surface watercourses.

Potential Effects on Groundwater Levels During Excavation works

Temporary dewatering of turbine foundations during construction has the potential to impact on local groundwater levels. The local groundwater levels which have been monitored over a 24-month period and a full understanding of local prevailing hydrogeological conditions has been gained. Groundwater level effects are not anticipated to be significant due the known local hydrogeological regime, and due to the proposed excavation method as outlined below. Groundwater levels across the Proposed Wind Farm site are well defined through monitoring of numerous groundwater wells and site investigation boreholes.

The known groundwater levels within the Proposed Wind Farm site are summarised in Section 9.3.7.6. Briefly, they range between 8.2 – 30.8 mOD across the Proposed Wind Farm site. Ground elevations and typical Winter groundwater levels are included in the Conceptual Site Model (Appendix 2). Known winter groundwater levels are below the proposed formation levels of all turbines, the drilling of the rotary core boreholes has confirmed that no groundwater strikes were met in the underlying 1010.5m of bedrock and as such we can confirm there will be no groundwater dewatering requirements during turbine base construction.

No groundwater level effects are anticipated from the construction of the Proposed Grid Connection underground cabling trench due to the shallow nature of the excavation (i.e. ~1.3m), the excavation of the trench within the road carriageway and the unsaturated nature of the subsoil/bedrock to be excavated.

The response below indicates that the excavation, except for joint boxes will be in the grass verge. See Cremin v Dromada Windfarm HC where grass verge was determined to be private property.

Impact Assessment – Proposed Wind Farm

Based on the engineering design, bedrock may be exposed where cut and fill excavations are proposed. Elsewhere, the proposed turbine base excavations will be within the subsoil strata and do not involve excavation into bedrock. The bedrock has been classified as a Regionally Important aquifer by the GSI, however the Site data from HES boreholes and site investigation boreholes indicates that groundwater is not met within the 0-10m bgl and was met first in borehole MW21-02 at 19.5m bgl i.e. very low permeability in the bedrock underlying the turbine locations. As outlined above, no groundwater dewatering will be required during the construction phase in any element of the Proposed Wind Farm.

The topographical and hydrogeological setting of turbine locations means no groundwater dewatering will be required. Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt, dewatering is defined as a requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. We consider that this example (the quarry example) is very different in scale and operation from the proposed operation of a temporary shallow excavations (3-4m), where the groundwater aquifer units (water strikes) are known to exist at depth (>19.5m). In order to explain this thoroughly we will outline our reasoning in a series of bullet points as follows:

- Firstly, the turbine locations are located on lands where the ground elevations are between ~35 and 60m OD;
- The elevations of the turbine foundations are above the elevations of groundwater levels recorded in monitoring wells and local domestic/farm wells, and therefore of the known groundwater levels within the Proposed Wind Farm site. Groundwater strikes were not met in any of the rotary core boreholes drilled to 10-10.5m at the turbine locations. Groundwater was only met in the deeper monitoring boreholes at depths greater than 19.5m. The turbine foundations will be excavated to 3-4m bgl and as such will not intercept any aquifer units, but will be excavated within the overlying subsoil and near-surface Limestone bedrock;
- The local bedrock comprises medium hard to hard Limestone and has been shown to be generally unfractured and unproductive (not water bearing) during site investigations. This means that groundwater flows at depth, beneath the turbine foundations, will be relatively minor;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations (as proven by the Site investigation drilling);
- Therefore, shallow inflows will be fed by recent rainfall, and possibly by limited seepage from localised permeable subsoils;
- As such any shallow groundwater seepage (within the subsoils) will be small in comparison to the expected surface water flows following any heavy rainfall events; and,
- Hence, it is considered that the management of surface water will form the largest proportion of water to be managed and treated, although where permeable subsoils are encountered, rainfall may infiltrate to ground rather than ponding at any excavation.

Any potential dewatering of excavations will take place above the local groundwater level, within excavations with ponded surface water. The water will be pumped a short distance to settlement ponds where it will recharge to

ground. There will be no net change in runoff/recharge, other than the displacement of the recharge by a short distance (10's of metres).

Impact Assessment – Proposed Grid Connection underground cabling route

The Grid Connection underground cabling trench depth will only be approximately 1.3 m in depth, the excavation will be temporary and transient, and the cable trench will be backfilled with excavated material and/or hardcore material, depending on site conditions. Therefore, there will be no net loss of permeability across the 1.3m depth. As a result, and given the shallow depth, there will be very limited potential for groundwater level effects to occur.

Residual adverse effects: As shown above, there will be no potential for residual adverse effects on local groundwater levels which could impact downgradient European Sites.

See Maintenance of Wind Turbine Blades and Microplastic Emission report above on particle emissions of 75g/blade per annum. These bisodol chemical particles have the potential for residual effects. The Precautionary Principle determines that refusal of Planning Approval is appropriate in such circumstances.

6.2.2.2 Operation 6.2.2.2.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Proposed Wind Farm Progressive replacement of the vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network, if the drainage design included surface water runoff leaving the Site. However, at this site, the drainage design has been optimised to allow for all rainfall which may fall on impermeable surfaces (such as at turbine hardstands) to recharge to ground as would normally occur at the Site. The Proposed Wind Farm site footprint comprises an area of 34.3 Ha.

Proposed Grid Connection

The Proposed Grid Connection underground cabling route comprises an area of 1.9Ha. Along the Proposed Grid Connection underground cabling route, a trench will be excavated for the emplacement of the grid connection cabling. Once installed, this trench will be backfilled and the road surface reinstated. As such, there will be no change in the permeability along this route.

Impact Assessment/Mitigation Measures

As summarised in Section 9.3.14 of the EIAR water Chapter (Appendix 2), the drainage design for the Proposed Wind Farm site includes for the release of any surface water captured within the interceptor drains to recharge back to ground, with a very nominal spatial diversion of the water (10's of metres). In doing so, all rainfall which falls on the Site will still infiltrate to ground. There will be no net increase in runoff from the Proposed Wind Farm site.

Proposed Mitigation by Design: Proposed Wind Farm The operational phase drainage system of the Proposed Wind Farm site will be installed and constructed in conjunction with the road and hardstanding construction work as described below:

- Interceptor drains will be installed up-gradient of proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be slowly re-distributed over the ground surface and infiltrate through the soil and subsoils;
- Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the Proposed Wind Farm site, likely to have entrained suspended sediment, and channel it to infiltration areas for sediment settling; and,
- Check dams will be used along sections of access road drains to attenuate flows and intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock.

Proposed Grid Connection

The trench associated with the Proposed Grid Connection underground cabling route will be backfilled and reinstated following the laying of the cable. As such, the permeability of the ground will remain unchanged. Residual adverse

effects: Due to the retention of groundwater recharge regime, with no surface water drainage from the Site, as well as the relative short displacement of any surface water before it infiltrates and the mitigation measures to ensure the quality of the surface water, there is no potential for residual adverse effect on downstream European Sites as a result of increased run-off from the Site during operation.

6.2.2.2.2 Potential Hydrological and Hydrogeological Effects on Designated Sites

The potential water environment effects on designated sites from the Proposed Project are principally related to the construction process, through potential sources such as sediment generation, cement-based materials and hydrocarbon spillages and potential pathways created during the excavation and movement of soils/subsoils and in some cases bedrock. During the operational phase of the Proposed Project, these potential sources and pathways no longer exist. Any potential impacts then on designated sites are related to the operational maintenance of the Proposed Wind Farm infrastructure.

Mitigation Measures:

Mitigation measures to protect designated sites during the operational phase of the Proposed Project include: Regular maintenance of the on-site drainage system; The maintenance schedule will be reduced once natural vegetation is re-established, which will provide consistent filtration through the soil/subsoil; The use of fuel storage bunds for any hydrocarbons (fuel/oils) and the ongoing maintenance of the bund structures; and, Any maintenance works which may involve soil movement (such as the removal of sediment from the settlement ponds) will take place during the dry months of the year (May- September).

Residual adverse effects:

Based on the considerable reduction in the potential sources of impacts during the operational phase, as well as the ongoing mitigation measures, there is no potential for residual adverse effects on European Sites during operation of the Proposed Project.

6.2.2.3 Potential for Adverse Effects Associated with Decommissioning

6.2.2.3.1 Refuelling; Fuel and Hazardous Materials Storage

Road-going vehicles will be refuelled off site wherever possible; Fuels volumes stored on site will be minimised;

- Any fuel storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- Oils or fuels stored in turbines will be drained and disposed of off-site by a licenced waste contractor, to prevent leakage to groundwater or surface water;
- The plant used will be regularly inspected for leaks and fitness for purpose;
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Decommissioning Plan (Appendix 1). Spill kits will be available to deal with an accidental spillage in and outside the refuelling area.

6.2.2.3.2 Residual adverse effects:

It can be concluded that following the implementation of preventative mitigation, there is no potential for the decommissioning of the Proposed Wind Farm to result in residual adverse effects on European Sites.

6.2.1.2.7 Best Practice Measures in Relation to Birds

Note that these measures are proposed as industry best practice rather than to mitigate any identified adverse effect. In addition to the below, there will be no blasting as part of construction of the Proposed Project.

- Works will commence outside the bird nesting season (1st of March to 31st of August inclusive). Any requirement for construction works to run into the subsequent breeding season following commencement will

be informed by further bird surveys to identify any potential breeding activity of birds of conservation concern once per month during the breeding season (April to July).

- The removal of woody vegetation will be undertaken in full compliance with Section 40 of the Wildlife Act 1976 – 2022. There are no tree removal works along the turbine delivery route, however where sections of vegetation are removed within the Proposed Wind Farm site, these will be replaced with suitable hedge/tree species which are common in the local context.
- During the construction phase, noise limits, noise control measures, hours of operation (i.e., dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds. All plant and equipment for use will comply with the European Communities (Noise Emission By Equipment For Use Outdoors) Regulations, 2001, as amended (SI 632/2001). Plant machinery will also be turned off when not in use.
- If winter roosting or breeding activity of birds of high conservation concern is identified, the roost or nest site will be located and no works shall be undertaken within a species-specific disturbance buffer in line with industry best practice (e.g., Goodship and Furness, 2022). No works shall be permitted within the buffer until it can be demonstrated that the roost/nest is no longer occupied.
- An Environmental Clerk of Works (ECoW) and Project Ecologist will be appointed. Duties will include:
 - o Organise the undertaking of a pre-construction walkover bird survey by a suitably qualified ornithologist to ensure that significant effects on birds will be avoided.
 - o Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Wind Farm.
 - o Oversee management of ornithological issues during the construction period and advise on ornithological issues as they arise.
 - o Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.
 - o Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress as necessary.

Case Law c-392/96. COMMISSION V IRELAND JUDGMENT OF THE COURT (Fifth Chamber) 21 September 1999

As regards projects for the use of uncultivated land or semi-natural areas for intensive agricultural purposes, covered by point 1(b) of Annex II to the Directive, the Commission challenges the threshold of 100 ha set by Article 24 of S.I. No 349 of 1989 and paragraph 1(a) of Part II of the First Schedule thereto, in conjunction with other provisions of the Irish legislation transposing the Directive. It states that 60 000 ha of semi-natural terrain in the west of Ireland have come to be used for intensive sheep farming and are suffering from serious degradation. The increase in sheep numbers should, in its view, have been the subject of an impact assessment, in which the intensity of use could have been determined by reference to a criterion of stocking density per hectare. Furthermore, 'project' is defined broadly in the Directive and also covers an 'intervention' relating to open land such as sheep grazing. Projects of that type have significant environmental effects in that they involve an alteration in uncultivated land or semi-natural areas through overgrazing which leads to soil degradation and erosion.

The Commission alleges that Ireland has transposed Article 4(2) of the Directive incorrectly by setting absolute thresholds for the classes of projects covered by points 1(b) (use of uncultivated land or semi-natural areas for intensive agricultural purposes), 1(d) (initial afforestation/land reclamation) and 2(a) (extraction of peat) of Annex II to the Directive. The absolute nature of the thresholds means that it is not possible to ensure that every project likely to have significant effects on the environment is subject to an impact assessment, because the mere fact that a project does not reach the threshold is sufficient for it not to be subjected to such assessment, regardless of its other characteristics. Under Article 4(2) of the Directive, however, account must be taken of all the characteristics of a project, not the single factor of size or capacity. Furthermore, Article 2(1) refers also to a project's nature and location as criteria for assessing whether it is likely to have significant environmental effects. The Commission considers that this analysis is consistent with the judgments of the Court in Case C-133/94 Commission v Belgium [1996] ECR I-2323 and in Case C-72/95. Kraaijeveld and Others v Gedeputeerde Staten van Zuid-Holland [1996] ECR I-5403.

According to the Commission, projects which do not exceed the thresholds set may none the less have significant environmental effects.

Two factors are important in that regard.

The first factor is that certain sites which are particularly sensitive or valuable may be damaged by projects which do not exceed the thresholds set. That is the case with areas identified as valuable and important for nature conservation and areas of particular archaeological or geomorphological interest.

The second factor is that the legislation fails to take account of the cumulative effect of projects. A number of separate projects, which individually do not exceed the threshold set and therefore do not require an impact assessment may, taken together, have significant environmental effects.

As regards projects for the use of uncultivated land or semi-natural areas for intensive agricultural purposes, covered by point 1(b) of Annex II to the Directive, the Commission challenges the threshold of 100 ha set by Article 24 of S.I. No 349 of 1989 and paragraph 1(a) of Part II of the First Schedule thereto, in conjunction with other provisions of the Irish legislation transposing the Directive. It states that 60 000 ha of semi-natural terrain in the west of Ireland have come to be used for intensive sheep farming and are suffering from serious degradation. The increase in sheep numbers should, in its view, have been the subject of an impact assessment, in which the intensity of use could have been determined by reference to a criterion of stocking density per hectare. Furthermore, 'project' is defined broadly in the Directive and also covers an 'intervention' relating to open land such as sheep grazing. Projects of that type have significant environmental effects in that they involve an alteration in uncultivated land or semi-natural areas through overgrazing which leads to soil degradation and erosion.

The Commission cites, by way of example, the afforestation carried out at Dunragh Loughs and Pettigo Plateau which was brought to its attention by Complaint No P 95/4724. Those sites are included in the list of Natural Heritage Areas (hereinafter 'NHAs') drawn up by the Irish authorities. Pettigo Plateau, in particular, is a vast intact blanket bog (approximately 2 097 ha) of great scientific interest and is one of the sites covered by the contract entered into on 28 December 1995 between the Commission and the National Parks and Wildlife Service pursuant to Council Regulation (EEC) No 1973/92 of 21 May 1992 establishing a financial instrument for the environment (LIFE) (OJ 1992 L 206, p. 1). Part of the plateau (619.2 ha) has been classified as a special protection area under Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (OJ 1979 L 103, p. 1). It is also a cross-border site in that the plateau extends into County Fermanagh in the United Kingdom, which proposes to classify the portion of the plateau in its territory as a special protection area under Directive 79/409 and as a special area of conservation under Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ 1992 L 206, p. 7). There is a risk that the part of the plateau in the United Kingdom will be subjected to the significant effects of the afforestation projects on the environment, since planting is liable to affect adversely the hydrology of the peatlands on both sides of the border.

2.2

In relation to methodology and cumulative impacts, the Department of Housing, Local Government and Heritage outlines the EIAR and NIS both use arbitrary reference areas for assessing the potential in combination/cumulative effects of collision mortality impacts. It is outlined for example, when considering the potential for the in-combination effects of collision mortality on SCI's of the SPA, such as the Black-headed Gull, arbitrary buffers of 5km and 25km around the proposed development are referenced, and it is recommended that any wind farm with potential connectivity to the Lough Corrib SPA that has similar such impacts should be considered, should they occur, and these may occur at distances much greater than 5km/25km from the proposed development given the size of Lough Corrib SPA. It is outlined if such developments do not occur or occur but do not result in the mortality of the same qualifying interest species, this should be made clear. The Department also recommends that when considering in-combination effects of other wind farms with connectivity to the same SPA the EIAR and NIS should make reference to any relevant figures in the relevant reports for any such developments and not just their conclusions. It is stated for example if it is established that another wind farm has connectivity with the SPA and it was predicted that this wind farm would have collision mortality impacts on, for example Black-headed Gulls, the predicted number of this collision mortality should be referenced and not just the conclusion. The combined figure should then be interpreted in relation to the population of the relevant SPA. While the details set out in your response to the submissions are noted, having regard to the observations of the Department Of Housing, Local Government and Heritage, to enable for a comprehensive cumulative and in combination assessment of collision risk impacts, details should be outlined for collision risk impacts for all relevant bird species in the county and SPA population, taking into account appropriate buffer distances and other wind farms, with reference also to be made to relevant figures from other wind farm reports, as per the Departments observation.

Section 7.9.2 of the Report details further information relating to the Assessment of Cumulative Effects on key ornithological receptor species including golden plover, black-headed gull, kestrel, lapwing, snipe and hen harrier. Section 7.9.2 of the revised NIS details further information relating to the Assessment of Cumulative Effects on key ornithological receptor species including golden plover, black-headed gull, kestrel, lapwing, snipe and hen harrier.

7.9.2 Assessment of Cumulative Effects – Proposed Wind Farm

Golden Plover Cumulative Collision Risk Effects

To undertake the requested cumulative assessment of collision risk for golden plover from the Lough Corrib SPA it was first necessary to identify where the SCI species is likely to encounter turbines. As outlined in the SPA Conservation Objectives the golden plover from the site forage in terrestrial habitats. During the winter season, foraging birds can travel 12km (Gillings and Fuller, 1999). Therefore, turbines that occur in suitable terrestrial habitats within the foraging range are most likely to be encountered. While the Department criticise the use of arbitrary reference areas, such as a 25km radius of the proposed turbines as per Section 7.9.1.2 of the EIAR, to evaluate impacts on SPA qualifying species like the golden plover, this 25km radius of the proposed turbines overlaps with the majority of the suitable terrestrial habitat within the foraging range of the SPA. Notwithstanding this, as it was requested, a review of wind farms within 12km of the SPA was undertaken. As previously outlined, there is abundant suitable habitat (e.g. agricultural grassland) throughout Galway, particularly to the east of Lough Corrib. And within this habitat, as outlined in Figure 4 below, there is a very low density of turbines. This area included two single turbines (Montiagh and Summerfield) at the southern end of Lough Corrib and the proposed Shancloon Wind Farm (Pre-Planning Stage- ABP Ref ABP 317307). Shancloon Wind Farm is approximately 12km from the Lough Corrib SPA. At such low densities of turbines, significant rates of collisions are unlikely. The rationale for this assessment is as follows.

- The two single turbines are not located particularly close to Lough Corrib, owing to their scale and distance from the SPA, impacts are predicted to be effectively zero.
- There are no reports yet on the proposed Shancloon Wind Farm planning file and as it is c.12km from the Lough Corrib SPA at the outer edge of sites with potential connectivity to the SPA. If it is very conservatively assumed (for the purposes of the cumulative assessment) that there is a similar rate of collisions at that wind farm as the Proposed Wind Farm (i.e. as per revised CRM- EIAR Addendum Appendix 7-5a: 3.049 collisions annually) predicted impacts would remain negligible. That is, if the rates of collisions were 3.049 and 3.049

respectively for each development per year it would mean that the combined losses would increase the annual mortality of the county population (c.4,423) by 0.51%. The predicted collision risk is negligible as per Percival (2003) criteria. As only a portion of the predicted collisions are likely to be associated with the SPA population, no adverse effects are predicted.

- While the 1% increase in background mortality referenced in Percival (2003) is often set as the threshold for judging significance, it is likely quite conservative. The threshold likely originates from a hunting threshold set by the European Commission (and referenced in EC, 2008)³⁶ and was not intended to indicate that all increases in mortality above 1% were significant. Among other reasons, the threshold was set at 1% by the European Commission because such losses are so low that they are within the margin of error from a mathematical point of view in population dynamics modelling studies. This context further limits the potential for significant cumulative collision risk effects to result or adverse effects on the SPA population of golden plover. The origin of the 1% threshold is summarised above and discussed at length in the recently permitted Castlebanny Wind Farm EIAR³⁷.

We have dealt with the Percival 2003 data previously showing its irrelevancy to 2026 infrastructure.

The west side of Lough Corrib has a much higher density of turbines than the east. As provided in Figure 3 above, these turbines are concentrated in the forestry and blanket bog to the west of Oughterard, Co. Galway. These wind farms are within the potential foraging range (c.12km) of the Lough Corrib SPA and include Knockranny Wind Farm (Permitted), Lettergunnet Wind Farm, Letterpeak Wind Farm, Knockalough Wind Farm, Ardderroo Wind Farm and the Galway Wind Park. As outlined in EIAR Section 7.9.1.2.2, Knockranny Wind Farm, Ardderroo Wind Farm, Lettergunnet Wind Farm and Letterpeak Wind Farm identified golden plover as key ornithological receptors. Their EIS/EIARs include the following information:

- The Ardderroo Wind Farm (ABP Ref. 303086) is sited in a conifer plantation with very little suitable open habitat for golden plover. In two years of vantage point surveying golden plover were recorded on five occasions, although no flights were onsite. Collision risk was assessed to be effectively zero.
- On Knockranny Wind Farm (PI Ref.13/829, Alterations proposed under PI Ref. 23/225) golden plover were recorded during surveys however the potential for collisions was considered to be low.
- On Lettergunnet and Letterpeak Wind Farms (LGLP) (PI ref. 10/1214 & 0/1225) Wind Farm only small numbers of wintering golden plover were recorded. No significant collision risk was predicted.

There are no other wind farms with the potential to significantly impact this species within 12km of the SPA.

As these wind farms do not occur in habitats that are likely to be visited by this species in large numbers or with any regularity, (e.g. they are not agricultural grassland) no significant collision risk is predicted. Collision rates are likely to be so low for this species on these sites as to be effectively zero.

In summary, following a review of wind farms within 12km of the Lough Corrib SPA the above findings serves to further corroborate the finding of no significant cumulative collision risk effects for golden plover as provided in the EIAR as lodged (Section 7.9.2.1 of the EIAR) and as per the NIS no adverse effect for the golden plover of the Lough Corrib SPA.

Cumulative Assessment of Red Listed Species

It was requested that there be a quantification of cumulative impacts on red-listed bird species using the land of the Proposed Wind Farm site over the decades. Red-listed species are those species of the highest conservation concern in Ireland due to their declining populations. This information is reported in Gilbert, G., Stanbury, A. and Lewis, A. (2021). Birds of Conservation Concern in Ireland 4: 2020-2026. Irish Birds, 43:1-2238.

The following red-listed key ornithological species were recorded to use the Proposed Wind Farm site: golden plover, black-headed gull, kestrel, lapwing and snipe. As the same information was requested for hen harrier it is also included in this response text.

As outlined in Section 7.5.2 of the EIAR, the land lost to the development footprint is small (i.e. 13.8ha or 1.46% of Site area) relative to the total area within the Site. Habitat loss impacts can extend beyond the development footprint through disturbance and displacement. The area of disturbance/displacement is potentially avoided to a distance

equal to or less than 500m (Pearce-Higgins et al. 2009), depending on the species. And to a distance of between 250-750m for hen harrier (Pearce-Higgins et al. 2009, Ruddick and Whitfield 2007). The area within 250m, 500m and 750m of the turbines is 156ha, 506ha and 855ha, respectively. Notwithstanding this, in order for there to be a significant habitat loss effect, there needs to be the loss of a scarce resource either on an individual project basis or cumulatively. In the present case, this is not the situation.

The Proposed Wind Farm site is dominated by improved agricultural grassland. As outlined in Section 6.4.1.1.1 of the EIA, all turbines (T1- T8), the temporary construction compound, substation, met mast and all internal site access tracks are located within improved agricultural grassland. These are species-poor grassland communities with relatively little recognised conservation value. It is not anticipated that there would be a land use change over the decades of the lifetime of the Proposed Wind Farm, i.e. the land would continue to be managed as improved agricultural grassland in the presence or absence of the Proposed Wind Farm. Improved agricultural grassland is one of the most abundant habitat types at a county and national level. Particularly so to the east of Lough Corrib. This abundance severely limits the potential for ecologically significant habitat loss effects to result on an individual project basis or cumulatively. Furthermore, not only the quantity of the habitat but also the quality is important. Improved agricultural grassland is typically considered of low ecological value. As previously stated, there is little conservation value within the areas of improved agricultural grassland.

In summary, it is proposed to construct a wind farm including all turbines (T1- T8), the temporary construction compound, substation, met mast, all internal site access tracks within improved agricultural grassland, which is a habitat of little ecological value and among the most abundant habitat types in Ireland. These specifics of the Proposed Wind Farm site and wider context severely limit the potential for ecologically significant effects to result on an individual project basis or cumulatively. As such, no significant cumulative effects are predicted for any key ornithological receptor species, including golden plover, black-headed gull, kestrel, lapwing and snipe, or hen harrier. The above quantification of habitat loss, discussion of quality of habitats and wider context serve to further corroborate the finding of no significant cumulative effects for golden plover, black-headed gull, kestrel, lapwing, snipe and hen harrier as provided in the EIA as submitted (Section 7.9.2 of the EIA).

2.3

Please outline the cumulative impact on red list species including Hen Harrier, Kestrels and other species using the site of the anthropocentric change of use of the lands over the decades, and this should be quantified.

Section 7.9.2 of the Report details further information relating to the Assessment of Cumulative Effects on key ornithological receptor species including golden plover, black-headed gull, kestrel, lapwing, snipe and hen harrier.

It is noted that during the operational phase of the proposed development, it is reported that Kestrel is a species at risk from mortality-related effects with a reported worst-case scenario fatality of one collision every 13.08 to 17.04 years for breeding season, and every 14.45 to 18.82 years for winter season (depending upon technology option), which is within the proposed operational lifetime of the project. In view of the foregoing and given that Kestrel is reported as a Red-List bird species of County Importance, further explanation was required of the rationale for the conclusion under EIAR that Kestrel collision mortality impact represents a potential slight effect, and that predicted collision risk is low.

2.4

Please clarify if the existing kestrels and their nesting within an observer's lands (E, A, D, and M. Jennings), have been included in the surveys and assessments carried out. These should be revised, if/where applicable.

Section 7.5.2.10 of the EIR provides clarification on the inclusion of a kestrel nest site on an observer's land in surveys and the associated impact assessment.

7.5.2.10 Kestrel (All seasons)

Kestrel Nest Site

Clarity was sought as to whether or not a kestrel nest site on an observer's land was included in surveys and the associated impact assessment.

In short, yes this breeding territory was identified during surveys as outlined in EIR Appendix 7-5 and again in 2024 during the more recent surveys³⁵ (please see Appendix 7-5a for details). The observer's land is within the viewshed of Vantage Point 2 (please see EIR Figure 7-1 for location details). In both cases, it is the more northern territory mapped that overlaps, approximately, with the observer's land. As outlined in Section 7.5.2.10 of the EIR, the identified breeding territories were taken into consideration in the associated impact assessment. In summary, no significant habitat loss, disturbance, displacement or collision risk effects were predicted. Please see Section 7.5.2.10 of the EIR for further details.

2.5

Please clarify the location of information in Appendices 6-5 and 7-5.

Appendix 6-5 and Appendix 7-5 were both submitted with the Planning Application as printed copies in March 2024. These appendices contain sensitive information relating to breeding, roosting and/or resting places of protected species, which could increase the risk of persecution and/or disturbance if locations are made publicly available. For this reason, the appendices were included in the application as printed copies intended to be available upon request but not to be uploaded to the publicly available planning file. However, Appendix 6-5 and 7-5, as submitted, have also been included in this Response to Further Information for clarity as appendices 6-5a and 7-5a to the Report.

2.6

The NIS outlines that for collision risk estimates for Common Gull (Wintering), that due to the increased population sizes of the species during winter, the collision risk analysis will be inflated relative to potential impacts on the breeding population which is a designated SCI of the SPA. A collision risk analysis has not been identified for the Common Gull breeding population in tables, this statement should be clarified with details to be outlined in tables, where relevant.

Section 7.3.8 of the EIAR provides details on the comprehensive suite of surveys that occurred for the Site. Common gull were effectively absent from the Site during the breeding season. In four years of vantage point surveying, a single bird on a single occasion was recorded during the breeding season Section 7.5.2.7 of the Report details the collision risk effects on breeding common gull, which are SCI species of the Lough Corrib SPA. This is addressed for both the breeding and non-breeding seasons.

no section 7.3.8

7.5.2.7 Common Gull (Winter)

Potential effects during the construction and operational phases of the Proposed Wind Farm		Significance (Percival, 2003)	Significance (EPA, 2022)
Construction Phase			
Direct Habitat Loss	<p>Common gull were observed within, or partially within, the Proposed Wind Farm Site on three occasions during winter seasons and numbers ranged from 40 no. to 250 no. birds.</p> <p>Common gull were only observed commuting over the Proposed Wind Farm. There were no observations of this species utilising habitats within the Proposed Wind Farm for roosting or foraging.</p> <p>The land lost to the development footprint is small (i.e. 13.8ha/1.46% of Proposed Project) relative to the total area within the Site. Significant areas of suitable roosting and foraging habitat for the species occur in the wider landscape and will be retained.</p> <p>No significant effects of direct habitat loss are anticipated.</p>	<p>The magnitude of the effect is assessed as <i>Negligible</i>. The cross tabulation of a <i>Low</i> sensitivity species and <i>Negligible</i> impact corresponds to a Very Low effect significance.</p>	<p>Likely Long-term Imperceptible Negative Effect</p>
Disturbance	<p>Common gull were observed within, or partially within, the Proposed Wind Farm on three occasions during winter seasons and numbers ranged from 40 no. to 250 no. birds.</p> <p>This species was not recorded utilising habitats within the Site for roosting or foraging. Significant areas of suitable roosting and foraging habitat for the species occur in the wider landscape and will not be subject to construction disturbance. In the event of disturbance, there are extensive areas of similar habitat in the wider area. This would likely render such an effect inconsequential.</p> <p>No significant effects of disturbance are anticipated.</p>	<p>The magnitude of the effect is assessed as <i>Negligible</i>. The cross tabulation of a <i>Low</i> sensitivity species and <i>Negligible</i> impact corresponds to a Very Low effect significance.</p>	<p>Likely Short-term Imperceptible Negative Effect</p>

Operational Phase			
Direct Habitat Loss	Direct effects are not anticipated as no additional infrastructure is proposed.	No Effect	No Effect
Displacement and Barrier Effect	<p>Common gull were observed within, or partially within, the Proposed Wind Farm on three occasions during winter and numbers ranged from 40 no. to 250 no. birds.</p> <p>This species was not recorded utilising habitats within the EIAR Site Boundary for roosting or foraging. Significant areas of suitable roosting and foraging habitat for the species occur in the wider landscape and will be retained. In the event of disturbance, there are extensive areas of similar habitat in the wider area. This would likely render such an effect inconsequential.</p> <p>There is no evidence to suggest that the Proposed Wind Farm lies on a migratory/ regular commuting route for this species, therefore barrier effect is not anticipated.</p> <p>No significant effects of displacement are anticipated.</p>	<p>The magnitude of the effect is assessed as <i>Negligible</i>. The cross tabulation of a <i>Low</i> sensitivity species and <i>Negligible</i> impact corresponds to a Very Low effect significance.</p> <p>No significant effects of displacement are anticipated.</p>	Likely Long-term Imperceptible Negative Effect
Collision Risk	<p>The species was recorded flying within PCH during vantage point surveys. A "Random" collision risk analysis has been undertaken (full details provided in Appendix 7-6). The collision risk has been calculated at a rate of 5.8 collisions per year, or less than one bird per year. To account for the potential for the nocturnal flight activity of water birds, it has been assumed in the collision risk analysis that this species was active for a quarter of night (full details provided in Appendix 7-6).</p> <p>Annual mortality of adult common gull has been calculated at 14% per annum (Bukaciński and Bukacińska, 2003). If 5.8 collisions were to occur per year, it would mean that the losses at the Proposed Wind Farm would increase the</p>	<p>The magnitude of the effect is assessed as <i>Low</i>. The cross tabulation of a <i>Low</i> sensitivity species and <i>Low</i> impact corresponds to a Very Low effect significance.</p>	Likely Long-Term Constant Slight Negative Effect

2.7

The revised NIS should clarify the potential for the proposed development to give rise to displacement or barrier effects on Common Gull (Breeding). Mitigation should be set out, if/where applicable.

Given that no common gull were recorded using the Proposed Project site within breeding season during the ornithological surveys undertaken, it is evident that the breeding population of the SCI species is not using the Site and that there is no potential for adverse effect to the species via displacement or barrier effects. No mitigation is necessary. This is now reflected in Section 6.2.1.2.5 of the revised NIS.

6.2.1.2.5 Common Gull (Breeding)

As evidenced by a comprehensive suite of surveys, common gull were effectively absent from the Proposed Wind Farm site during the breeding season. In four years of vantage point surveying, a single bird on a single occasion was recorded during the breeding season. Owing to this extremely low rate of occurrence within the Proposed Wind Farm site, it is concluded that the breeding population of the SCI species is not using the Proposed Wind Farm site and that there is no potential for adverse effect to the species via habitat loss, displacement, barrier effects or disturbance.

The revised NIS should include an assessment of SCI “Wetlands and Waterbirds” A999 including in section 5.1.2.3.14.

The potential for the Proposed Project to adversely affect this SCI supporting habitat has been fully assessed in the NIS as submitted. A potential pathway for impact was identified via water quality deterioration of SCI supporting habitat as a result of the Proposed Project. A range of mitigation measures are prescribed in the submitted NIS to block the pathway. However, the revised NIS has been updated in Section 5.1.2.3.14 to include an assessment of the impact of the Project on the individual Targets and Attributes associated with the SCI supporting A999 habitat. Mitigation is provided in Section 6.2.2 of the revised NIS to block the identified pathway for impact on this SCI habitat via water quality deterioration. With the mitigation in place, it is concluded that there is no potential for adverse effect on ‘Wetlands and Waterbirds (A999)’ of Lough Corrib SPA.

5.1.2.3.14 Wetlands [A999] Lough Corrib is a site of international importance for wintering waterfowl. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest. Potential indirect effects on the supporting wetland habitat of waterbirds within the SPA in the form of degradation of water quality was identified. The SPA is located approx. 32km downstream of the Proposed Grid Connection underground cabling route via the Clare River.

The following relevant information has been extracted from the NPWS site synopsis and Natura 2000 Data Form for the SPA:

- *‘The Site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Greenland White-fronted Goose, Gadwall, Shoveler, Pochard, Tufted Duck, Common Scoter, Hen Harrier, Coot, Golden Plover, Black-headed Gull, Common Gull, Common Tern and Arctic Tern. The Site is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds. The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the Site and its associated waterbirds are of special conservation interest for Wetlands & Waterbirds.*
- *Lough Corrib SPA is an internationally important site which supports in excess of 20,000 wintering waterbirds, including a population of Pochard that is, itself, of international importance. A further six species of wintering waterfowl have populations of national importance. The Site also contains a nationally important communal roost site for Hen Harrier. Lough Corrib is the most important site in the country for breeding Common Scoter. Its populations of breeding gulls and terns are also notable, with nationally important numbers of Black-headed Gull, Common Gull, Common Tern and Arctic Tern occurring. It is of note that several species which regularly occur are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Greenland White-fronted Goose, Hen Harrier, Golden Plover, Common Tern and Arctic Tern. Lough Corrib is a Ramsar Convention site.’*

Targets and Attributes The Conservation Objective for the habitat is ‘To maintain the favourable conservation condition of wetlands in Lough Corrib SPA’.

It is considered that there is a potential to undermine the target (see Table 5-30 below) associated with ‘wetland habitat quality and functioning’, as a result of deterioration in water quality due to silt-laden run-off and other pollutants.

There is no potential to undermine the target related to ‘wetland habitat area’, given that the Proposed Project is completed outside of the SPA and there will be no loss of wetland habitat area as a result.

Attribute	Target
Wetland habitat area	No significant loss to wetland habitat within the SPA, other than that occurring from natural patterns of variation
Wetland habitat quality and functioning	No significant impact on the quality or functioning of the wetland habitat within the SPA, other than that occurring from natural patterns of variation

6.2.2 Hydrological Impacts

6.2.2.1 Construction

6.2.2.1.1 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Drainage Recharge

Construction phase activities that will require earthworks resulting in the removal of vegetation cover and excavation of mineral subsoil (where present), and bedrock in certain areas, may result in the following potential sources of sediment laden water:

- Drainage and seepage water resulting from infrastructure excavations;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the Proposed Grid Connection underground cabling trench including small amounts of peat soils, resulting in entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels (although these are limited in scale and channel length).

Proposed Wind Farm:

These activities can result in the generation of suspended solids in drainage water, and as there are no drainage outlets (other than recharge to ground) across the Site, there is a risk that sediment laden recharge water can enter the underlying aquifer. To reiterate, there are no recorded surface water features within the Proposed Wind Farm site.

Surface water runoff that will occur at site infrastructure will be recharged locally into subsoils. This recharge water will occur close to source and can migrate vertically to groundwater below the Site. The potential impacts on groundwater quality are assessed separately below in Section

2.9

Table 8-1 Wind farm projects within 25km of the Proposed Project should be revised to detail turbine dimensions.

Section 8.1.3 Table 8-1 of the revised NIS has now been updated to include turbine dimensions of other wind farm projects within 25km of the Proposed Project.

8.1.3 Other Wind Farm Projects

For the purposes of this cumulative assessment, wind farms within a 25-kilometre radius of the Proposed Project area were considered in further detail below. Details of wind farm projects within 25km of the Proposed Project are provided in Appendix 6 and are summarised below. Thirteen wind farms were identified within the cumulative study boundary.

Table 8-1 Wind farm projects within 25k of the Proposed Project

Pl. Ref.	Location and Distance from Proposed Project	Wind Farm	Decision	Status	Turbine No.	Turbine Dimensions
221175	Cloonascragh, Tuam c.7km	Cloonascragh Locally Owned Turbine	Granted by GCC	Permitted	1	Blade tip height 168m Rotor diameter 136m
09/1675	Montiagh South c. 9km	Domestic turbine	Granted by GCC	Existing	1	Blade tip height 15.05m Rotor diameter 5.6m
09/1571	Summerfield c. 10km	Domestic turbine	Granted by GCC	Existing	1	Hub height: 15m Rotor diameter 6m
23/74	Park , Athenry Co. Galway c.17km	Domestic turbine	Granted by GCC	Permitted	1	Blade tip height 27.1m Blade swept diameter: 13.1m
08/2407 ACP Ref. 07.2329 02	Cloonlusk c.9km	Cloonlusk Wind Farm	Granted by ABP	Existing	2	Rotor diameter 82m Hub height 78m

Pl Ref: 091239	Leitir Gungaid & Doire Crith c.22km	Lettergunnet Wind Farm	Granted by GCC	Existing	11 (Increased under Pl. Ref 10/1214)	Tip height 119m Rotor diameter 82m
Pl Ref: 10/1225	Shannagurraun & Truskaunnagappul c.25km	Letterpeak (Shannagurran) Wind Farm	Granted by GCC	Existing	7	Tip height 119m Rotor diameter 82m
Pl Ref: 14/1273	Knockalough, Finisklin & Laughil c. 22km	Knockalough Wind Farm	Granted by GCC	Existing	11	Blade tip height 131m Rotor diameter 101m
Pl Ref: 13/829	Cnoc Raithni (Knockranny) c. 21km	Knockranny Wind Farm	Granted by ABP	Permitted	11	Blade tip height 150m Rotor blade length 69m

ACP Ref: 303086	Ardderroo, Galway c. 23km	Ardderroo Windfarm	Granted by ABP	Permitted	25	Tip height 178.5m Rotor diameter 149m
ACP Ref. 307058	Clonberne c.19km	Clonberne Wind Farm	N/A	Pre-Application Stage	11	Tip height 180m Rotor diameter 162m
ACP Ref. 317307	Shandloon c.10km	Shandloon Wind Farm	N/A	Newspaper notice submitted to ACP 28.08.2025	11	Max blade tip height 180m Rotor diameter 149.1m - 155m
ACP Ref. 316466	Cooloo c.18km	Cooloo Wind Farm	N/A	Pre-Application Stage	9	Max blade tip height 180m Turbine rotor diameter up to 162m

2.10

The NIS should be revised to assess the potential impact of turbine obstacle lighting on the relevant European Sites Special Conservation Interests (SCI's)

As some bird species are known to be attracted to artificial lighting (phototaxis), there is potential for some bird species to be put at increased risk of colliding with a turbine if attracted to artificial lighting on turbines. However, some taxonomic groups (e.g., some burrow nesting seabirds) and nocturnally migratory species (especially passerines) are more attracted to lights than others. None of the SCI species associated with nearby European Sites are within these taxa. As detailed in the NatureScot guidance document: Effects of Aviation Obstruction Lighting on Birds at Wind Turbines, Communication Towers and Other Structures², it is stated that: "It is likely that collision risk at lit turbines for non-passerine taxa are likely to be relatively low in general." This is of note as all of the SCI species recorded on the Proposed Project site are non-passerines. The revised NIS has been updated with an assessment in light of the above in Section 6.2.2.2.3. There is no potential for adverse effect to SCI species of Lough Corrib SPA due to lighting associated with the Proposed Project.

Mitigation

2.11

A number of mitigation measures for key ornithological receptors set out in the EIAR relating to construction timing, the requirement for further surveys for breeding birds, and the fencing off of habitat areas utilised by certain bird species, do not correspond to the mitigation for the same species identified as Special Conservation Interests (SCI's) in the NIS. The revised NIS should include these mitigation measures.

It should be noted that the mitigation measures included in the EIAR are not proposed in order to mitigate any identified significant effect. As stated in Section 7.6.2.1 of Chapter 7 of the EIAR:

“Note that these measures are proposed as industry best practice rather than to mitigate any identified significant effect and will be updated as required to address any conditions of a grant of permission or findings of any pre-construction survey results.” It should also be noted that the assessment undertaken in the NIS of the potential for disturbance, displacement, collision risk and habitat loss effects on each of the SCI populations assessed (i.e Hen Harrier, Golden Plover, Common Gull and Black-headed Gull), did not identify any potential for adverse effect to any SCI population. Similarly, the assessment undertaken in Chapter 7 of the EIAR did not identify any potential for significant impact on these species. Therefore, no mitigation to block any identified pathway for adverse effect on populations of species associated with the SPA is necessary. The best practice measures listed in Section 7.6 of the EIAR are included as industry best practice measures rather than being designed specifically to mitigate any identified impact pathway. Notwithstanding this, they are included within the revised NIS in Section 6.2.1.2.7.

2.12

You are requested to clarify if the correct methodology and matrices needed to inform mitigation, have been carried out in the cumulative impact assessment for the EIAR and NIS. Consideration should be given to this issue, with regard given to C392/96.

The cumulative impact assessment has been undertaken in accordance with Guidelines on the Information to be Contained in Environmental Impact Assessments (EPA 2022) and European Commission (2021) Methodological guidance on Article 6(3) and 6(4) of the Habitats Directive. Consideration has been given to Case Law C-392-96 with further detail provided in Section 6.6 of the Report.

Summary of issues relating to Bats

1. Insects are Attracted to White Wind Turbine Bases
2. Wind turbines displace bats from drinking sites

Item 3. Bats (EIAR & NIS)

3.1

In relation to the biodiversity sections of the EIAR including the survey work undertaken to inform the collision risk assessment for bats, the Bat Report (Appendix 6-2) outlines the calculated activity thresholds were adapted. Please clarify if the bat collision risk analysis was undertaken based on Table 3-6 or 3-7 of the Bat Report. Collision risk analysis should be based on worst case scenarios and the collision risk calculations should be revised, if/where applicable.

As discussed in Section 3.5 of Appendix 6-2 Bat Report of the EIAR, the calculated activity thresholds shown in Table 3-6 of the Bat Report were considerably high for all species surveyed, which would result in bat activity appearing to be low across the site. To provide a more precautionary and representative assessment of bat activity in agricultural grassland habitats, the thresholds were adjusted based on MKO's experience with similar habitat types. The thresholds presented in Table 3-7 have been deliberately reduced to reflect a worst-case scenario, ensuring a conservative approach to assessing potential impacts. Consequently, the bat collision risk analysis was undertaken based on Table 3-7.

6.5.3.2 Effects on Fauna During Operation

6.5.3.2.2 Impacts on Other Fauna Species

The EIAR identified the following faunal species as Key Ecological Receptors (KERs) in the context of the Proposed Project and carried out a full impact assessment and applied mitigation where required: badger, otter, and bats.

As discussed in Section 6.4.3 of the submitted EIAR, the potential for the Proposed Project to result in impacts on other protected fauna, besides those recorded within the Proposed Project site during ecological surveys undertaken, and other species identified as being KERs, has been considered. As stated in the EIAR (Table 6-14),

The recorded evidence suggests that the Proposed Project site is not utilised by populations of higher than local significance and no potential for significant effects have been identified at the population level. Due to the small footprint and nature of the Proposed Project, they are unlikely to be significantly affected by the Proposed Project. For this reason, other faunal species are not considered further in this EIAR. Significant effects are not anticipated.

This is based on the ecological faunal surveys carried out by MKO at the Site, which did not identify a population of the listed species of more significance than at the local level. While it is possible that pine martin, shrews, dormouse, hedgehog, butterfly species and other insects, snails and worms, as well as a range of bird species, are either known to occur at the Site or are likely to occur at the Site, it is concluded that there is no potential for significant effect on these species. Habitat loss associated with the Proposed Project, which will have a relatively small footprint in the context of the wider landscape, will be restricted to species poor agricultural grasslands with some hedgerow loss. Given the proposed Biodiversity Management and Enhancement Plan (BMEP) in place, which will provide a 100% net gain of native hedgerow, and the creation of species rich calcareous grasslands which will provide increased, linked-up areas of foraging for fauna, there is no potential for significant effects on the listed species as a result of the Proposed Project

6.3 Residual Impacts

Not Significant Effect

Taking into consideration the sensitive design of the project, the proposed best practice and adaptive mitigation measures; significant residual effects on bats with regard to 1) Collision mortality, barotrauma and other injuries, 2) Loss or damage to commuting and foraging habitat, 3) Loss of, or damage to, roosts and 4) Displacement of individuals or populations are not anticipated.

6.4 Cumulative Effects

The Proposed Project was considered in combination with other projects and/or plans (existing approved and pending decision), in the surrounding area that could result in cumulative impacts on bats. This included a review of online Planning Registers and served to identify past, present and future plans and projects, their activities and their predicted environmental effects. The projects and/or plans considered are detailed in Section 2.8 in Chapter 2 of the EIA.

Following the detailed assessment provided in the preceding sections, it is concluded that, the Proposed Project will not result in any residual adverse effects on bats, when considered on its own. There are no other wind farm sites located within 5km of the Proposed Wind Farm site; however, three existing, permitted or proposed wind farm sites are located within 10km of the Proposed Project. There are four further EIA projects and three extractive industries within 10km. No potential for the Proposed Project to contribute to any cumulative adverse effects on any bat populations is anticipated when considered in-combination with other plans and projects.

In the review of the projects that was undertaken, no connection, that could potentially result in additional or cumulative impacts was identified. Neither was any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the Proposed Project. Taking into consideration the reported residual impacts from other plans and projects in the area and the predicted impacts with the Proposed Project, no residual cumulative impacts have been identified regarding bats.

As discussed above, the footprint of the Proposed Project has been designed through an iterative process to avoid high value and species rich habitats and key infrastructure is restricted to species poor agricultural grassland. The areas of highest value for fauna have also been avoided. It is concluded that there is no potential for likely significant impact to fauna as a result of wake effects.

No scientific evidence provided for conclusion that there is no potential for likely significant impact to fauna as a result of wake effects.

6.5.3.2.1 Assessment of Potential Effects on Bats during operation

Table 6-22 Assessment of Potential Effects on Bats

Description of Effect	<p>There is no potential for loss or fragmentation of foraging or roosting habitat for bat species during the operational phase of the Proposed Project as there will be no additional loss of any habitats following construction.</p> <p>The bat survey report that is provided in Appendix 6.2, found bat species composition and abundance to be typical of the geographic location and largely open nature of the Site.</p> <p>As per NatureScot Guidance, the operational phase of wind farms presents the following risk which is assessed in this section:</p> <ul style="list-style-type: none"> > Collision mortality, barotrauma and other injuries; (Operational Phase Impact) <p>The following high-risk species were recorded during the dedicated surveys:</p> <ul style="list-style-type: none"> > Leisler's bat, > Common pipistrelle, > Soprano pipistrelle, > Nathusius' pipistrelle. <p>Overall Risk for the above listed species was determined, in accordance with Table 3b of NatureScot guidance, by a cross-tabulation of the Site risk level (i.e. Low) bat activity outputs for each species. The assessment was carried out for both median and maximum activity categories in order to provide insight into typical bat activity (i.e. median values) and activity peaks (i.e. maximum values). NatureScot recommends that that most appropriate activity level (i.e. median or maximum) be utilised to determine the overall risk assessment for a species. As</p>
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	<p>per NatureScot guidance there is no requirement to complete an Overall Risk Assessment for low-risk species.</p> <p>During the extensive suite of surveys undertaken the following low risk species were recorded:</p> <ul style="list-style-type: none"> ➤ Myotis spp., ➤ Brown long-eared bat, ➤ Lesser horseshoe bat. <p>Overall activity levels were low for the above species therefore no significant collision related effects are anticipated.</p> <p>There is also potential for disturbance related effects associated with operational phase lighting within the Proposed Wind Farm which is considered below.</p>
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<p>Characterisation of unmitigated effect</p>	<p>A summary of the results of the collision risk assessment contained in the Bat Report, Appendix 6-2, is provided here.</p> <ul style="list-style-type: none"> ➤ There is <i>Medium</i> collision risk level assigned to the local population of Leisler's Bat in Summer and <i>Low</i> collision risk level in Spring and Autumn. ➤ There is <i>Low</i> collision risk level assigned to the local population of Soprano pipistrelle bat in Spring, Summer and Autumn. ➤ There is <i>Medium</i> collision risk level assigned to the local population of common pipistrelle in Summer and <i>Low</i> in Spring and Autumn. ➤ There is <i>Low</i> collision risk level assigned to the local population of nathusius' pipistrelle bat. <p>Site-level collision risk for high collision risk bat species was typically <i>Low</i> to <i>Medium</i>, with the exception of Nathusius' pipistrelle and Soprano pipistrelle which had a <i>Low</i> risk level. Overall bat activity levels were typical of the nature of the Site, which is predominantly open grassland habitats with low levels of bat activity recorded during the static detector surveys as well as the walked and driven transects undertaken.</p> <p>However, following per detector R-analysis, Detectors D07 and D08 recorded <i>High</i> median activity levels of high-risk species in spring and summer.</p>
<p>Assessment of Significance prior to mitigation</p>	<p>Following the precautionary principle, there is potential for the operation of the Proposed Wind Farm to result in significant effects on the local bat population.</p>

<p>Mitigation</p>	<p>While <i>High</i> median activity was recorded at two locations, it is noted that habitats at these locations will change during the construction phase of the Proposed Wind Farm with the required implementation of the bat buffers. A monitoring and mitigation strategy has been devised for the Proposed Wind Farm, in line with the case study example provided in Appendix 5 of the NatureScot 2021 Guidance and based on the site-specific data. After year 1 monitoring, if a curtailment requirement is identified (i.e. significant bat fatalities encountered), a curtailment programme, in line with relevant guidelines, will be devised around key activity periods and weather parameters, as well as a potential increase in buffers.</p> <p>Bat Vegetation buffer</p>
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In accordance with NatureScot and NIEA Guidance, a minimum 50m buffer to all habitat features used by bats (e.g., hedgerows, tree lines etc.) should be applied to the siting of all wind turbines. However, Eurobats No. 6 guidance and NIEA recommends increased buffers of 100m and 200m around woodland/forestry areas, however, there is no scientific evidence to support these increased buffer distances in the UK.

NatureScot recommends that a distance of 50m between turbine blade tip and nearest woodland (or other key habitat features) is adequate mitigation. This 50m buffer will be implemented from the outset and monitored as per the post-construction monitoring. The success of the buffer mitigation will be assessed as part of post construction monitoring and updated where necessary. The formula provided in Section 6.1.3 of the Bat Report (Appendix 6-2) is presented to provide appropriate mitigation in relation to bats, and the relevant input required from turbine parameters, is the combination of the blade length and hub height. The turbine model to be installed on the Site will have an overall ground-to-blade tip height of 185m, rotor diameter of 163m, and hub height of 103.5m. The minimum bat buffer required for the Site is therefore 87.12m from the centre of the turbine.

This mitigation measure has been applied and no woodland felling is required within the Site. There will be a requirement to remove some linear vegetation i.e. treelines/hedgerows, to facilitate the required bat buffers. These vegetation-free areas will be maintained during the operational life of the Proposed Wind Farm.

Blade feathering

NIEA Guidelines also recommend that, in addition to buffers applied to habitat features, all wind turbines are subject to 'feathering' of turbine blades when wind speeds are below the cut-in speed of the proposed turbine. This means that the turbine blades are pitched at 90 degrees or parallel to the wind to reduce their rotation speed to below two revolutions per minute while idling. This measure has been shown to significantly reduce bat fatalities (by up to 50%) in some studies (NIEA, 2021).

In accordance with NIEA Guidelines, blade feathering will be implemented as a standard across all proposed turbines when wind speeds are below the cut-in speed of the turbine.

Operational monitoring

To assess the effects of the Proposed Wind Farm on bat activity, at least 3 years of post-construction monitoring is proposed. Post-construction monitoring will include static detector surveys, walked survey transects and corpse searching to record any bat fatalities resulting from collision.

The results of post-construction monitoring shall be utilised to assess any potential changes in bat activity patterns and to monitor the implementation of the mitigation strategy. At the end of Year 1, and if a curtailment requirement is identified (i.e. significant bat fatalities encountered), a curtailment programme, in line with relevant guidelines, will be devised around key activity periods and weather parameters, as well as a potential increase in buffers.

	<p>At the end of each year, the efficacy of the mitigation and monitoring plan will be reviewed, and any identified efficiencies incorporated into the programme. This approach allows for an evidence-based review of the potential for bat fatalities at the Site, post construction, to ensure that the necessary measures, based on a new baseline post-construction, are implemented for the protection of bat species locally. The effectiveness of any mitigation/curtailment needs to be monitored in order to determine (a) whether it is working effectively (i.e. the level of bat mortality is incidental), and (b) whether the curtailment regime can be refined such that turbine down-time can be minimised whilst ensuring that it remains effective at preventing casualties.</p> <p>Section 6.21 of the Bat Report (Appendix 2) provides detail with regard to the monitoring to be carried out in years 1,2 and 3 and includes bat activity surveys and carcass searches.</p> <p>Lighting</p> <p>With regard to the potential for lighting to increase collision risk, it is noted that there will be limited illumination of the turbines in the form of aviation lighting. Post construction monitoring will be carried out (as outlined below) to assess any potential changes in bat activity patterns and collision risk. Significant effects as a result of lighting are not anticipated; however, if in the course of this monitoring, any potential for significant effects on bats is identified, the site-specific mitigation measures will be reviewed and any changes necessary will be implemented to avoid any such impacts.</p>
Residual Effect following Mitigation	Following the implementation of the monitoring and mitigation described above, there is no potential for significant residual effects on bat species.

6.5.5 Likely Significant Effects on Designated Sites 6.5.5.1 European Designated Sites

The Proposed Wind Farm is located completely outside of the boundary of any European site. Where the Proposed Grid Connection route crosses over the Clare River via the existing road, this is located within the boundary of Lough Corrib SAC.

A potential for likely significant effect was identified on the following European sites:

- Lough Corrib SAC
- Lough Corrib SPA

In relation to European sites, an Appropriate Assessment Screening Report and Natura Impact Statement (NIS) have been prepared to provide the competent authorities with the information necessary to complete an Appropriate Assessment for the Proposed Project in compliance with Article 6(3) of the Habitats Directive. As per the EPA Guidance (2022),

“A biodiversity section of an EIAR, for example, should not repeat the detailed assessment of potential effects on European sites contained in documentation prepared as part of the Appropriate Assessment process, but it should refer to the findings of that separate assessment in the context of likely significant effects on the environment, as required by the EIA Directive”.

This section provides a summary of the key assessment findings with regard to Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

The Stage 1 Screening Assessment concluded as follows:

‘It cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the Proposed Project, individually or in combination with other plans and projects, would be likely to have a significant effect on the following European Sites: Lough Corrib SAC Lough Corrib SPA As a result, an Appropriate Assessment is required and a Natura Impact Statement shall be prepared in respect of the Proposed Project.’

The findings presented in the NIS are that:

‘Where the potential for any adverse effect on any European Site has been identified, the pathway by which any such effect may occur has been robustly blocked through the use of avoidance, appropriate design and mitigation measures as set out within this report and its appendices. The measures ensure that the construction and operation of the Proposed Project does not adversely affect the integrity of European sites. Therefore, it can be objectively concluded that the Proposed Project, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Site.’

6.5.5.2 Nationally Designated Sites

As discussed in Section 6.3.1.1, the Lough Corrib pNHA has been identified as being within the Likely Zone of Impact of the Proposed Project. A potential for impact as a result of deterioration in groundwater quality and/or alteration in groundwater flow paths as a result of construction of the Proposed Wind Farm site was identified, as well as via surface water connectivity due to the existing water crossing over the Clare River along the Proposed Grid Connection underground cabling route:

Lough Corrib pNHA [000297]

This pNHA is also assessed under its SAC and SPA designation within the NIS which accompanies this application. As discussed in Section 6.5.2.1.3 and 6.5.2.1.4, a range of mitigation measures are in place to protect surface water receptors and groundwater receptors during construction of the Proposed Project. Further detail with regard to these measures are provided in Chapter 9 ‘Hydrology and Hydrogeology’ of this EIAR.

With the prescribed mitigations in place, there is no potential for impact on the Lough Corrib pNHA via the identified pathways. The potential for impacts as a result of groundwater deterioration and groundwater flow changes on turloughs designated as pNHAs has also been assessed.

The following pNHAs are in the vicinity of the Site, as shown on Figure 6-2:

Belclare Turlough [000234]

Killower Turlough [000282]

Turlough Monaghan [001322]

Turloughcor [001788]

Turlough O'Gall [000331]

Knockavanny Turlough [000289]

Lough Hackett [001294]

Levally Lough [000295]

Drumbulcaun Bog [000263]

Rostaff Turlough [000385]

Altore Lake [000224]

Rathbaun Turlough [000215]

Kiltullagh Turlough [000287]

Cloughmoyne [000479]

The potential for impacts on local groundwater aquifers as a result of water quality deterioration and alteration in groundwater flow paths, as discussed in Section 6.5.2.1.3, has been fully assessed in Chapter 9 ‘Hydrology and Hydrogeology’. The Proposed Project is located within the Clare-Corrib groundwater body. As summarised in Section 6.3.1.3.2, overall, groundwater flow directions are to the southwest, as evidenced by the tracer studies carried out (see Plate 6-1). The above listed pNHAs are located to the northwest, north and northeast of the Proposed Project site. Therefore, there is no potential for impact on these designated sites via groundwater pathways.

The groundwater pathway from Ballyglunin to Lough Corrib in association with particle emissions determine that there is potential for impact on designated sites via groundwater pathways.

3.2

Consideration should be given to the potential for bat collision risk from insects being attracted to turbines.

The potential for insects and in turn bats to be attracted to turbines has been considered in Section 6.5.3.2.2 of the EIA Addendum. In addition, an adaptive mitigation and monitoring plan has been designed in line with relevant industry guidance, as outlined in Appendix 6-2, Section 6 of the Bat Report as submitted.

6.5.3.2.2 *Insect Attraction to Turbines*

The potential for insects and in turn bats to be attracted to turbines has been considered in preparation of this Report. A full suite of baseline surveys has been completed at the site as detailed in the original EIA. The Proposed Wind Farm has been designed in accordance with industry guidance (NatureScot) to avoid the most significant areas of faunal habitat (i.e. woodlands, mature treelines and species rich habitats) which may be used by commuting and foraging bats. Additional mitigation to prevent potential bat attraction to turbines including the removal and maintenance of a vegetation-free bat buffer, as well as blade feathering is included. Blade feathering will be implemented at night when wind speeds are below the cut-in speed of the proposed turbine. This coincides with periods when bats are known to be most active i.e. lower wind speeds and has been shown to significantly reduce bat fatalities (by up to 50%) in some studies (NIEA, 2021). In addition, an adaptive mitigation and monitoring plan has been designed in line with relevant industry guidance, as outlined in Appendix 6-2, Section 6 of the Bat Report as submitted with the original EIA.

6.2 Bat Monitoring Plan

Overall risk levels for high collision risk bat species were typically Low or Medium. This risk level is reflective of the nature of the sites predominately open grassland habitats. Furthermore, the walked transects revealed consistently low levels of bat activity in the area.

However, taking a precautionary approach, and given that high collision risk was recorded at median and peak activity levels, an adaptive monitoring and mitigation strategy has been devised for the Proposed Project, in line with the case study example provided in Appendix 5 of the NatureScot, (2021) and based on the site-specific data.

6.2.1 Operational Monitoring

To assess the effects of the Proposed Project on bat activity, at least 3 years of post-construction monitoring is proposed. Post-construction monitoring will include static detector surveys, walked survey transects and corpse searching to record any bat fatalities resulting from collision.

The results of post-construction monitoring shall be utilised to assess any potential changes in bat activity patterns and to monitor the implementation of the mitigation strategy. At the end of Year 1, and if a curtailment requirement is identified (i.e. significant bat fatalities encountered), a curtailment programme, in line with relevant guidelines, will be devised around key activity periods and weather parameters, as well as a potential increase in buffers.

At the end of each year, the efficacy of the mitigation and monitoring plan will be reviewed, and any identified efficiencies incorporated into the programme. This approach allows for an evidence-based review of the potential for bat fatalities at the Proposed Wind Farm site, post construction, to ensure that the necessary measures, based on a new baseline post-construction, are implemented for the protection of bat species locally. The effectiveness of any mitigation/curtailment needs to be monitored in order to determine (a) whether it is working effectively (i.e. the level of bat mortality is incidental), and (b) whether the curtailment regime can be refined such that turbine down-time can be minimised whilst ensuring that it remains effective at preventing casualties.

The below subsections provide additional detail on the proposed survey effort, timing, and mitigation.

6.2.1.1 Monitoring Year 1

Bat activity surveys

The post-construction surveys will be carried out as per the pre-construction survey effort. Static monitoring will take place at each turbine during the bat activity season (between April and October) (NatureScot, 2021, NIEA, 2021). Full spectrum recording detectors will be utilised for the same duration as during pre-application surveys and at the same density (NatureScot, 2021). As described in Section 3.5 above, the assessment of bat activity levels will include the use of “Ecobat” (or similar alternative), a web-based interface, allowing uploaded activity data to be contrasted with a comparable reference range, allowing objective and robust interpretation. Walked survey transects will also be conducted.

Key weather parameters and other factors that are known to influence collision risk will be monitored and shall include:

- Windspeed in m/s (measured at nacelle height)
- Temperature (°C)
- Precipitation (mm/hr)

Carcass searches

Carcass searches, to monitor and record bat fatalities, shall be conducted at each turbine in accordance with NIEA Guidance. This shall include searcher efficiency trials and an assessment of scavenger removal rates to determine the appropriate correction factor to be applied in relation to determining an accurate estimate of collision mortality. Surveys should cover all activity seasons and the use of a trained dog detection team will be carried out to ensure maximum efficiency.

6.2.1.2 Monitoring Years 2 & 3

Monitoring surveys shall continue in Year 2 and 3, and where a curtailment requirement has been identified, the success of the curtailment strategy shall be assessed in line with the baseline data collected in the preceding year(s). The performance of the curtailment programme in terms of its ability to respond to the changes in bat abundance based on temperature and wind speed shall be analysed to confirm it is neither significantly over- nor under- curtailing during different periods of bat activity.

At the end of each year, the efficacy of the mitigation/curtailment programme shall be reviewed, and any identified efficiencies incorporated into the programme. The requirement for continued post-consent monitoring will also be considered. Should no bat fatalities be recorded in Year 1, curtailment (where applicable) in Year 2 and Year 3 could be reduced/re-evaluated or removed with monitoring continuing to inform this strategy. A monitoring programme will be submitted to, and agreed with, the Planning Authority. Any subsequent changes will be agreed with the Planning Authority.

Insects are Attracted to White Wind Turbine Bases: Evidence from Turbine Mimics: [Lusha M Tronstad, Madison Crawford, Delina Dority, Michael E. Dillon.. September 2023. *Western North American Naturalist* 83\(2\):232-242 DOI: \[10.3398/064.083.0208\]\(#\).](#)

Wind power is one of the fastest growing forms of renewable energy, but the interactions between wind turbines and insects are largely unknown beyond the observation that the accumulation of dead insects on turbine blades drastically reduces the power produced. Insects may be attracted to wind energy facilities because of topography, the heat that turbines produce, the lighting, or the visual cue of the turbine itself. Turbines can present a striking visual contrast relative to the surrounding landscape, particularly when they are painted bright white and reflect ultraviolet wavelengths. To test the hypothesis that wind turbine color attracts insects, we sampled insects near experimental wind turbine mimics of 9 colors. The mimics were located on a hill with characteristics similar to sites of nearby wind energy facilities. Passive traps painted the same colors and placed next to their corresponding turbine mimic provided an estimate of insect attraction to turbines of different colors. Insect abundance was highest next to the white, violet, and blue turbine mimics, and lowest adjacent to the green, orange, yellow, light gray, and dark gray turbine mimics. Our results suggest that white, the predominant color of wind turbines globally, is one of the most attractive colors to insects. We encourage others to investigate whether painting turbine bases a less attractive color (e.g., gray or green) may drastically reduce the attraction of insects to wind energy facilities.

3.3

Clarity should be outlined on if the Lesser Horseshoe Bat roosts c.2.3km from Turbine 5 at Caltragh, Belcare. The EIAR outlines the project is outside of the 2.5km foraging range for the species. Clarification should be provided in relation to the presence of any roost site for the species within the foraging range, including within caves, and environmental assessments should be updated, if/where applicable.

Lesser horseshoe bat roosts in proximity to the site have been fully considered as part of Appendix 6-2 Bat Report of the EIAR. Lesser horseshoe bat is a low collision risk species, furthermore, a range of mitigation measures to reduce the potential for collision has been implemented as set out in Section 6.1 of the Bat Report as well as an operational monitoring plan. Section 6.5.2.2.4 of the Report contains further information regarding the assessment of Lesser horseshoe bat. Additional detail has been provided in Section 5.1.1.1 Table 5-1 of the revised NIS relating to the potential for adverse effects on the Lesser Horseshoe Bat as a result of the Proposed Project.

6. BEST PRACTICE AND MITIGATION MEASURES

This section describes the best practice and site-specific mitigation measures that are in place to avoid and reduce the potential for significant effects on local bat populations.

6.1 Standard Best Practice Measures

6.1.1 Noise Restrictions

During the construction phase, plant machinery will be turned off when not in use and all plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (S.I. No. 632 of 2001).

6.1.2 Lighting Restrictions

Where lighting is required, directional lighting will be used to prevent overspill on to woodland/forestry edges. Exterior lighting, during construction and post construction, shall be designed to minimize light spillage, thus reducing the effect on areas outside the Proposed Wind Farm site, and consequently on bats i.e. Lighting will be directed away from mature trees/treelines around the periphery of the site boundary to minimize disturbance to bats. Directional accessories can be used to direct light away from these features, e.g. through the use of light shields (Stone, 2013). The luminaries will be of the type that prevent upward spillage of light and minimize horizontal spillage away from the intended lands.

The proposed lighting around the Proposed Wind Farm site shall be designed in accordance with the Institute of Lighting Professionals Guidance Note 08/23 Bats and artificial lighting in the UK (ILP, 2023).

In addition, the applicant commits to the use of lights during construction, operation and decommissioning (such that they are necessary) in line with the following guidance that is provided in the Dark Sky Ireland Lighting Recommendations:

- Every light needs to be justifiable,
- Limit the use of light to when it is needed,
- Direct the light to where it is needed,
- Reduce the light intensity to the minimum needed,
- Use light spectra adapted to the environment,
- When using white light, use sources with a “warm” colour temperature (less than 3000K).

With regard to the potential for lighting to increase collision risk, it is noted that there will be limited illumination of the turbines in the form of aviation lighting. Post construction monitoring will be carried out (as outlined below) to assess any potential changes in bat activity patterns and collision risk. Significant effects as a result of lighting are not anticipated; however, if in the course of this monitoring, any potential for significant effects on bats is identified, the site-specific mitigation measures will be reviewed and any changes necessary will be implemented to avoid any such impacts.

6.1.3 Bat Felling Buffers

In accordance with NatureScot and NIEA Guidance, a minimum 50m buffer to all habitat features used by bats (e.g., hedgerows, tree lines etc.) should be applied to the siting of all wind turbines (See example provided in Plate 6-1 below). However, Eurobats No. 6 guidance and NIEA recommends increased buffers of 100m and 200m around woodland/forestry areas, however, there is no scientific evidence to support these increased buffer distances in the UK.

NatureScot recommends that a distance of 50m between turbine blade tip and nearest woodland (or other key habitat features) is adequate mitigation. This 50m buffer will be implemented from the outset and monitored as per the post-construction monitoring. The success of the buffer mitigation will be assessed as part of post construction monitoring (outlined in Section 6.2 below) and updated where necessary.

The formula below is presented to provide appropriate mitigation in relation to bats, and the relevant input required from turbine parameters, is the combination of the blade length and hub height. The turbine model to be installed on the Proposed Wind Farm site will have an overall ground-to-blade tip height of 185m, rotor diameter of 163m, and hub height of 103.5m.

This mitigation measure has been applied and no felling is required within the Proposed Wind Farm site. There will be a requirement to remove some linear vegetation i.e. treelines/hedgerows, to facilitate the required bat buffers. This is outlined in further detail in Section 6.1.4 below. These vegetation-free areas will be maintained during the operational life of the Proposed Project.

It is necessary to calculate the distance between the edge of the habitat feature and the centre of the tower (b). Using

$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

the formula:

Where, bl = Blade length, hh = hub height, fh = feature height all in metres. E.g. (below) b = 69.3m (Plate 6-1)

6.1.4 Proposed Linear Vegetation Removal

A number of trees and hedgerows will be subject to removal to facilitate the Proposed Wind Farm infrastructure footprint and required bat buffers, as shown in Figure 6-1. Trees within the designated bat buffers are not deemed to provide significant potential roosting opportunities; therefore, no impacts on roosting bats are anticipated.

Furthermore, no removal of linear vegetation is proposed for the Proposed Grid Connection or the TDR and as such, no impacts on roosting bats are anticipated.

6.1.5 Proposed Habitat Replacement

In the absence of appropriate design, the loss or degradation of commuting/foraging habitat has potential to reduce feeding opportunities and/or displace bat populations. However, the Proposed Project is predominantly located within agricultural grasslands and linear landscape features such as stone walls, hedgerows and trees which will be largely retained or avoided.

Linear vegetation within the required turbine bat buffers will be removed (Chapter 6, Appendix 6-4, Figure 1-1). A replanting design has been curated to provide alternative commuting corridors within the Site. To comply with NatureScot recommendations in relation to habitat buffering to avoid bat fatalities, a total of 1.8km of treeline/hedgerow habitat will be lost as a result of the Proposed Wind Farm, including the recommended buffers applied for bats. Further details are outlined in Appendix 6-4 BMEP.

Linear landscape features in the wider area that will be retained, and the loss of gappy hedgerow/treelines is not anticipated to have a significant effect on local bat populations. However, it is proposed to plant new linear features and bolster existing habitat features to offset any potential loss in linear habitat features and to provide additional new

opportunities for commuting and foraging bats. A total of 3.6km of linear habitat will be added, which will result in a net gain in linear habitat features within the Proposed Wind Farm site.

The locations in which the proposed linear hedgerow planting will take place will be carried out along selected boundaries of fields within the Site. Refer to the BMEP outlined in Appendix 6-4 of the EIAR for hedgerow planting details.

Overall, the proposed replanting will result in a 100% net gain in the linear landscape features within the Proposed Wind Farm site. Species planted in these locations will be of a similar composition to those occurring on site, namely, hawthorn and hazel. Further details with regard to species, planting location, and management is contained within the BMEP.

6.1.6 Blade Feathering

NIEA Guidelines also recommend that, in addition to buffers applied to habitat features, all wind turbines are subject to ‘feathering’ of turbine blades when wind speeds are below the cut-in speed of the proposed turbine. This means that the turbine blades are pitched at 90 degrees or parallel to the wind to reduce their rotation speed to below two revolutions per minute while idling. This measure has been shown to significantly reduce bat fatalities (by up to 50%) in some studies (NIEA, 2021).

In accordance with NIEA Guidelines, blade feathering will be implemented as a standard across all proposed turbines when wind speeds are below the cut-in speed of the turbine.

6.5.2.2 Effects on Fauna During Construction

6.5.2.2.4 Impacts on Lesser Horseshoe Bat Roosts

Data in relation to lesser horseshoe bat roosts within 10km of the Proposed Wind Farm was requested by NPWS and Bat Conservation Ireland (BCI) in November 2023. Eleven roost records, including five lesser horseshoe bat roosts, were provided (Appendix 6-2 Bat Report, Table 4-1); however, no record of the roost in question was received. Additionally, an updated request to BCI in July 2025 did not reveal any new roost records.

A review of landscape features did not reveal the presence of any caves within the Proposed Wind Farm site. The nearest confirmed cave is over 5km away which is outside the core foraging range (i.e. 2.5km) of lesser horseshoe bat. There are three other karst features on the GSI database²⁷ located outside the EIAR site boundary which are marked as caves, although these are recorded as unconfirmed with ‘unknown’ details suggesting they may be souterrains. Two manmade subterranean sites were identified and inspected within the Proposed Wind Farm site (Appendix 6-2, Table 4-4); however, neither structure presented suitable features for roosting bats.

Lesser horseshoe bat roosts in proximity to the site have been fully considered. The Proposed Project has been designed such that there will be no net loss of linear habitat for commuting and foraging bats and no loss of bat roosts. Approximately 3.6km of linear habitat will be added to mitigate for the loss of approximately 1.8km of linear features, which will result in a 100% net gain in linear habitat features within the Proposed Wind Farm site. Lesser horseshoe bat is a low collision risk species, furthermore, a range of mitigation measures to reduce the potential for collision has been implemented as set out in Section 6.1 of the Bat Report as submitted with the planning application as well as an operational monitoring plan. There is therefore no potential for significant effect to the local lesser horseshoe bat population and there is no requirement to update the assessment.

The potential for the Proposed Project to result in likely significant effect to the designated Qualifying Interest (QI) Lesser Horseshoe Bat roost has been considered in the revised Natura Impact Statement (NIS) provided. Section 5.1.1.1 of the revised NIS assesses the potential for adverse effect on the QI Lesser Horseshoe Bat roost as follows,

According to the site-specific conservation objectives²⁸, Lough Corrib SAC has been selected for this species because of the presence of one summer roost (id. 217). This roost is mapped as being located to the north of the Lough, over 25km away from the Proposed Project site. Given the distance between the Proposed Project and the QI roost, as well

as the likely remoteness of the Proposed Project from any potential auxiliary roosts connected with the QI roost, there is no potential for adverse effect on this species.

Therefore, there is no potential for adverse effect to the QI Lesser Horseshoe Bat roost as a result of the Proposed Project.

5.1.1.1 Identification of Individual Qualifying Features with the Potential to be Affected

Table 5-1 Assessment of Qualifying features potentially affected

Qualifying feature	Conservation Objective (NPWS, Version 1, April 2017 ¹⁴),	Rationale	Potential for Adverse Effects Y/N
[1303] Lesser Horseshoe Bat <i>Rhinolophus hipposideros</i>	<i>To restore the favourable conservation condition of Lesser Horseshoe Bat in Lough Corrib SAC</i>	According to the site-specific conservation objectives, Lough Corrib SAC has been selected for this species because of the presence of one summer roost (id. 217). This roost is mapped as being located to the north of the Lough, over 25km away from the Site. Given the distance between the Site and the QI roost, as well as the likely remoteness of the Proposed Project from any potential	No
		auxiliary roosts connected with the QI roost, there is no potential for adverse effect on this species.	

3.4

An assessment of the potential for the proposal to give rise to effects on the Lesser horseshoe bat, a QI for the Lough Corrib SAC (000297) has not been identified in the NIS and this should be addressed.

Section 6-5.2.2.4 of the Report contains further information regarding the assessment of the Lesser horseshoe bat. Additional detail has been provided in Section 5.1.1.1 Table 5-1 of the revised NIS relating to the potential for adverse effects on the Lesser Horseshoe Bat as a result of the Proposed Project.

Wind turbines displace bats from drinking sites. Carolin Scholtz , Hannah Klein , Christian C. Voigt. Biological Conservation 302 (2025) 110968. <https://doi.org/10.1016/j.biocon.2025.110968>

We conclude from our results that the operation of wind turbines on farmland can contribute to a reduction in local bat diversity, not necessarily due to casualties at wind turbines, but rather due to displacement from wind turbines. This decline in the abundance of narrow and open space foraging bats near wind turbines is associated with a loss of their ecological function on farmland (Scholz and Voigt, 2022). Bats are known to provide ecosystem services by consuming insect pests (Kunz et al., 2011; Boyles et al., 2011; Williams-Guillén et al., 2016; Maslo et al., 2022; Russo et al., 2018). Therefore, displacement of bats over large areas around wind turbines may contribute to reduced crop production and the need for increased pesticide application to compensate. Displacement effects on wildlife caused by wind turbine operations may contribute to cryptic cascading trophic effects that have not been previously recognised (Thaker et al., 2018; Scholz and Voigt, 2022). Our results highlight the urgent need to consider the loss of critical habitats for vulnerable bats and other wildlife when planning wind turbines (Barré et al., 2018). We therefore argue that valuable bat habitats, such as ponds, should be considered at a distance of several kilometres from wind turbines when expanding wind energy production. Ignoring the need to protect critical bat habitats could jeopardise an environmentally friendly wind energy production.

Summary of Wake issues:

1. Wake Modeling And Simulation Of A Real Scale Wind Turbine Using Large Eddy Simulation And Dynamic Adaptive Mesh Refinement

Item 4. Protected Species, Protected Habitats and Plans Species, Local Species (EIAR)

4.1

Clarification should be provided as to whether the site and area includes for any species protected under the flora protection order, and in the event of these species existing, protection measures should be outlined.

As detailed in Section 6.4.1.7 of the EIAR, no species listed under the Flora Protection Order was recorded within the Proposed Project site. However, spring gentian (*Gentiana verna*), which is classed as Near Threatened in the Red Data List of Vascular Plants, was recorded within the Site on areas of dry calcareous heath and limestone pavement. These areas are completely avoided by the footprint of the Proposed Project. Furthermore, where suitable habitat for this species does occur in proximity to the Proposed Project footprint, mitigation has been prescribed to avoid impact on these habitats as prescribed in Section 6.5.2.1.3 of the EIAR, by means of construction phase fencing as shown on the updated Figures in Appendix 6-7 of the Report. The Proposed Project footprint is restricted to species-poor, improved agricultural grassland. Any high value habitats within the Proposed Project site, which may have potential to support plant species listed under the Flora Protection Order, have been completely avoided by the Proposed Project.

4.2

The habitat mapping Figure 6-5 (at a scale of 1:23,000) is not clearly legible. Mapping should be outlined at a scale of 1/1250 to enable an assessment of the proposed developments impact on habitats.

It is stated in Item 4.2 that the submitted Habitat Map is not clearly legible. A series of updated habitat maps have now been submitted. Figure 1a shows an overall Habitat Map at a scale of 1:15,000. The remaining figures show small-scale sections of the Proposed Wind Farm site at a scale of 1:1250. These maps are provided in Appendix 6-6 Habitat Map Pack of the Report.

4.3

Please clarify if there will be any turbine over sailing protected habitats areas. In the event of this occurring an assessment of this impact on protected habitats should be carried out. Mitigation measures should be outlined, if/where applicable.

As described in the Section 15.1.5 of Chapter 15 of the EIAR, turbine delivery within the Proposed Wind Farm site will be via vehicle with total length 86.9m. The potential for oversail of protected habitats including Annex I habitats, hedgerows, treelines and woodlands has been assessed following review of the swept path analysis of turbine delivery within the Proposed Wind Farm site. There will be no oversail of Annex I habitats or woodland habitats. **Where oversail of hedgerow or treeline is likely to occur, such trees may be pruned to accommodate the turbine delivery, however, such pruning will be kept to a minimum.** There will not be significant loss of hedgerow or treeline habitat within the Proposed Wind Farm site as a result of oversail. Furthermore, as part of the Proposed Project, a 100% net gain is proposed in terms of hedgerow replanting. There is no potential for significant effect to habitats as a result of turbine delivery.

4.4

Please clarify if wake effects will arise from the proposed development on habitats, badgers, species and insects. Consideration should be given to these issues

The potential for wake effects from turbines to impact fauna has been considered and is detailed in Section 6.5.3.2.3 of the Report. A bat impact assessment was carried out in the submitted EIA in Chapter 6 Biodiversity. The potential for impact from wake effects such as barotrauma and collision mortality is assessed in Section 6.5.3.2.1 of the submitted EIA.

6.5.3.2.3 *Wake Effects on Fauna*

The potential for wake effects from turbines to impact fauna has been considered. The Proposed Project has avoided key areas of value of fauna including badger and high value habitats that support insects and other species. The footprint of the Proposed Project is restricted to highly managed agricultural grassland. A bat impact assessment was carried out in the submitted EIA in Chapter 6 Biodiversity. The potential for impact from wake effects such as barotrauma and collision mortality is assessed in Section 6.5.3.2.1 of the submitted EIA. This impact has been assessed in line with NatureScot guidelines and based on the bat surveys, undertaken in line with the guidance, carried out at the Proposed Wind Farm site. A range of mitigation measures have been prescribed to ensure that there is no potential for significant effect on bats including blade feathering, implementation of bat vegetation buffers around turbines, and an adaptive operational mitigation monitoring plan.

Potential effects of wake which could indirectly impact fauna such as micrometeorology are considered here. Downward turbulence from turbines can alter the surface-atmosphere exchange of energy. This can lead to an increase in near surface air temperature and land surface temperature, particularly in grasslands*. However, it has been concluded that overall, wind farm impacts on land surface temperature are small in magnitude compared to the background inter-annual variability. Temperature-related effects do not occur at all wind farms. Effects exhibit seasonal variations, and depend on site characteristics, environmental conditions, and local factors such as topography and land use. [*Slawsky, L.M.; Zhou, L.; Baidya Roy, S.; Xia, G.; Vuille, M.; Harris, R.A. Observed thermal impacts of wind farms over northern Illinois. *Sensors* 2015, 15, 14981–15005. [CrossRef]]

The use of historic data from Illinois, where a continental climate prevails does not reflect the temperate climate of Ireland. See response at page 228 below.

Wake Modeling And Simulation Of A Real Scale Wind Turbine Using Large Eddy Simulation And Dynamic Adaptive Mesh Refinement. Leandro J.L. Stival, Joshua R. Brinkerhoff & Fernando O. De Andrade & João Marcelo Vedovotto. *An Acad Bras Cienc* (2025) 97(4): e20240875 DOI 10.1590/0001-3765202520240875 *Anais da Academia Brasileira de Ciências | Annals of the Brazilian Academy of Sciences* Printed ISSN 0001-3765 | Online ISSN 1678-2690 www.scielo.br/aabc | www.fb.com/aabcjournal

Table I. Parameters of the NREL 5MW Wind Turbine.

Parameter	Value
Number of rotor blades	3
Rotor Diameter	126 m
Rated Power	5.3 MW
Rated Wind Speed	11.4 m / s
Rated Rotational Speed	12.1 rpm
Blade Length	61.5 m

The inflow wind velocity profile was imposed at the inlet with a hub height velocity of $u = 8\text{m/s}$.

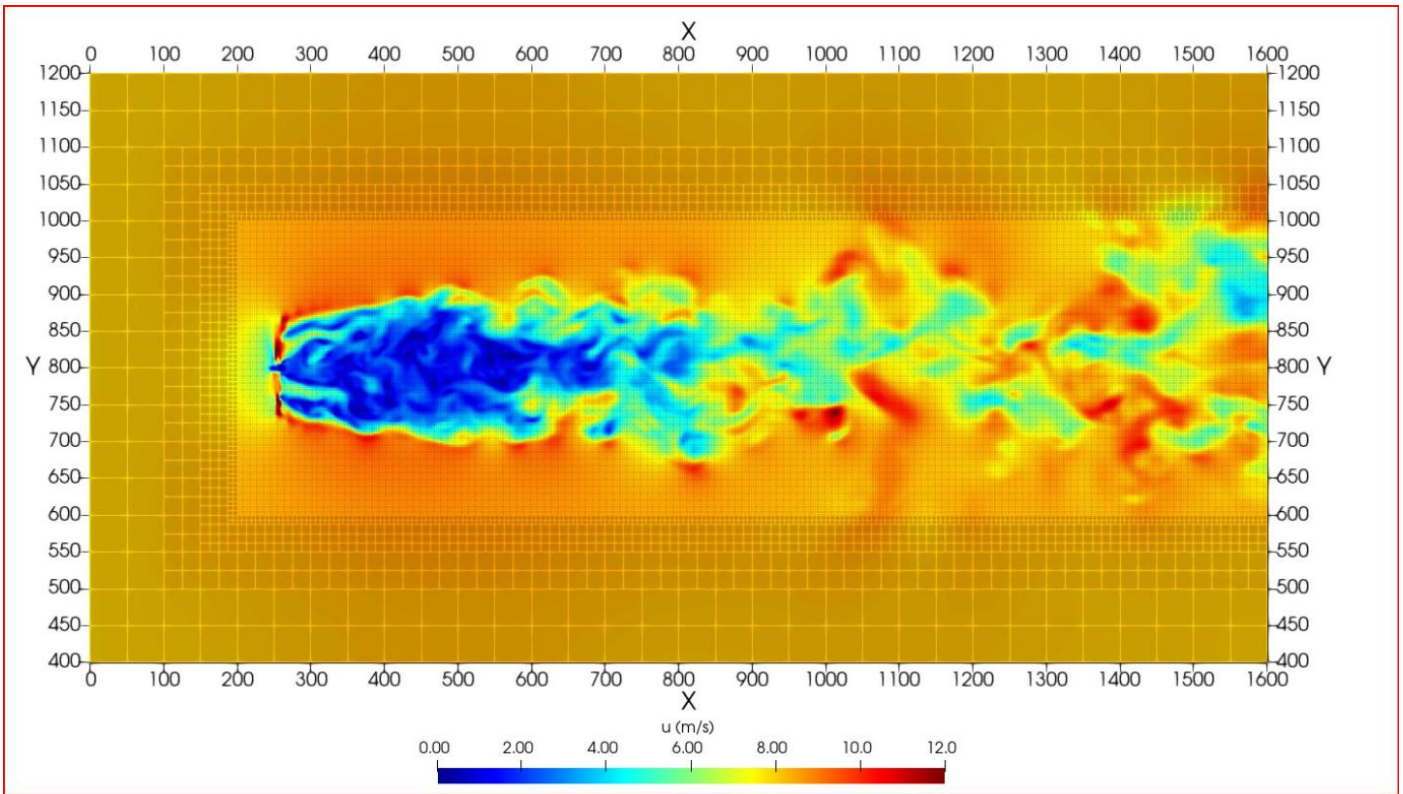


Fig. 1: The flow velocity contours development in the top view of the NREL 5MW wind turbine.

Response from ML: This is a view from above the turbine looking towards ground. The turbine is to the left & you can see the turbulence towards the right & extending beyond 1,600m downwind. Note it extends outside the diameter of the turbine.

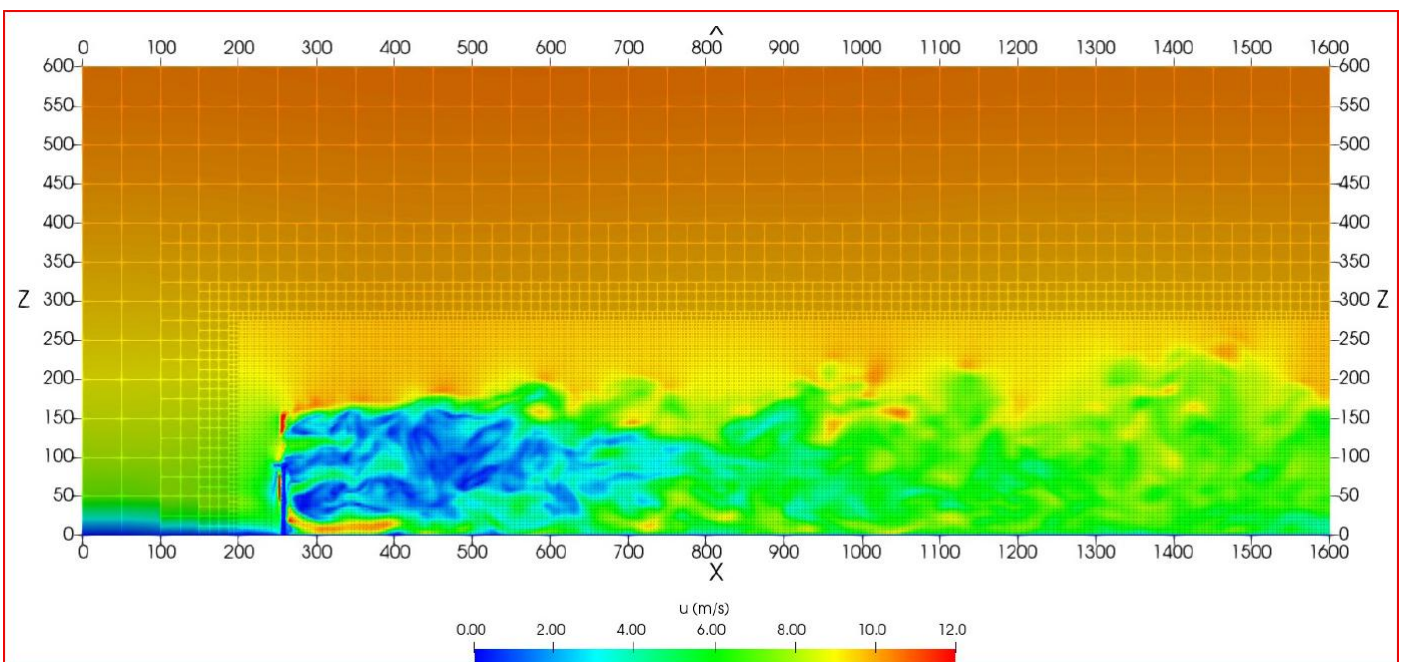


Fig. 2: The flow velocity contours development in lateral view of the NREL 5MW wind turbine.

Response from ML: This is a vertical view from the side the turbine. The turbine is to the left & you can see the turbulence towards the right & extending beyond 1,600m downwind. Note it extends above the diameter of the turbine.

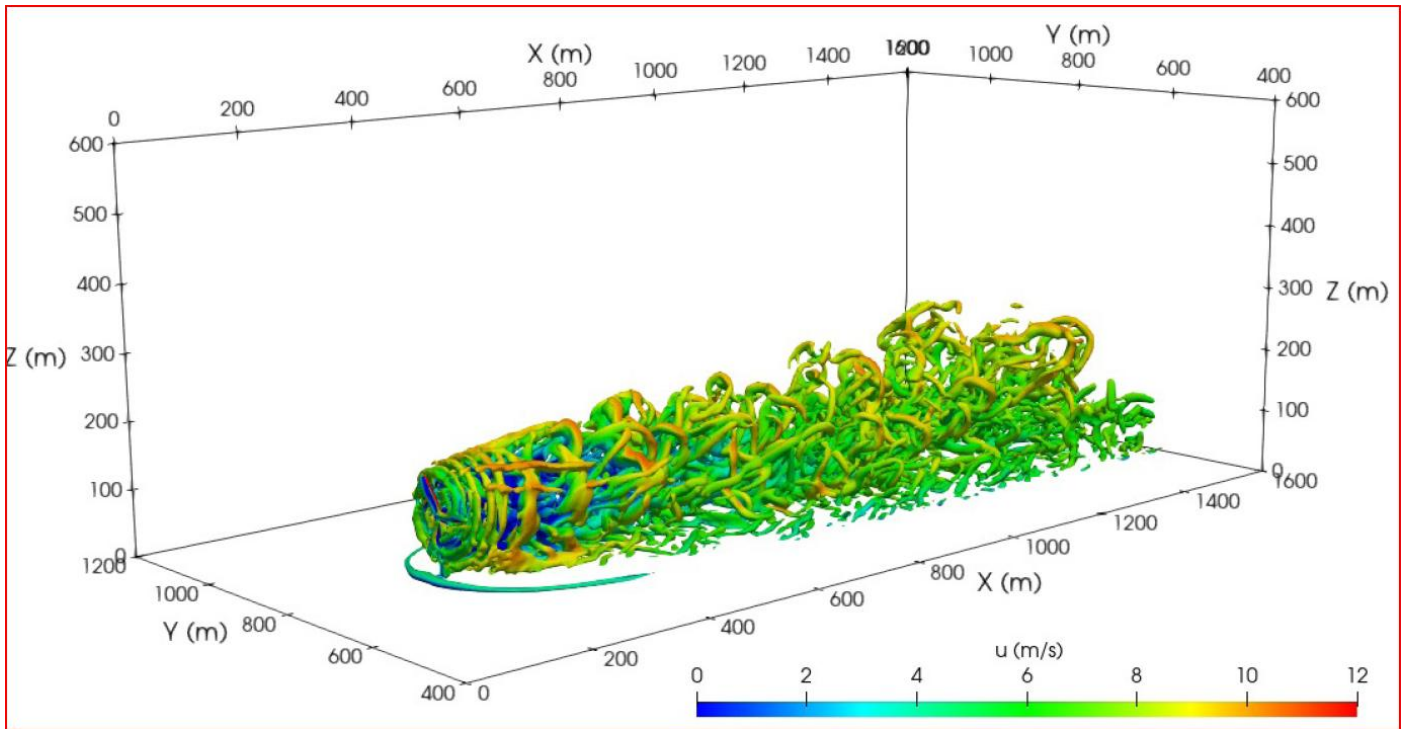


Fig. 3: Dynamic iso-surfaces of Q (Jeong & Hussain 1995), coloured by velocity around the wind turbine. Response from ML: This is a 3D view from the side the turbine. The turbine is to the left & you can see the turbulence towards the right & extending beyond 1,600m downwind. Note it extends above and outside the diameter of the turbine.

How could a bird cross this turbulence? How could they take off from ground?

This turbulence creates noise in down wind turbines as well as power losses. It is similar to air turbulence in an aircraft. Aircraft are delayed by c1.5minutes at take off to avoid such turbulence from preceding aircraft.

In my opinion birds could not take flight in such turbulence & would be displaced by the barrier created from ground up to c300metres in the vertical plane. Windfarms have these turbulent areas on parallel turbines.

This wake in our temperate climate bring cold air from c300m above ground level down to ground level. This action creates a microclimate at the ground with a reduction of around 3 degrees Centigrade. This temperature reduction effects crop growth for kilometres downwind & reduces residential temperatures. Both of these create financial losses for downwind property owners & without their knowledge or consent.

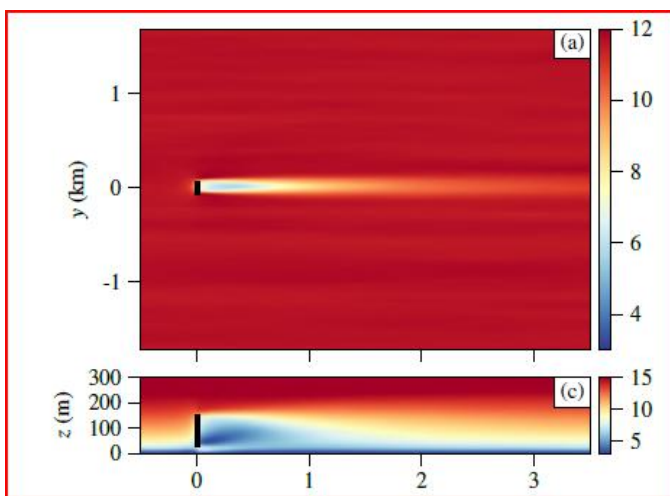


Fig. 4: One turbine & wake from above - top & side- bottom.

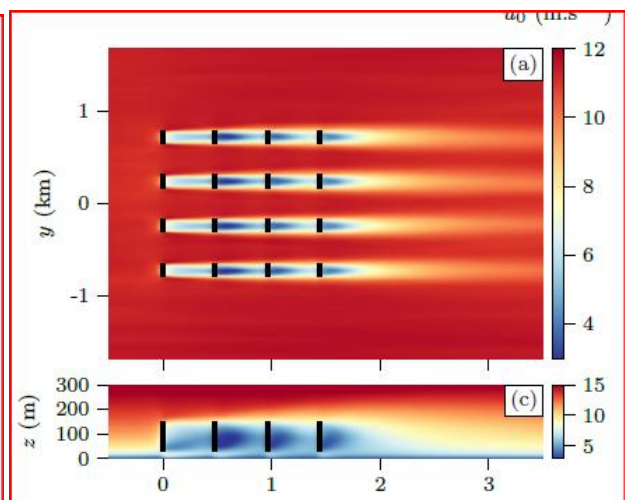


Fig. 5: Multiple turbines & wakes from above- top & side- bottom.

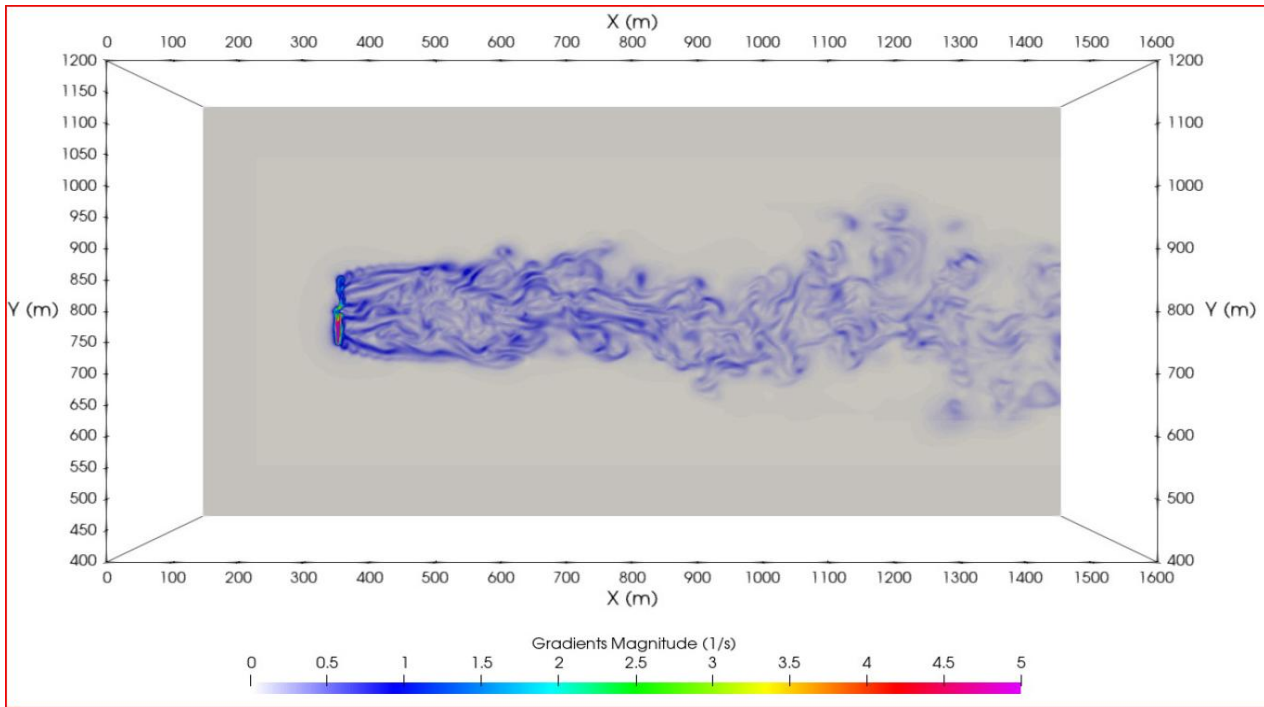


Fig. 6: Similar to Fig. 1.

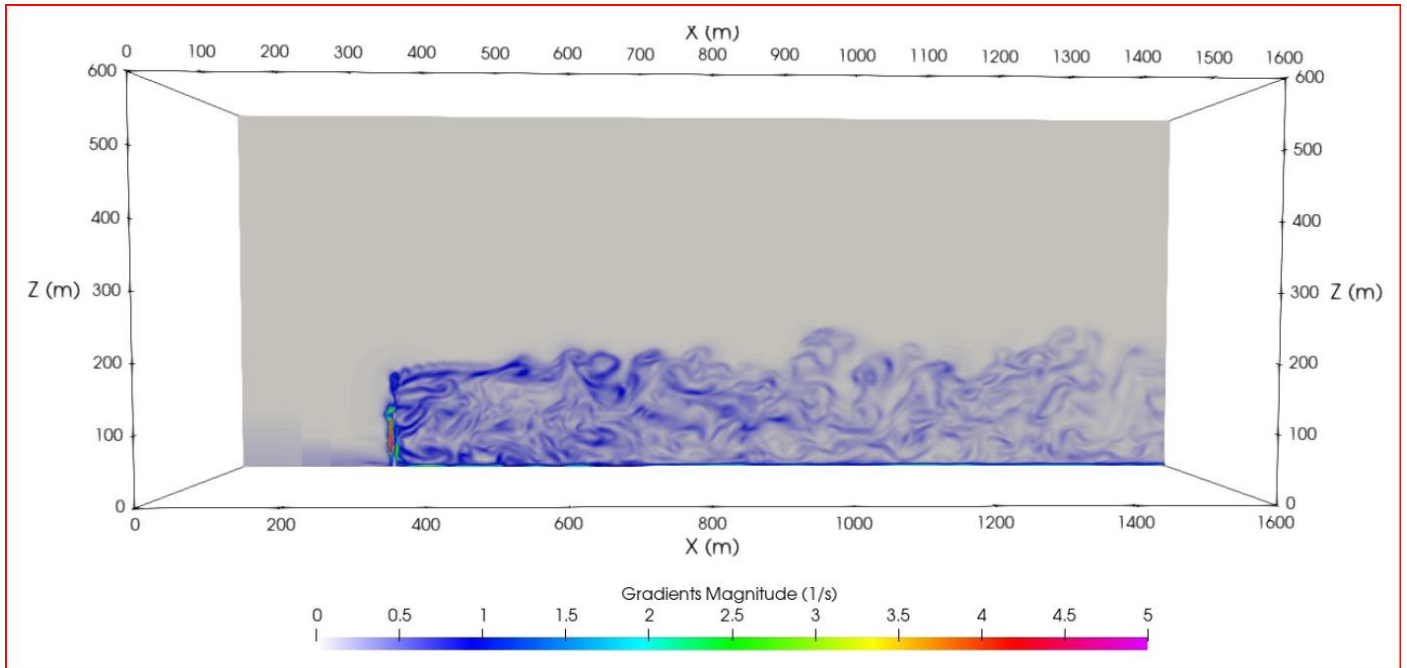


Fig. 6: Similar to Fig. 2: Vertical Contours of gradients of velocity of the overflow around the wind turbine.

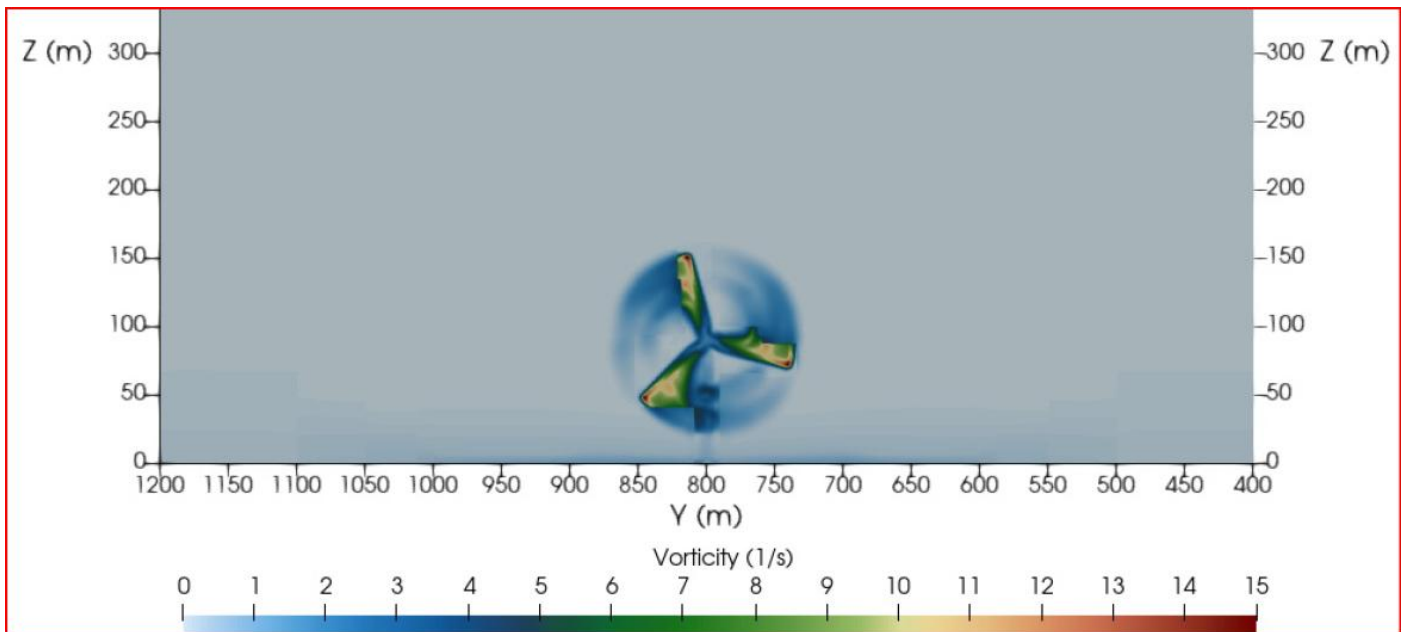


Fig. 7: Vectors of vorticity magnitude in the downstream position of the wind turbine. Insects are attracted to wind turbines & the bats follow the insects. The blade tip speed is c90metres per second. This is 324km/hr. In reality about 1.5 times the speed of a F1 motor racing car.

The 162m diameter would cover Croke Park from the outside of the Canal end to the outside of Hill 16.

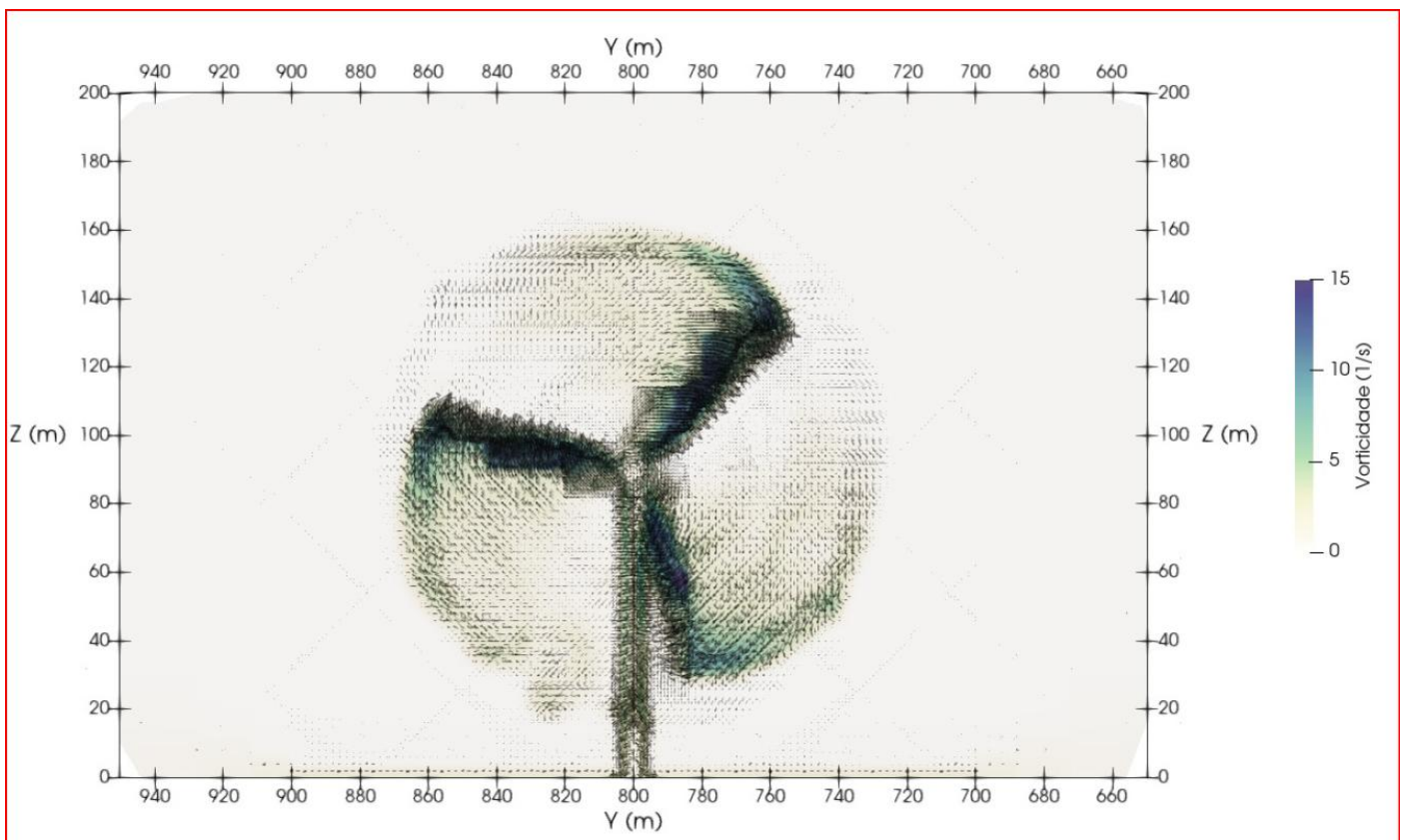


Fig. 7: Contours vorticity magnitude in the downstream position of the wind turbine.

Wind turbine noise generation and propagation through large eddy simulation and acoustic analogy. Giacomo Rismondo, Giovanni Petris, Marta Cianferra and Vincenzo Armenio. *J. Fluid Mech.* (2025), vol. 1024, A33, doi:10.1017/jfm.2025.10709

The analysis is representative of medium-sized turbines with low tip Mach number (~ 0.10). The fluid dynamic analysis revealed: a turbulent boundary layer over the blades, together with a trailing edge vortex sheet; a complex near-wake

structure, including tip and root vortices; an intermediate wake with vortex instabilities triggering leap-frogging and vortex grouping mechanisms; and a far wake characterised by fully developed turbulence. Two primary noise generation mechanisms were identified. The unsteady pressure field over the turbine surface generates tonal noise at the blade passing frequency and a high-frequency broadband noise, associated with the trailing edge vortex sheet (linear-noise contribution). The turbulent wake generates broadband low-frequency noise, driven by the complex fluid-dynamic processes outlined previously (nonlinear noise contribution). The linear part of the noise was found to dominate over the nonlinear one in the acoustic far field, while the opposite is true in the acoustic near field. As a composition of the two contributions to the noise, the directivity exhibits a non-symmetric dipole shape oriented along the flow direction, with lobes recovering symmetry moving from the near to the far field. Finally, analysis of the acoustic decay rates reveals that the linear term in the near field decays according to an $r-(n+1)$ law within the rotor plane, where n is the number of blades, consistent with recent findings on the acoustics of rotating sources.

The near wake is influenced by the presence of the rotor itself and its geometrical properties; a three-dimensional complex flow is present, characterised by coherent periodic helicoidal vortex structures, namely the root and tip vortices; in the case of an isolated marine propeller, a strong rectilinear vortex is evident, namely the hub vortex. These vortex structures are connected through a thin vortex sheet released by the blades. The breakdown and instability of the hub and tip vortices, occurring in the intermediate wake, are responsible for the transition from the near to the far wake, with a considerable amount of turbulent kinetic energy detected at the outer radii. Finally, a fully composite turbulent wake develops in the far wake. Further downstream, a self-similar behaviour is detected with the mean streamwise velocity deficit profile collapsing into a single Gaussian distribution.

Several experimental and numerical investigations are present in the literature, exploiting the dynamics of rotor wake, as well as the instability mechanism responsible for the transition from near to far wake. Most of them used simplified methods such as actuator technique, which may give some information about the characteristics of the wake. Geometry-resolving simulations are more recent, and few of them have been carried out using eddy-resolving techniques, like large eddy simulation.

Rotor acoustics

The noise produced by rotors, especially wind turbines, is classified into three main groups, namely low-frequency noise, inflow turbulence noise and aerofoil self-noise. The rotation of blades produces the so-called thickness noise, characterised by a tonal spectrum, with peaks at the blade passing frequency (BPF) and its super-harmonics. The rotating lifting surfaces, namely the loading noise source, contribute to BPF and broadband noise, the latter in the high-frequency range; this is because the transition from laminar to turbulent boundary layer and flow separation induce fluctuating pressures on the blade surface, as well as a thin vortex sheet radiating from the blade trailing edge. This noise-generation mechanism is known as trailing-edge noise and contributes to the acoustic signature over a wide range of frequencies (Lee *et al.* 2021). The noise emitted by the tip vortex influences both the low- and high-frequency regions of the spectrum and is not yet fully understood. The incoming turbulence, associated with the atmospheric boundary layer (ABL) or upwind wind turbines (in wind farm applications), produces a broadband noise. Depending on the characteristics of the turbulence, such as the time and length scales of the disturbances, the inflow turbulence noise mechanism contributes both to high- and low-frequency noise.

Experimental studies have contributed to the knowledge of noise generated by rotors. Specifically in the field of wind turbines, Debruijn, Stam & Dewolf (1984) performed acoustic measurements in small and medium wind energy conversion (WEC) systems, finding that the radiated noise is more affected by the rotational speed than the wind inflow velocity. Van der Borg & Vink (1994) carried out noise measurements on wind turbines, evaluating separately the contribution of tonal noise and that obtained with different blades on the same rotor, finding that changing blade geometry has a marginal effect on noise production. Oerlemans, Sijtsma & López (2007) performed acoustic field measurements for a three-blade wind turbine with a rotor diameter of 58 m, to characterise noise sources and to verify the dominance of trailing edge noise over other mechanisms. Ramachandran, Raman & Dougherty (2014) exploited the beamforming method to measure the aerodynamic noise sources in wind turbines, confirming that the trailing-edge noise source is dominant in the noise produced by the blade.

The fluid dynamic analysis showed the following features: a turbulent boundary layer develops over the blades together with a composite system of tip vortex, blade wake and root vortices in the near wake; the intermediate wake is characterised by destabilisation of the tip vortex and the mutual inductance mode triggering the leap-frogging mechanism; the fully turbulent wake populated by a number of turbulent structures is present in the far field. Our results agree with those of the relevant literature.

The contribution of the wake to the noise is significant in the low-frequency range $f < 4 fT$. Among the vortical structures present in the wake, the role of vortex grouping has been highlighted: it causes the loss of tonal peaks, at the blade passing frequency, and generates low-frequency broadband noise.

The contribution to the noise originating from different regions has been investigated, considering two different configurations, the first composed of three different annular concentric regions, and the other composed of different sub-regions of the wake. The analysis of the first configuration confirmed that the trailing edge vortex system is the most important noise source, as regards the linear part of the noise; while the tip vortex system, together with its instability and evolution in the intermediate wake, is the dominant mechanism of the nonlinear noise source.

Exploring the effect of wind farm flow on wind turbine noise propagation through numerical simulations. Jules Colas, Ariane Emmanuelli, Didier Dragna, Philippe Blanc-Benon, Benjamin Cotté, Richard Stevens. 10th International Conference on Wind Turbine Noise Dublin- 21st to 23rd June 2023

The rapid expansion of onshore wind farms has led to increasing concern over the noise impact on the surrounding areas. Noise from wind turbines comes primarily from the aeroacoustic broadband noise generated by the wind interacting with the rotating blades. This noise is mostly in the low-frequency range and can propagate over several kilometers. Recent measurements have demonstrated the importance of amplitude modulation (AM) in wind farm noise annoyance (van den Berg, 2005; Hansen *et al.*, 2019). Numerical simulations have explored the AM phenomenon, revealing that close to the source, AM is primarily caused by the rotating source and changes in noise production due to flow inhomogeneity (Tian and Cotté, 2016). AM occurring downwind is attributed to the focusing zone generated by the wind turbine's wake. The displacement of these focusing zones due to blade movement creates high variations in downwind sound pressure levels (Barlas *et al.*, 2017a). Therefore, precise sound propagation simulations and source models, that take the atmospheric boundary layer (ABL) into account, are necessary to predict these noise characteristics. Studies have investigated the effects of flow on sound propagation for single wind turbines, including the effects of the wake (Barlas *et al.*, 2017b) and the 3D effects of the flow (Heimann and Englberger, 2018). **However, the precise interaction between multiple turbines and its impact on AM or sound pressure level (SPL) has not been fully explored.**

Response from ML: Unknown impacts suggest the Precautionary Principle

4.5

The site and its vicinity may include for a range of species, including pine martin, shrews, dormouse, hedgehogs, cuckoo, bull finches, butterfly and larvae, bees, wasps, snails, worms. While the EIAR details the potential for impacts on fauna, e.g. Irish hare, Fox, Irish Stoat, consideration of the effect of the project on the above listed species should be outlined. This should also consider the proposed and revised Biodiversity Management and Enhancement Plan, in Item 5.

The potential for the Proposed Project to result in impacts on other protected fauna, besides those recorded within the Proposed Project site during ecological surveys undertaken, and other species identified as being KERs, has been considered in Section 6.4.3 of the EIAR, and is detailed in Table 6-14. Further detail is outlined in Section 6.5.2.2.5 of the Report.

There is no further reference in this reply in relation to pine martin, shrews, dormouse, hedgehogs, cuckoo, bull finches, butterfly and larvae, bees, wasps, snails, worms. Again ACP is being ignored. There is no Section 6.5.2.2.5 in the Report.

6.4.3 Identification of Key Ecological Receptors Table 6-14 lists all identified receptors and assigns them an ecological importance in accordance with the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009). This table also provides the rationale for this determination and identifies the habitats that are Key Ecological Receptors. These ecological receptors are considered in Section 6.5 of this report and mitigation/ measures will be incorporated into the Proposed Project where required, to avoid potential significant impacts on the features.

Table 6-14 Key Ecological Receptors identified during the assessment.

Ecological feature or species	Reason for inclusion as a KER	KER
Designated sites	<p>Nationally Designated Sites</p> <p>The following Nationally designated site is located downstream of the Proposed Project (via surface water, downstream of the Proposed Grid Connection underground cabling route). A pathway for impact via groundwater quality deterioration as a result of the Proposed Project was also identified:</p> <ul style="list-style-type: none"> ➤ Lough Corrib [000297] <p>This designated site has been assessed as of International Importance due to its also having a European designation.</p>	Yes
	<p>European Designated Sites</p> <p>The following Special Areas of Conservation are identified in the AA Screening as being within the Likely Zone of Impact and are assessed fully in the NIS that accompanies this application:</p> <ul style="list-style-type: none"> ➤ Lough Corrib SAC [000297] ➤ Lough Corrib SPA [004042] <p>These sites are assigned International Importance and included as a KER as there is potential for indirect effects on them via water pollution.</p> <p>Note: SPAs within the Likely Zone of Impact are considered in Chapter 7, Birds and in the NIS.</p>	Yes

Chapter 7, Birds and In the FWS		
Local groundwater aquifers and nearby karst features including turloughs	The Proposed Project site is located within the Clare-Corrib groundwater body. Due to the karstic nature of the Site, a potential for impact on local groundwater aquifers in the vicinity of the Proposed Project site as a result of construction works was identified, as well as on a number of nearby karst features, including turloughs, as discussed in Section 6.3.1.3.2. Although several of these identified turloughs are undesignated, turloughs are a priority habitat listed under Annex I of the Habitats Directive and as such are assigned County Importance . The potential for impacts on turloughs that have a national or European designation are assessed in Section 6.5.5.	Yes
Nearby surface watercourses with associated fisheries and aquatic fauna.	There are no watercourses occurring within the Proposed Wind Farm site. The only surface watercourses occurring within the EIAR Site Boundary are those occurring along the Proposed Grid Connection underground cabling route i.e. the Clare River and tributaries. The Clare River is of International Importance due to its designation under	Yes
	<p>Lough Corrib SAC and the presence of the Annex I habitat 'Water courses of plain to montane levels, with submerged or floating vegetation of the Ranunculion fluitantis and Callitriche-Batrachion (low water level during summer) or aquatic mosses [3260]' at this location of the Proposed Grid Connection underground cabling route water crossing</p> <p>In the absence of appropriate mitigation and design, taking a precautionary approach; potential for indirect effect on these watercourses during construction of the Proposed Grid Connection underground cabling route has been identified. Depositing/lowland rivers (FW2) and associated aquatic habitats and related species have therefore been identified as a KER for further assessment.</p> <p>The aquatic species that are associated with the watercourses occurring along the Proposed Grid Connection underground cabling route and downstream have been assigned Local Importance (Higher Value) as they have a high biodiversity value in the local context. A number of species designated as QIs of Lough Corrib SAC are also assigned International Importance, including white-clawed crayfish, Atlantic salmon and lamprey species. There is a potential for indirect effect on these features as well as European eel, aquatic invertebrates and other aquatic species as a result of construction of the Proposed Project. Fish and other aquatic species are therefore included as a KER for further assessment along with the river habitats described above.</p>	

<p>Limestone pavement and associated habitats and protected flora:</p> <p>Exposed calcareous rock (ER2)</p> <p>Calcareous heath (HH2)</p> <p>Dry calcareous and neutral grassland (GS1)</p> <p>Spring gentian (<i>Gentiana verna</i>)</p>	<p>Article 17 mapped areas within the Proposed Wind Farm site, mapped as 'Limestone pavement [8240]', as well as the associated habitats calcareous heath (HH2) and calcareous grassland (GS1), which correspond to Annex I habitats 'European Dry Heaths [4030]' and 'Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) [6210]' respectively, are of International Importance due to their inclusion as part of Article 17 reporting to the European Union. A number of records of spring gentian (<i>Gentiana verna</i>) were found on the Site associated with these habitats. This species is listed as Near Threatened on the Irish Red Data list and is of Local Importance (Higher value). The Proposed Project footprint is located completely outside of these habitats, therefore there is no potential for direct impacts on these habitats and associated flora.</p> <p>However, a potential for impact as a result of dust deposition or vehicular access during construction of the Proposed Wind Farm site was identified and these habitats are included as KERs for further assessment.</p>	<p>Yes</p>
<p>Oak-ash-hazel woodland (WN2)</p>	<p>This habitat is a semi-natural woodland type of high value for local biodiversity and is of Local importance (Higher value). Where this woodland type occurs on limestone pavement within the Proposed Wind Farm site, it is assigned County Importance due to its being a community type of the Annex I habitat 'limestone pavements [8240]'. The footprint of the Proposed Wind Farm is located completely outside of these habitats, therefore there is no potential for direct impact. However, a potential for impact as a result of vehicular access during construction of the Proposed Wind Farm was identified and this habitat is included as a KER for further assessment.</p>	<p>Yes</p>
<p>Treelines (WL2) and Hedgerows (WL1)</p> <p>Stone walls (BL1)</p>	<p>Hedgerows and treelines have been assessed as being of Local importance (higher value) as they provide connectivity to the wider landscape and provide supporting habitat for a wide variety of faunal species. In order to facilitate construction of the Proposed Wind Farm and maintain a separation in distance between the turbine blades and hedgerow features (likely to be used by commuting and foraging bat species locally), there will be some loss of hedgerow/treeline habitat within the Proposed Wind Farm site. For this reason, these habitats have been identified for further assessment as a KER.</p> <p>Stone walls, often occurring in association with hedgerows within the Site have been assessed as of local importance (higher value) as they provide connectivity to the wider landscape and provide supporting habitat for a wide variety of faunal species. In order to facilitate some of the Proposed Wind Farm footprint there will be some loss of hedgerow habitat with associated stone wall within the Proposed Wind Farm site. For this reason, stone walls have been identified for further assessment as a KER in combination with hedgerows.</p>	<p>Yes</p>

	assessment as a KER in combination with heathwoods.	
Immature woodland (WS2) and Scrub (WS1)	Areas of immature woodland (WS2) and scrub (WS1) are located completely outside of the Proposed Project footprint and are therefore not considered further as KERs.	No
Dry meadows and grassy verges (GS2)	Areas of Dry meadows and grassy verges (GS2) are located completely outside of the Proposed Project footprint and are therefore not considered further as KERs.	No
Improved agricultural grassland (GA1)	Most of the Proposed Wind Farm infrastructure is located within Improved agricultural grassland (GA1). This is a highly modified habitat with a low biodiversity value. This is classified as Local Importance (Lower Value). For these reasons, this habitat has not been identified as a KER.	No
Spoil and bare ground (ED2), & Buildings and artificial surfaces (BL3)	These habitats are common and widespread in the wider area. The habitats have been assessed as of Local Importance (lower value) as they are largely associated with artificial site access tracks and are of low biodiversity value. Similarly, the existing road in which the Proposed Grid Connection underground cabling route is located, which is categorised under buildings and artificial surfaces (BL3) is not of ecological significance. For this reason, they have not been identified for further assessment and are not a KER.	No
Badger	Badger as an ecological receptor has been assigned Local Importance (Higher value) on the basis that the habitats within the Proposed Wind Farm site are utilised by a locally occurring badger population of Local Importance. The Proposed Wind Farm layout has been altered to avoid potential for direct impacts on the species as a result of the development infrastructure. Given that the species is known to inhabit the area, potential for direct and indirect impacts on badger therefore considered further in this assessment and the species has been included as a KER for further assessment.	Yes

Otter	<p>While there is no suitable habitat for otter within the Proposed Wind Farm site, a number of records of otter activity were found in the vicinity of the existing water crossings of the Proposed Grid</p>	Yes
	<p>Connection underground cabling route, including along the Clare River. As otter are a QI of Lough Corrib SAC, this population is assigned International Importance.</p> <p>The Proposed Grid Connection underground cabling route has the potential to result in indirect effects on the receptor (as a result of deterioration in water quality i.e. supporting habitat, or disturbance/displacement during construction of the Proposed Grid Connection underground cabling route only) and it is therefore included as a KER and requires further assessment following a precautionary approach.</p>	
Bats	<p>The habitats within and surrounding the Proposed Project site are likely to be utilised by a bat population of Local Importance (higher value). All bat species in Ireland are protected under both national legislation – (Wildlife Act, 1976, as amended) and European legislation – (Habitats Directive (92/43/EEC). Bats are likely to forage and commute within the vicinity of the Proposed Project. No roosting bats were identified during the surveys and no roosting site of National Importance (i.e. site greater than 100 individuals) was recorded within the Site. It is suspected that some PRFs within the Site may provide potential roosting habitat for small numbers of roosting bats. However, none of these PRFs reside within the bat felling buffers. The Site was not found to host a roosting site of ecological significance.</p> <p>The Proposed Project has the potential to result in direct and indirect effects on the receptor. Therefore, bats are included as a KER for further assessment.</p>	Yes
Reptiles and Amphibians	<p>It is considered that the Proposed Project will not result in a significant loss of suitable habitat for reptiles and amphibians. No evidence of populations of amphibians/reptiles being significant at more than a local level was recorded. No likely significant effects on these species are anticipated and therefore further survey/ assessment was not deemed necessary. Based on the lack of amphibian or reptile records for the Site, these species have been assessed as of Local Importance (higher value).</p>	No

Marsh fritillary	Due to the absence of the species occurring within the Site and the small area of suitable supporting habitat occurring within the Proposed Wind Farm site but completely outside of the development footprint, no potential for significant effect on the populations known to occur to the east of the Proposed Project site, or a possible metapopulation that may occur within the Site, have been identified. The species is therefore not considered as a KER for further assessment.	No
Invasive species	No invasive species were recorded within the footprint of the Proposed Project. Nuttall's waterweed and crayfish plague were recorded during the aquatic surveys, however, there are no instream works as part of the Proposed Project. Invasive species are therefore not included as a KER.	No
Additional fauna (e.g Irish hare, Fox, Irish Stoat, etc).	The recorded evidence suggests that the Proposed Project site is not utilised by populations of higher than local significance and no potential for significantly effects have been identified at the population level. Due to the small footprint and nature of the Proposed Project, they are unlikely to be significantly affected by the Proposed Project. For this reason, other faunal species are not considered further in this EIAR. Significant effects are not anticipated.	No

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There is no Section 6.5.2.2.5 in Report

4.6

You are requested to outline the cumulative impact of the proposed development with the anthropogenic effects of noise on biodiversity.

As discussed in Section 12.5.2.1.1 within the Noise Chapter of the submitted EIAR, noise mitigation measures have been prescribed to ensure that noise levels remain within the limits during construction and operation of the Proposed Project. Section 6.6.1.1 of the Report provides further detail on the potential for cumulative effects as a result of noise disturbance to fauna.

12.5.2.1 Proposed Wind Farm

12.5.2.1.1 Turbines and Hardstands and Met Mast Noise Works for the turbines are at a significant distance from the closest NSL, with the nearest NSL being H001 at a distance of 767 m from T06. The nearest third-party NSL is H002, at a distance of 768 m from T01. Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to nearby houses. This represents a conservative approach to the assessment; construction noise levels will be lower at properties located further from the works.

Table 12-13 details the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8 hours over a 12-hour assessment period.

These levels of noise are within the construction noise criterion outlined in Table 12-1; therefore it is concluded that there will be no significant noise impact associated with the construction of turbines and hardstands, therefore no specific mitigation measures are required.

During construction, it is possible that some blasting may be required, as a more efficient method of extracting rock from the Proposed Wind Farm site. Mitigation in relation to blasting outlined in Section 12.6.1.3 will be implemented if blasting does occur.

Vibration

Due to the distance of the proposed works from sensitive locations, vibration effects are not likely at any NSL.

Description of Effects

The likely predicted noise and vibration impacts are below the limits and/or thresholds identified. With respect to the EPA's criteria for description of effects, the likely potential associated effects at the nearest noise sensitive locations associated with construction of turbines and hardstanding areas are described as negative, not significant, and short-term.

6.6.1.1 Cumulative Impact of Noise on Biodiversity The Proposed Wind Farm site in its existing state is a highly modified agricultural environment which is regularly subject to anthropogenic noise in the form of farming activities and livestock management and machinery. The Site is also adjacent to a public road network including the N83 National Road. The construction phase of the Proposed Project has the most potential to produce anthropogenic noise and add to cumulative noise effects. As discussed in Section 12.5.2.1.1 within the Noise Chapter of the submitted EIAR, noise mitigation measures have been prescribed to ensure that noise levels remain within the limits during construction and operation of the Proposed Project. There will be no blasting as part of the Proposed Project. The construction phase will be relatively short term and localised. Staff and machinery will be restricted to dedicated construction access routes. The predicted operational noise levels of the turbines will be within the relevant best practice noise criteria curves for wind farms at all locations. Mitigations measures including noise monitoring and the provision of curtailment if required are prescribed for the operation of the Proposed Project within Chapter 12 of the EIAR. Given the nature of the existing environment at the Proposed Wind Farm site, within a highly managed agricultural setting, as well as the Proposed Grid Connection along existing public roads, and the recorded populations of fauna within the Site, no potential for cumulative effects as a result of noise disturbance to fauna are predicted.

Note Reports from Les Huson in relation to Noise.

Summary of issues:

1. The emerging need for ecosystem restoration to mitigate the impacts of onshore wind energy.
2. Carbon losses are calculated on wind turbine output and not brochure capacity & savings have to include reduced growth sequestration from Wake from -3°C reduction for kilometers downwind

Item 5. Biodiversity Management and Enhancements Plan (BMEP) – (EIAR)

5.1

The referenced Figure 1-1 of the Biodiversity Management and Enhancement Plan (BMEP) which includes habitats clearance areas has not been identified and this should be outlined. The clearance areas should be clearly outlined in the context of existing hedgerow, treelines and woodland, and proposed hedgerow and woodland replanting, on mapping scale of 1:2500.

Appendix 6-7 Habitat Loss and Replanting Map Pack of the Report now provides Figure 1-1 of the BMEP at a scale of 1:2500 which show the habitat loss (hedgerow and treeline) associated with the Proposed Project.

The emerging need for ecosystem restoration to mitigate the impacts of onshore wind energy Lukas Seifert, Bente Jessen Graae, Dagmar Hagen and Roel May. Sustainable Environment 2025, Vol. 11, No. 1, 2567100
<https://doi.org/10.1080/27658511.2025.2567100>

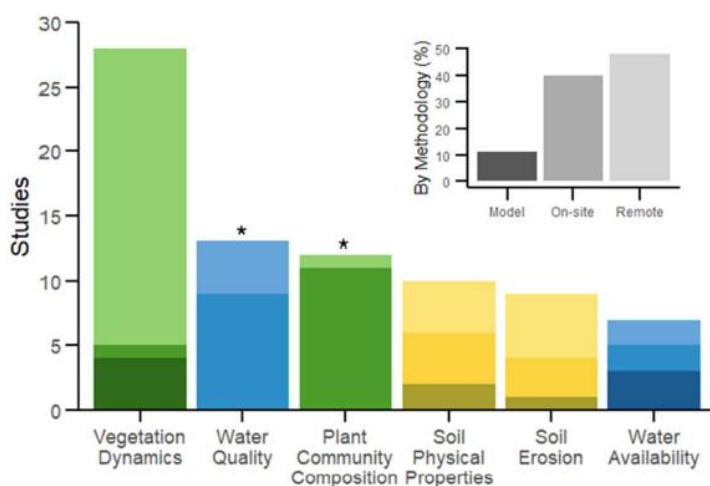


Figure 3. The number of empirical studies on the specific impacts of onshore wind energy on ecosystems. Each impact group is represented by a stack of bars, with different shades (dark, medium, and light) indicating the proportions of different methodologies used. The inset displays the overall proportions of methodologies used across all empirical studies ($N = 62$). * No model simulations were used in studies on water quality and plant community composition.

Emerging evidence links wind power plants to changes in vegetation, soil, and hydrology. This may contribute to ecosystem degradation, which has been defined as ‘[...] a persistent decline in the structure, function, and composition of an ecosystem compared to its former state’ (Society of Ecological Restoration, 2024).

Literature was retrieved on 25 July 2024, from Web of Science, Scopus, and ProQuest. For Tethys, a faceted search strategy was used to retrieve all references listed under land-based wind and linked to habitat change as a stressor and the physical environment as a receptor. The initial search yielded a total of 1477 references. All references were imported into the EndNote reference manager (The EndNote Team, 2013), and duplicates removed automatically.

Studies were excluded when they: (1) were not in English, (2) did not focus on onshore wind energy, (3) lacked relevance to vegetation, soil, or hydrology, (4) focused on wildlife disturbance, or (5) were not available as full text. This process resulted in 70 references meeting the criteria for inclusion. Following initial selection, a backward and forward reference search was conducted using the Web of Science citation map, identifying 18 additional studies that met the inclusion criteria. In total, 88 studies were included in this review.

Negative impacts on vegetation dynamics can result from vegetation clearings prior to construction, vehicle movement in construction areas (Christol et al., 2021), or wake effects caused by wind turbine blade movement (Diffendorfer et al., 2022; Li et al., 2016). For example, the development of wind power plants has been linked to deforestation (Balotari-Chiebáo & Byholm, 2024; Diffendorfer & Compton, 2014; Enevoldsen, 2018) and declines in overall native vegetation cover (Cetin et al., 2022; Guan, 2023; Turkovska et al., 2021). The associated vegetation loss can be substantial, with individual wind turbines contributing to the clearance of up to 3000 m² of vegetation (Shen et al., 2017). On the project level, the vegetation loss could be as much as 25% of the whole project area (Balik et al., 2017).

Environmental impacts

Vegetation dynamics

Remote sensing studies have confirmed negative impacts on vegetation cover. Qin et al. (2022) found that 59% of 319 wind power plants across the United States exhibited reduced vegetation growth within their main operation area. Other researchers reported decreases in the Normalized Difference Vegetation Index (NDVI), indicating reduced vegetation cover and greenness after wind power plant construction in coastal regions (Aksoy et al., 2023), alpine ecosystems (Ma et al., 2023), and grasslands (Song et al., 2023; Tang et al., 2017). Xia and Zhou (2017) also found a decrease in NDVI after wind power plant construction, although their results were not statistically significant. Lastly, Diffendorfer et al. (2022) observed both increases and decreases in vegetation greenness within the growing season.

Plant community composition

Several studies have examined the impacts of onshore wind energy development on plant community composition. While Ji et al. (2023) documented an increase in species diversity around wind turbines in meadow grasslands, Fraga et al. (2009) found that species diversity was decreased inside the main operation area of a wind power plant within a blanket bog. A long-term study by Urziceanu et al. (2021) found that plots disturbed by wind turbines contained less than 40% of the inventoried rare, endemic, and threatened species of the characteristic steppe vegetation. Losses of endemic species as a result of wind power development were also recorded in mixed-grass prairies (Davis et al., 2018), mires with wet heath vegetation (Fagúndez, 2008), and deserts (Keehn & Feldman, 2018).

Soil erosion

When vegetation is cleared during the construction phase of a wind power plant, bare soil becomes susceptible to erosion from wind and rainfall (Nazir et al., 2020). Peatlands, when drained for safer wind turbine placement, pose a significant risk of carbon loss through erosion (Smith et al., 2014), which can be intensified by the drying of surface soils, depending on season and wind direction (Wang et al., 2023). Additionally, the construction of access roads for wind power plants can trigger peat slides, contributing to further soil loss (Dykes, 2022). In the Karaburun region of Turkey, researchers recorded a total loss of approximately 18,000 tons of soil organic carbon between 2000 and 2019, likely caused by wind energy development (Pekkan et al., 2021). When planning the siting of wind power plants in Chile, it was suggested that the associated soil erosion could increase soil loss by as much as 50% (Martí et al., 2023). Studies conducted in the Yunnan province of China imply that soil loss may even increase by over 1000% when accounting for factors like vegetation damage and rainfall (Ma et al., 2023).

Soil physical properties

Soil physical properties encompass factors such as soil texture, structure, density, temperature, and water-holding capacity (Sanchez, 2019). The construction of onshore wind power plants can alter soil physical properties through activities like excavation, road construction, and the building of related infrastructure (Christol et al., 2021). These disruptions can cause the loss of native soils, topsoil disturbance, and microtopographic changes. They can also lead to soil compaction (Chen et al., 2019), which tended to be highest near wind turbines and decreased with distance (Xie et al., 2014). Furthermore, alterations in ground-level microclimate and soil temperature have been measured (Armstrong et al., 2016), along with changes in nutrient content (Chen et al., 2019; Luo et al., 2021) and soil salinity (Chen et al., 2019). Ji et al. (2023) also studied the influence of wind power plant operation on soil carbon content but found no significant impacts. The effects from decommissioning are expected to be similar to the ones from

construction, which is why turbine pads and underground powerlines are often left in situ to minimize further soil disturbance (Welstead et al., 2013).

Water availability

Onshore wind energy development can affect an ecosystem's water availability via changes in microtopography and soil physical properties (Christol et al., 2021). Gunn et al. (2002) found that during the construction of an access road for a wind power plant in a peatland, the organic topsoil layer was 6L SEIFERT ET AL. compacted, causing water to collect on the upslope side. The water availability can also be reduced actively by inserting ditches to regulate water flow and drain the soil for safer wind turbine placement, which is common practice in peatlands (Murray, 2012). Ditches can be inserted temporarily during construction to regulate surface runoff caused by earthwork activities and to prevent wind turbine pads from being uplifted, or permanently to regulate increased runoff caused by road construction (Stunell et al., 2009). It was suggested that the effects of drainage for wind energy development can far exceed conservative land use estimates and need to be backed up by continuous long-term studies on hydrological impacts (Ramchunder et al., 2009; Renou-Wilson & Farrell, 2009). In addition to drainage, some studies found impacts of wind power plants on local precipitation. Jawaheer et al. (2018) observed a decrease in precipitation one year after the construction of the Roches Noires wind power plant in Mauritius. Similarly, Pryor et al. (2018) found a decrease in summer precipitation caused by wind power plant operation, though the effect was not statistically significant. These findings are contradicted in a study by Fiedler and Bukovsky (2011), who used a regional climate model to demonstrate a significant increase in precipitation resulting from wind power plant operation.

Water quality

Studies on water quality have predominantly centered around wind power plants in peatlands, where peat degradation can contribute to reduced water quality by mobilizing metals and pollutants stored in the peat (Evans et al., 1999). The establishment of wind power plants was linked to increases in water turbidity and nutrient contents (Stunell et al., 2009), as well as dissolved organic carbon content (Ramchunder et al., 2009) in downstream aquatic habitats. The concentration of dissolved organic carbon and suspended sediments was higher in streams disturbed by wind power plants compared to undisturbed reference streams (Grieve & Gilvear, 2009; Heal et al., 2020; Lindsay & Bragg, 2005; van Niekerk, 2012; Waldron et al., 2009). At the Whitlee wind power plant in Scotland, researchers measured increased macronutrient concentrations (Zheng et al., 2018) and export rates (Murray, 2012) following wind power plant construction on peatland. Another study conducted on peatland reported significant impacts on pH and alkalinity (Millidine et al., 2015). However, studies conducted in a Karst environment found no impacts on groundwater quality (Valente et al., 2022).

Consideration of mitigation and restoration

The majority of studies (41 studies) focused exclusively on impacts, while fewer considered the subsequent need for mitigation (24 studies) or restoration (23 studies). This was especially apparent in empirical research, where more than half of the studies (35 out of 62 studies) focused exclusively on impacts, while only few acknowledged the subsequent need for mitigation (16 studies) or restoration (11 studies). In contrast, only 6 of the 26 non-empirical studies focused exclusively on impacts, while the majority addressed the need for mitigation (8 studies) or restoration (11 studies). Another emerging trend was the low concern for restoration in studies that analyzed vegetation impacts. The share of vegetation studies was 58% in the studies exclusively focusing on impacts, and 55% in those mentioning mitigation. This trend was reversed in the restoration group, where most studies concerned soil-related impacts (45%), but only 30% concerned impacts on vegetation, despite the overall dominance of vegetation studies in the reviewed literature. For hydrological studies, no clear trend was observed regarding their consideration of mitigation and restoration.

Discussion

Highlights

This literature review analyzed 88 studies on the impacts of onshore wind energy on vegetation, soil, and hydrology. Empirical studies were more common than non-empirical studies. They primarily focused on vegetation dynamics and highlighted both positive and negative effects, such as increased biomass in grasslands and deserts, but significant

vegetation loss in forests. For impacts on soil and hydrology, empirical evidence remained limited. Few studies included direct field-based measurements of soil compacted, causing water to collect on the upslope side. The water availability can also be reduced actively by inserting ditches to regulate water flow and drain the soil for safer wind turbine placement, which is common practice in peatlands compaction or hydrological alterations, and only a small subset monitored long-term recovery. Moreover, most empirical research lacked standardized methods or site replication, making it difficult to generalize findings across studies. Importantly, nearly half of the studies focused solely on identifying impacts, while few acknowledged the subsequent need for mitigation or restoration. This trend was reversed for non-empirical studies. This imbalance highlights the need to more actively consider how environmental impacts can be mitigated and how degraded ecosystems can be restored in the context of onshore wind energy.

5.2

You are requested to detail the removal of vegetation proposed, including woodland and hedgerow species, which may include hazel groves, oak, ash, hawthorn. Please clarify the specific species to be removed, and the specific replanting to occur in relation to any species removal. This should be clearly outlined on site layout plans and in BEMP mapping.

As described in Section 6.5.2.1.1 of the EIAR, the Proposed Project will result in the removal of 23.3ha of improved agricultural grassland (GA1) [A Guide to Habitats in Ireland (Fossitt 2000)] and 1800m of hedgerow/treeline (WL1/WL2) and associated stone wall (BL1). Detail on the value of hazel woodlands in the context of the Proposed Project site is set out in Section 6.4.3 of the EIAR. In Section 6.5.2.1.3 of the EIAR and Section 3.1 of the BMEP, it is stated that any areas of woodland in close proximity to the Proposed Project will be roped off or fenced off with access strictly prohibited. Section 6.5.3.2.2 of the Report further context to the proposed vegetation removal as a result of the Proposed Project.

5.3

The EIAR makes reference to the BMEP entailing native woodland planting and these areas should be outlined in the BEMP.

While there will be no loss of woodland associated with the Proposed Project, native woodland planting is categorised as treeline line planting in the BMEP (as submitted). The BMEP sets out the replanting of 3600m of linear vegetation within the Site in order to increase hedgerow and treeline habitat and offset the loss of 1.8km of hedgerow and treeline habitat associated with the Proposed Project as shown in Figure 3.1 of the BMEP. the section above. The BMEP also focusses on the establishment of 14.5ha of species-rich calcareous grassland within the Proposed Project site. The purpose of this is to increase the extent of this declining Annex I habitat and to link up existing areas of Annex I species rich calcareous habitats within the Proposed Project site.

5.4

You are requested to clarify if there are ancient woodlands within the site and these and treatments of same should be outlined in the BEMP. This should be outlined on plans and in the BEMP mapping.

As described in Section 6.4.1.2.1 of the EIAR, some areas of hazel woodland occur within the Site and have been classified as oak-ash-hazel woodland (WN2). The importance of this woodland habitat has been recognised and they have been assessed as corresponding with the Annex I habitat type: wooded limestone pavement. As such, woodlands have been completely avoided by the Proposed Project footprint and mitigation has been prescribed for their protection as set out in Section 6.5.2.1.3 of the EIAR and Section 3.1 of the BMEP. Any areas of woodland in close proximity to the Proposed Project will be roped off or fenced off with access strictly prohibited. This fencing is shown in Figure 3-1 of the submitted EIAR Appendix 6-4 (BMEP) and in the updated figures in appendix 6-7.

5.5

Clarity should be outlined on the removal of vegetation and its carbon storage provision. Calculations should be outlined in relation to the carbon storage lost from the proposed removal of vegetation, and from carbon storage anticipated to be attained at the post consent stage following proposed replanting. Mitigation measures should be outlined for the above Biodiversity items, if/where applicable.

Chapter 11 of the EIAR identifies, describes and assesses the potential significant direct and indirect effects on climate arising from the construction, operation and decommissioning of the Proposed Project. A detailed carbon loss and savings assessment is contained in Section 11.4 of the EIAR which considers how the Proposed Project will affect Ireland’s climate via the emission of greenhouse gas emissions associated with all phases of the Proposed Project. The carbon loss assessment provided in Section 11.4.2.1.1 of Chapter 11 of the EIAR is informed by the greenhouse gases associated with the Proposed Project, i.e., the full lifecycle and embodied carbon of materials used (including roads), as well as carbon losses resulting from ground disturbance during excavation. As detailed in Section 11.4.2 of Appendix 11-2 Climate Chapter Addendum of the Report, to ensure a robust assessment in Section 11.5, loss of carbon fixing vegetation have been considered in Section 11.5.2 and 11.5.3 for the detailed impact assessment and Annex 11-1a for further information on assumptions used in this assessment.

11.5.2.1 Calculating Carbon Losses and Savings

11.5.2.1.1 Carbon Losses

The Scottish Government online carbon calculator was used to assess the impacts of the Proposed Wind Farm in terms of potential carbon losses and savings taking into account drainage, habitat improvement, and site restoration. The online calculator is pre-loaded with information specific to the CO₂ emissions from the United Kingdom’s electricity generation plant, which is used to calculate emissions savings from proposed wind farm projects in the UK. Similar data to that used in the worksheet to calculate the CO₂ emissions from the UK electricity generation plant, was not allowable for input for the Irish electricity generation plant, and so the CO₂ emissions savings from the Proposed Wind Farm have been calculated separately from the online carbon calculator as set out in Section 11.5.2.1.2 below. In relation to embodied carbon and associated transport movements of all other ancillary elements of the Proposed Project, the TII Carbon Tool has been utilised to assess the impacts of the Proposed Project in terms of potential carbon losses, and in particular construction phase transport emissions associated with the movement of aggregate material and ancillary elements to the Site; this includes for infrastructure relating to the Proposed Grid Connection. A copy of the outputs is provided as Appendix 11-1 of this EIAR, ‘Carbon Calculations’. Where available and relevant, site-specific information was inserted into the online carbon calculators. Otherwise, default values were used. The main CO₂ losses due to the Proposed Project are summarised in Table 11-6.

Table 11-6 CO₂ Losses from the Proposed Project

Origin of Losses	CO ₂ Losses (tonnes CO ₂ equivalent)	
	Expected	Maximum
Losses due to turbine life (e.g., manufacture, construction, decommissioning)	48,583	49,331
Losses due to backup	31,200	36,920
Losses from reduced carbon fixing potential	1,076	2,170
Losses associated with embodied carbon in construction materials (including aggregates and ancillary infrastructure components associated with the Proposed Project)	17,248	17,248
Losses associated with traffic and transport movements (for all elements of the Proposed Project)	165	165
Total	98,272	105,834

The worksheet models and online tools calculate that the Proposed Project will give rise to 98,272 tonnes of CO₂ equivalent losses over its 30-year life. Of this total figure, the proposed wind turbines directly account for 48,583 tonnes, or 49.1%. Losses due to backup account for 31,200 tonnes, or 31.7%. Losses from reduced carbon fixing potential accounts for 1.1% or 1,076 tonnes. Losses due to embodied carbon accounts for 17,248 tonnes or 17.4% and losses due to construction phase transport emissions accounts for 0.2% or 165 tonnes. The figure of 1076 tonnes of CO₂ arising from ground activities associated with the Proposed Project is calculated based on the entire development footprint being “Acid Bog”, as this is one of only two choices the model allows (the other being Fen). The habitat that will be impacted by the Proposed Wind Farm is predominantly comprised of pastoral agricultural land and smaller areas of scrub and exposed rock. Given the absence of peat, the Proposed Wind Farm will not give rise to any impact on peat habitat. The model assumes that the habitat present is acid bog and as such, presents the 1,076 tonnes CO₂ value above. Therefore, the actual CO₂ losses are expected to be lower than this value. The figure of 17,248 tonnes of CO₂ arising from the embodied carbon of construction materials associated with the Proposed Project is calculated based the types of materials available in the TII Carbon tool such as, concrete, steel, cement and granular fill, and assumes that each HGV or LGV will be carrying material at its full capacity.

The figure of 165 tonnes of CO₂ arising from transport movements associated with construction activities of the Proposed Project is calculated based on the assumption that material will be imported locally or from a port/city location where applicable. Details on the assumptions made for the modelling of embodied carbon and construction phase transport emissions are included in Appendix 11-1.

The values discussed above are based on the assumption that the hydrology of the Proposed Project and habitats within the Site are not restored on decommissioning of the Proposed Project after its expected 30-year useful life. As detailed in the Decommissioning Plan, Appendix 4-7, the wind turbines and met mast will be dismantled and removed offsite. It is not intended to remove the concrete foundations from the ground as it is considered that its removal will be the least preferred options in terms of having potential effects on the environment. The associated foundations will be reinstated and revegetated with an appropriate seed mix and the resumption of natural drainage processes that will have existed prior to any construction. The electrical and fibre optic cabling that connects each turbine to the proposed onsite 110kV electrical substation will be removed from the cable ducting. The cable ducting will be left in-situ as it is considered the most environmentally prudent option, avoiding unnecessary excavation and soil disturbance for an underground element that is not visible with no environmental impact associated with leaving the ducting in-situ. Taking into account the proposals incorporated in the Decommissioning Plan, the actual CO₂ losses are expected to be lower than the values detailed in Table 11-6.

11.5.2.1.2 Carbon Savings

According to the model described above, the Proposed Project will give rise to total losses of 98,272 tonnes of carbon dioxide. A simple formula can be used to calculate carbon dioxide emissions reductions resulting from the generation of electricity from wind power rather than from carbon-based fuels such as peat, coal, gas and oil.

The formula is: CO₂ (in tonnes) = (A x B x C x D) / 1000 where:

A = The rated capacity of the wind energy development in MW

B = The capacity or load factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc.

C = The number of hours in a year

D = Carbon load in grams per kWh (kilowatt hour) of electricity generated and distributed via the national grid.

For the purposes of this calculation, the rated capacity of the Proposed Project is assumed to be 56 MW (based on 8 No. 7 MW turbines). A load factor of 0.35 (or 35%) has been used for the Proposed Project¹⁸. The number of hours in a year is 8,760. A conservative figure for the carbon load of electricity generated by natural gas in Ireland was sourced from Sustainable Energy Authority Ireland’s (SEAI) December 2022 report, ‘Energy in Ireland.’ The provisional emission

factor for electricity generated in Ireland in 2022 was 296 g CO₂/kWh. The calculation for carbon savings is therefore as follows: CO₂ (in tonnes) = (56 x 0.35 x 8,760 x 296) / 1000 = 50,822 tonnes per annum

Based on this calculation, 50,822 tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the Proposed Wind Farm. Over the proposed 30-year lifetime of the development, therefore, 1,524,660 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation.

Based on the Scottish Government carbon calculator as presented above in Section 11.5.2.1.1, 98,272 tonnes of CO₂ will be lost to the atmosphere due to changes in the ground conditions and due to the construction and operation of the Proposed Wind Farm. This represents 6% of the total amount of carbon dioxide emissions that will be offset by the Proposed Project. The 98,272 tonnes of CO₂ that will be lost to the atmosphere due to changes in ground conditions and due to the construction and operation of the Proposed Project will be offset by the Proposed Project in approximately 23 months of operation.

11.4.2 Methodology for Calculating Losses

The development of a wind farm requires the construction of infrastructure, i.e., turbines and associated foundations and hardstands, internal site roads, construction compounds, etc. which results in the loss of carbon-fixing potential of on-site vegetation. The determination of the carbon losses associated with the carbon-fixing potential of this vegetation is not possible due to a lack of Irish specific emission factors required for accurate calculation. The lack of consistent national-level field data and methodologies limits the ability to make accurate projections on carbon sequestration potential for other carbon fixing habitat types, i.e., hedgerow, grassland, etc., and therefore carbon loss associated with removal. While it can be assumed that loss of carbon fixing vegetation will occur as part of the Proposed Project due to the removal of these habitat types, the exact carbon loss is not quantifiable. However, to ensure a robust assessment in Section 11.5 below, these carbon losses have been considered; please see Section 11.5.2 and 11.5.3 below for the detailed impact assessment and Appendix 11-2 for further information on assumptions used in this assessment.

Therefore, there was no carbon loss assessment required for loss of forestry. There will be no loss of woodland associated with the Proposed Project, and therefore there is no planting of native woodland proposed. While some areas of hazel woodland occur within the Site and have been classified as oak-ash-hazel woodland, the importance of this woodland habitat has been recognised, and the Proposed Project has been designed to completely avoid this habitat, i.e., there will be no felling and therefore no carbon losses associated with the removal of this vegetation.

As identified in Section 6.5.2.1.1 of Chapter 6 Biodiversity of the EIAR, the Proposed Project will result in the removal of 23.3ha of improved agricultural grassland (GA1) and 1800m of hedgerow/treeline (WL1/WL2) and associated stone wall (BL1). There will be carbon losses associated with this loss of vegetation, as stated in Section 11.6.2.1 above, however the quantification of the exact carbon losses associated with vegetation removal is not possible due to a lack of Irish specific emission factors required for accurate calculation. Similarly, it is not feasible to quantify carbon storage potential associated with replanting due to the range in carbon sequestration rates which are dependent on species composition, soil type, climate, and land management practices.

For hedgerows, carbon storage depends on factors such as age, density, and cutting regimes; while Above-Ground Biomass (AGB) can be estimated, below-ground and soil carbon changes are harder to quantify. Assumptions of carbon storage potential in existing hedgerow could be applied however this information is not yet available and research to determine this is ongoing by Teagasc. As stated in the EPA 2014 Publication 'Carbon Sequestration by Hedgerows in the Irish Landscape',

“reporting and accounting for hedgerow activities under the LULUCF sector have not been possible in the past due to:

- A lack of historic data (baseline data), which are used as a reference period for calculating [greenhouse gas] changes over time
- No national spatial or geographic information systems to detect changes in the area of hedgerows and non-forest woody biomass over time; and
- No inventory information on biomass stock changes in these land-cover types.”

It has been determined that AGB of hedgerows can be measured via direct methods which involves the destructive sampling and weighing of hedgerow material, nevertheless, despite this lack of Irish data, the replanting of hedgerows will over time mitigate the temporary loss of carbon sequestering vegetation that arises during the loss of this habitat during the construction phase. It is important to note that, as outlined in the submitted BMEP, in order to offset the loss of 1800m of hedgerows, it is proposed to replant 3600m of hedgerow habitat within the Proposed Project site for a 100% net gain; once the 3600m of hedgerow is planted and mature, will result in an improvement to current site conditions due to the more extensive coverage of this habitat type. For grasslands, permanent systems can be assessed to show measurable long-term soil carbon accumulation, however changes in soil organic carbon are often slow and influenced by past land use. To determine the carbon sequestration potential of permanent grassland systems, measurements of soil carbon changes is required; to date accurate methods to assess this for Irish grasslands are still being determined.

Note that carbon losses are calculated on wind turbine output and not brochure capacity & savings have to include reduced growth sequestration from Wake-3⁰Centigrade reduction for kilometers downwind.

Summary of Grid Connection issues:

1. Any condition in relation to the proposed grid connection or access over private lands is limited under Section 34(4) to lands which are under the control of & are owned by the Applicant, & the lands are not so owned, and where the imposition of conditions/mitigation measures over the full extent of the route provided for grid connection works cannot be the subject matter of condition where mitigation measures relate to these lands as the said lands do not fall within the jurisdiction conferred by Section 34(4). Article 22(2)(g) provides that where the Applicant is not the legal owner of the land or structure concerned the written consent of the owner to make the application is required. The application proposes works across lands where no consent of the owners of these lands has been submitted notwithstanding the requirements of Article 22(2)(g) of the Planning and Development Regulations. The only exception to this obligation is where the Applicant is a Statutory Undertaker which on the face of the documentation submitted does not fall within this exception and where therefore it is necessary where the development is not being carried out by a Statutory Undertaker that the written consent of the landowner be submitted and accordingly, the application does not comply with the requirements of Article 22(2)(g) of the Planning and Development Regulations. There is no evidence or no basis to disapply the default provision in respect of the grid connection works where the said grid connection is being located in lands where the written consent of the said owner of the lands is required, and where there is no evidence of a type that complies with the obligations under Article 22(2)(g)(ii) on the face of the documentation and specifically, there is no statutory undertaker that has been identified nor could be identified which complies with the requirements such as to disapply the obligation to furnish the said written consent which is required as a mandatory obligation under the said regulations. The Proposed Grid Connection underground cabling route measures approximately 14.3km, of which approx. 12km is located within the public road corridor.

Item 6. Grid Connection (EIAR & NIS)

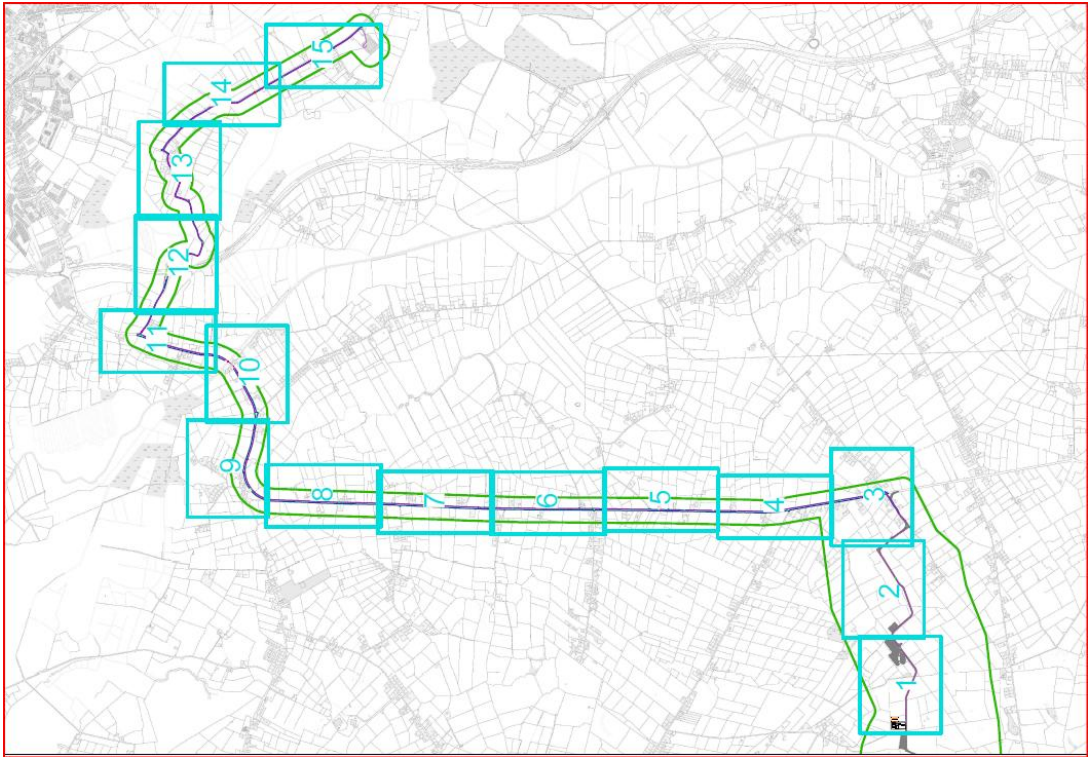
6.1

The design methodology for the grid connection crossings in the EIAR is not consistent with that set out in the NIS. The EIAR outlines the River Clare crossing at the site of the Lough Corrib SAC will be via Horizontal Directional Drilling (HDD), with the NIS outlining the River Clare crossing is via an existing bridge crossing. Clarification is sought on the river crossings proposed, and this should be addressed in environmental assessments, where appropriate, and in relevant drawings, sections.

The design methodology for the Proposed Grid Connection watercourse crossings is correct, and has been assessed as per the crossing methodology detailed in Appendix 4-8a Addendum Grid Connection Infrastructure. An additional Appendix 4-9 Watercourse Crossing of the Report details further information in relation to the proposed watercourses.

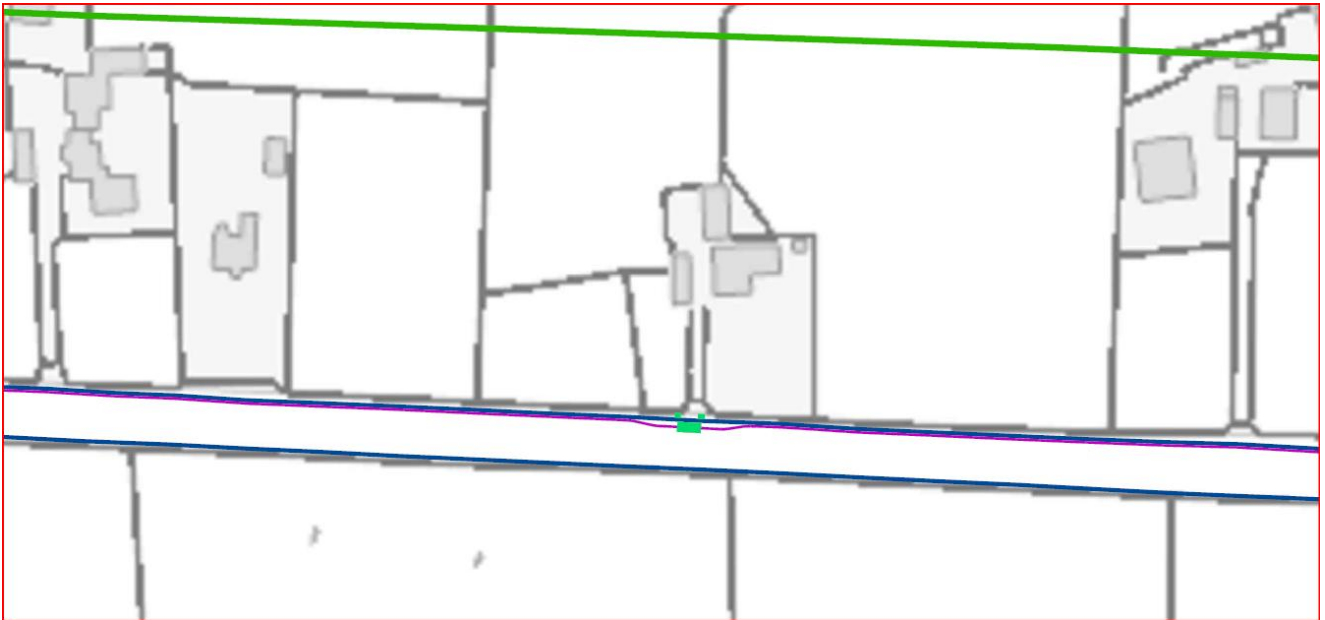
Section 6.2.2.1.1 of the revised NIS has been updated to reflect that the Proposed Grid Connection Underground Cabling Route will cross the River Clare via Horizontal Directional Drilling (HDD). This is fully assessed in the revised NIS with mitigation included to prevent water quality deterioration associated with construction of the Proposed Grid Connection. It has been concluded that there is no potential for the proposed works to result in a residual adverse effect on any European Site once the prescribed measures are implemented.

Note The proposed grid connection constitutes trespass as outlined in *Dromada v Denis Cremins* (attached) and it is not legal for ACP to be involved in trespass on private lands in contravention of the Constitution.

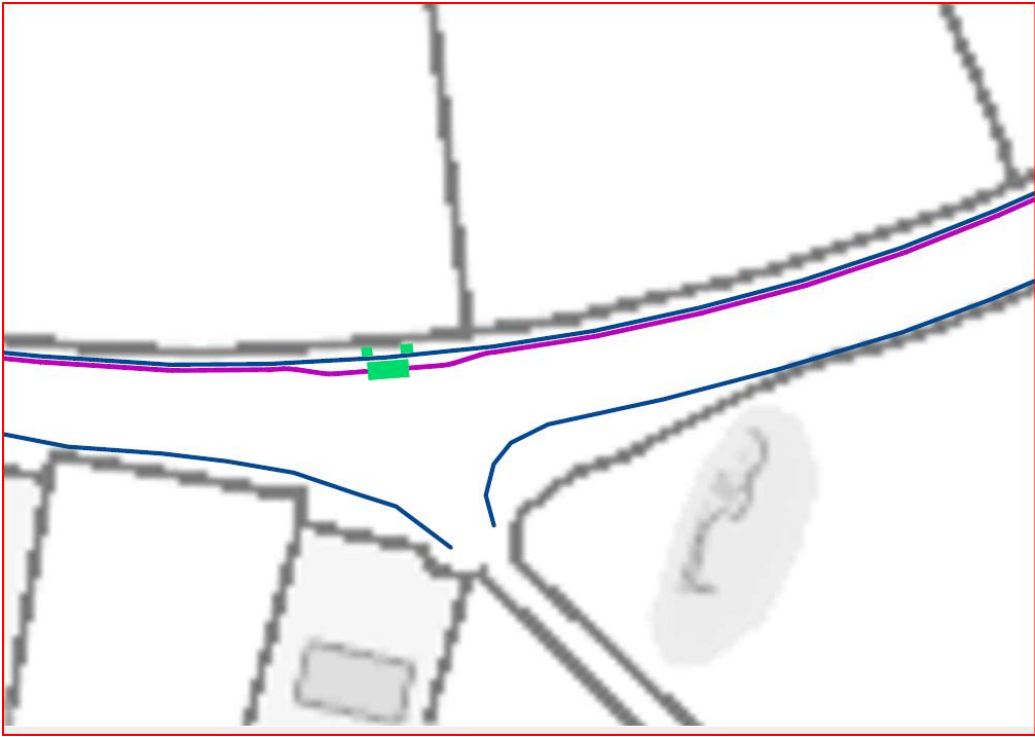


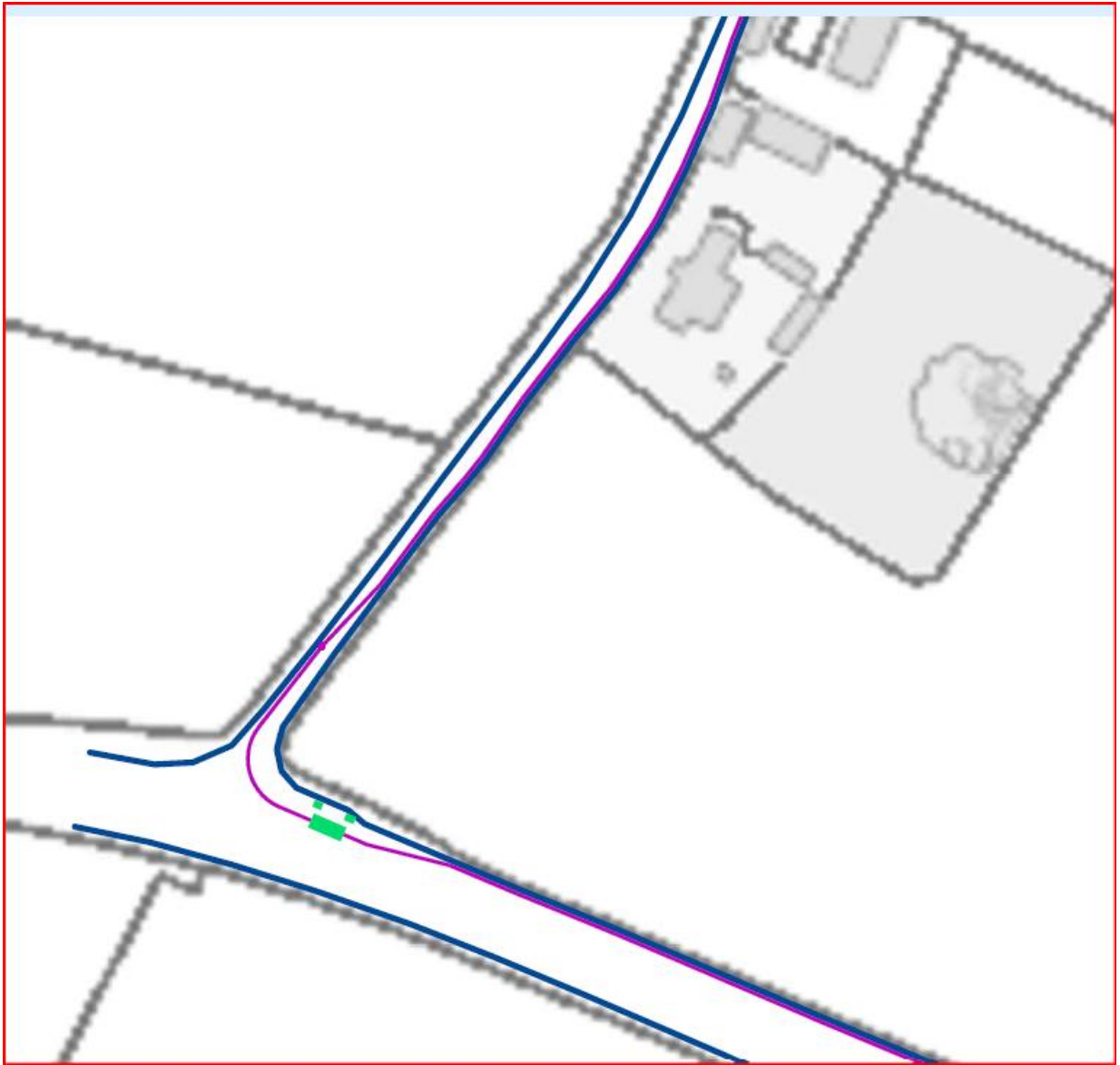














6.2

Site layout plans should be revised to detail the location of all HDD locations, and these should be outlined relative to local drainage and water courses.

The Planning Drawings (included in the Planning Pack) are relevant to S37E Application for the Proposed Wind Farm only. Drawings of the Proposed Grid Connection assessed are included in Appendix 4.8: Grid Connection Infrastructure of the EIAR to facilitate ACP to complete a robust EIA of the Proposed Project. In response to the query by ACP, Appendix 4-8a Addendum Grid Connection Infrastructure of the Report has been updated to outline the proposed HDD at Watercourse Crossing 2 (WC2) to show all proposed HDD locations and HDD pit locations are clearly outlined. The final location and configuration of all HDD location will be detailed in a separate Planning Application for the Proposed Grid Connection infrastructure.

6.3

Potential noise and vibration effects of the HDD on all relevant species should be outlined for any HDD crossing.

As described in Section 6.4.2.3.4 Table 6-13 of Chapter 6 of the EIAR, no evidence of bat roosting was found in the bridge structure over the Clare River where HDD is proposed. Updated surveys were conducted along the Proposed Grid Connection underground cabling route on the 19th of August 2025, which included more detailed bat roost inspections of the existing crossing structures. No evidence of bat roosts were found during the updated 2025 surveys, with further detail on these surveys provided in Section 6.4.2.3 of the Report. Section 6.5.2.2.1 of the EIAR further describes the Assessment of Potential Effects on Bats of any HDD proposed at crossings. Section 6.2.1.2.8 of the revised NIS contains updated detail on potential disturbance to Otter as a result of proposed HDD along the Proposed Grid Connection Route. Section 6.5.2.2.6 of the Report provides further information on potential impacts of HDD on Fauna.

6.4

A schematic of Water Crossing WC1 Type A using standard trefoil formation for the Claretuam Bridge on the N83 should be outlined, if /where applicable.

Drawings of the Proposed Grid Connection assessed are included in Appendix 4.8: Grid Connection Infrastructure of the EIA, which includes a schematic of WC1 via Option A – standard trefoil formation. Appendix 4-9 Watercourse Crossings, provided as an additional appendix to the Report, provides site specific details of all proposed watercourse crossings along the Proposed Grid Connection underground cabling route.

6.5

Cross profiles of all water crossing locations indicating watercourses, riverbanks should be outlined.

Appendix 4-9 Watercourse Crossings, provided as an additional appendix to the Report, provides cross profile details of all proposed watercourse crossings along the Proposed Grid Connection underground cabling route.

6.6

Clarify if any instream works are proposed.

As stated in Section 4.5.1 of the EIAR no surface watercourses exist within the Proposed Wind Farm site. Section 9.3.3.1.1 of the EIAR details that the closest watercourse to the Proposed Wind Farm site is the Ballinduff stream (also referred to as Bunnatubber spring by the EPA) situated 2.6km west of the Proposed Wind Farm site. As described in the EIAR, there are 4 no. watercourses along the Proposed Grid Connection route. No instream works proposed as of the Proposed Grid Connection works. This is detailed in Section 4.7.2.9 Table 4-4 of the EIAR, Section 2.3.2.13 and Section 7 Table 7-1 of Appendix 4-3 Construction Environmental Management Plan (CEMP) of the EIAR. This is also detailed in additional appendix of the Report Appendix 4-9 Watercourse Crossings.

6.7

Please be advised that TII have made an observation on the design methodology on water crossings for the proposed grid connection. TII recommends for water crossing WC1 (Claretuam Bridge) the existing freeboard should be preserved to allow for increasing the size of drainage culverts to provide additional capacity and accommodate additional water flows as required, and consider a HDD crossing (Option D) of WC1 should be deployed as opposed to Option A. While your response to submissions outlines the proposed watercourse crossing methodologies are deemed appropriate, given the design methodology concerns of TII a detailed response for the proposed water crossing at WC1 should be outlined.

As detailed in Section 4.7.2.9 of the EIAR, a total of 4 no. existing watercourse crossings and 1 no. Motorway crossing will be traversed along the N83 National Road and the L6141 to cater for the Proposed Grid Connection underground cabling route towards the existing Cloon 110kV substation. The locations of the watercourse and motorway crossings are shown on Figure 4-28 of the EIAR and specific details of each crossing are shown in Appendix 4-8 Grid Connection Infrastructure of the EIAR Addendum Report. Drawing No. 210627-17 provides crossing specific details of WC1 Type A using standard trefoil formation for the Claretuam Bridge on the N83 above a double concrete pipe. The watercourse crossing methodologies for the provision of the Proposed Grid Connection underground cabling component at these locations is set out in Section 4.7.2.9 of the EIAR, with the most appropriate option selected for each crossing. In stream works are not required at any watercourse crossing along the Proposed Grid Connection underground cabling route. Appendix 4-9 Watercourse Crossings of the Report presents details of each of the 4 no. proposed watercourse crossing points and their respective crossing methodologies. Taking into account the observation made by TII on the design methodology on watercourse crossings for the Proposed Grid Connection the Applicant has reviewed the proposed crossing methodologies for all crossings. The Applicant has noted the comments of TII in relation to HDD (Option D) at WC1 at the Claretuam Bridge. The Applicant and the project engineer has assessed the proposed watercourse crossing methodology at WC1, and concluded that due to the nature of the watercourse type, a double concrete pipe, and its depth approximately 3.3m from the road level, as shown in Drawing No. 210627-17 of Appendix 48a, the proposed crossing methodology of Option A for the Proposed Grid Connection is appropriate at this location.

It is re-iterated here for clarity that the Proposed Grid Connection does not form part of the subject application, but rather will form a separate planning application to ABP under Section 182A of the Act, and all relevant stakeholders will be contacted as part of that application process.

The grid connection is coloured red as part of the planning Application as if it is in the ownership & control of the Applicant. This Application is then invalidated if the Applicant is withdrawing the Grid proposal.

Summary of issues:

1. Shadow Flicker is an issue

Having due regard to the Draft WEDG 2019 and in accordance with best industry practice, the elimination of adverse shadow flicker at dwellings or other potentially affected properties is essential, and that in this regard each turbine should be fitted with an automatic shadow detection and related turbine shut down system which would be triggered during periods where shadow flicker is predicted at any of the identified receptors, until the potential for shadow flicker ceases. It is, however, reported that it may take a short period for complete curtailment to occur, depending on the rotor speed once the pause criteria are met. In this context, the applicant should have provided details of the projected time period (using at least two wind speeds representative of normal operating conditions) once pause criterion is met for turbines to come to a stop and eliminate the potential for shadow flicker at sensitive receptors. In the interests of clarity, and given that within the broader 2km area a 1,620m study area (Section 5.12 WEDG shadow Flicker Guidelines refer) and other 'worst case' and 'expected shadow' boundaries should have been used to model potentially affected properties, the applicant should have confirmed that its intention that the shadow flicker control system and associated pause criteria would have been employed in relation to all of the 243 identified sensitive receptors within the 2km shadow flicker study area. Where the foregoing is not the case, details in relation to how it was proposed that this technology would have been deployed with respect to identified sensitive receptors and study boundaries was required.

2. Wind Turbines and how House Prices are effected

Item 7. Shadow Flicker (EIAR)

7.1

You are requested to provide clarification on the shadow flicker calculations for dwellings presented in the EIAR given the details outlined for dwelling H075 in Table 5-10 Maximum Potential Daily & Annual Shadow Flicker. Calculations should include all dwellings within the study area including H213.

Section 5-9 of the Report provides further clarification on the shadow flicker assessment used to model and predict daily and annual shadow flicker results for the Proposed Wind Farm and on the numbering of dwellings included in Table 5-10 of the EIAR. Following the FIR by ACP, a review was conducted of Table 5-10 of the EIAR, with further detail also provided in this Section of the Report.

5.9 Shadow Flicker Assessment Results

5.9.1 Daily and Annual Shadow Flicker

The WindFarm computer software (version number 5.0.2.2) was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker. The model results assume worst-case conditions, including;

100% sunshine during all daylight hours throughout the year,

An absence of any screening (vegetation or other buildings),

That the sun is behind the turbine blades,

That the turbine blades are facing the property, and

That the turbine blades are moving.

The maximum daily shadow flicker model assumes that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a

sunshine factor of 26.46% has been applied to the annual shadow flicker results as detailed above. Taking this information into consideration, the predicted shadow flicker which is estimated to occur at nearby sensitive receptors is presented in Table 5-10.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the Guidelines' recommendation of committing to less than 30 minutes of shadow flicker per day, or less than 30 hours of shadow flicker per year. If there is any predicted exceedance of shadow flicker at any property, the turbines that contribute to the exceedance are also identified, with mitigation measures required for these contributing turbines.

A total of 243 no. residential buildings have been included in the shadow flicker assessment, the results of which are presented in Table 5-10 below.

Of the 243 no. sensitive receptors modelled, it is predicted that 104 no. sensitive receptors may potentially experience daily shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day, in the absence of mitigation measures. Of these **104 no. sensitive receptors**, 13 no. are participating landowners, and therefore no mitigation is required for these sensitive receptors. Mitigation will therefore be required for the remaining 91 no. properties in order to bring the predicted levels below the threshold of 30 minutes per day and 30 hours per year. This prediction is assuming worst-case conditions (i.e. 100% sunshine on all days where the shadow of the turbines passes over a house, wind blowing in the correct direction, no screening present, etc.) and in the absence of any turbine control measures.

Of the 243 no. properties modelled, when the regional sunshine average (i.e. the mean amount of sunshine hours throughout the year) of 26.46% and is taken into account, the DoEHLG total annual guideline limit of 30 hours is predicted as to being potentially exceeded at 5 no. of the properties. Of these 5 no. properties, 2 no. **are participating landowners, and therefore no mitigation is required.**

Note this is not true. Shadow Flicker can be a health issue for different people. Some people are susceptible & some are not. Compliance with Health Standards is not optional. There are 104 susceptible receptors & turbines would have to be shut down to safeguard them. Noise at nighttime is similar & turbines would have to be shut down overnight.

It is worth noting that in reality, the 'estimated actual' shadow flicker is considered conservative and likely to be significantly less than predicted in Table 5-10 as the following items are not considered by the model:

The model has not been provided as required by EU Case Law on Lacunae & that invalidates the Application.

Receivers may be screened by cloud cover and/or vegetation/built form i.e. hedging, adjacent buildings, farm buildings, garages or barns;

Each receiver will not have windows facing in all directions onto the wind farm;

At distances, greater than 500-1000m 'the rotor blade of a wind turbine will not appear to be chopping the light but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances.

Section 5.9.3.14 outlines the mitigation strategies which may be employed at the potentially affected properties to ensure the daily and annual shadow flicker thresholds will not be exceeded.

5.10 5.10.1

5.10.2 Likely Significant Effects and Associated Mitigation Measures 'Do Nothing' Scenario

If the Proposed Project were not to proceed, the existing uses of small-scale agriculture would continue. The opportunity to harness the wind energy resource of County Galway would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment would also be lost. Construction Phase Within this section, the impact will consider the Proposed Project i.e. both the Proposed Wind Farm and the Proposed Grid Connection will be considered as a whole. Where the

Proposed Wind Farm and the Proposed Grid Connection are required to be considered separately, this is identified within the assessment.

5.10.2.1 Population Those working on the construction phase of the Proposed Project will travel daily to the Site from the wider area. The construction phase will have no effect on the population of the area in terms of changes to the population trends or density, household size or age structure.

5.10.2.1.1 Population Levels Pre-Mitigation Impacts Proposed Wind Farm Those working on the construction phase of the Proposed Wind Farm (turbines and associated foundations and hardstanding areas, Meteorological mast, access roads, temporary construction compound, underground cabling, site drainage, hedgerow felling, and all ancillary works and apparatus), will travel daily to the Site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure. Proposed Grid Connection Those working on the construction phase of the Proposed Grid Connection will travel daily to the site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure.

5.10.2.1.2 Employment and Investment Pre-Mitigation Impacts Proposed Wind Farm The design, construction, operation and decommissioning of the Proposed Wind Farm will provide employment for technical consultants, contractors and maintenance staff. As discussed, it is proposed to construct the Proposed Wind Farm and Proposed Grid Connection infrastructure concurrently which would require approximately 100 employees in total, with an estimated 80 jobs focussing on the construction phase of the Proposed Wind Farm. The construction phase of the Proposed Wind Farm will last between 18-24 months and the decommissioning phase will likely last approximately 6-9 months. The Proposed Wind Farm will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive effect on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term moderate positive indirect effect. Wind Energy Ireland estimates that there are over 5,000 people employed in roles related to wind energy in Ireland in 2023 This figure is anticipated to grow significantly in the coming years as the race to achieve the targets set out in the Climate Action Plan accelerates. Proposed Grid Connection The design, construction and operation of the Proposed Grid Connection will provide employment for technical consultants, contractors and maintenance staff. As discussed, it is proposed to construct the Proposed Wind Farm and Proposed Grid Connection infrastructure concurrently which would require approximately 100 employees in total, with an estimated 20 jobs focusing on the construction phase of the Proposed Grid Connection. Construction of the Proposed Grid Connection infrastructure is estimated to last approximately 9 months of the overall 18-24month construction timeframe. Residual Impact The injection of money in the form of salaries and wages to those employed during the construction phase of the Proposed Project has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive effect on their cash flow. This will have a short-term slight positive indirect effect. Significance of Effects The significance of effects on employment levels and local investment during the construction phase will be slight.

5.10.2.1.3 Land Use Patterns & Activities Pre-Mitigation Impacts Proposed Wind Farm Current land use within the Proposed Wind Farm site comprises small scale agriculture. Current land use in the wider landscape comprises of agricultural, commercial and residential activities. There is no potential for impact on residential and commercial land use in the area. During the construction phase there may be slight interference with agricultural practices where farm practices may be redirected to other fields temporarily. Proposed Grid Connection The current land use and activities at the Proposed Grid Connection footprint comprises pastoral agriculture and transport/access along the national and local road network. Within the Proposed Wind Farm site, the Proposed Grid Connection underground cabling route will follow along the proposed internal access routes. Grazing livestock will be removed from these lands as appropriate. Local temporary traffic disruptions are likely along the N83 and L6141; however, once the construction of each element is complete, agricultural practises can return in the areas surrounding the onsite infrastructure and traffic flow will resume as normal. The proposed works will be rolling in nature; with 100m to 200m being constructed along the N83 and L6141 at any one time. it is estimated that approx. 118 days will be required to lay the underground

grid connection cable in the local road. With respect to the traffic volumes that will be generated during the construction of the underground cabling route, it is estimated that there will be approximately 144 daily return trips made by a truck transporting materials and construction staff to and from the Site. By its nature the impacts of these additional trips will therefore be temporary and slight. Mitigation and Monitoring The following measures will be adhered for the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures.

The construction of the Proposed Grid Connection underground cabling route through the L-61461 local road, N83 National Road, and L6141 Local Road will be undertaken in a rolling construction method with 100m to 200m of cabling installed and back filled each day providing access in the evenings and night hours along the route. A Traffic Management Plan, agreed with the Local Authority, will be in place for the construction phase of the Proposed Grid Connection underground cabling route. The Traffic Management Plan is included as Appendix 15-2 to this EIAR. Local access for residents living along the Proposed Grid Connection underground cabling route will not be closed for the construction phase, along the N83 National Road the road carriageway is wide enough to have access solutions in place, and there are also alternative access roads into the area. Residual Impact Due to the small footprint of the above-ground elements of the Proposed Project infrastructure, on a site scale and even more so on a local scale, the residual effect is considered Negative, direct, slight, permanent impact on land use and negative, direct, slight short-term impact on activities. Significance of Effects The significance of effects on employment levels and local investment during the construction phase will be slight.

5.10.2.1.4 Property Values Pre-Mitigation Impacts Proposed Wind Farm

As noted in Section 5.7 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of a wind farm near them. Proposed Grid Connection As noted in Section 5.7 above, the conclusions from available international literature indicate that 95% of property values (residential and agricultural) show no correlation with the presence of grid infrastructure in the area, with opinions on nearby grid infrastructure diminishing over time. In some cases, property values were demonstrated to increase, however, causation with grid infrastructure cannot be determined. Residual Impact It is on this basis that it can be concluded that there would be a short term negative imperceptible impact from the construction phase of the Proposed Project. Significance of Effects The effect on property values due to the construction of the Proposed Project is not significant.

This statement is incorrect.

Wind Turbines and House Prices Along the West of Ireland: A Hedonic Pricing Approach. Gillespie T, McHale P (2023), Centre for Economic Research on Inclusivity and Sustainability (CERIS) Working Paper Series, 2023/01.

Despite the benefits associated with wind energy, wind turbines impose undesirable externalities on residents mainly through aural and visual pollution. In this paper, I perform a preliminary evaluation on the effect of wind turbines on listed house prices in Ireland. I employ a unique dataset of exact turbine locations with housing and amenity data in seven counties along the west and southern coast of Ireland. With this I conduct a hedonic pricing analysis incorporating spatial and temporal fixed effects. The analysis finds a robust and significant reduction in property value of -14.7% within 1km of a turbine. The effect increases with turbine height, count, and level of urban influence. However, there is evidence that the price effect decays over time, becoming insignificant after 10 years. Furthermore, exhibited effects likely persist beyond 1km, although they are not significant in this analysis. In short, the results presented in this paper are consistent with existing European studies, enforcing the recommendation that turbines should be constructed in highly remote areas to minimise impacts on residents.

The estimated effects from proximity to a wind turbine on house price for dwellings in three of the six area classes: rural areas with high urban influence, rural areas with moderate urban influence, and highly rural/remote areas. Cities, satellite towns, and independent urban towns are not reported due to sample size concerns. There are fewer than 10 observations within 1km of a turbine and no more than 60 observations within 1-2km across all three urban classes combined. Proximity to a wind turbine has a significant negative effect across all three rural classes with the greatest estimated effects in rural areas with moderate urban influence at -20.1%.

Commercial wind turbines and residential home values: New evidence from the universe of land-based wind projects in the United States Eric J. Brunner, Ben Hoen, Joe Rand, David Schwegman, Energy Policy 21 September 2023
www.elsevier.com/locate/enpol

While the majority of U.S. studies have found small negative and insignificant effects of proximity to wind turbines on property values, the evidence from studies that use data from European countries typically finds that proximity to wind turbines reduces residential property values.

For example, using data from Denmark, Jensen et al. (2014) estimate that homes where residents can see a turbine decline in value by 3%, and these homes decline by an additional 2% if residents can hear the turbines when compared to those properties outside of visible or auditory range. They also find effects fade as distance increases.

Gibbons (2015) finds that English and Welsh homes with a visible wind energy project within 2 km experience approximately a 5%–6% decline in value relative to homes without a view and those located farther away.

From the Netherlands and using a difference-in-differences identification strategy, Droes and Koster (2016) find a 1.4% reduction in home prices for homes located within 2 km of a wind turbine with the effects being larger for homes located near turbines in urban areas and for larger turbines.

Similarly, using data from Germany, Sunak and Madlener (2016) and Sunak and Madlener (2017) find that turbine visibility and close proximity to wind turbines reduces residential home values by approximately 9%–20% respectively.

Jensen et al. (2018), Droes and Koster (2021) and Eichholtz et al. (2023), using data from Denmark, the Netherlands, respectively, find that close proximity to wind turbines reduces residential property values by between 3%, 6% and 7%.

The stark difference in findings between studies conducted in the U. S. and those conducted in Europe raises an important question: why do European studies nearly universally find that wind turbines reduce residential property values (and in many cases by a considerable magnitude), while studies from the U.S. typically find small and statistically insignificant effects? While the existing literature provides no definitive answer to that question, there are several possibilities. First, the population density of Europe is approximately 3.5 times higher than that of the U.S. Furthermore, that figure represents average population density and most wind turbines in the U.S. are located in the less densely populated areas of the Midwest and Southwest. Thus, it is simply harder to site wind turbines farther away from residential locations in Europe than in the U.S. Second, and relatedly, European studies tend to have significantly more residential sale transactions in close proximity to a wind turbine. For example, Droes and Koster (2016) observe 149,939 transactions within 2 km of a wind turbine while in the largest U.S. study to date, Hoen et al. (2015) observe approximately 1200 homes within 1 mile of a turbine.

Influence of onshore wind turbines on land values Jan von Detten, Johann V. Seebaß, Jan C. Schlüter, Florian Hackelberg. 4 May 2023. Springer . <https://doi.org/10.1365/s41056-023-00067-5>

The economic consequences of wind turbines on property prices and land values are a widely discussed political and social issue. In this study, in addition to the previous research on the impact of wind turbines on property prices, the influence of wind turbines on standard land values was examined for the first time. The study thus provides new insights, particularly with regard to the debate on distance areas and financial compensation payments for residents. The chosen investigated area is located in Northern Germany and comprises three coastal districts in the state Schleswig-Holstein with a total of 1382 land zones and a high density of wind turbines. Using ordinary least squares models, the significant influence of wind turbines on the standard land values could be shown within a radius of up to 9km. Using an exemplary municipality for the study area, an average change in the standard land value of 7.33% per 1000m distance could be determined. Overall, the standard land values of less densely populated areas were affected more than urban areas.

Jensen et al. (2018) examined around 40% of Denmark's total area in their study and found that, within a radius of 3km around a wind turbine, property prices are negatively influenced. In addition, they demonstrated a correlation between the number of wind turbines and the amount of price decrease. Studies from the Netherlands and England also found that the visibility of the plant has a decisive influence (Gibbons 2015; Dröes and Koster 2014). Gibbons (2015) found that properties with visible wind turbines within a radius of 2km have a 5–6% decrease in value. This effect depended largely on the height of the wind turbines. For Greece, Skenteris et al. (2019) applied various hedonic pricing models to evaluate the visual impact of wind farms on dwelling prices. Depending on their modelling setup, they found either no significant effects or a negative correlation within 2km radius. Westlund and Wilhelmsson (2021) found reductions in the value of Swedish properties in vicinity to wind turbines, which exponentially decrease in distance. Moreover, their

results indicate that not only the sheer existence of such turbines but also their number and their height impacts value changes.

Sunak and Madlener (2016) took disturbing variables into account, the authors found that their difference-in-difference approach had a significant effect of 9–14% on the offer prices when a wind turbine has a clear visual impact on the property. The most recent study is provided by Frondel et al. (2019), who have evaluated more than 2.7 million offer prices over the years 2007 to 2015 using an OLS model. An average negative influence of 7.1% was found for properties located within one kilometre of a wind turbine. The influence decreases steadily up to a distance of 8–9km from the plant, after which no further effect could be determined. With up to 23.0%, wind turbines have a particularly high influence on the supply prices of old and rural properties, whereas no significant effect was observed in urban areas. The results of Sunak and Madlener (2016), who applied augmented spatial models on German data, imply that sheer distance to wind turbines is of less importance than the actual visual impact on a specific dwelling or property.

The impact of wind farm visibility on property values: A spatial difference-in-differences analysis.

Yasin Sunak, Reinhard Madlener. *Energy Economics* Volume 55, March 2016, Pages 79-91.

<https://doi.org/10.1016/j.eneco.2015.12.025>

Today's investment decisions in large-scale onshore wind projects in Germany are no longer determined only by the investment's economic benefit, but also by concerns associated to social acceptance. Despite a mostly positive attitude towards the expansion of wind power, local public concerns often stem from the belief that the proximity to large-scale wind farms may lead to a decrease in property prices. In particular, the change in landscape caused by the construction of a wind farm may have an adverse impact on the view from some properties, and thus may negatively affect their price. To investigate the potential devaluation of properties in Germany due to wind farms, we use a quasi-experimental technique and apply a spatial difference-in-differences approach to various wind farm sites in the federal state of North Rhine-Westphalia. We adopt a quantitative visual impact assessment approach to account for the adverse environmental effects caused by the wind turbines. To properly account for spatial dependence and unobserved variables biases, we apply augmented spatial econometric models. The estimates indicate that the asking price for properties whose view was strongly affected by the construction of wind turbines decreased by about 9–14%. In contrast, properties with a minor or marginal view on the wind turbines experienced no devaluation.

Even if wind turbines are visible from distances of up to 30 or 40 km under certain circumstances, usually the significance of a visual impact can be expected to drop substantially beyond distances in excess of two to three kilometers (Bishop, 2002, Sullivan et al., 2012).

Clean Energy Wire, Journalism for the energy transition. Benjamin Wehrmann 21 Jan 2019.

German homeowners could see the value of their property fall if wind turbines are built in their vicinity, according to a study by research institute RWI. The value of a one-family house falls by an average of 7 percent when a wind turbine begins operation within 1 kilometre of the property, RWI estimates, based on a review of close to 3 million offers on an online real estate website. The effect disappears at a distance of 8 to 9 kilometres, RWI says, adding that the drop in value is down to potential noise pollution and the turbines' aesthetic impact on the landscape. The study found that the value of older houses in rural areas dropped by up to 23 percent, while almost no devaluation was observed for houses built on the outskirts of larger towns. "Wind power may be important for the success of the energy transition but implications for property owners can be severe in some cases," RWI researcher Manuel Frondel said. Several regional governments in Germany have imposed strict minimum distances from residential areas for new onshore wind turbines, but critics argue this could pose a significant challenge to meeting the country's renewable power targets. According to a study commissioned by WWF in October 2018, available land will become "the new currency" of Germany's energy transition

Impact Analysis of the Niyol Wind Farm on Surrounding Rural Residential and Agricultural land Values in Logan County Colorado. June 11, 2020. FORENSIC APPRAISAL GROUP 116 E. Bell Street Neenah, WI 54956 ph (920) 558-4638 www.forensic-appraisal.com.

- The Landsink (Ontario, CA) study found a loss range of -8.85% to -50%, with a loss average of -39% for residential homes within 664ft to 2,531ft of a wind farm.

- The Appraisal Group One Wisconsin Study found a typical loss of 1-10 acre residential lots within ½-mile of wind turbines to be -19% to -40%.
- The Clarkson University upstate New York study of both residential and agricultural properties found a loss ranging from -15.6% to -31% within 1-3 miles of a wind farm.
- The Forensic Appraisal Coral Springs (WY) study of large residential lots (35 acres) which would be abutting a proposed wind farm suffered a value impact of -25% to -44%.
- The McCann study (IL) of residential properties found an average impact of -25% within 2-miles of a wind farm.
- The Forensic Appraisal Big Sky (IL) study found a loss range of -12% to -25% of residences within 0.31mi to 1.72mi of a wind turbine, with an average impact of -19% at an average distance of 0.65 miles to a wind turbine.
- The Twin Grove II Wind Farm (McLean County, IL) study of a 198MW wind farm comprised of 120 turbines being 397ft in height over an 11,000 acres area.

A paired sales analysis of residential property within the influence of the wind farm found the improved property is negatively impacted by the presence of wind turbines. The impact measured ranged from -46.6% to -7.7%, with the higher impact closest to the wind turbines and the impact diminishing as the distance is increased. The distances measured ranged 1,483ft to 5,481ft away from a residence.

The Twin Grove II Wind Farm also found an overall impact of -6.63% to -8.5% for vacant agricultural properties within the wind farm zone.

Properties within the Wind Farm Footprint= -35% impact on property value

Properties : 1-Mile outside of the Wind Farm Footprint = -22%

impact on property value : Agricultural Properties within the Wind Farm Footprint= 8.5%
impact on property value

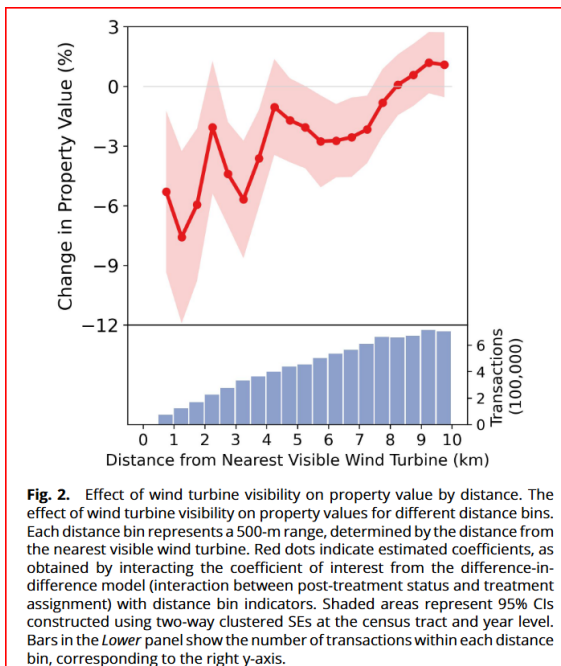
Application of these estimated losses to the client's property value is:

<i>Niyol Wind Farm Loss to Property Value Estimate</i>			
	<i>Total assessed value</i>	<i>impact</i>	<i>value loss</i>
<i>Properties within the footprint</i>	<i>\$6,948,960</i>	<i>-35%</i>	<i>-- \$1,405,051</i>
<i>Properties 1-mile outside of the Footprint</i>	<i>\$4,014,430</i>	<i>-22%</i>	<i>-\$1,528,771</i>
			<i>-\$2,933,822</i>

The visual effect of wind turbines on property values is small and diminishing in space and time. Wei Guoa, Leonie Wenzc, and Maximilian Auffhammere. Edited by Geoffrey Heal, Columbia University, New York, NY; received June 3, 2023; accepted January 10, 2024. 121 (13) e2309372121. <https://doi.org/10.1073/pnas.2309372121>

Results Property Value Impacts.

We find that having at least one wind turbine in a home's viewshed (10 km radius) reduces the sales price of such a property on average by 1.12%. **But note the 8% drop in the 1-2km range in Fig. 2 below.**



The impact of visual disamenity created by wind turbines may also vary depending on the distance from the nearest visible turbine. To test how the effect varies by distance, we re-run the baseline specification with the indicators of interest interacted with 500-m (0.3-mile) distance bin indicators for the proximity of the closest wind turbine. The effect of wind turbine visibility decreases as distance increases (Fig. 2). **The effect is largest in immediate proximity of wind turbines—with the visual disamenity reducing property values by up to 8% within a neighborhood range of 1.5 km (0.9 miles). Even though this number is economically large, there are two noteworthy caveats. First, the CI is sizable including reductions in property value between 3 and 13%. Second, the number of properties within this distance bin is small. Nationally, there are fewer than 250,000 transactions within 1.5 km of the nearest wind turbine, as opposed to approximately 8.5 million transactions within 10 km.**

Moreover, we find that properties within 10 km from wind turbines are 1.16 to 1.7% lower in sales price than those 10 to 50 km away. These gaps are not driven by differences in the housing characteristics of properties located in different communities. Therefore, the cross-sectional difference in property value between visible and non-visible areas as well as between proximate and distant areas indicates a potential selection effect that is consistent with the siting of wind turbines in places with lower property values.

We investigate whether the visual impact of wind turbines varies with the intensity of visibility using two measures: The number of wind turbines in view and the intensity classified by whether there are more than 20 turbines in sight. We find that the capitalization of the visual disamenity increases with the treatment intensity, with every additional 10 wind turbines in view reducing the property value by an additional 0.2% [Table 1, column (2)]. Furthermore, wind farms with more than 20 turbines reduce the property value in visible areas by an average of 2.48%, whereas those with less than 20 turbines have a reduction effect of only 1.02% on visible areas [Table 1, column (3)]. These findings suggest that the density of wind turbines in view plays a role in driving the magnitude of the visual disamenity valuation.

The findings indicate that wind turbines have a negative effect on property value in locations where they are visible. On average, across the whole sample, house prices decrease by up to 8% after the construction of a wind turbine within viewshed and close neighborhood range from the property, with the effect decaying as the distance increases. The average effect falls to a 1% reduction for houses within 10 km of visible wind turbines. It also diminishes over time—both in terms of more recent installations having a smaller disamenity effect and in the sense that the reduction in value a property experiences peaks 3 y after the installation and then becomes smaller the more years pass. These findings are consistent with a cognitive model where people get used to new structures in their environment over time.

The reduction in property values resulting from wind turbine installations raises questions about how this might affect siting decisions for future wind farms. This paper highlights the externality of wind power developments as they are capitalized in the housing markets. These estimates could also serve as a future basis for calculating compensation to local homeowners for placing a new wind turbine within their viewshed.”

Commercial wind turbines and residential home values: New evidence from the universe of land-based wind projects in the United States, Eric J. Brunner, Ben Hoen, Joe Rand, David Schwegman. Energy Policy Volume 185, February 2024, 113837. <https://doi.org/10.1016/j.enpol.2023.113837>

We examine the impact of proximity to land-based commercial wind turbines on residential home values in the United States using data on the universe of commercial wind turbines and residential property transactions from 2005 to 2020. Using event study and difference-in-differences identification strategies we find that, on average, homes located within 1 mile of a commercial wind turbine experience approximately an 11% decline in value following the announcement of a new commercial wind energy project, relative to counterfactual homes located 3 to 5 miles away.

The impact of on-shore and off-shore wind turbine farms on property prices. May 2018. Cathrine Ulla Jensen, Toke Emil Panduro, Thomas Lundhede, Bo Jellesmark Thorsen. Energy Policy 116(1):50-59
DOI: [10.1016/j.enpol.2018.01.046](https://doi.org/10.1016/j.enpol.2018.01.046)

We present the results of a large-scale analysis on how on-shore and off-shore wind turbines affect the property prices of nearby single family residential and vacation homes in Denmark. **We find that on-shore wind turbines negatively affect the price of surrounding properties to a distance of three kilometers.** The negative impact increases with the number of wind turbines at a declining marginal rate but declines with distance. In the case of off-shore wind turbine farms, we do not find a significant effect of having an off-shore wind farm in view from a property itself or from the nearest beach, likely because the closest off-shore turbine is 9 km from the closest traded home. We illustrate the policy relevance of our findings by providing maps showing how the marginal impact of a wind turbine varies across the landscape according to the spatial distribution of home density and homes values in the proximity of a wind turbine site. The results suggest that ceteris paribus, wind turbine farms should be built quite far away from residential areas with turbines gathered in larger wind farms rather than installed as single turbines.

Wind turbines, solar farms, and house prices. August 2021. Martijn I. Dröes, Hans R.A. KosterEnergy Policy 155(1):112327. DOI: [10.1016/j.enpol.2021.112327](https://doi.org/10.1016/j.enpol.2021.112327). License [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

This paper examines the effect of wind turbines and solar farms on house prices. Using detailed data from the Netherlands between 1985 and 2019, the results show that tall wind turbines have considerably stronger effects on house prices, as compared to small turbines. **For example, a tall turbine (>150m) decreases house prices within 2 km by 5.4%, while a small turbine (<50m) has an effect of maximally 2% and the effect dissipates after 1 km.** Further results indicate that solar farms lead to a decrease in house prices within 1 km of about 2.6%. By comparing the overall impact on house prices, we show that the external effects of solar farms per unit of energy output are comparable to those of wind turbines. Thus, building solar farms instead of wind turbines does not seem to be a way to avoid the external effects of renewable energy production.

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ANN O'LOUGHLIN



Four people who took High Court actions against a wind farm operator have been awarded a combined sum of over €300,000 in damages arising from nuisance caused by the wind farm.

Ms Justice Emily Egan held that noise levels from the two-turbine Ballyduff Windfarm at Kilcomb, near Enniscorthy, Co Wexford, amounted to an “unreasonable interference” with the enjoyment of two properties.

The challenges, taken against Meenacloghspar (Wind) Limited, of Stillorgan Road, Donnybrook, Dublin 4, were the first private nuisance claims from wind turbine noise to run in Ireland or the UK, the judge said at the time.

However, she said there was insufficient evidence before the court to conclude that that the relationship breakdown could be attributed to the nuisance, or that “but for the [nuisance], Mr Rollo and Ms Webster would be still living together as a couple”.

The judge said Mr Rollo was not currently being prevented from enjoying Hill House due to the nuisance, and with the granting of the injunctive relief, will not prevent him in the future.

“Rather, Mr Rollo cannot return to Hill House because of the couple’s separation,” she said.

The judge also awarded damages arising from the devaluation of both properties caused by the nuisance. She said €55,000 should be awarded to Mr Shorten and Ms Carty to this end, and €30,000 to Mr Rollo and Ms Webster.

5.10.2.1.5 Tourism Pre-Mitigation Impact Proposed Wind Farm

Given that there are currently no tourism attractions specifically pertaining to the site there are no impacts on tourism associated with the construction phase of the Proposed Wind Farm. The Proposed Wind Farm site has some rural aesthetic qualities given the relative lack of buildings and infrastructure present on the site. It is mostly flat agricultural farmland fields defined by vegetated field boundaries and stone walls; however, these views are common throughout the local area and due to the intensive agricultural land-use, it is noted that the landscape has been subject to substantial levels of human interference and modification. Views from within the Proposed Wind Farm site are generally contained given the surrounding flat landscape and the stone walls, treelines and hedgerows present. With regard to tourist attractions and amenity use surrounding the Proposed Wind Farm site, as described in Section 5.4, Knockma Hill is the closest tourist attraction to the Proposed Wind Farm site, however traffic management safety measures will be in place, as outlined within the Traffic and Transport Assessment, included as Section 15.1 of this EIAR where required. Please see below for Traffic impact mitigation measures and Chapter 15 Material Assets for mitigation measures relating to the Proposed Wind Farm site. Proposed Grid Connection Given that there are currently no tourism attractions specifically pertaining to the site there are no impacts on tourism associated with the construction phase of the substation and temporary construction compound. Furthermore, these proposed structures are located on private property therefore no entrance to tourists is currently or will be permitted. There are no tourist attractions located along the Proposed Grid Connection underground cabling route. As the Proposed Grid Connection underground cabling route is not located at a cul de sac, tourists seeking to travel to various attractions in the wider

landscape during the construction phase, can utilise other routes and therefore will not be impacted by the rolling construction phase of the underground cabling route on the N83, L61461 or L6141. However, should tourists want to utilise portions of any of these roads, the laying of cables will be carried out in a rolling nature with approximately 100-200m of cable being constructed in one day, it is estimated that this section of the underground cabling route, including the HDD works will take 118 days to complete, as outlined within the Traffic and Transport Assessment, included as Section 15.1 of this EIAR. The location of the construction will be transient in nature with the extent of the section of road closed kept to a minimum. Residual Impact Based on the above it is concluded that there would be a short-term, negative, imperceptible impact on tourism and the wider landscape due to the construction phase of the Proposed Project. Significance of Effects The effect on tourism in the wider landscape due to construction phase the Proposed Project is not significant.

5.10.2.1.6 Residential Amenity Pre-Mitigation Impact Proposed Wind Farm

The potential for impacts on residential amenity is discussed in Section 5.8 above. There is the potential for impacts on residential amenity during the construction phase of the Proposed Wind Farm due to air, traffic, noise and vibration emissions due to the presence of additional traffic and plant machinery. Proposed Grid Connection There is potential for impacts on residential amenity due to the construction of the Proposed Grid Connection. The Proposed Grid Connection underground cabling route will be located within 2 no. local roads (L61461 and L6141) and the N83 National Road, with a total length of 14.3 km. this has the potential to give rise to traffic disruptions.

Mitigation and Monitoring Measures

All mitigation as outlined above and the corresponding chapters: Chapter 11 Air Quality, Chapter 12 Noise and Vibration, and Chapter 15 Material Assets will be implemented in order to reduce insofar as possible, impacts on residential amenity at properties located in the vicinity of Proposed Project construction works. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures. Residual Impact Based on the above it is concluded that there would be a short-term, negative, imperceptible impact on residential amenity due to the construction phase of the Proposed Project. Significance of Effects The effect on residential amenity due to construction phase the Proposed Project is not significant.

5.10.2.2 Health The following impact assessment is produced in accordance with guidance as set out in Section 5.2.2

5.10.2.2.1 Health and Safety Pre-Mitigation Impacts

Proposed Wind Farm Construction of the Proposed Wind Farm will necessitate the presence of a construction site and travel on the local public road network to and from the site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative impact on health and safety.

Proposed Grid Connection

The construction of the Proposed Grid Connection will include working under existing 110kV lines which may impact on electrical infrastructure and supply in the area and along a local road which may give rise to traffic impacts. Furthermore, working in the cavity of power lines and traffic flow is potential health and safety hazard for construction workers. Mitigation and Monitoring Measures The Proposed Project will be constructed, operated and decommissioned in accordance with all relevant Health and Safety Legislation, including: Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005); Safety, Health and Welfare at Work (General Application) (Amendment) Regulations 2016 (S.I. No. 36 of 2016); S.I. No. 528/2021- Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021 and Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006). The following measures below are also detailed in Appendix 4-5 Construction and Environment Management Plan. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures. A Health and Safety Plan covering all aspects of the construction process will address the Health and Safety requirements in detail. This will be prepared on a preliminary basis at the procurement stage and developed further at construction stage. All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be established. The contractor will be obliged under the construction contract and

current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project. Safepass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The developer is required to ensure a competent contractor is appointed to carry out the construction works. The contractor will be responsible for the implementation of procedures outlined in the Safety and Health Plan. Public safety will be addressed by restricting Site access during construction. Fencing will be erected in areas of the Site where uncontrolled access is not permitted.

The suitability of machinery and equipment for use near power lines will be risk assessed. All staff will be trained on operating voltages of overhead electricity lines running the Site. All staff will be trained to be aware of the risks associated with underground cables. All contractors that may visit the Site are made aware of the location of lines before they come on to Site. When activities must be carried out beneath overhead lines, e.g., component delivery or substation construction, a site-specific risk assessment will be undertaken prior to any works. The risk assessment must take into account the maximum potential height that can be reached by the plant or equipment that will be used prior to any works. Information on safe clearances will be provided to all staff and visitors. Signage indicating locations and health and safety measures regarding electrical cables will be erected in canteens and on Site. All staff will be made aware of and adhere to the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) (Amendment) Regulations 2021'. This will encompass the use of all necessary Personal Protective Equipment and adherence to the Site Health and Safety Plan. The suitability of machinery and equipment for use near power lines will be risk assessed. All staff will be trained on operating voltages of electricity cables running the Site. All staff will be trained to be aware of the risks associated with overhead lines. All contractors that may visit the Site are made aware of the location of lines before they come on to Site. When activities must be carried out beneath overhead lines, e.g., component delivery, a site-specific risk assessment will be undertaken prior to any works. The risk assessment must take into account the maximum potential height that can be reached by the plant or equipment that will be used prior to any works. Overhead line proximity detection equipment will be fitted to machinery when such works are required. The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013'. The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project; Where possible, eliminate the hazards or reduce the risks; Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan; Ensure that the work of designers is coordinated to ensure safety; Organise co-operation between designers; Prepare a written Safety and Health Plan; Prepare a safety file for the completed structure and give it to the client; and Notify the Authority and the client of non-compliance with any written directions issued. The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to):

Development of the Safety and Health Plan for the construction stage with updating where required as work progresses; Compile and develop safety file information. Reporting of accidents / incidents; Weekly Site meeting with PSCS; Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out: o Induction of all site staff including any new staff enlisted for the project from time to time; o Toolbox talks as necessary; o Maintenance of a file which lists personnel on Site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date; o Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance; o Monitor the compliance of contractors and others and take corrective action where necessary; and o Notify the Authority and the client of non-compliance with any written directions issued. Residual Impact With consideration of the implementation of the detailed mitigation measures there will be a short-term slight negative residual effect on health and safety during the construction phase of the Proposed Project. Significance of

Effects Based on the assessment above the effects on health and safety during the construction phase of the Proposed Project are considered to be short term slight significant.

5.10.2.2.2 Air Quality: Dust, NO₂, PM₁₀ and PM₂₅ and CO₂ Emissions Pre-Mitigation Impacts

Proposed Wind Farm Potential dust and exhaust emission sources during the construction phase of the Proposed Wind Farm include upgrading of existing access tracks and construction of new access roads, turbine and meteorological mast foundations, temporary construction compound. An increase in dust and exhaust emissions has the potential to cause a nuisance to sensitive receptors in the immediate vicinity of the Proposed Wind Farm site. The entry and exit of construction vehicles from the Proposed Wind Farm site may result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to residents and other road users. The transport of volumes of stone to be transported into the Proposed Wind Farm site also has the potential to create dust, which could affect nearby sensitive receptors. These effects will have a short-term, slight, negative impact on air quality. The potential dust impacts that may occur during the construction phase of the Proposed Wind Farm are further described in Chapter 10: Air Quality.

Proposed Grid Connection Potential dust and exhaust emission sources during the construction phase of the Proposed Grid Connection include the construction of a 110kV internal substation, a temporary construction compound, and the laying of approximately 14.3km of underground cabling and the road upgrade works which are associated with this process. The entry and exit of construction vehicles from the Proposed Grid Connection has the potential to result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to road users and local residents. These impacts will have a short-term slight, negative impact on air quality. The potential dust impacts may occur at construction phase of the Proposed Wind Farm are further described in Chapter 10 Air Quality.

Mitigation and Monitoring Measures The following mitigation measures will be implemented during the construction of the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures. Sporadic wetting of loose stone surface will be carried out during the construction phase to minimise movement of dust particles to the air. In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff. All plant and materials vehicles shall be stored in dedicated areas within the Site. Turbines and construction vehicles will be transported to the Site on specified haul routes only. Construction materials for the Proposed Wind Farm and Proposed Grid Connection will be sourced locally from licenced quarries and transported on specified haul routes only. The agreed haul route roads adjacent to the Site will be regularly inspected for cleanliness and cleaned as necessary. The roads adjacent to the Site entrances will be checked weekly for damage/potholes and repaired as necessary. Waste material will be transferred to a licensed /permitted Materials Recovery Facility (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery or disposal. The MRF facility will be local to the Site to reduce the amount of emissions associated with vehicle movements A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-5). **Residual Impacts** With the implementation of the above measures for this construction phase, residual impacts on air quality from exhaust emissions associated with construction activities and machinery are considered to be in short-term imperceptible negative impact. **Significance of Effects** The effects on air quality from exhaust emissions during the construction phase of the Proposed Project are considered to be imperceptible.

5.10.2.2.3 Water Quality Pre-Mitigation Impacts Proposed Wind Farm

The construction phase ground works and use of plant onsite may give rise to the potential release of suspended solids and hydrocarbons into groundwaters. There are no surface watercourses within the Proposed Wind Farm. There are no underground water or sewerage networks at the Proposed Wind Farm infrastructure locations. There are no source protection zones located within the Proposed Wind Farm, however there are a number of Group Water Schemes within the Proposed Wind Farm site. There are a number of private wells located in the vicinity of the Proposed Wind Farm, and GSI mapping indicates several private boreholes in the area also. Chapter 9 Water assesses the potential for impact on group water schemes and other public water supplies during the construction phase. The pre-mitigation impact on water quality is assessed as Indirect, negative, moderate, temporary, likely effect. **Proposed Grid Connection** There are a number of Group Water Schemes located within and in close proximity to the Proposed Grid Connection infrastructure. The Proposed Grid Connection

underground cabling trench depth will only be approximately 1.3m in depth, the excavation will be temporary and transient, and the cable trench will be backfilled with hardcore material. There are 4 no. watercourse crossings located along the Proposed Grid Connection underground cabling route. The proposed onsite 110kV substation and temporary construction compound are not located in proximity to any surface watercourses. The potential sources of suspended sediment include runoff from spoil excavated from the Proposed Grid Connection infrastructure and entering surface or groundwater systems. The pre-mitigation effect on water quality is assessed as indirect, negative, moderate, temporary, likely effect. Mitigation and Monitoring Measures It is proposed that all rock needed to construct the Proposed Project will be imported into the Site from local quarries. This rock will be used to construct the sub-base layer of proposed upgraded and new access roads, hardstand areas and turbine base areas. Once installed the subbase layer will be overlain by a clean capping layer of high-grade stone material which will be sourced from local quarries. Further information relating to the mitigation measures for control of hydrocarbons during maintenance works as described in Chapter 9: Section 9.5.2.5 A bespoke drainage design which includes but is not limited to interceptor drains, check dams, swales and ponds will be implemented on the Site. Chapter 9 of this EIAR details all best practice and mitigation measures to minimise the potential for entrainment of suspended sediment or potential hydrocarbon leak. Please see Chapter 9 for details and Chapter 18 for a full list of mitigation and monitoring measures for the Proposed Project. Residual Impacts With the implementation of the drainage design and all mitigation measures listed in Chapter 9: Water (separation distances, prevailing geology, topography and groundwater flow directions), it is considered that the residual effects are to be short-term, imperceptible, negative effect on water quality.

Significance of Effects The effects on water quality during the construction phase of the Proposed Project are considered to be imperceptible.

5.10.2.2.4 Noise and Vibration Pre-Mitigation Impacts Proposed Wind Farm

There will be an increase in noise levels in the vicinity of the site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to sensitive receptors as located closest the site. This will be a short-term, very low sensitivity and low magnitude of change human health. The noisiest construction activities associated with wind farm development are excavation and concrete pouring of the turbine bases. Excavation of a turbine base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours. Construction noise at any given noise sensitive location will be variable throughout the construction project, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise impacts that will occur during the construction phase of the Proposed Wind Farm are further described in Chapter 12: Noise and Vibration. Proposed Grid Connection There will be an increase in noise levels in the vicinity of the site during the construction phase, as a result of heavy machinery and construction work which has the potential to cause a nuisance to Sensitive Receptors located closest the Proposed Grid Connection works. This will be a short-term, very low sensitivity and low magnitude of change on human health due to increased noise levels from construction. The noisiest construction activities associated with the construction activities are excavation and concrete pouring of the substation and end mast foundations.

Mitigation and Monitoring Measures Best practice measures for noise control will be adhered to on Site during the construction phase of the Proposed Project to impacts associated with this phase of the development. Please refer to Chapter 12: Noise and Vibration and Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures. No plant used on Site will be permitted to cause an on-going public nuisance due to noise. The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on Site operations. All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract. Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers. Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use. Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen. During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Chapter 12 using methods outlined in British Standard BS 5228-1:2014+A1:2019 Code of practice for noise

and vibration control on construction and open Sites – Noise. The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs Monday to Saturday. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e., concrete pours, large turbine component delivery, rotor/blade lifting) it could occasionally be necessary to work out of these hours. Residual Impact With the implementation of the above mitigation measures, there will be a short-term, slight impact on health due to an increase in noise levels during the construction phase of the Proposed Project. Significance of Effects For the reasons outlined above, the effects on human health due to noise emissions from the Proposed Project during construction will be slight.

5.10.2.2.5 Traffic and Transport Pre-Mitigation Effects Proposed Wind Farm It is proposed that the wind turbine components be delivered to the Proposed Wind Farm site from Galway Port via the N83 National Road. It is proposed that the turbine components will travel north through Galway City before joining the N83 National Road. The temporary road providing access to the Proposed Wind Farm site is then accessed from the N83 National Road. All deliveries of turbine components to the site will follow this route. The proposed route is described in further detail in Chapter 4: Description of the Proposed Project of this EIAR. Non-turbine construction traffic e.g., Heavy Goods Vehicles (HGVs) and Light Goods Vehicles (LGVs) movements involved in the delivery of construction related materials to the Proposed Wind Farm site will also enter the Proposed Wind Farm via the temporary road leaving the N83 National Road. This will have a temporary slight negative effect on traffic users on the delivery routes. Proposed Grid Connection Materials to be used to construct the proposed onsite 110kV substation will be delivered to the site via the N83 and will enter from the south via the temporary road. This may have a negative temporary effect on existing road users, which will be minimised by the implementation of the mitigation measures included in the traffic management plan. The underground cable route works will last approximately 188 days, completed with a traffic management plan in place and will follow the TII and EirGrid requirements. The grid route trenches will be excavated in a rolling manner, approx. 100-200m per day and backfilled each evening. By its nature the effects of these additional trips and diversions on the network will be transient, will be temporary and will be slight.

Mitigation and Monitoring Measures

A complete Traffic and Transport Assessment (TTA) of the Proposed Project has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 15.1 of Chapter 15: Material Assets. A Traffic Management Plan has also been developed in order to minimise any potential effect on the local population during the construction phase of the Proposed Project due to traffic. The plan will be developed and implemented to ensure any effect is short term in duration and slight in significance during the construction of the Proposed Project. Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be made known. Local access to properties will also be maintained throughout any construction works and local residents will be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures. Residual Effects Once the Traffic Management Plan is implemented for the construction phase of the Proposed Project, there will be a short-term slight negative effect on local road users. Significance of Effects Based on the assessment above, the effects on traffic from the Proposed Project during construction will be slight.

5.10.2.2.6 Major Accidents and Natural Disasters

Pre-Mitigation Impacts Proposed Wind Farm A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Wind Farm. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16: Major Accidents and Natural Disasters. As outlined in 1.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of major accident and/or disaster during the construction is identified as ‘Contamination’ of the Site and risk of ‘Fire/Explosion’ during construction. Proposed Grid Connection A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Proposed Grid Connection. Seven risks (Critical Infrastructure Emergencies, Severe Weather, Flooding, Utility Emergencies, Traffic Incident, Contamination, and

Fire/Gas Explosion) specific to the construction phase have been identified and are presented in Chapter 16: Major Accidents and Natural Disasters. The risk register concludes that there is low potential for natural disaster and/or major accident to occur at the Proposed Grid Connection. As outlined in Section 16.4.1 of this EIAR, the scenario with the highest risk score in terms of the occurrence of a major accident and/or disaster during construction is identified as 'Contamination' of the Site and risk of 'Fire/Explosion' during construction.

Residual Impact The impact assessment concludes that the risk of a major accident and/or disaster during the construction phase of the Proposed Project is considered 'low' in accordance with the 'Guide to Risk Assessment in Major Emergency Management' (DoEHLG, 2010). Significance of Effects Based on the above risk assessment in Chapter 16, the effects to/from Major Accidents and Natural Disasters during the construction phase of the Proposed Project is not significant.

5.10.2.2.7 Shadow Flicker Pre-Mitigation Impacts Proposed Project Shadow flicker, which occurs during certain weather conditions due to the movement of wind turbine rotor blades, as described in Section 5.2.2.2 of this chapter, can only occur during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the Proposed Wind Farm or the construction or operational phase of the Proposed Grid Connection. Any shadow flicker effects that occur in the commissioning phase of the proposed turbines will be short in duration and is dealt with under Section 5.10.3.2.7 below.

5.10.3 Operational Phase

5.10.3.1 Population The effects set out below relate to the operational phase of the Proposed Project.

5.10.3.1.1 Population Levels Pre-Mitigation Impacts Proposed Wind Farm The operational phase of the Proposed Project will have no impact on the population of the area with regard to changes to trends, population density, household size or age structure. Proposed Grid Connection The operational phase of the Proposed Grid Connection will have no impact on the population of the area with regard to changes to trends, population density, household size or age structure. Residual Impact No residual impacts Significance of Effects No significance of effects.

5.10.3.1.2 Employment and Investment. The operational phase will present an opportunity for mechanical-electrical contractors and craftspeople to become involved with the maintenance and operation of the Proposed Project. On a long-term scale, the Proposed Project will create approximately 2-3 jobs during the operational phase relating to the maintenance and control of the Proposed Project, having a long-term slight positive effect. The injection of money in the form of Community Gain income and landowner payments to the landowners who are participating in the Proposed Project, where a rental agreement has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a long-term positive impact on their cash flow. This will have a long-term slight positive indirect effect. Rates payments for the Proposed Project will contribute significant funds to Galway County Council, which will be redirected to the provision of public services within the county. These services include provisions such as road upkeep fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives. Proposed Community Benefit Scheme Should the Proposed Project receive planning permission, there are substantial opportunities available for the local area in the form of Community Benefit Funds. The value of this fund will be directly proportional to the installed capacity and/or energy produced at the site and will support and facilitate projects and initiatives including youth, sport and community facilities, schools, educational and training initiatives, and wider amenity heritage and environmental projects. Should the Proposed Project qualify under the Renewable Energy Support Scheme (RESS), a Community Benefit Fund of €2 per megawatt hour will be available to local residents under the Community Benefit Fund. Based on this value, the Proposed Project could generate up to €300k for the Community Benefit Fund for the first 15 years of operation of the Proposed Wind Farm. If the Proposed Project does not qualify under RESS, a guaranteed fee of €1 per megawatt hour will be available to locals through the Community Benefit Fund. Based on this, the Proposed Project has the potential to generate up to €150k per annum for the Community Benefit Fund for the lifespan of the Proposed Project. Further details on the proposed Community Gain proposals are presented in Appendix 2-1 and Section 4-5 of Chapter 4 of this EIAR.

5.10.3.1.3 Land Use Patterns and Activities Pre-Mitigation Impacts Proposed Wind Farm

The footprint of the Proposed Wind Farm will occupy only a small percentage of the site; 13.8 hectares of the overall 945-hectare site. Farming practices will not be impacted during the operational phase. As such, its small-scale relative to the site and Population Study Area combined with its ability to coexist with ongoing site activities and activities within the landscape indicate that the Proposed Wind Farm will not impact significantly on other land uses within the site and the wider area. Proposed Grid Connection The Proposed Grid Connection's footprint is limited to a small percentage of the site and overall Population Study Area. During the operational phase, farming practices will resume around the onsite 110kV substation and underground cabling route footprint, and traffic movements on the L61461, N83 and L6141 will resume as normal. The small scale of the substation relative to the site and Population Study Area, its ability to coexist with ongoing site activities and activities within the landscape indicate that the Proposed Grid Connection infrastructure will have no significant impact on other land-uses within the site and the wider area. Residual Impact Due to the small footprint of the Proposed Project infrastructure on a Site scale and even more so on a local scale, the residual effect is considered Negative, direct, slight, permanent effect on land use and activities during the operational phase. Significance of Effects The effect on land use/activities due to the operational phase of the Proposed Project will be slight.

Note that this is not true. The wake effect causes a drop in temperature in temperate climates & this drop creates crop losses and house heating losses. Without landowner consent, this is unconstitutional.

5.10.3.1.4 Property Values Pre-Mitigation Impacts Proposed Wind Farm As noted in Section 5.7, the conclusions from available international literature indicate that property values are not impacted by the positioning of a wind farm near houses. Proposed Grid Connection As noted in Section 5.7, the conclusions from available international literature indicate that property values are not impacted by the positioning of grid infrastructure near houses. Residual Impacts It is on this basis that it can be reasonably concluded that there would be a long-term imperceptible impact from the Proposed Project. Significance of Effects No significance of effects.

Note that this statement is untrue. See above for numerous reports show considerable property losses. Windfarm developers, where approved, are objecting to farmer family children that apply for planning approval on their parent's lands

5.10.3.1.5 Tourism Pre-Mitigation Effect Proposed Wind Farm There are no tourism attractions within or adjacent to the Site that could be affected by the operation of the Proposed Wind Farm. The nearest notable tourist attraction is Knockma Hill. As outlined in Section 5.4 above, Knockma Hill is recognised as a locally important walking route and amenity area. There will be a change to the landscape setting as described in Chapter 14 of this EIAR. Proposed Grid Connection The nearest tourist attraction to the Proposed Grid Connection underground cabling route is Knockma Hill. The Proposed Grid Connection underground cabling route will travel through the public road network (L61461m N83 and L6141).

Residual Effects Based on the literature review in Section 5.4 the majority of studies indicate that wind farm developments do not deter visitors to tourist attractions or scenic landscapes where turbines are visually evident. As such, it is considered that the Proposed Project will have a long-term imperceptible negative impact of visitor experience to attractions in the wider landscape. Significance of Effects The effect on tourism in the wider landscape due to the operational phase of the Proposed Project will be imperceptible. 5.10.3.1.6 Residential Amenity Pre-Mitigation Effects Proposed Wind Farm Potential impacts on residential amenity during the operational phase of the Proposed Wind Farm could arise primarily due to noise, shadow flicker or changes to visual amenity. Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the Proposed Wind Farm will be capable of meeting all required guideline limits in relation to noise and the shadow flicker set out in the Guidelines or the draft Guidelines if adopted. The noise and vibration assessment is detailed in Chapter 12. It should be noted that the Proposed Wind Farm will be brought in line with the noise thresholds imposed on the development by the consenting authority should the application be granted. The visual impact of the Proposed Wind Farm is addressed in Chapter 14: Landscape and Visual. The turbine locations have been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 740 metres of non-involved sensitive receptors, achieving the recommended four times turbine setback for visual amenity purposes. Proposed Grid Connection Potential impacts on residential amenity during the operational phase of the substation farm could arise

primarily due to noise and changes to visual amenity. Detailed noise modelling has been carried for the proposed substation, please see below and Chapter 12 Noise and Vibration for details. The visual effects of the temporary construction compound, the 110kV onsite substation and the underground cable have been assessed in Chapter 14 of this EIAR also. The nearest sensitive receptor is located approximately 440m north of the proposed onsite 110kV substation location and temporary construction compound and will be further screened by hedgerows and topography. The Proposed Grid Connection electrical cabling route is located underground; therefore, no visual effects are deemed to arise from this element. Mitigation and Monitoring Measures There are no turbines proposed within 740m (4 x tip height) of any sensitive receptors. All mitigation measures outlined in Chapter 12 (Noise), shadow flicker (Section 5.9 of this EIAR) and visual (Chapter 14) in this EIAR will be implemented in order to reduce insofar as possible, impacts on residential amenity at properties located within the in the vicinity of the Proposed Project. A 2.6m high palisade fence will be erected around the substation which will be painted RAL 6005 (green) to help blend the substation infrastructure in with the surrounding rural landscape. Please see Chapter 14 for residential amenity pertaining to visual effects.

Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of measures. Residual Effects The Proposed Project has been designed in accordance with best practice measures set out in in the Guidelines and the draft Guidelines in terms of setbacks for visual amenity. Furthermore, the Proposed Project can be brought inline to meet shadow flicker and noise thresholds imposed as part of a planning consent. The residual effect is considered to be a negative, moderate, long-term impact residential amenity with a significant residual effect for a small number of sensitive receptors located within 1km who have open views of the proposed turbines. Significance of Effects Based on the assessment above there will be a moderate effect on residential amenity during the operational phase and a significant effect for a small number of sensitive receptors. 5.10.3.2 Health 5.10.3.2.1 Health and Safety Pre-Mitigation Effect Proposed Wind Farm Rigorous safety checks and continued maintenance are conducted on the turbines and ancillary infrastructure during operational phase to ensure there are no health and safety risks posed by the Proposed Wind Farm. This will have a potential long-term, slight impact on health and safety during the operation phase. Any waste generated at the site will be managed in accordance the Waste Management Act 1996 and under the relevant EU legislation. Proposed Grid Connection Rigorous safety checks and continued maintenance are conducted on the substation and ancillary infrastructure during design, construction, commissioning and operation to ensure the risks posed to staff and landowners are negligible. This will have a potential long-term, slight impact on health and safety during the operation phase.

This Application referred to Chapman 2015 in relation to Population Health issues. However, it omitted to include the following response:

Summary of main conclusions reached in 25 reviews of the research literature on wind farms and health.
Compiled by Prof Simon Chapman, School of Public Health and Teresa Simonetti, Sydney
University Medical School
simon.chapman@sydney.edu.au
Updated 10 April 2015.

The following Response is from the Australian Parliament in a reference to Health issues from windfarms.

Select Committee on Wind Turbines: Final report. August 2015. ISBN 978-1-76010-260-9

Wind turbines and ill-health

2.7 The committee has taken evidence from a number of people who reside in proximity to wind turbines who have complained of a range of adverse health impacts. These include tinnitus, raised blood pressure, heart palpitations, tachycardia, stress, anxiety, vertigo, dizziness, nausea, blurred vision, fatigue, cognitive dysfunction, headaches, nausea, ear pressure, exacerbated migraine disorders, motion sensitivity, inner ear damage and worst of all, sleep deprivation.

2.8 Dr Sarah Laurie told the committee:

The human cost of the failure to protect people from excessive noise pollution, especially at night, is terrible. I have personally helped to prevent a number of suicides of people who were utterly desperate because of the consequences of excessive noise pollution and who reached out for help.

From my experience there is a subset of people who are terribly impacted very early on. Those people are the ones who tend to present with acute vestibular disorder type of symptoms—dizziness and motion sickness, which can be accompanied by extreme anxiety. Those people often just cannot last very long, and they move if they can.

2.9 Ms Janet Hetherington, an adjacent landholder to the Macarthur wind farm in south-west Victoria, relayed her own experience:

At my farm, I experience severe adverse health effects such as vibration, heart palpitations, tinnitus, head pressure, headaches, sleep deprivation, anxiety, night sweats, nausea, itchy skin, cramps, and ear, nose and throat pain. Twice now I have experienced horrendous pain in my chest stabbing through to my backbone in between my shoulder blades. I contemplated calling an ambulance both times but could not move to do so because of the severity of the pain. Ten minutes later it had dissipated, leaving me with great stress and anxiety and feeling washed out. All these sensations leave me drained in the morning. I find it very hard to start work that day.

2.10 Ms Anne Gardner also attributed her and her husband's ill health to the nearby Macarthur wind farm. She described the following symptoms:

My husband experienced bolts of pressure which tallied up with pressure peaks measured by Les Houston (sic) 86 per cent of the time while my husband was blind to the acoustic measurements of the time. Refer to his recap statement. I suffer day and night from headaches, nose and ear pressure, nausea, heart palpitations and chest burning from vibrations through the floor, couch, chair and in bed all night.⁶

2.11 Mr Clive Gare and his wife host 19 towers from the North Brown Hill wind farm located 17 kilometres from Jamestown in South Australia. Mr Gare told the committee:

After a short period of living with an operating wind farm, we had these products installed. I find that, because I work and reside in close proximity to the wind farm, I suffer sleep interruption, mild headaches, agitation and a general feeling of unease; however, this occurs only when the towers are turning, depending on the wind direction and wind strength. My occupation requires that I work amongst the wind towers during the day which means I suffer the full impacts of noise for days at a time without relief. The impacts are that we are not able to open our windows because of the noise at night and we are not able to entertain outside because of the noise.

In conclusion, if we did not have soundproof batts in VLam Hush windows [special window laminate designed to dampen noise], our house would not be habitable. In my opinion, towers should not be within five kilometres of residences, and I would personally not buy a house within 20 kilometres of a wind farm.

2.12 The committee notes that the Gares have received payment of \$2 million over five years to host turbines and have reported serious adverse impacts. The committee notes, therefore, that their evidence is an 'admission against interest' and as such represents highly reliable evidence.

2.13 Mr John Pollard, a resident of Glenthompson near the Oaklands Hill wind farm in Victoria, told the committee:

The wind farm guidelines on health issues of this very serious problem have to be assessed. They will not acknowledge infrasound. I will relate one incident that happened in our home one night. My wife was sleeping in the chair beside me and I was watching television. This is after they had turned the turbines off. She was dead to the world and I was just watching the television. All of a sudden she woke up, completely startled and disorientated, and I was really worried about her because I thought she had had a stroke or something. Eventually she came to her senses and she said the turbines must be on. I said, 'No, they're not. It's 10.30. They turn off at nine o'clock.' I went outside and they were still running. So I thought that next day I would ring AGL. When I was about to ring, they rang me and said, 'I'm sorry, John. We forgot to turn the turbines off last night.'

2.14 Waubra resident Mr Donald Thomas identified hearing difficulties from the nearby Waubra wind farm turbines.⁹ He claimed that these difficulties disappeared when he left the area:

I went to the doctor with what I kept saying was a lot of ear pressure and earaches. I went to see a specialist, and my ears came back as being in good health and functioning pretty well, even though I have lost a lot of hearing. Basically, my left ear does not work too good... My ears—especially when I go to my Stud Farm Road property, I have ear pressure that can develop into a headache and rapid heartbeat. If I leave that area and go back to one of my other properties, that can settle back down.

2.15 Mr Peter Jelbart, a 25 year old who had lived with his family nearby the Macarthur wind farm in south-west Victoria, noted the difficulty of sleeping in the family home. He told the committee he had worked and slept unaffected in noisy environments outside of the family home in Victoria:

While I was working in Western Australia I used to do three weeks on, one week off and come home for a week. Over in Western Australia I was sleeping at times on the sides of busy highways and in the back of trucks with ice packs running... At home, I noticed pretty much from day one that there is a serious problem there. Something is completely different when sleeping. I would wake up after a couple of hours of sleep—at times, not even after a couple of hours—and have disrupted sleep that I have had nowhere else. There is a proper problem... Whether it is low-frequency noise and the infrasound combining with it, it seems worse when it is quiet. Around our house the yard is pretty well protected by trees. When it is relatively quiet around the house yard there is still a really soft drone that comes through and just gets into you. It is pretty hard to explain. There are probably a lot of people going through the same thing who will have the same trouble trying to explain it, especially to people who have not experienced it. The problem with it is, it also seems to affect different people over different periods of time.¹¹

2.16 The committee has had the opportunity to take evidence from researchers in the United States and Canada who expressed their concern with the health effects of turbines. Ms Lilli-Ann Green is the Chief Executive Officer of a healthcare consulting firm in the United States. In 2012, Ms Green and her husband conducted interviews with people living near wind turbines in 15 different countries. As she told the committee: We have interviewed people on three continents who live more than five miles from the nearest wind turbine and are sick since wind turbine wind turbines need to be sited from people in order to do no harm. People report to us that over time their symptoms become more severe. Many report not experiencing ill effects for some time following wind turbine construction, meanwhile their spouse became ill the day the wind turbines nearby became operational. They speak of thinking they were one of the lucky ones at first, but after a number of months or years they become as ill as their spouse. Not one person who stayed near wind turbines reported to us that they got used to it or got better; they all became more ill over time... I really believe that we just do not have enough information yet. But throughout the interviews, country by country, people described the same symptoms. Many times they used the same phrases to describe them and the same gestures—and they were not speaking English. There is a common thread here.

2.17 Dr Jay Tibbetts, a medical practitioner and vice chair of the Brown County Board of Health in Wisconsin, drew the committee's attention to the board's October 2013 finding that the Shirley wind farm was a 'human health hazard'. Dr Tibbetts described how the declaration came about:

The [Board of Health] has been studying adverse health effects for the past 4 ½ years in the Shirley Wind Project. We have reviewed many peer reviewed studies, at least 50 medical complaints including ear pain, pressure, headache, tinnitus, vertigo, nausea, chest pain, chest pressure, loss of concentration, sleep deprivation and more, as well as more than 80 other complaints from citizens of Shirley Wind. There have been 2 formal studies of infrasound/low frequency noise by acousticians in 2012 and 2014. The latter study revealed symptom generating [Infrasound/Low Frequency Noise] at a distance of 4 ½ [miles].

2.18 The committee also heard of detailed research by Professor Emeritus Robert McMurtry from Western University in Ontario, Canada. Professor McMurtry made a number of points to the committee:

- adverse health effects have been reported globally in the environs of wind turbines for more than 30 years with the old design of turbines and the new;

- the wind energy industry has denied adverse health effects, preferring to call it 'annoyance'. Annoyance is recognised and was treated by the World Health Organization as an adverse health effect, which is a risk factor for serious chronic disease including cardiovascular and cancer;
- the regulations surrounding noise exposure are based upon out-of-date standards ETSU-97, which fail to evaluate infrasound and low-frequency

Professor Chapman and his critics

2.19 Professor Simon Chapman AO, Professor of Public Health at the University of Sydney, has been an outspoken critic of those who suffer ill-effects from wind turbines. In both his written and oral submissions, Professor Chapman cited many of his own publications in support for his view that:

...the phenomenon of people claiming to be adversely affected by exposure to wind turbines is best understood as a communicated disease that exhibits many signs of the classic psychosocial and nocebo phenomenon where negative expectations can translate into symptoms of tension and anxiety.

2.20 Several highly qualified and very experienced professionals have challenged this argument. Dr Malcolm Swinbanks, an acoustical engineer based in the United Kingdom, reasoned:

The argument that adverse health reactions are the result of nocebo effects, ie a directly anticipated adverse reaction, completely fails to consider the many cases where communities have initially welcomed the introduction of wind turbines, believing them to represent a clean, benign form of low-cost energy generation. It is only after the wind-turbines are commissioned, that residents start to experience directly the adverse nature of the health problems that they can induce.

2.21 The committee highlights the fact that Professor Chapman is not a qualified, registered nor experienced medical practitioner, psychiatrist, psychologist, acoustician, audiologist, physicist or engineer. Accordingly:

- he has not medically assessed a single person suffering adverse health impacts from wind turbines;
- his research work has been mainly—and perhaps solely—from an academic perspective without field studies;
- his views have been heavily criticised by several independent medical and acoustic experts in the international community; and
- many of his assertions do not withstand fact check analyses.

2.22 Professor Chapman has made several claims which are contrary to the evidence gathered by this committee. First, he argues that the majority of Australia's wind turbines have never received a single complaint. There are various problems with this statement:

- (i) wind turbines located significant distances from residents will not generate complaints;
- (ii) many residents suffering adverse health effects were not aware of any nexus between their health and the impact of wind turbines in order to make a complaint;
- (iii) just because residents do not lodge a formal complaint does not mean they are not suffering adverse health effects;
- (iv) data obtained by Professor Chapman from wind farm operators of the numbers of complaints lodged cannot be relied upon; and
- (v) the use of non-disclosure clauses and 'good neighbour agreements' legally restricts people from making adverse public statements or complaints.

2.23 Second, Professor Chapman has argued that complaints of adverse health effects from wind turbines tend to be limited to Anglophone nations. However, the committee has received written and oral evidence from several sources

directly contradicting this view. The German Medical Assembly recently submitted a motion to the executive board of the German Medical Association calling for the German government to provide the necessary funding to research adverse health effects. This would not have happened in the absence of community concern. Moreover, Dr Bruce Rapley has argued that in terms of the limited number—and concentrated nature—of wind farm complaints:

It is the reporting which is largely at fault. The fact is that people are affected by this, and the numbers are in the thousands. I only have to look at the emails that cross my desk from all over the world. I get bombarded from the UK, Ireland, France, Canada, the United States, Australia, Germany. There are tonnes of these things out there but, because the system does not understand the problem, nor does it have a strategy, many of those complaints go unlisted.

2.24 Third, Professor Chapman has queried that if turbines are said to have acute, immediate effects on some people, why were there no such reports until recent years given that wind turbines have operated in different parts of the world for over 25 years. Several submissions to the committee have stated that adverse health effects from wind turbines do not necessarily have an acute immediate effect and can take time to manifest.

2.25 Fourth, Professor Chapman contests that people report symptoms from even micro-turbines. The committee heard evidence that once people are sensitised to low frequency infrasound, they can be affected by a range of noise sources, including large fans used in underground coal mines, coal fired power stations, gas fired power stations and even small wind turbines. As acoustician Dr Bob Thorne told the committee:

Low-frequency noise from large fans is a well-known and well-published issue, and wind turbines are simply large fans on top of a big pole; no more, no less. They have the same sort of physical characteristics; it is just that they have some fairly unique characteristics as well. But annoyance from low-frequency sound especially is very well known.

2.26 Fifth, Professor Chapman contends that there are apparently only two known examples anywhere in the world of wind turbine hosts complaining about the turbines on their land. However, there have been several Australian wind turbine hosts who have made submissions to this inquiry complaining of adverse health effects.

Paragraphs 2.11–2.12 (above) noted the example of Mr Clive Gare and his wife from Jamestown. Submitters have also directed attention to the international experience.

In Texas in 2014, twenty-three hosts sued two wind farm companies despite the fact that they stood to gain more than \$50 million between them in revenue. The committee also makes the point that contractual non-disclosure clauses and 'good neighbour' agreements have significantly limited hosts from speaking out. This was a prominent theme of many submissions.

2.27 Sixth, Professor Chapman claims that there has been no case series or even single case studies of so-called wind turbine syndrome published in any reputable medical journal. But Professor Chapman does not define 'reputable medical journal' nor does he explain why the category of journals is limited to medical (as distinct, for assertion). However, the committee does note that a decision to publish—or not to publish—an article in a journal is ultimately a business decision of the publisher: it does not necessarily reflect the quality of the article being submitted, nor an acknowledgment of the existence or otherwise of prevailing circumstances. The committee also notes that there exist considerable published and publicly available reports into adverse health effects from wind turbines.

2.28 The committee also notes that a peer reviewed case series crossover study involving 38 people was published in the form of a book by American paediatrician Dr Nina Pierpont, PhD, MD. Dr Pierpont's *Report for Clinicians* and the raw case data was submitted by her to a previous Australian Senate inquiry (2011) to which Dr Pierpont also provided oral testimony. Further, at a workshop conducted by the NHMRC in June 2011, acoustical consultant Dr Geoffrey Leventhall stated that the symptoms of 'wind turbine syndrome' (as identified by Dr Pierpont), and what he and other acousticians refer to as 'noise annoyance', were the same. Dr Leventhall has also acknowledged Dr Pierpont's peer reviewed work in identifying susceptibility or risk factors for developing wind turbine syndrome / 'noise annoyance'. Whilst Dr Leventhall is critical of some aspects of Dr Pierpont's research, he does state:

Pierpont has made one genuine contribution to the science of environmental noise, by showing that a proportion of those affected have underlying medical conditions, which act to increase their susceptibility.³⁰

2.29 Seventh, Professor Chapman claims that no medical practitioner has come forward with a submission to any committee in Australia about having diagnosed disease caused by a wind farm. Again, Professor Chapman fails to define 'disease'.

Nonetheless, both this committee, and inquiries undertaken by two Senate Standing Committees, have received oral and written evidence from medical practitioners contrary to Professor Chapman's claim.

2.30 Eighth, Professor Chapman claims that there is not a single example of an accredited acoustics, medical or environmental association which has given any credence to direct harmful effects of wind turbines. The committee notes that the semantic distinction between 'direct' and 'indirect' effects is not helpful. Dr Leventhall and the NHMRC describe stress, anxiety and sleep deprivation as 'indirect' effects, but these ailments nonetheless affect residents' health.

2.31 Finally, Professor Chapman queries why there has never been a complainant that has succeeded in a common-law suit for negligence against a wind farm operator.

This statement is simply incorrect. The committee is aware of court judgements against wind farm operators, operators making out of court settlements or withdrawing from proceedings, injunctions or shutdown orders being granted against operators, and properties adjacent to wind turbines being purchased by operators to avoid future conflict. The committee also reiterates its earlier point that contractual non-disclosure clauses have discouraged legal action by victims.

Mitigation and Monitoring Measures The following mitigation measures will be implemented during the operation of the Proposed Project to ensure that the risks posed to staff and landowners remain imperceptible throughout the operational life of the Proposed Project. Please refer to Chapter 18 Schedule of Mitigation and Monitoring Measures for a full list of mitigation and monitoring measures for the Proposed Project. Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits. The doors will only be unlocked as required for entry by authorised personnel and will be locked again following their exit. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed, faded, or are becoming hidden by vegetation or foliage, with prompt action taken as necessary. Signs will also be erected at suitable locations across the Site as required for the ease and safety of operation of the wind farm. These signs include:

Buried cable route markers at 50m (maximum) intervals and change of cable route direction; Directions to relevant turbines at junctions; "No access to Unauthorised Personnel" at appropriate locations; Speed limits signs at Site entrance and junctions; "Warning these Premises are alarmed" at appropriate locations; "Danger HV" at appropriate locations; "Warning – Keep clear of structures during electrical storms, high winds or ice conditions" at Site entrance; "No unauthorised vehicles beyond this point" at specific Site entrances; and Other operational signage required as per Site-specific hazards. The Substation, which will be operated by Eirgrid will be locked and fenced off from public access. The substation will be operational remotely and manually 24 hours per day, 7 days a week. Supervisory operational and monitoring activities will be carried out remotely using a SCADA system, with the aid of computers connected via a telephone modem link. Periodic service and maintenance work which include some vehicle movement. For operational and inspection purposes, substation access is required. Servicing of the substation equipment will be carried out in accordance with the manufacturer's specifications, which would be expected to entail the following: Six-month service – three-week visit Annual service – six-week visit Weekly visits as required. An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the Site. Access for emergency services will be available at all times. The components of a wind turbine are designed to last up to 30-35 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be

carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the Site's health and safety requirements. Residual Effect With the implementation of the above mitigation measures, there will be a long-term, imperceptible effect on health and safety during the operational life of the Proposed Project. Significance of Effects Based on the assessment above the effects on health and safety during the operational life of the Proposed Project will be imperceptible.

5.10.3.2.2 Noise and Vibration Pre-Mitigation Effect

Proposed Wind Farm An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Chapter 12: Noise and Vibration. The predicted noise levels associated with the Proposed Wind Farm will be within best practice noise criteria curves recommended in the Guidelines, therefore, it is not considered that a significant effect is associated with the Proposed Wind Farm.

Proposed Grid Connection

The predicted noise level from the operation of the onsite 110kV substation at the nearest NSL (H060) at approximately 449 m from the noise source at the onsite 110kV substation (transformer of substation layout) is 24 dB LAeq,T. This level of noise is considered low, and it is concluded that there will be no significant noise emissions from the operation of the onsite 110kV substation at any NSL.

Mitigation and Monitoring Measures Please see Chapter 12 Section 12.6 for noise and vibration mitigation and monitoring proposals for the Proposed Project. Please refer to Chapter 18: Schedule of Mitigation and Monitoring Measures for a full list of mitigation and monitoring measures for the Proposed Project.

Residual Effects The predicted residual operational turbine noise effects at the closest noise sensitive receptors range from not significant to imperceptible. Please see Chapter 12 Noise and Vibration for details.

Significance of Effects As stated in the noise assessment in Chapter 12, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied. The effects are considered not significant.

5.10.3.2.7 Shadow Flicker Pre-Mitigation Effects Proposed Wind Farm

Assuming worst-case conditions, **a total of 104 properties as a result of the Laurclavagh Renewable Energy Development may experience daily shadow flicker** in excess of the current DoEHLG guideline threshold of 30 minutes per day. The DoEHLG total annual guideline limit of 30 hours is predicted to be exceeded at 5 no. properties when the regional sunshine average of 26.46% is taken into account. As stated in Section 5.2.3 there are 243 no. properties located within 1.63km (of the proposed turbines, (of which 242 are inhabited dwellings, and 1 is an uninhabited derelict building). Of the 104 properties predicted to experience daily shadow flicker in excess of the current guideline threshold of 30 minutes per day, 13 are participating landowners. 91 no. existing properties may be subject to mitigation measures in order to ensure the Guideline's 30-minute daily and/or 30-hour annual shadow flicker thresholds are not exceeded.

Proposed Grid Connection There is no potential for the Proposed Grid Connection infrastructure to cause shadow flicker, and so no effect is predicted. Mitigation and Monitoring Measures Where daily or annual shadow flicker exceedances are predicted at any inhabitable or third-party dwelling of the identified 91 no. sensitive receptors, a site visit will be undertaken firstly to determine the presence of existing screening and window orientation at each potentially affected property. This will determine if the receptor has an actual line of sight to any turbine and actual potential for shadow flicker to occur. Once this exercise is completed and all of the potentially affected properties, the following measures will be employed. Screening Measures In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including: Installation of appropriate window blinds in the affected rooms of the residence; Planting of screening vegetation; Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation. If agreement can be reached with the homeowner, then it would be arranged for the required mitigation to be implemented in cooperation with the affected party as soon as practically

possible and for the full costs to be borne by the wind farm operator. Wind Turbine Control Measures If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine control measures will be implemented. Wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines. A shadow flicker control unit allows a wind turbine to be programmed and controlled using the wind farm's Supervisory Control and Data Acquisition (SCADA) system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary. All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to avoid excessive shadow flicker occurrences at properties which are not naturally screened or cannot be screened with measures outlined above. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the Proposed Wind Farm and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine. In order to ensure that the model and SCADA system is accurate and working well a site visit will be carried out to verify the system. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to. 1. 2. 3. 4. 5. 6. Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.). Recording the house number, time and duration of site visit and the observation point GPS coordinates. Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation. In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded. The data will then be sent to the wind farm operational team to confirm that the model and SCADA system are working. Following 12 months of full operation of the Proposed Project a report can be prepared for the Local Authority describing the shadow flicker mitigation measures used at the wind farm and confirming the implementation and successful operation of the system. This method of shadow flicker mitigation has been technically well-proven at wind farms in Ireland and also in areas outside Ireland that experience significantly longer periods of direct sunlight. In order to demonstrate how the SCADA control system can be applied to switch off particular turbines at the relevant times and dates, Table 5-11 below lists the 91 properties at which a shadow flicker mitigation strategy may be necessary to ensure the Guidelines 30-minute per day shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to reduce daily shadow flicker to below the guideline limit of 30 minutes. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree alternative mitigation measures with the relevant property owner. The mitigation strategy outlined in Table 5-11 below is based on the theoretical precautionary scenario. The details presented in Table 5-11 list the days per year and the turbines that could be programmed to switch off at specific times, in order to reduce daily shadow flicker to a maximum of 28 minutes, which is below the guideline limit of 30 minutes.

Where a shadow flicker mitigation strategy is to be implemented, it is likely that the control mechanisms would only have to be applied to a turbine to bring the duration of shadow flicker down to the 28-minute post-mitigation shadow

flicker target. Table 5-12 below displays the 3 no. third-party sensitive receptors which are predicted to receive in excess of the Annual Shadow Flicker Limit of 30 hours per year.

Overall, the details presented in Table 5-12 demonstrate that using the turbine control system, it will be possible to reduce the level of shadow flicker at any affected property to below the daily guideline limit of 30 minutes, by programming the relevant turbines to switch off at the required dates and times. Notwithstanding this, the approach set out above should shadow flicker associated with the Proposed Wind Farm be perceived to cause nuisance at any home, the affected homeowner is invited to engage with the Wind Farm operator. Should a complaint or query in relation to shadow flicker be received within 12 months of commissioning of the Proposed Wind Farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. The homeowner will be asked to log the date, time and duration of shadow flicker events occurring on at least five different days. The provided log will be compared with the predicted occurrence of shadow flicker at the residence, and if necessary, a field investigation will be carried out. Likewise, the Proposed Project can be brought in line with the requirements of the draft Guidelines should they be adopted during the planning application process for this development. Residual Effect Following the implementation of the above suite of mitigation measures, the Guidelines limit of 30 mins per day or 30 hours per year will not be exceeded and this will result in a long-term, imperceptible negative residual effect from shadow flicker on human health. Significance of Effects Based on the assessment above and the mitigation measures proposed the effects related to shadow flicker will be not significant.

7.2

Please confirm if the shadow flicker software utilised in the EIAR has been validated.

As stated in Section 5.2.3.3 of Chapter 5 of the EIAR for the purposes of this shadow flicker assessment, the software package WindFarm Version 5.0.2.2 has been used to predict the level of shadow flicker associated with the Proposed Project. WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints. The use of specialist computer software programmes specifically designed for the wind energy industry and their utilisation in EIAR has been verified through their use a numerous previous wind energy development EIARs. There are a number of organizations, both within Ireland, Europe and Globally who are users [WindFarm from ReSoft – Users (ReSoft Website, Last Accessed: 15 August 2025, - <https://www.resoft.co.uk/html/users.html>)] of the WindFarm software package, including ESB International Limited (Ireland), University of Limerick (Ireland), AtkinsRéalis (Global) and the Australian Antarctic Division (Australian Government).

The Citizens need to see the actual screenshots of the constraints used in these models. Denial of this information breaches EU Caselaw on lacunae.

Summary of issues:

1. There is a connected underground karstic pathway under the site that links into Lough Corrib with flows of 200m³/hr. This creates the link for various chemicals to enter the drinking water sources supplying Galway City & County with over 100,000m³ of drinking water daily.
2. The application fails to provide the lacunae for the modelling software used in breach of EU Caselaw CJEU Case 258/11. Screenshots for each step with inputted constraints are essential for public consultation. The inadequate separation distances between turbines is a direct result of this. Providing turbine locations in a 6-figure Northing-Easting grid is an intentional mechanism to deny information.
3. The separation distances between turbines does not comply with WEG2006 or Draft WEG2019. This noncompliance raises a multitude of issues such as increased downwind turbulence & noise, barrier effects for birds & bats, increased wake distances.

Item 8. Water (EIAR & NIS)

8.1

You are requested to outline the design capacity of the attenuation and infiltration devices for the management of construction waters and storm water management. Calculations addressing storm water runoff should be clearly outlined.

Section 4.5 of the Report has been updated to reflect the design capacity of the attenuation and infiltration devices for the management of construction waters and storm water management

8.2

The NIS outlines the same mitigation to prevent significant impacts on water quality during construction is likely to be applicable to the decommissioning phase. The NIS should be revised to outline the mitigation measures that shall apply at decommissioning stage.

Section 6.2.2.3 of the revised NIS has now been updated with additional detail around mitigation measures required during decommissioning of the Proposed Project.

4.0 DESCRIPTION OF THE PROPOSED PROJECT

4.5 Site Drainage

4.5.1 Introduction

The Proposed Wind Farm site is located within an area of free draining agricultural land, which is distal to surface watercourses. The nearest surface watercourse, the Ballinduff stream, is located 2.6km west of the Proposed Wind Farm site. From a drainage design perspective, the key points of note regarding this site are: The absence of surface watercourses within the site. There are no recorded drainage ditches or streams and there are no groundwater features such as turloughs within the Proposed Wind Farm site; Rainfall within the Proposed Wind Farm site infiltrates to ground through the sandy, gravelly clay subsoils. The permeability of these subsoils is variable across the Site (refer to Section 9.3.7.3.3 of the EIAR), however the permeability is sufficiently high that all rainfall infiltrates to ground and there is no surface water runoff from the site; 26 no. infiltration tests were performed at the Proposed Wind Farm site. The results of the infiltration tests show that permeability varies across the Site, with permeability ranging between $<0.1\text{m/h}$ ($<2.7 \times 10^{-5}\text{ m/s}$) to more than 20 m/h ($<5 \times 10^{-3}\text{ m/s}$). The mean infiltration rate from the tests is $\sim 2\text{m/h}$ ($5 \times 10^{-4}\text{ m/s}$); This mean infiltration rate is considered representative of the overall site; The average annual rainfall at the site is 1,226mm, which equates to a rainfall depth of $3.8 \times 10^{-5}\text{ m/s}$ across the site, more than one order of magnitude lower than the mean infiltration rate from the 26 no. permeability tests; and, This mean infiltration rate ($5 \times 10^{-4}\text{ m/s}$) is a sufficient permeability to allow all rainfall during the annual 24-hour extreme rainfall event (35.4mm) to infiltrate to ground across the site, even accounting for the reduced permeability from hardstanding areas.

4.5.2 Drainage Design Principles Runoff control and drainage management are key elements in terms of mitigation against effects on the underlying groundwater aquifer (surface water effects will not occur due to the lack of surface watercourses as detailed above). Two distinct methods will be employed to manage drainage water within the Proposed Project. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage and recharge patterns. The second method involves collecting any drainage/runoff waters from works areas within the Proposed Wind Farm site that might carry silt or sediment, and nutrients, to route them along collector drains within which treatment (settling) and recharge can occur, and outfall to infiltration areas and subsequent infiltration through the subsoil. As per the prevailing natural conditions at the Proposed Wind Farm site, there will be no direct discharges to surface waters. During the construction phase all runoff from works areas (i.e., potential dirty water) will be attenuated and treated to a high quality prior to being allowed to slowly percolate to ground through the infiltration areas and along the collector drains themselves.

4.5.3 Drainage Design A drainage design for the Proposed Project, incorporating all principles and measures outlined in the drainage design description in the EIAR, was included in Appendix 4-6 to the EIAR. Minor updates to the drainage design have been made to the drainage design following the request for FI by the Commission, and these updates are included in Appendix 4-6a of The Report. 4.5.3.7 Drainage Design Calculations The design of the proposed infiltration areas is shown within Drawing Detail D501 included within the Drainage design drawings (refer to EIAR Appendix 4-6). A representative calculation for the capacity of the proposed infiltration areas is included below, which uses the mean infiltration rate for the site ($5 \times 10^{-4}\text{ m/s}$), which is applied over the area of Turbine T2 (refer to Drawing D101 FI as included in Appendix 4-6a) as an example.

Clean surface water will be collected within the upstream interceptor drain (blue dashed line in Drawing D101 FI) and directed to level spreaders to infiltrate to ground. Any surface water runoff from the construction works area downgradient of this interceptor drain will be collected within the downstream interceptor drain (pink dashed line on

Drawing D101 FI). The total construction works area between the upstream and downstream interceptor drains, where the hardstand is located is 9,900 m². As the construction works will be relatively short-term, the 1 in 10 year 24-hour rainfall event is used as the extreme rainfall event which may occur during this period. This return period represents a rainfall depth of 54.8mm. Under this scenario, an infiltration area with the following dimensions satisfies the criteria set out in BRE365 (refer to Table 4-1 below for infiltration area calculations): Infiltration area dimensions = 8.85m (l) × 3.5m (w) × 1m (d) A revised drawing (D501_V2 FI) showing the standard design for the infiltration areas to be used during the construction phase is included in Appendix 4-6a of The Report. This design is proposed as the standard design to be used across the Proposed Wind Farm site. We accept that this design represents the mean conditions across the site, however it is considered applicable to the site for the following reasons: There is no potential for storm water runoff to reach downstream watercourses; Currently (pre-development) all rainfall infiltrates to ground, therefore the design of the construction phase drainage is intended to mimic the existing drainage (infiltration) regime; and, The proposed design will ultimately ensure that there are no negative effects on either the hydrological or hydrogeological environment and there is no potential for construction phase drainage to affect downgradient flood risk.

Note that the blades have to be cleaned of insect detritus. This involves detergents and power hoses. The contaminated fog created by such cleaning discharges & emerging particles from blades onto the soil & into the underground waterbody causing pollution to the nearby drinking water sources.

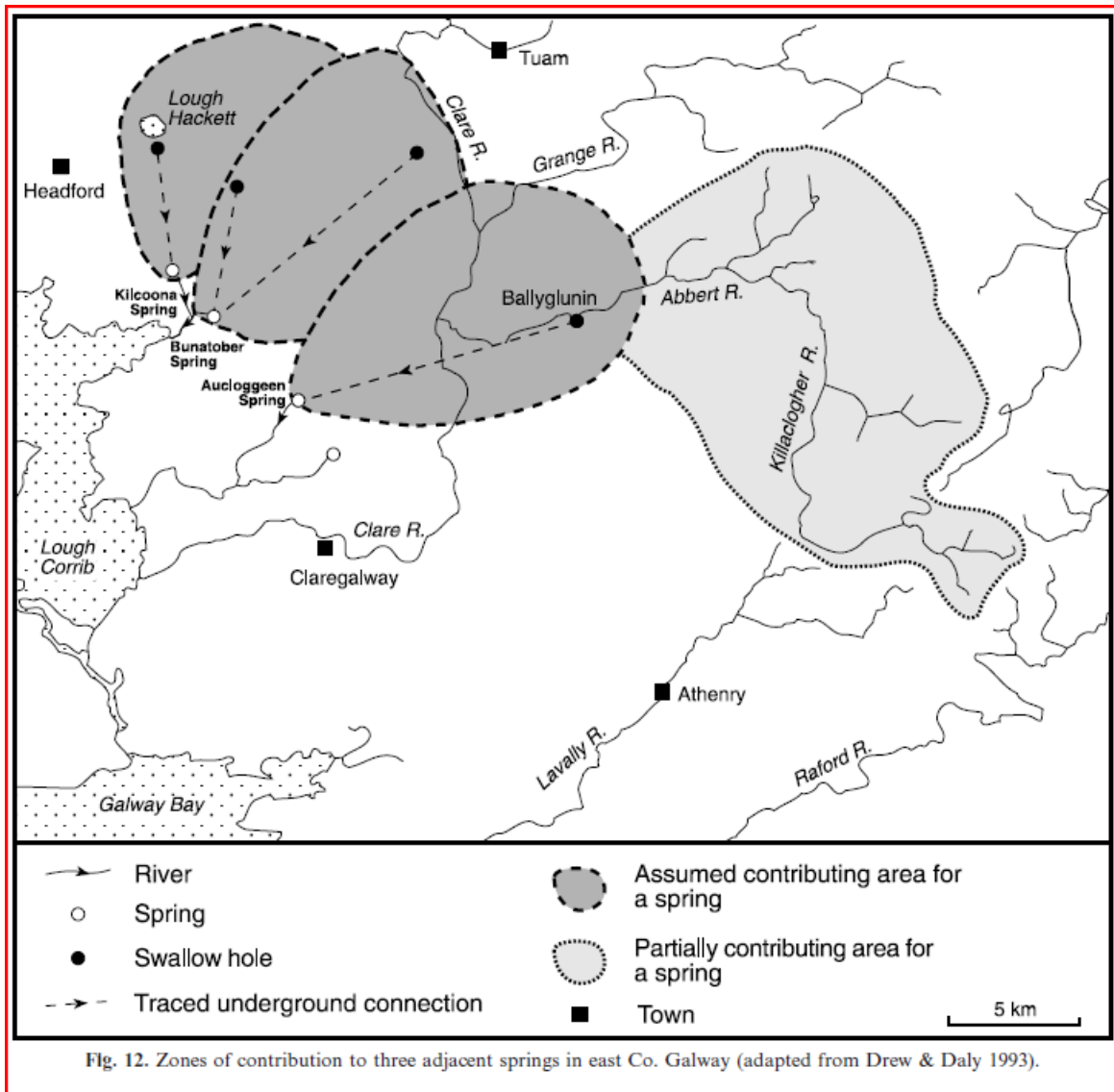
Groundwater Resources in a Complex Karst Environment Involved by Wind Power Farm Construction Alessio Valente , Vittorio Catani, Libera Esposito, Guido Leone , Mauro Pagnozzi and Francesco Fiorillo. Sustainability 2022, 14, 11975. <https://doi.org/10.3390/su141911975>

When wind farms are built in karst areas, the major interest for researchers, communities and economies is to evaluate the impacts on the quantity and the quality of groundwater. This is because karst areas are of fundamental importance to people since they hold huge groundwater reservoirs, which feed springs and represent the main source of fresh water in many areas of the world.

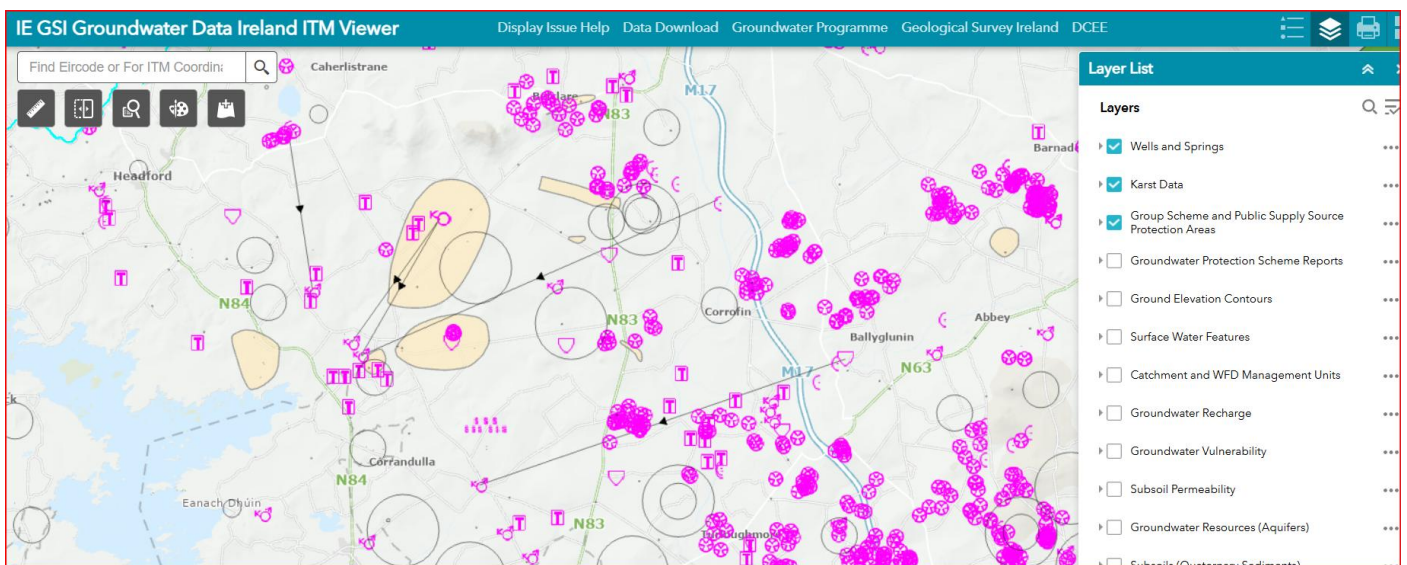
The recharge of the groundwater resources is produced by the infiltration of the surface water into the underground, which occurs in a concentrated or diffuse manner. Concentrated infiltration occurs at points, such as sinkholes/shafts and swallow holes, and allows for the fast transfer of water from the surface to the underground. On the other hand, diffuse infiltration occurs via the soil mantle or fractures in the outcropping karst rocks, and generates percolation, which can take a significant amount of time before water reaches the water table.

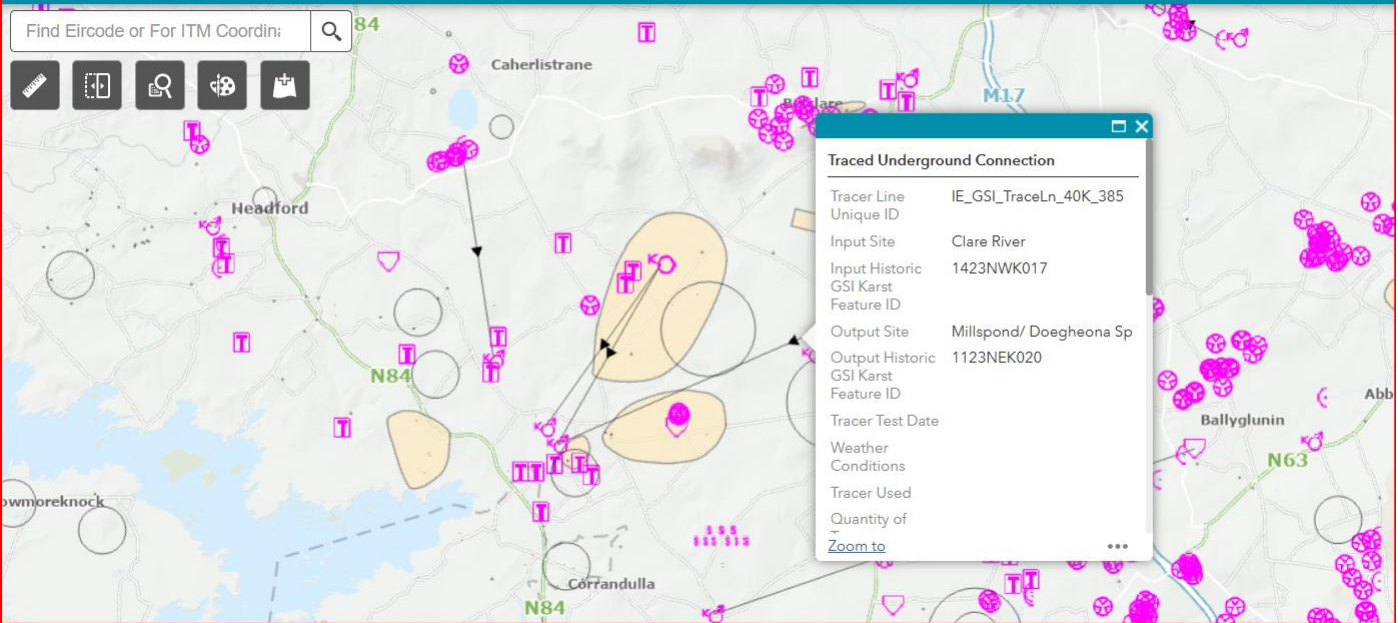
In karst areas, infiltration is strongly controlled by the features of the topographic surface, which is generally characterized by peculiar landforms called endorheic areas. These are closed depressions where the internal runoff is completely absorbed by one or more sinkholes or swallow holes. Endorheic areas represent important recharge areas for groundwater, and are often connected to one or more springs.

In such an environment, wind farms can affect groundwater resources in several different ways. Water quantity and quality may change due to alterations in the natural surface and subsurface flow paths and the interactions between the groundwater and surface water. Water can be diverted by road systems or systems for collecting rainwater, avoiding the supply to endorheic areas and sinking streams. The excavation and extraction of geological material can also alter the surface and groundwater flow, draining water and moving it away from the springs. Water quality can be affected by activities that aggravate soil erosion and alter the surface conditions, such as heavy equipment traffic, rock and soil extraction/accumulation for the construction of access roads to work sites, as well as the excavation of deep foundations.

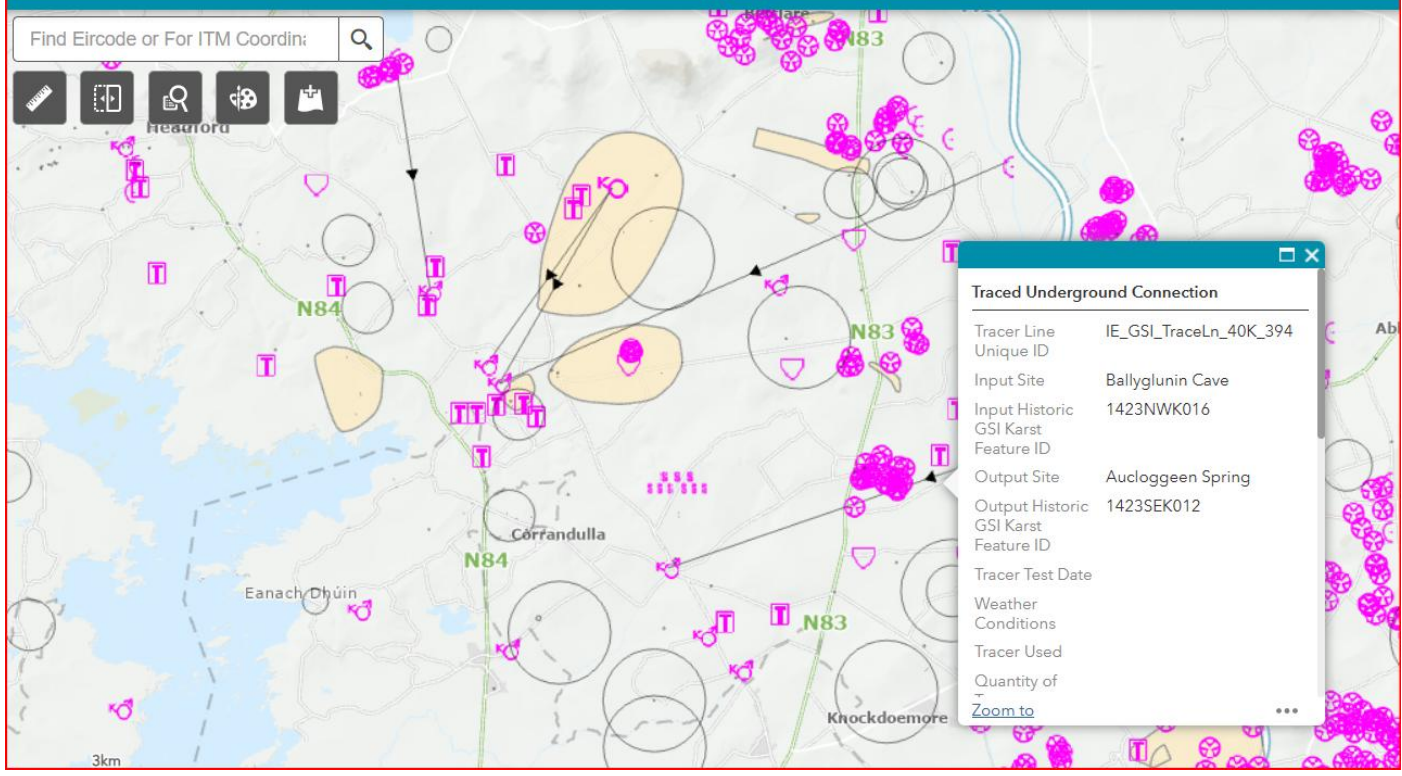


Note the pathway from the East, under Laurclavagh to Lough Corrib & groundwater drinking water sources as identified by the foremost Karstic expert Dr. David Drew, retired, TCD,





Traced Underground Connection	
Tracer Line Unique ID	IE_GSI_TraceLn_40K_385
Input Site	Clare River
Input Historic GSI Karst Feature ID	1423NWK017
Output Site	Millspond/ Doegheona Sp
Output Historic GSI Karst Feature ID	1123NEK020
Tracer Test Date	
Weather Conditions	
Tracer Used	
Quantity of Tracer	
Trace Operator	David Drew
Result (degree of certainty)	Positive
Minimum Groundwater Flow Rate	15m/hr
Hydraulic Gradient (slope of water table)	
Data Source	Drew D.P. and Daly D. 1993
Catchment	Lough Corrib
Peak Concentration (tracer at sampling point)	
Other Information	Flow rates show anisotropy in k with higher E-W k
Suspected Flow Path	
County	Galway
Tracer Line Length (m)	10761



Traced Underground Connection	
Tracer Line Unique ID	IE_GSI_TraceLn_40K_394
Input Site	Ballyglunin Cave
Input Historic GSI Karst Feature ID	1423NWK016
Output Site	Auclogheen Spring
Output Historic GSI Karst Feature ID	1423SEK012
Tracer Test Date	
Weather Conditions	
Tracer Used	
Quantity of Tracer	
Trace Operator	David Drew
Result (degree of certainty)	Positive
Minimum Groundwater Flow Rate	200m/hr
Hydraulic Gradient (slope of water table)	
Data Source	Drew D.P. and Daly D. 1993
Catchment	Lough Corrib
Peak Concentration (tracer at sampling point)	
Other Information	Flow rates show anisotropy in k with higher E-W k
Suspected Flow Path	
County	Galway
Tracer Line Length (m)	10646
Direction	

Note the groundwater flow rate of 200m³/hr = 4,800m³ per day.

The wind turbines are located too close to each other that will result in increased wake turbulence that in turn will increase noise emission and the characteristic of amplitude modulation. The NVA has not considered these effects. WEDG 2006 target noise limits have been misinterpreted in the NVA to produce higher proposed noise limits. Target noise limits should be lower at 35 dB(A) in 7 m/s wind speed at standardised height. Predicted sound levels in the NVA are too low. When more conservative noise model inputs are used the predicted noise levels shown in the NVA will be at least 2 dB higher. The current WEDG 2006 does not reflect best practice and is outdated, but if applied properly, shows that this proposed wind farm would be non-compliant. The NVA should not rely on guidelines used to underpin ETSU-R-97 because those guidelines are currently under review and the WEDG 2006 does not refer to them. The requirement from WEDG 2006 that '*that there is no significant increase in ambient noise levels at any nearby noise sensitive locations*' has not been addressed in the NVA. Ambient sound levels are shown to be below the 17 dB(A) instrument noise floor in wind speeds up to 9 m/s (10m AGL) compared with sound levels optimistically predicted to be more than 38dB(A). A 10dBA increase in noise is a doubling of the noise levels. If we assume that background noise is c17dBa, we note that a suggested 43dBa for nighttime situations, is an increase of 26dBa, which is almost a factor of 8 increase. This increase is then heard as intermittent bangs that prevent sleep. The turbines are not synchronised to create a bang everytime the blade passes the tower. For numerous turbines, this results in bangs every few seconds. The soundscape in the area will change dramatically and this is contrary to the requirement of the WEDG 2006. The layout of the wind turbines is such that excessive amplitude modulation will arise but the NVA has not accounted for any penalty due this or other special audible characteristics (tonality, impulsive sound). Current best practice in assessing wind farm noise should be reflective of target noise limits set in Germany and the Australian States of New South Wales and Tasmania. Low frequency noise impact has not been assessed. With noise model inputs used in the NVA there will be dwellings that will exceed the correct 35 dB(A) noise limit target at 7 m/s. With more conservative noise model inputs many more dwellings will exceed the correct 35 dB(A) noise limit target at 7 m/s.

Table 12-10 Sound Power Level for Nordex N163 with STE Blades at 103.5 m Hub Height

Wind Speed (m/s)	Sound Power Level dB LWA
3	95.0
4	96.5
5	101.0
6	105.8
7	106.5
8	106.6
9	106.6

Table 12-9 Proposed Wind Farm Turbine Co-ordinates

Turbine	ITM Easting	ITM Northing	Top of Foundation Levels (metre OD)
T01	534,719	743,135	25
T02	535,362	743,777	33
T03	535,624	743,329	35
T04	536,599	744,396	54
T05	536,497	743,788	43
T06	536,894	743,549	37
T07	537,371	743,516	39
T08	538,278	743,808	40

Northing & Easting 6-figure grid locations

Laurclavagh Separation Distances between turbines [not in compliance with WEG 2006 or Draft WEG 2019 with 7x Rotor Diameter] Which increases the noise further due to increased turbulence.

Turbine	Easting	difference	square	Northing	difference	square	sum of squares	Sqrt : Separation distances
1	534719			743135				
2	535362	643	413449	743777	642	412164	825613	T1 to T2 909m
3	535624	262	68644	743329	-448	200704	269348	T2 to T3 519m
4	536599	975	950625	744396	1067	1138489	2089114	T3 to T4 1445m
5	536497	-102	10404	743788	-608	369664	380068	T4 to T5 616m
6	536894	397	157609	743549	-239	57121	214730	T5 to T6 463m
7	537371	477	227529	743516	-33	1089	228618	T6 to T7 478m

8	538278	907	822649	743808	292	85264	907913	T7 to T8 953m
3	535624			743329				
5	536497	873	762129	743788	459	210681	972810	T1 to T2 986m

Note The separation distances do not comply with the Wind Energy Guideline 2006/2019 of 7 times the diameter. [7x162.5 = 1,137.5m]. These inadequate separation distances determine that this application is not over 50Mw & invalidated for SID consideration.

2006 Wind Energy Guidelines

5.13 Windtake

The question of windtake should be dealt with at scoping stage and/or during pre-application discussions, to ensure that any proposed layout of wind turbines takes into account the development potential of an adjoining site for a similar development. In general, to ensure optimal performance and to account for turbulence and wake effects, the minimum distances between wind turbines will generally be three times the rotor diameter (=3d) in the crosswind direction **and seven times the rotor diameter (=7d) in the prevailing downwind direction**. Bearing in mind the requirements for optimal performance, a distance of not less than two rotor blades from adjoining property boundaries will generally be acceptable, unless by written agreement of adjoining landowners to a lesser distance. However, where permission for wind energy development has been granted on an adjacent site, **the principle of the minimum separation distances between turbines in crosswind and downwind directions indicated above should be respected.**

Draft Revised Wind Energy Development Guidelines December 2019

4.9.6 Windtake

The question of windtake should be dealt with at scoping stage and/or during pre-application discussions, to ensure that any proposed layout of wind turbines takes into account the development potential of an adjoining site for a similar development. In general, to ensure optimal performance and to account for turbulence and wake effects, the minimum distances between wind turbines will generally be three times the rotor diameter (=3d) in the crosswind direction **and seven times the rotor diameter (=7d) in the prevailing downwind direction**. Bearing in mind the requirements for optimal performance, a distance of not less than two rotor blades from adjoining property boundaries will generally be acceptable, unless by written agreement of adjoining landowners to a lesser distance. However, where permission for wind energy development has been granted on an adjacent site, **the principle of the minimum separation distances between turbines in crosswind and downwind directions indicated above should be respected.**

Wind Turbine Separation Distances Matter, June 2014. Peter R Mitchell, AM, BChE

“Evidence is that the manufacturer-recommended separation distances of 7 to 8 rotor diameters for turbines in line with the prevailing wind and 5 rotor diameters for turbines abreast, still allows turbulent air exiting one turbine to retain significant turbulence when entering the next; so the manufacturers’ recommended spacings can be considered as an unfortunate compromise and inadequate to contain noise.

The most efficient turbine spacing, i.e., that which allows the turbines to economically extract the most energy from the wind, has been shown to be some 15 rotor diameters. Most efficient extraction of useful energy will approximately coincide with the least production of waste energy, namely sound and vibration.

The Waubra Foundation currently considers that for a block of turbines that is likely to be subject to changing wind directions, noise will be minimised if the turbine spacing in all directions approaches the most efficient spacing of about 15 rotor diameters.”. <http://waubrafoundation.org.au/resources/shepherd-khubbard-h-noise-radiation-characteristics-westinghouse-wwg-0600-wind-turbine-generator/>

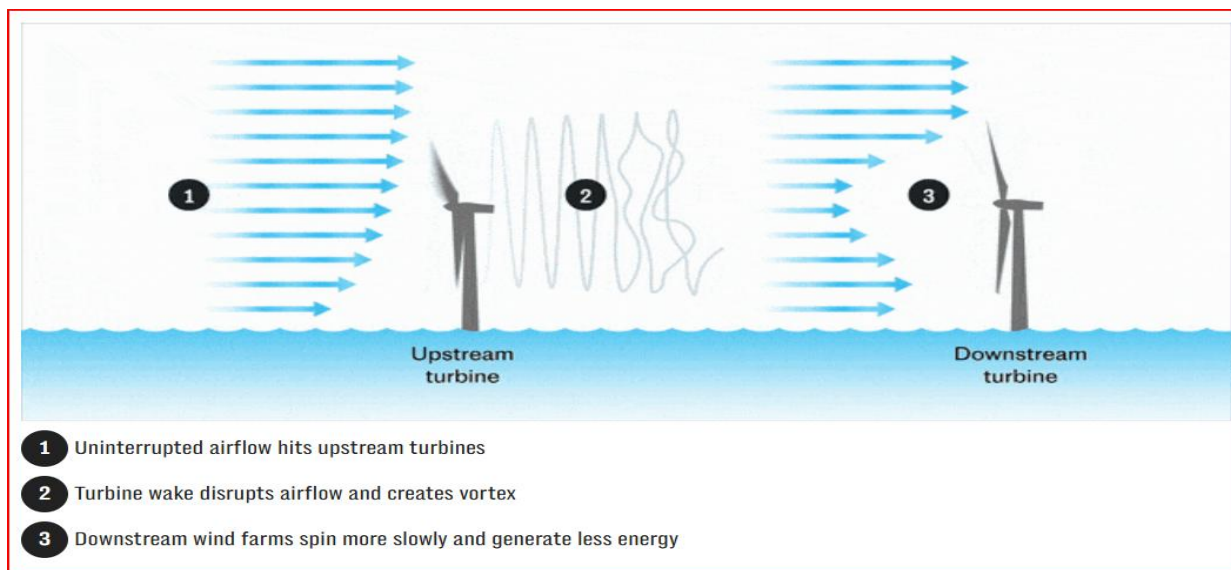
- Dispute over wake losses between developers of two huge offshore wind farms one of many currently underway in UK planning system. Equinor and SSE 1/5/2025 say that wake losses caused by an RWE offshore wind project will cost their massive Dogger Bank arrays £582m (\$778m) over their lifetime, arguing it would be "perverse" not to require mitigation or compensation as a result. The Norwegian oil major and British power

giant submitted the estimate last week in the planning proceeding for Dogger Bank South, a 3GW project that German utility RWE is developing. **This indicates the similar losses to downwind property, agricultural lands & the availability of access to such data for the Wind Energy Industry to take such proceedings. This data is not included with this application.**

The main problem for the wind industry is that there is currently a lot of uncertainty,” says Pablo Ouro, a renewable energy expert who is leading the Manchester University study. “And uncertainty is not good news for financial projects.”

Wind theft happens when air hits the turbines of one wind farm and is disrupted, leaving behind less powerful air flows for wind farms positioned further downstream. It had not been much of a problem for the offshore wind industry until relatively recently. But there is only so much seabed that is suitable for fixed wind turbines, and the turbines themselves are growing in size. As recently as the mid-2010s, a typical turbine was just shy of 200 metres tall. Now, monsters like the world’s largest turbine being built in Bradenberg, Germany, can reach as high as 364 metres – higher than London’s Shard skyscraper. And as the turbines grow bigger, so do their wakes. This means that for upcoming projects, **the wake effect of one wind farm can easily still hit another as far as 37 miles (60km) away**, says Ouro. The differences from the wake effect are not huge, in the sense that there will not be an impact of more than say 4pc to 5pc,” Ouro says. “But actually, for a relatively large wind farm over more than one year, that’s a lot of money.

Earlier this year, for example, Ørsted and Equinor complained that Total’s proposed Outer Dowsing wind farm off the Yorkshire coast could cost them a combined £363m in lost revenues. Ørsted estimated that the scheme would affect its existing Race Bank, Hornsea 1 and Hornsea 2 projects, sapping 0.52pc, 0.67pc and 0.68pc of their outputs respectively at a total cost of up to £199m. Meanwhile, Equinor says its Dudgeon and Sheringham Shoal projects will lose 0.88pc and 0.76pc respectively, with planned extensions also set to suffer. The company predicts the cumulative impacts could amount to up to £164m in lost revenues. Elsewhere, Scottish Power owner Iberdrola alleges that RWE’s proposed Five Estuaries project will reduce the output of its East Anglia 2 wind farm by as much as 2.1pc. And yet another row is raging in the Irish Sea, where Ørsted is duking it out with EnBW, BP and Flotation Energy over the effects upcoming projects could have on its existing portfolio.



The failure to provide the Lacunae of the modelling software determines that this application should be refused.

CJEU Case 258/11 at 44

“So far as concerns the assessment carried out under Article 6(3) of the Habitats Directive, it should be pointed out that it cannot have lacunae and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the protected site concerned.”

Judgement of the Court Case 258/11

Article 6(3) of Council Directive 92/43/EEC of 23rd May 1992 on the conservation of natural habitats and of wild fauna and flora must be interpreted as meaning that a plan or project not directly connected with or necessary to the management of a site will adversely affect the integrity of that site if it is liable to prevent the lasting preservation of the constitutive characteristics of the site that are connected to the presence of a priority natural habitat whose conservation was the objective justifying the designation of the site in the list of sites of Community importance, in accordance with the Directive. The precautionary principle should be applied for the purposes of that appraisal.

Failure to provide the Windpro or Windfarm software is not in compliance with Court Case 258/11 on Lacunae

Windpro Manual: 8a.1.1 Offshore Vs Onshore optimization Manual

The New Optimizer in windPRO covers both onshore and offshore optimization. For offshore layouts the geometry is not fixed, for this functionality the user is referred to as the Classical windPRO optimizer. The key differences between onshore and offshore optimizations lie in the setup of the wake decay constant for the annual energy production (AEP) calculation and in the model for calculating the cost of building the wind farm (if costs are included in the objective). Hence, for pure optimizations of AEP there is no difference in the way that the Optimizer operates. However, the performance will of course be guided by the user-provided information such as WTG area and resource, which typically have distinct characteristics offshore and will be reflected in the resulting optimization solutions. A feature that is particularly useful for offshore applications is the integration of cost surfaces. This feature allows to better integrate costs that change over space into the cost analysis. Further details of onshore and offshore cost models are given in section 8a.4.2.

8a.1.2 The GUI tree-structure and its levels: Site>WTG>Size>Run

A flexible graphical user interface (GUI) has been developed for the New Optimizer to accommodate several different scenarios of use (see section 8a.2 for a description of the scenarios). This flexible GUI is represented by a tree located on the left side of the Optimizer window. The tree will be gradually built-up by the user with the required input information and with the different optimization scenarios run by the user. A lot of information needs to be defined and setup prior to running the optimizations. This setup of pre-defined data and pre-calculated information is a prerequisite for gaining sufficiently fast, yet accurate, optimization results. Building the tree, setting up and preparing the optimization, different information and decisions must be defined and entered.

8a.1.2.1 Site

The Site level is the fundamental level of the optimization, but there can be multiple Sites in the tree to allow studying the effect of different basic assumptions. In the Site, the following information and settings must be defined:

Site Climate/Resources- here the pre-calculated wind resource across the site must be defined by selecting an 'rsf' or 'siteres' file. Ideally, the resource has a grid resolution of 0.5 times the turbine rotor diameter or less as this leads to a good balance between resolution and performance.

Objective – this is the choice of what the user wants to optimize: AEP (annual energy production), LCOE (cost of electricity) or NPV (profit of project). These are described in detail in section 8a.4. For each choice of objective several associated decisions are required. For instance, Wake Decay constant in the PARK calculation (all objectives), setting up a Cost Model (LCOE and NPV) including cost map configurations, or setting the expectation for the future average Electricity Price.

Constraints- The particular requirements for the site must be defined and ALWAYS requires definition of a WTG Area. This defines the limits of the site area or sub-areas where turbine placement is allowed, any requirements for minimum and maximum turbine numbers or capacity in each sub-area. It also defines exclusion zones and set-back buffers as well as minimal spacing requirements for turbines in each sub-area. Logically, the WTG area must be fully covered by the defined site climate/resource data, which is checked with maximum accuracy upon clicking Coverage Check, which also allows a visual inspection on a map. In addition to this the spacing or interturbine Distance defined

in the WTG area may be activated or deactivated. Finally, constraints on turbine component Lifetime, turbine noise at noise sensitive areas, and Wake constraints for new and existing WTGs may be activated (see section 8a.5 for further details).

Connection points – Objectives which require cost calculation (LCOE and NPV) may include known connection points for external grid and road connection. These points must be pre-defined as Control points and selected here.

Existing WTGs – If there are known turbines in the area from other projects which will create wakes on this project they must be defined as existing WTGs and selected here. Their wake effect on the new turbines will be included and the additional wake that they might experience can be considered.

Noise sensitive areas – If noise constraint is activated one or more noise sensitive area (NSA) points must be selected here.

8a.1.2.2 WTG

At the WTG level the required data must be defined for the objective and constraints selected on the Site level. All new turbines in optimizations in this branch of the tree will use the selected turbine and data.

WTG & Mode- Any optimization requires the selection of a turbine model from windPRO's WTG catalogue, a Hub height, and a Turbine Configuration for that turbine model. For traditional power curve data the appropriate power curve is selected, which is the basis for the AEP and wake loss calculations. From windPRO 4.2 onward, the Turbine Configuration can be selected instead that contains the available operation modes with the pairings of power curves with noise curves and load response files. One mode must be selected for the optimization from the list of available modes. It remains an option to use the Power Matrix format, too.

The noise and the load data from the Turbine Configuration or the Power Matrix are used for constraint validations if the site is set up to account for those constraints.

Lifetime/Loads – If lifetime constraint is activated the turbine Design Standard and Design Class must be defined as well as the Load Response Model for use in the calculation of loads and lifetime.

Noise Data – When noise constraint has been activated, the noise data must be selected from the Noise curves provided in the WTG catalogue. When a Turbine Configuration or a Power Matrix is selected, the noise data is retrieved from those via the selected mode.

Use individual WTG cost model- When multiple WTG types are defined for the same Site, it might be relevant to define different cost models for each WTG type individually. In that case this option must be activated and the cost model for the current WTG type defined here. This will override the cost model selected on the Site level

Introduction 5 Figure 6:

8a.1.2.3 Size (and 'Add Sizes & Runs' button)

The Size level has no setting up on the window to the right. Instead, it is created in a single step together with at least one Run at its sub-level (child). This is done via the Add Sizes & Runs button (see green highlight in Figure 6).

Once the Sizes and Runs have been created this window shows an overview of all the runs for this size. In this regard a run is simply an optimization for the park size in question and subject to optimization settings.

The benefit from adding Sizes & Runs in a single step is mainly efficiency, so that more park sizes can be created at once with identical optimization settings without further effort.

Define Park size(s)- Here the user can define the park sizes of interest. Note that ALL sizes from minimum through to maximum will be created once the button Create & queue runs is pressed after which a separate optimization will be run for each size. It is therefore recommended to limit the range of sizes such that it results in a reasonable number of optimizations. The table above the size selection summarizes the requirements for minimum and maximum turbine numbers in the WTG area. Limits on capacity are automatically converted to turbine numbers given the selected WTG.

Alternatives, to defining a range of sizes are either to define a User layout where the user must select the initial positions for the optimization or Fill max which will seek to fill the maximum number of turbine units (see section 8a.3 for further details).

Run setup for each Size – This setup defines the optimization strategy for each created optimization run. Default is Smart with the alternatives Random and Custom. The latter unlocks the lower section of the window unleashing the full flexibility of the optimization solution (see section 8a.3 for details). The Realizations setting available for Random simply defines how many times to repeat the experiment of starting an optimization run from a random initial layout. Setting realizations to 5, for example, will yield five different random runs for each size.

When setup is done in the Setup & Run window the optimizations can either be put in the queue directly by pressing Create & queue runs or be parked for now to be run later by pressing Create & park runs.

8a.1.2.4 Run

The deepest level of the GUI tree is the Run level. At this level each optimization run is presented and when they are completed a resulting optimized layout can be created in the windPRO object list and map window by pressing Realize Final Layout. Through the course of the optimization the positions of WTGs at the current step of the optimization run are visible and updated in the Layout plot. Similarly, the Steps list will show the current and history of the Objective. Alternatively, the Wake loss (available for all objective) or AEP, Wake loss or Cost1 are plotted (only available for LCOE and NPV objectives. This information is also available in the Convergence plot. At the top of the view is a detailed summary of the settings for the run, including a Status indication whether it is running, done or failed.

Details of constraints and/or individual turbine production and wake loss information may be viewed via the buttons Show AEP/Wake and Show Constraints to the lower left of the Optimizer window.

The current status of a run is indicated in the Status line in the Summary when the run is selected in the tree. The status is also in the tree itself on the level of the run and via the icons shown to the left on that line. The legend for these icons and a summary status of all current runs within the tree are shown just below the tree.

8a.1.3 Copy-pasting of levels in GUI structure

As a new feature of windPRO 4.2., it is now possible via a right click on the respective level to copy and paste all levels of the tree-structure, be it a Site, WTG, Size, or Run level. It is both possible to select the level and all children, or only the right-clicked level. This enables faster setups for comparing different WTG types or different run configurations. For example, optimization results from site setup with a desired lifetime of 20 years can be compared to a site with 30 years in just three clicks: Copy site with all children, paste all, start all parked runs.

8a.2 Which decision to optimize?

Many important decisions need to be taken when developing a wind farm. Several of these decisions can benefit from an optimization approach but may not fit well into a traditional optimization setup. In some of the cases the variables on which the decisions are based on (the objective) such as AEP, or financial metrics as cost-of-energy (COE) may not be suitable or sufficiently sensitive to the decisions in question. One such example is the size of a wind farm. The relation between the number of WTGs in the farm and the associated AEP, is simply an increase with the number of WTGs. COE on the other hand typically decreases smoothly with the number of WTGs. This makes AEP and COE unsuitable for determining the optimal size of a wind farm on their own [1]. To accommodate these additional and important decisions in the optimization setup, but not directly in the actual algorithmic optimization process, the decision of these variables is supported by the structure of the GUI. The main use-scenarios are described in the following and includes the following key decisions in wind farm development:

- Design of a layout
- Number of WTGs in the park
- Choice of turbine model
- Fulfillment of constraints

Section 8a.1.2 has described how to establish the tree with a Site, WTG and one or more optimization runs and the settings and inputs needed at each level of the GUI tree. All these settings are done on the Setup & Run tab (cf. Figure 8), which basically is the action mode of the Optimizer, where optimizations can be added and setup and details can be viewed.

To compare multiple finalized optimizations the Optimizer has a 'comparison mode' which is available via the Compare tab (cf. Figure 10). In compare mode, the GUI allows for easy comparison across results for different WTGs, sizes and runs mainly showing the results and some overall settings. Once in compare mode (i.e. on the Compare tab) the GUI tree will behave slightly differently as it will start highlighting the runs which are being compared in mustard color (cf. Figure 11). The highlight shows the level selected by the user below which runs will be compared. When a site is selected results will be compared for WTGs defined for that site. For each WTG the best run across all sizes will be chosen and highlighted in mustard color. When selecting a WTG all sizes below that level will be compared, for each size the best run will be chosen if there is more than one run. Selecting a size will simply compare all runs for that size. At the current stage it is not possible to compare across sites, as they may have different objectives and constraints which cannot easily be compared.

8a.2.1 Design of layout (given park size)

Designing a layout with a single fixed number of WTGs is the basic and simplest mode of use for the Optimizer. Just one optimization needs to be set up and run once the data and settings on the Site and WTG levels have been defined. The flexibility of the GUI tree helps to compare different strategies for the optimization, described in further detail in section 8a.3. Such strategies could include the default, which is called Smart, a user defined initial layout (via User Layout), or perhaps relying more on stochasticity by including random runs. In the last case, several random runs can be started via Realizations. Once a single run has been added for the park size in question more runs can be added by selecting the size in the tree and pressing the button Add Runs, which in this case has replaced the Add Sizes & Runs button (shown when the WTG level is selected). If, on the other hand, a particular run in the tree is selected, then the button renames to Clone Run – this will allow to use the result of that run at starting point for another run. This can be useful for continuing an optimization or doing an optimization with multiple stages. The three variants of the 'Add...' button are shown in Figure 12.

An example of a size with several runs is demonstrated in Figure 13 showing the view on Setup & Run tab. Figure 14 shows the view on the Compare tab, which is more focused on comparing the objective for the final layout across the runs.

8a.2.2 Number of WTGs (park size)

The New Optimizer can be used to analyze parks with different sizes, but it does not optimize for the number of turbines since the objectives are not well suited to optimize the park size: If the objective is to maximize the AEP, it is generally best to place as many wind turbines as possible into the park. In such case the Fill max option can be used. On the contrary, if the objective is to minimize the costs, it would be optimal to place none. In practice, the problem is often to find the wind turbine positions that are optimal for the specified objective with a given park size, and it is more useful to analyse different set-ups per park size and for different park sizes. To analyze the park size, simply set the appropriate range of sizes from min to max in the Add Sizes & Runs setup as shown in Figure 15. Then choose the preferred setup of the runs which will be created for each size (see section 8a.1.2.3 for further details). The Optimizer uses parallelization so several runs will start and run simultaneously to speed-up performance.

Once completed, the results can be visualized and analyzed on the Compare tab and by selecting the relevant WTG in the tree.

In some cases, the runs for the largest park sizes will fail before all turbines could be placed by the start model. This can indicate the maximum number of turbines which is possible to place, but care must be taken as several factors influence this outcome. One thing is making sure that the grid resolution is not too coarse, generally around 0.5 RD ensures good performance. Another possibility is that the default start model (Smart) places turbines according to the objective – but that the maximum is determined by a constraint, hence placement may not be ideal regarding

minimizing constraint exceedance. Section 8a.2.4 describes a procedure that improves chances of finding a valid layout in such cases.

8a.2.3 Choice of turbine model

To analyze the choice of WTG model, simply add all the relevant WTG models to the Site. In such cases setting the maximum allowed capacity of the grid in the WTG area is beneficial as this will automatically influence the maximum number of turbines for each model, given its capacity. It may also be relevant to set individual cost models for each WTG if detailed cost information is available. However, this is not required as the default cost model will automatically account for the difference in rotor size and generator capacity of each WTG type.

The results across the WTGs may be compared on the Compare tab by selecting the relevant site in the tree. If there are more sizes and runs for each WTG the best run (with regard to the selected objective) is chosen to represent each WTG type.

8a.2.4 Fulfillment of constraints (spacing, noise, lifetime, wake)

In some cases, the optimization is more driven by the constraints (noise or loads) than by the objective (AEP, LCOE or NPV). This does not mean that the objective is irrelevant, but rather that the design space is very difficult to navigate in for the Optimizer because large parts are invalid due to the constraints. In some cases, this may lead to runs failing for particular sizes because the start model cannot generate a valid layout, i.e. place all turbines without violating the constraints. If this happens it can be beneficial to add several runs with the Random run setup for a failed size and with the setting Allow invalid start model activated. This will allow the start model to place all the required turbines but disregard the constraints (except the WTG area). The step model will then seek to minimize the constraint exceedance first, and if that succeeds then optimize the objective function.

8a.3 Optimization algorithm

The wind farm optimization problem is a difficult problem mainly due to the occurrence of several local minima and so-called non-linearity and interaction in the objective functions, chiefly arising from the turbine wake interaction. If one turbine is moved the optimum position for all other turbines in the park may change or they may exceed a constraint they did not before. These effects may be accentuated by too coarse a resource grid and too coarse a directional resolution in the wake model or simply by multi-directional wind roses. When constraints are included, these may also prevent otherwise beneficial layout changes and effectively split the solution space into many smaller un-connected “islands” (in a high dimensional sense), which are extremely difficult to navigate for an optimization algorithm. The supported objectives and constraints are described in section 0.

The structure of the New Optimizer reflects the structure of the underlying solution approach, which is a classical iterative search, but with many built-in smart features that improve its performance and efficiency. In this framework, an optimization needs a Start model, an initial ‘first guess’ and then a Step model that subsequently seeks to make iterative, incremental improvements to further improve and optimize the Start model. As the final optimal model is not known a priori, one or more Stop criteria are needed to decide when to halt the search of the Step model. This could be once a maximum time or a maximum number of fruitless attempts to take a new step improvement have been tried.

The better the initial Start model the more focused the iterative Step model can perform its search. In fact, the wind farm optimization problem is so complex that with many turbines it is very difficult for an iterative solution to find a good optimum. Increasing the likelihood of ending up in an only modestly good local optimum. In this sense the old saying “Well begun is half done” is extremely pertinent and the reason for the development of the Smart Start models described in section 8a.3.1.

Figure 20 shows the basic options available for setting up optimization runs. The Optimizer includes multiple options both for the Start model, Step model and Stop criteria and is quite flexible in this sense. However, the basic options shown represent the main recommended combinations of Start and Step models.

The full flexibility is available when choosing the Custom option where all the Start, Step and Stop options become available. These options are summarized in the bullet points below including the two additional options, Seed and Realization, which are explained in their respective parentheses.

- Custom
 - o Start: Fill; Manual; Resource Greedy; Random; Smart
 - o Step: Random, Local; Random, Regional; Random, Global
 - Resolution: Discrete (Limit to grid points), Continuous
 - o Stop: Max runtime, Max fruitless tries, (exhausted neighborhood)
 - o Stochastic (use of random numbers)
 - o Seed (to ensure reproducibility of stochastic methods)
 - o Realizations (how many runs to generate for a stochastic method)

The last listed Stop criterion, exhausted neighborhood, is in parentheses as it is never selectable for the enduser and always applied when the optimization runs with the Discrete resolution setting, where turbine positions are limited to the grid points in the resource grid. This Resolution setting with options Discrete or Continuous is a property of the step model as it is referred to as Limit to grid points in the basic options setup (i.e. not Custom).

To keep the GUI user-friendly, we have pre-defined combinations of Start model and Step model (cf. Figure 20) that are known to perform well together. Above all the Smart option which is the default option will perform the best in the majority of cases. The pre-defined (default) combinations are listed below indicating the Start and Step models

- User Layout
 - o Start: Manual (i.e., user defined)
 - o Step: Random, Regional
- Fill max
 - o Start: Fill
 - o Step: Random, Local
- Best location subset
 - o Start: Fill
 - o Step: Random, Local
- Smart
 - o Start: Manual (i.e., user defined)
 - o Step: None
- Random
 - o Start: Random
 - o Step: Random, Regional

The following sections describe the Start, Step and Stop options in further detail.

8a.3.1 Start model

The purpose of the Start model is to define the initial guess of the optimization solution and to make that guess as good as possible. As described earlier, for complex optimization problems “well begun really is half done”, and most likely much more than just half done. A poor starting model will be more likely to end up in modest local optimal solutions. All the start models operate strictly on the resource grid. If this grid is excessively coarse relative to the rotor diameter of the turbine model, that is to say $>1RD$, the performance of the Start models may deteriorate, in particular the more advanced ones like the Smart Start model. The optimal trade-off between speed and resolution lies around $0.5RD$ for the resource grid spacing relative to the turbine rotor diameter.

Unless the Allow invalid start model is activated the Start model will respect all activated constraints. The option can only be activated for the Random start model. See section 8a.2.4 for further information.

The Smart Start model picks the optimal position (approximately) for each new WTG it places, regarding the actual chosen objective and the effects of already-placed turbines. If stochastic is activated, a measure of randomness is added in the placement of each individual turbine.

The Random Start model is fully stochastic and picks the positions at random across the entire grid. More than one Realization is recommended for this model, typically 7-8 or more, which simply means doing several similar runs with different sets of random numbers. This model can be beneficial particularly if the optimization is strongly influenced by restrictive constraints. A fixed Seed may be set to exactly reproduce random numbers as this seed is used both for the start and step models to ensure full consistency. A fixed seed cannot be used with multiple realizations.

The Resource Greedy option is mainly included for historic reasons and for comparisons with the Classical windPRO Optimizer. It picks each turbine position according to the best available resource position disregarding wake effects and any objective function. This option performs well for sites with strong resource variation (e.g. a ridge) using the AEP objective.

The Fill Start model will simply disregard the resource and start filling turbines from one corner only respecting the constraints until the required number have been placed. If selected via the Fill max option, the filling will continue until no more turbines can be placed due to the constraints. The Fill algorithm has been improved in 4.2.

The Manual Start model is defined by the user who selects the turbine's starting positions.

The Best location subset model allows the user to identify the optimal subset of locations from a defined set of turbine locations, which can be useful in repowering decision making. This model requires an additional configuration since the set of turbines must be defined from which the best subset is selected from. Note that only WTGs that are positioned within the defined WTG area are available for that selection.

8a.3.2 Step model

The Step model iteratively seeks to improve the Start model until a Stop criterion is met. All the Step models are stochastic, which means that they rely on random numbers. This means that both a turbine is selected at random and that a new position for that turbine is selected at random. The main difference between the Step models is the pool of positions from which these new positions are drawn.

The Random, Local Step model assumes that the current layout and turbine positions are relatively close to the optimum. The assumption is typically valid for Smart Start models and Manual user defined Start models. The local step model draws random positions from a local area around the turbine.

The Random, Regional Step model draws the random positions from a relatively large region around the turbine, expecting improvements to be found further away, and the optimum position is not in the direct neighborhood.

The Random, Global Step model draws new positions from the entire domain. It is not utilized in any of the standard options as convergence is inefficient. However, as a first broad search phase it can be useful followed by a Random, Regional step model initiated via a Clone run, for example.

When grid spacing is finer than the expected optimal trade-off at around $0.5D$, the default option is Limit to grid points (Discrete). When grid spacing exceeds $0.5D$, the default option is Continuous, which will allow turbines to move away from grid points and prevent local optima due to a grid that is too coarse which is important. The drawback is that the most natural Stop criterion cannot be used as will be described in the next section.

The main difference between the local, regional, and global set-up is the areas around the turbines considered for steps. In a local step, the local area is $5D$ at the start of the optimization run and becomes iteratively smaller until it reaches $1D$ at the end of the run in the discrete case or $0.5D$ in the continuous case. The distance that defines the regional area is a square root of the vertical and horizontal distance of the whole WTG area, but at least $5D$ in case of small WTG areas, at the start of the optimization run. It also ends up at $1D$ in the discrete case and $0.5D$ in the continuous case. In the global step, the whole area is constantly considered during the run.

8a.3.3 Stop criteria

The purpose of the Stop criteria is to detect if an optimization is converged or so close to being converged that further improvement will be insignificant. Another purpose is to give the user a chance to set a maximum waiting time (with the risk of stopping prematurely far from an optimum).

Max runtime is the maximum time Step model is allowed to run. When the time is up the optimization is stopped. The time to generate the starting model is not included in the timing.

Max fruitless tries simply defines the maximum number of unsuccessful attempts to take a step which accepted before stopping. Both invalid steps (i.e., failed constraints) and steps without improved objective values are counted.

Exhausted neighborhood is an option hidden from the user which is the most efficient stopping criterion. It can only be used for runs with the resolution set to Limit to grid points (Discrete). It is a memory that tests if all possible positions in the search neighborhood for all turbines have been tried in vain – and if so, the current layout is by definition an optimum and the run is stopped. For continuous runs the search neighborhood is always infinite no matter how small it is, and this Stop criterion cannot be employed.

8a.3.4 Objective & Constraints

Put simply, the Objective of an optimization is what we seek to optimize. The design variables are the degrees of freedom given to the Optimizer, which are allowed to be modified to find the best possible objective. In this Optimizer only the turbine positions, their X and Y coordinates are explicit design variables. The number of turbines and the turbine models are implicit design variables which the user can analyze and optimize via the flexible structure of the GUI-tree. The choice of objective may differ for different users, the supported objectives are described in next section.

Constraints are known limitations which must be fulfilled for a solution to be accepted, hence, we call a solution which fulfills all constraints Valid. A solution where at least one constraint is violated is Invalid (and will not be accepted).

8a.4 Objectives

An optimization needs a quantity that must be optimized, the Objective, given a set of design variables that may be varied. For some objectives optimization implies maximization, which is the case when wind farm production (AEP) or project profit is the objective. For other objectives optimization implies minimization, which is the case for cost-of-energy optimization.

8a.4.1 AEP

AEP is simply the Annual Energy Production including wake losses. The AEP calculation is based on the resource data in the selected .rsf or .siteres file, containing sector-wise Weibull parameters (A and k) and frequencies (f). Wake effects are calculated using the PARK2 wake model and the user-defined wake decay constant. Wind farm layout optimizations using AEP as the objective have a drawback, particularly if the available WTG area is large: The optimization may lead to very spread-out layouts that would incur excessive costs for building roads and grid connection. This is the main motivation for choosing other objectives, in particular, objectives which include the costs of building the wind farm.

8a.4.2 Costs

Costs are not included as an objective on its own in the New Optimizer, at least not directly. However, the estimation of costs is an important input to financial objectives such as cost-of-energy (COE) or profit (NPV), to account for the balance between the created value (i.e., AEP) and the expected costs required to realize that potential. Costs in the New Optimizer are estimated using the windPRO Cost tool. This tool estimates costs using parameterized formulas fitted to a large amount of real historic costs and based on extensive literature reviews. As an example, turbine costs scale with generator capacity (MW), specific capacity (MW/m²), rotor size (m²) and hub height (m) via an elaborate regression expression. The cost tool comes with six predefined cost models, three price levels 'high', 'mid' and 'low' for onshore and offshore, respectively.

In the cost tool, the costs are divided into four main categories as listed below.

- Devex: development expenditure
- Capex: capital expenditure
- Opex: operational expenditure
- Abex: abandonment expenditure

Development expenditures (Devex) quantify the cost associated with developing the project, getting permissions to build the wind farm etc. Capital expenditures (Capex) represent the main investment of building the wind farm. Operational expenditures (Opex) represent the costs of keeping the wind farm running through its lifetime, and abandonment expenditures (Abex) quantify the estimated amount of money to eventually remove the wind park. Capex is the only cost category which depends on the actual design of the layout via the costs for the internal grid connection between the turbines (and roads for onshore).

When costs vary over space, cost maps can be imported to account for that via the Add cost map button. These costs are functionally handled as other costs but instead of fix input parameters the cost values are retrieved from the cost map.

For each cost a Cost Index may be defined to account for expected future trends in the price development. This index should exclude the effect of the general baseline inflation.

In Figure 25 please note the possibility to insert adjustments to the baseline costs via entries in the table column Cost function value. It is via values in this column that the high and low alternative cost models are defined, by an increase or decrease of these factors.

In the Optimizer the wind farm is assumed to be built and put into operation the year after the current year, which for 2024 would be 2025. Devex is assumed to occur the year before the installation, i.e. the current year. When the reference year defined in the cost tool deviates from the year that a cost occurs the price index (if set) will be used to adjust the costs accordingly. The default cost index is zero through the lifetime.

Note that the total cost values shown in the optimizer are not discounted only index corrected (if set by the user) and summed over the lifetime.

For the grid (offshore and onshore) and road connection costs (onshore only) an additional sub-optimization is solved for finding the shortest possible way to connect the turbines in the layout. Either to each other or to any of the Connection points if defined for the Site. The resulting inter-connection distance is what enters the cost calculation. The solution to this sub-optimization relies on graph theory and the optimization problem is referred to as the minimum spanning tree. The connections of the minimum spanning tree are visualized in the Layout plot for each run as the black connection lines between the WTGs (and connection points, if any).

As a final remark it is important to stress that the cost model is deliberately kept relatively simple with a minimum of assumptions which are calibrated against actual project costs. Hence, the user does not need, in fact cannot, set a large range of particular cost items such as the cost of crossing a stream or railway. Although that degree of flexibility might appear beneficial, if the input quantities are not known the values will be associated with a very large uncertainty, as will the resulting overall cost estimates. The current cost tool seeks to strike an ideal balance between accuracy and detail/flexibility, but with a preference for accuracy over detail. In the end what is important is getting the right order of magnitude of costs as input to the financial objectives.

8a.5 Constraints

The following sections describe the constraints supported by the New Optimizer. The supported constraints are shown in Figure 27. Note that including Lifetime or Noise constraints are subject to additional windPRO license requirements as they draw on calculation functionality in the LOAD RESPONSE and DECIBEL modules, respectively.

8a.5.1 Area & distance (sub-areas)

Defining a WTG area object is a prerequisite for all optimizations. The WTG area object serves the purpose to define the area limitations for turbine placement. A site may be split into arbitrarily many sub-areas and each sub-area may have individual limitations on minimum and maximum numbers of turbines or installed capacities. Sub-areas may also have individual requirements for turbine spacing typically defined as an elliptical constraint in terms of rotor diameters oriented along the prevalent wind direction. The Optimizer will always adhere to the areal requirements defined in the selected WTG area, whereas minimum requirements for inter-turbine distances must be separately activated via the Distance constraint. Even if no distance constraint is activated the Optimizer will not accept a turbine spacing below

1D. Some tips and considerations to the WTG area import are available in section 8a.6.2, and detailed information about the WTG area object is available at Appendix 8 OPTIMIZE Classic in section 8.0.1.5.

8a.5.2 Wake loss

The maximum wake loss constraint (cf. Figure 27) allows to define maximum wake losses for both new WTG and existing WTG objects; the maximum wake losses can be specified independently from each other.

8a.5.3 Noise

The noise constraint requires an activated license for the DECIBEL module. The calculation is a stripped-down version of the ISO 9613-2 standard. The noise constraint is defined for a single wind speed selected in the Model settings for the noise requirement (Figure 28). Noise sensitive areas must be selected on the Site level (Figure 29) and WTG source noise data on the WTG level (Figure 30).

8a.5.4 Component Lifetime (loads)

The lifetime constraint requires an active license for the LOAD RESPONSE module and sets a constraint on required minimum lifetimes for selected turbine components for each WTG position. The calculation of lifetimes and activation of the lifetime constraint requires a resource file including all the siting parameters for fatigue calculation, i.e., a .siteres file. Such a file may be calculated using the RESOURCE calculation in windPRO drawing upon the IEC61400-1 ed. 4 calculation functionality in SITE COMPLIANCE, or can be downloaded from the free online GASP dataset. The calculation options are a stripped-down version of LOAD RESPONSE as can be seen from the Model settings in Figure 31.

The lifetime calculation also requires the setup of the wind turbine Design Standard and Class as well as selection of the Load Response Model which can be either a generic model or a specific model provided by a manufacturer. For the response model, a set of sensors must be selected for the constraint, here it is recommended to focus on the key components such as blade root and tower bottom, and perhaps low speed shaft (LDD).

8a.6 Practical recommendations

8a.6.1 Run setting recommendations

As default setting, we recommend:

- Interval — this allows a specific number of WTG's to be placed.
- Smart start — this algorithm excels to maximize the objective when there are not many constraining conditions, e.g. limited space.

For sites where it is difficult to allocate the desired number of turbines and only distance constraints are activated, we recommend:

- Fill Max — this places as many WTG as possible.

For sites where it is difficult to allocate the desired number of turbines and constraints in addition to distance constraints are activated, we recommend:

- Interval
- Random + Allow invalid start model — this allows a specific number of WTG's to be placed when there are multiple constraining factors that complicate to place the desired number of turbines (it is often helpful to increase the run time when both random and allow invalid start model options are selected).

For sites with fix locations for WTGs and an optimal subset of WTGs shall be selected, e.g. for Repowering, we recommend:

- Best location subset

For large sites, high resolution resource data or many turbines that leave to long computation times, we recommend

Limit to grid points — This often yields a good starting point in much shorter time, and the solutions can then be further optimized in a consequent step, e.g. using Manual start 6) For layouts where a good layout has already been found and it shall be refined, we recommend:

Manual start 8a.6.2 WTG Area import

A convenient approach is to import pre-defined WTG Areas (cf. Figure 33: WTG area Import from file.) as shapefile format (.shp). Each feature of the shapefile a WTG area is handled separately for which properties can be defined, e.g., whether the area is an exclusion zone or a WTG area, the minimum and maximum number of WTGs to be placed, the minimum distance between WTG (cf. Figure 33). Moreover, a buffer zone can be specified (cf. Figure 34) for the optimization.

8a.6.3 Example projects

Three sample projects are provided to show the range of utilities of the optimizer tool: a sample on-shore project, a sample off-shore project, and a sample project for the new noise curtailment optimizer.

The onshore sample project Aparados da Serra.w42p provides a variety of optimization scenarios. These include runs with AEP, LCOE and NPV objectives, runs with different constraints and on different WTG area structures. Lastly, it shows a performance comparison for different turbine types and a performance comparison for different optimization configurations.

The offshore sample Cost model offshore.w42p showcases the new option of including cost maps in the cost set-up that can be used to represent a whole variety of costs, e.g., bathymetry-based costs, soil structure foundation costs, or travel costs.

The noise curtailment Curtailment optimizer demo project.w42p shows how a non-compliant wind farm layout can be made compliant with noise regulations while still obtaining the maximum possible energy yield from optimal curtailment strategies.

12.5.3 Operational Phase Potential Impacts

This section presents an assessment of the elements of the Proposed Project that are likely to generate operational noise with the potential for adverse effects on NSLs.

12.5.3.1 Turbine Noise Assessment

Using the assessment methodology described in Section 12.3.7.1, the predicted turbine noise levels have been calculated at all NSLs within the study area of the Proposed Project. A **conservative omnidirectional turbine noise prediction assessment** has been carried out using the ISO 9613-2 calculation standard and best practice guidance for turbine noise prediction contained in the IOA GPG. These calculations are based on conditions favourable to noise propagation, i.e., downwind propagation from source to receiver and/or downward refraction under temperature inversions. The results of the noise prediction models have been compared against the turbine noise limits that have been assigned to each of the NSLs as presented in Section 12.4.2 which in turn have been derived in accordance with the criteria set out in Section 12.3.2.2.1. Results for the full set of NSLs are presented in Appendix 12-7, and noise contours are presented in Appendix 12-8. Table 12-18 presents the details of the exercise at the locations with the top 10 predicted noise levels at 8 m/s (wind speed at maximum noise output for N163 candidate turbine), which are:

H001

H016,

H021,

H022,

Table 12-18 Review of Predicted Turbine Noise Levels against Relevant Criteria

House ID	Description	Predicted Noise Level dB LA90 at Standardised Wind Speed at 10m height					
		3	4	5	6	7	≥8
H001	Predicted Turbine Noise Level	29.9	31.4	35.9	40.3	41.4	41.5
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	--	--	--	--	--	--
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	--	--	--	--	--	--
H016	Predicted Turbine Noise Level	28.8	30.3	34.8	39.2	40.3	40.4
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	--	--	--	--	--	--
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	--	--	--	--	--	--
H021	Predicted Turbine Noise Level	28.8	30.3	34.8	39.2	40.3	40.4
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	--	--	--	--	--	--
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	--	--	--	--	--	--
H022	Predicted Turbine Noise Level	28.8	30.3	34.8	39.2	40.3	40.4
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	--	--	--	--	--	--
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	--	--	--	--	--	--
H027	Predicted Turbine Noise Level	28.9	30.4	34.9	39.3	40.4	40.5

House ID	Description	Predicted Noise Level dB L _{A0n} at Standardised Wind Speed at 10m height					
		3	4	5	6	7	≥8
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	-	-	-	-	-	-
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	-	-	-	-	-	-
H057	Predicted Turbine Noise Level	28.9	30.4	34.9	39.3	40.4	40.5
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	-	-	-	-	-	-
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	-	-	-	-	-	-
H060	Predicted Turbine Noise Level	30.0	31.4	36.0	40.4	41.4	41.6
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	-	-	-	-	-	-
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	-	-	-	-	-	-
H075	Predicted Turbine Noise Level	29.2	30.7	35.2	39.6	40.7	40.8
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	-	-	-	-	-	-
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	-	-	-	-	-	-
H093	Predicted Turbine Noise Level	28.8	30.3	34.8	39.2	40.3	40.4
	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	-	-	-	-	-	-
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	-	-	-	-	-	-
H105	Predicted Turbine Noise Level	29.2	30.6	35.2	39.6	40.6	40.8

	Daytime Limits	40	40	40	45	45	45
	Potential Daytime Exceedance	-	-	-	-	-	-
	Night Limits	43	43	43	43	43	43
	Potential Night-time Exceedance	-	-	-	-	-	-

At all NSLs the omni-directional turbine noise levels are below the noise criterion curves; no exceedances are noted.-- As discussed in Section 12.3.7.1, it noted again that the noise prediction calculations have been made using the ISO 9613-2 standard and relate to conditions favourable to noise propagation (typically downwind propagation from source to receiver and/or downward refraction under temperature inversions). A +2 dB uncertainty has been applied to turbine emissions in line with the IOA GPG.

12.6.2 Operational Phase

12.6.2.1 Wind Turbines

12.6.2.1.1 Turbine Curtailment

An assessment of the operational wind turbine noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 12.3 of this Chapter. The findings of the assessment, presented in Section 0 confirm that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all locations. Notwithstanding the above, this section discusses the principle of noise curtailment, to present an example of in reduced noise mode operations, should it be necessary to reduce the noise contribution from any installed turbine.

Wind turbines can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve noise criteria during certain periods (i.e. day or night) and in specific wind conditions (i.e. wind speed and direction). The turbine technology that has been assumed for this assessment offers various low noise modes of operation which typically will have an associated energy output reduction. Operating the turbines in reduced modes is generally referred to as curtailment and is a proven effective mitigation to ensure noise limits are complied with. As an example of this turbine control capability, the following table shows the sound power levels for the Nordex N163 turbine at the hub height of 103.5 for Normal Operation and should be read as augmenting Table 12-18, along with the sound power levels for the various operational modes that can be applied to this turbine. As can be seen at mid to higher wind speeds a reduction in the noise level of the order of 5dB can be achieved dependent on the operational mode set on the specific turbines.

Table 12-19 Sound Power Levels at Reduced Modes

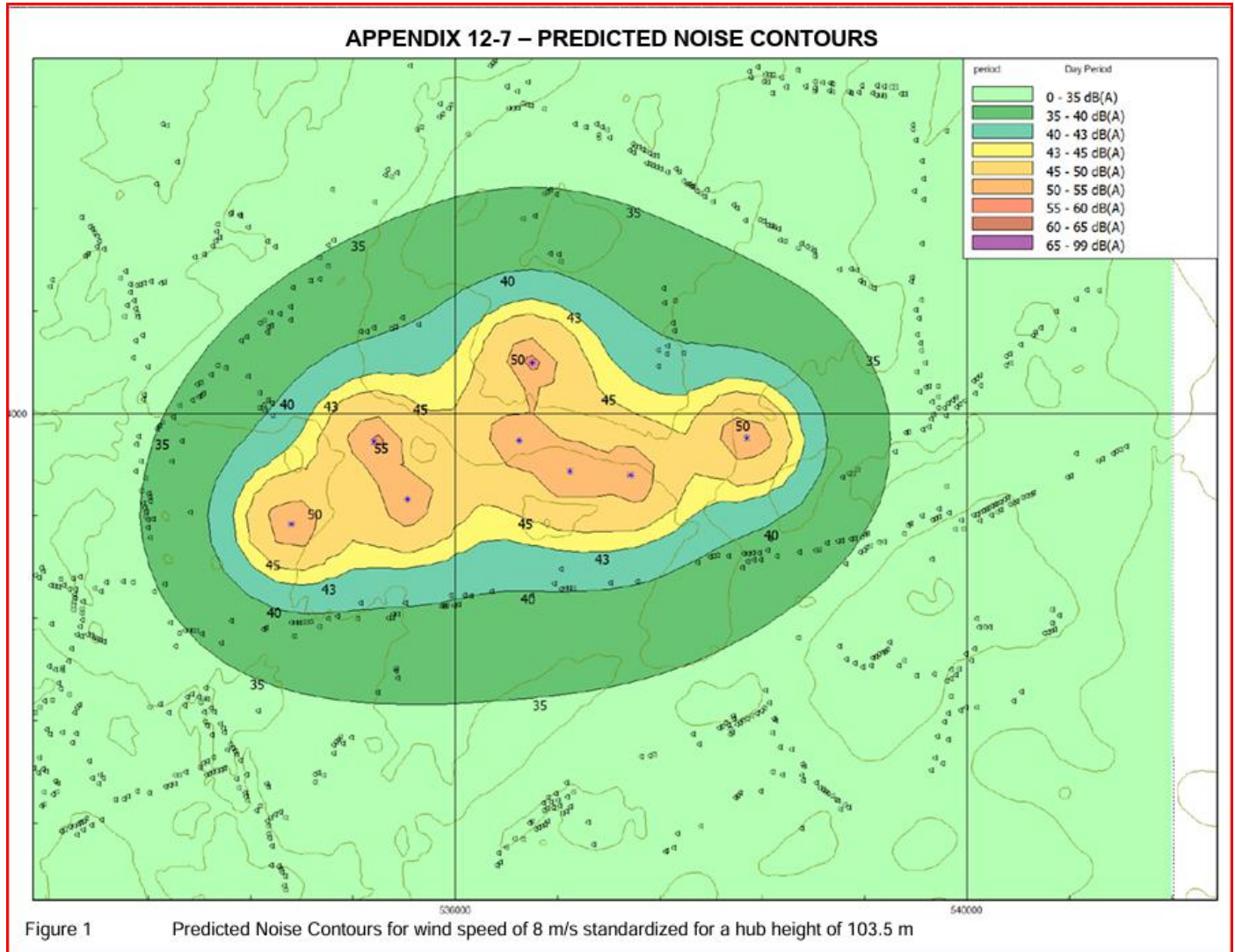
Wind Speed m/s	Sound Power Levels, dB L _{WA}					
	Mode 0	Mode 1	Mode 3	Mode 5	Mode 7	Mode 9
3	95.0	95.0	95.0	95.0	95.0	95.0
4	96.5	96.5	96.5	96.6	96.6	96.6
5	101.0	101.0	101.0	101.0	101.0	100.5
6	105.4	105.4	104.9	104.2	103.3	101.0
7	106.5	106.3	105.5	104.5	103.5	101.0
8	106.6	106.4	105.5	104.5	103.5	101.0
9	106.6	106.4	105.5	104.5	103.5	101.0

All modern turbines have the ability to control their power and noise levels in a similar manner, and the suitability of any turbine for the site will be dependent on whether it can operate in an efficient manner while also remaining within any noise limits that may be conditioned in the event of favourable consideration.

Summary of issues:

1. The noise graphs are calculated from the software modelling, which isn't provided. Manufacturers wind tunnel outputs for singular wind turbines squeezed into a site, are not acceptable.
2. There are several loads and unbalanced forces acting on the wind turbine tower which are ultimately transferred to the foundation and can be classified into two types: static (or dead load) due to the self-weight of the components and the dynamic loads (which in some instances can be cyclic & cause vibration)

Item 9. Noise & Vibration (EIAR)



9.1

You are requested to clarify if the wind farm noise calculations are based on collective / standalone turbines.

Table 12-10 of the EIAR presents the sound power level for each one of the proposed turbines, in this instance Nordex N163 turbines with a hub height of 103.5 m above ground level. There are eight such turbines in the Proposed Wind Farm as presented in Table 12-9 of the EIAR. AWN confirms that the predicted noise levels in Table 12-18 and in Appendices 12-7 and 12-8 of the EIAR are the combined noise levels of all eight turbines at each of the noise-sensitive locations. Calculations are carried out fully in accordance with the guidance in IOAGPG. In summary the calculated noise levels are collective, based on all eight turbines operating at the same time.

Note this information could have been provided through screenshots of the Windfarm/WindPro Modelling software. However, the Applicant did not provide this data as part of the Planning Application as part of the Lacunae. A statement mentioning a confirmation from AWN, another Planning Noise Consultant has no value & doesn't meet the public visibility/interpretation requirements of a planning application. There is either science or there isn't.

The 6-figure northing & easting grid references for the turbines fails to meet the 2016 & 2019 WEG's separation distances of 7 times the Rotor diameter, & this indicates that this planning application is meant to deceive the public. No reliance can be accepted from such a confirmation or response. The failure to comply with the separation distances creates increased turbulence & noise downwind to other turbines. Was this assessed and why is it not presented? Some of the scientific papers attached to this submission indicate turbulence at the front & sides of a turbine & skywards in addition to downwind turbulence. This turbulence meshes to create vortex's of turbulence, where birds cannot fly. The situation would be similar to a jet taking off where the next jet has to wait for 1.5minutes to allow turbulent air to settle.

9.2

Consideration should be given to seismic effects, seismic effects and infrasound from the karstic limestone spindles vibration, impacts of vibration on property.

Section 12.3.4 provides further detail on vibration and seismic effects as a result of the operation of the Proposed Wind Farm. Section 12.3.3.1 of the EIAR discusses low-frequency noise in its application to noise assessment, with further detail provided in Section 12.3.3.1 of the Report.

12.3.4 Operational Phase Vibration

Seismic effects are not expected nor likely from the proposed wind turbines or any other part of the Proposed Project, for any type of ground. There are no known issues of effects of this nature at similar developments. Section 12.3.4 of the EIAR discusses the vibration in its application to the assessment. It states: A report published in Germany by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources", Conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of 300 m and greater from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels. The shortest distance from any turbine in the Proposed Wind Farm to the nearest NSL is in approximately 767m (being the distance from turbine T06 to NSL ref. H001). At that distance, the level of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria are not specified for the operational phase of the Proposed Wind Farm. As such, no perceptible vibration effects are expected at any noise-sensitive location.

Note that the Applicant doesn't refer to the underlying bedrock in this historic German Report. It is obvious that karstic rock with clint & gryke spindles will vibrate like a tuning fork. The response to the FI is totally inadequate. Using historic references for far smaller turbines from non-karstic areas is not scientific or acceptable, All one needs to consider is that a rotating blade at c90m/s with varying wind speeds at various heights & blade locations will transfer this varying kinetic energy from the blades & torque to a central column & this in turn will transfer it to the foundations, which will "rock" on the underlying material. This application provides zero science for the large turbines proposed.

12. NOISE AND VIBRATION

12.3.3.1 .Infrasound/ Low Frequency Noise

Section 12.3.3.1 of the EIAR discusses low-frequency noise in its application to noise assessment. It concludes that: There is a significant body of evidence to show that the infrasound associated with wind turbines will be below perceptibility thresholds and typically in line with existing baseline levels of infrasound within the environment. As presented in the response to previous submissions referred to in Section 1.0, the following is committed to by the applicant and will be implemented in full: In the unlikely event that an issue with low frequency noise is associated with the proposed development once operational, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011. Notwithstanding the above, Awn confirms that low-frequency noise issues due to the operation of the proposed wind turbines are not expected at the noise-sensitive locations.

12.3.3.1 Infrasound/Low Frequency Noise Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011) is noted here: "There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic

“thump” as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature.” With respect to infrasonic noise levels below the hearing threshold, the World Health Organisation (WHO) document Community Noise (WHO, 1995) has stated that: “There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects.”

In 2010, the UK Health Protection Agency published a report entitled Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation. The exposures considered in the report related to medical applications and general environmental exposure. The report notes: “Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies. For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects.”

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. In relation to the issue of infrasound, the article states the following: “Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles. Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low frequency sounds.

A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view.” The article concludes that: “from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including ‘infrasound’) or ground-borne vibration from wind farms, generally has adverse effects on wind farm neighbours”.

A report released in January 2013 by the South Australian Environment Protection Authority namely, Infrasound levels near windfarms and in other environments (EPA, 2013)² found that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people. The study included several houses in rural and urban areas, both adjacent to and away from a wind farm, and measured the levels of infrasound with the wind farms operating and switched off.

There were no noticeable differences in the levels of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building. The EPA’s study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rural environments, and stated that: “The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment.”

A German report³, titled “Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources” presents the details of a measurement project which ran from 2013. The report was published in 2016 by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg and concluded the

following in relation to infrasound from wind turbines: “The measured infrasound levels (G levels) at a distance of approx. 150 m from the turbine were between 55 and 80 dB(G) with the turbine running. With the turbine switched off, they were between 50 and 75 dB(G). At distances of 650 to 700 m, the G levels were between 55 and 75 dB(G) with the turbine switched on as well as off.” “For the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013 Draft) 4” “The results of this measurement project comply with the results of similar investigations on a national and international level.” There is a significant body of evidence to show that the infrasound associated with wind turbines will be below perceptibility thresholds and typically in line with existing baseline levels of infrasound within the environment.

Note that all of these references are at least 9 years old, when turbines were far smaller than the present proposal. It beggars belief that the Applicant didn't objectively refer to current reports.

Structural vibration considerations for the design of onshore piled wind turbine foundations. N.R Featherston. Mott Macdonald Limited. 18th December 2019

Wind turbine structures are generally tall slender towers with a rotor and blade assembly placed at the top of the tower. These slender structures are prone to vibration due to dynamic environmental actions (such as wind forces) as well as the structure's own dynamics (Bhattacharya & Adhikari, 2011). Analysis of the dynamic behaviour of wind turbines is fundamental to the stability, performance and operational safety of these structures. Wind turbine towers need to sustain continuous vibration-induced forces throughout their operational life (Satari and Hussain, 2008). Tower height is an important factor in the design of a wind turbine. The height of the tower is typically a compromise between the need to place the rotor as high as possible (thereby taking advantage of stronger winds), and the need to limit the height to accommodate structural foundation and constructability limitations

The operating frequency of the three-blade turbine can potentially cause dynamic amplification of the forces acting on it significantly enough to pose a threat to the overall structural integrity. Sufficient separation between the structural system natural frequency and the turbine operational frequencies is crucial to avoiding potentially catastrophic failures. The turbine operating frequency is typically lower than the structural system natural frequency, however it could approach it as higher turbine output is obtained.

Idealized assumptions of fixity at the base of the tower are generally un-conservative; a more realistic analysis accounting for the foundation flexibility yields lower estimates of the natural frequency for the system.

In these cases, soil-foundation-structure interaction modelling should be considered.

2 VIBRATION CONDITION CHECKS

There are usually two conditions that are checked for when designing a machine foundation (Chowdhury & Dasgupta, 2009):

- Resonance check
- Amplitude check

2.1 Resonance check

All machinery under operation usually induces a periodic dynamic load on the foundation and in most of the cases can be represented by a function like $P_0 \sin \omega m t$, where P_0 = magnitude of the unbalanced force from the machine during its operation and ωm = operating frequency of the machine usually expressed in radians/sec, Hertz or revolutions per minute (rpm).

Due to this induced dynamic load from the machinery, the pilecap foundation including some portion of the soil underlying the foundation is subjected to vibration and it is essential that the natural frequency (ω_n) of this vibration should be well away from the operating frequency of the turbine machinery i.e. the resonance condition should not

prevail. Irrespective of any code the normal practise is to design the foundation in such a way that its operating frequency is at least 20% away from the natural frequency of the foundation.

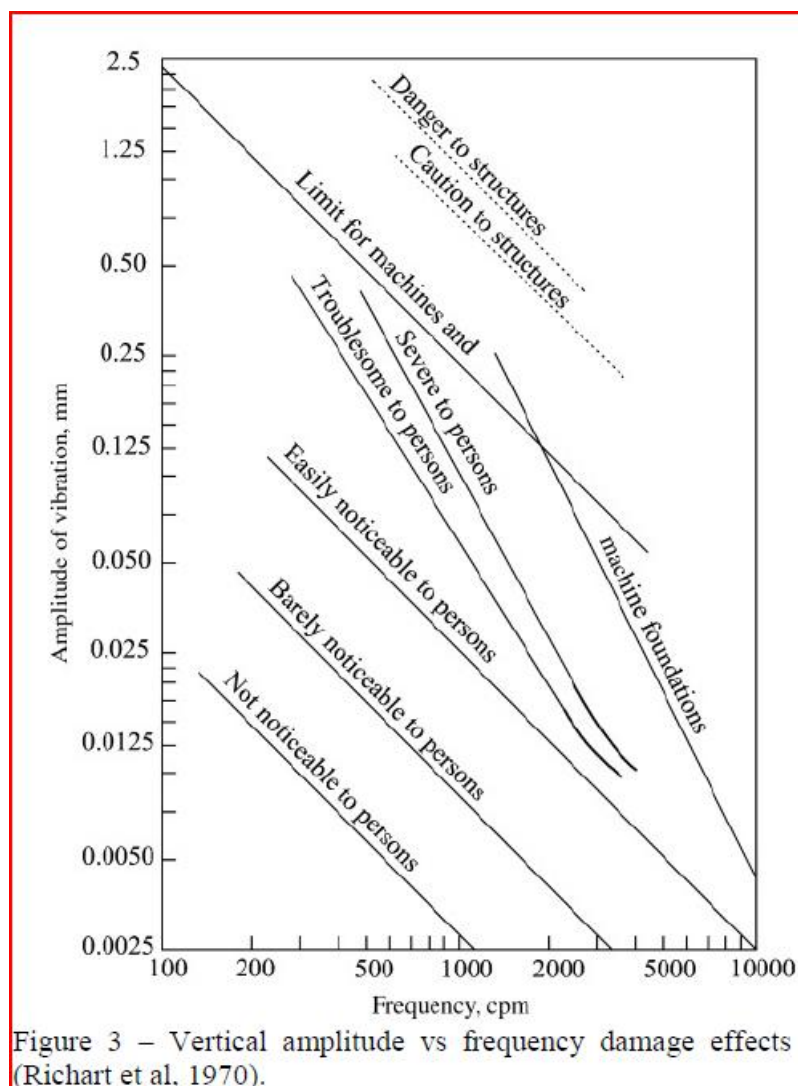
2.2 Amplitude check

Under this condition, it is common to check that the amplitude of vibration of the pilecap foundation is well within the acceptable limits of engineering practise (and see Figure 3). The acceptable or the tolerable limits are usually suggested by the vendor supplying the equipment or in the absence of such data are usually obtained from the code requirements.

If the amplitude of vibration is more than this acceptable limit, it can erode the performance of the equipment in the following way:

- Rapid deterioration of the machinery due to heavy wear and tear.
- Excess amplitude of vibration, inducing fatigue in the coupling and the connecting shafts leading to repeated breakdowns.
- Increase in decibel level during operation causing discomfort to operators of the system.
- Accumulation of explosive gases which could be dangerous to human life and property.

Based on the above discussion it is mandatory that for foundations with dynamic load actions, the above two conditions are met.



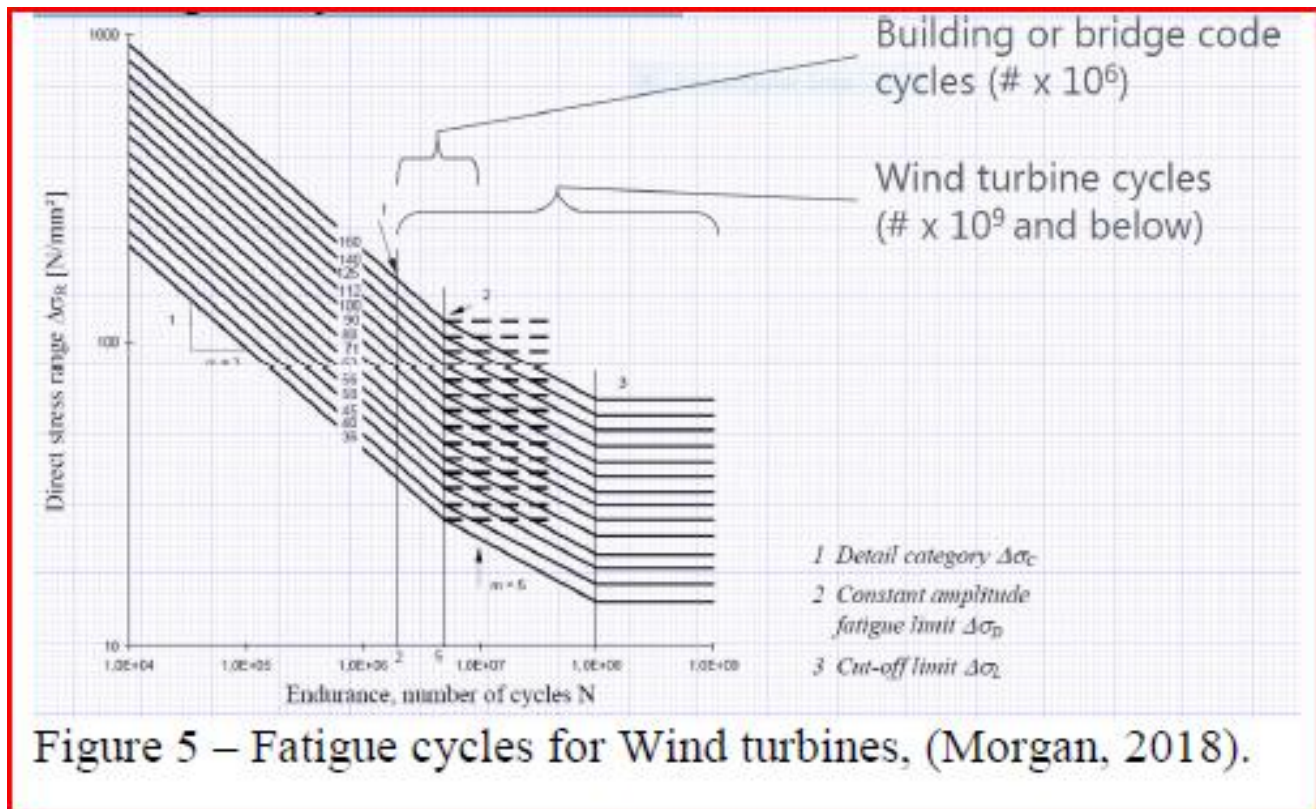
3 LOADING AND VIBRATION

CHARACTERISTICS OF ONSHORE WIND TURBINES

There are several loads and unbalanced forces acting on the wind turbine tower which are ultimately transferred to the foundation and can be classified into two types: static (or dead load) due to the self-weight of the components and the dynamic loads (which in some instances can be cyclic).

3.1 Self-weight loads

These include the dead loads of the nacelle, the rotor's self-weight and tower's self-weight. Gravity forces on the blades generally cause sinusoidal loading due to their rotation. This kind of load is important for fatigue analysis since wind turbines are designed to produce electricity for a minimum of 20 years. Thus, a turbine with blades rotating at an average of 11.2 rpm will be subjected to 1.1773×10^8 stress cycles over its lifetime (Sassi, 2016). In the average life of a wind turbine tower it is therefore subjected to an order of magnitude higher number of loads than a bridge receiving daily traffic would.



3.2 Dynamic loads

Any machinery with a rotating component causes forces on its foundation. The amplitude of the centrifugal force F depends on the rotating mass m , the mass unbalance e and the angular frequency ω as follows:

$$F = me \omega^2 \quad (1)$$

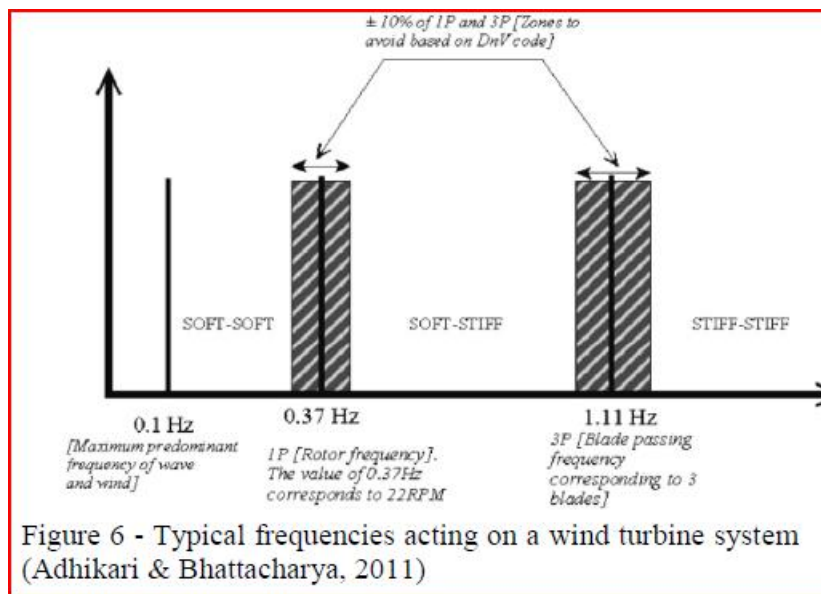
Foundations carrying machinery on soil with or without foundation piles can be analyzed as one or two mass-spring systems (van Koten, 2012). The harmonic loading by rotating machines can be accurately determined. Concise formulas are available for the stiffness, equivalent mass and damping calculations.

The natural system frequencies and displacement amplitudes can be obtained by hand calculations, without the use of complex software. The amplitude can then be evaluated as acceptable or not.

Soil at the sides of foundations has been found to considerably increase the damping and strongly reduce the displacement amplitudes (van Koten, 2012). The vertical vibrations are well damped by the soil, but the horizontal vibrations can be disturbing even at a large distance from the foundation. The challenging part of the analysis is

therefore the understanding of the dynamic loads acting on the wind turbine which are discussed below (Bhattacharya, 2014):

- (a) The lateral load acting at the level of the hub (top of the tower) from the rotating blades produced by the turbulence in the wind. The magnitude of this dynamic component will depend on the turbulent wind speed.
- (b) The load caused by the vibration at the hub level due to the mass and aerodynamic imbalances of the rotor. This load has a frequency equal to the rotational frequency of the rotor (referred to as 1P loading in the literature). This is the known as the Primary system excitation frequency. Since most industrial wind turbines are variable speed drive machines, 1P is therefore not a single frequency but rather a frequency band between the frequencies associated with the lowest and the highest rpm.
- (c) Loads in the tower due to vibrations caused by blade shadowing effects (this is referred to as 2P/3P in the literature). The blades of the wind turbine passing in front of the tower itself cause a ‘shadowing effect’ and consequently inflict a loss of wind load on the tower. This is also a dynamic load having frequency equal to three times the rotational frequency of the turbine (3P) for three bladed wind turbines, and two times (2P) the turbine rotational frequency for a two bladed turbine. The 2P/3P loading is also a frequency band such as 1P and is simply obtained by multiplying the limits of the 1P band by the number of the turbine blades.



It is worth noting that the DnV (2001) Code of Practice states the following: ‘If it is confirmed that the tower frequency is kept outside ranges defined as the rotor frequency $\pm 10\%$ and the blade passing frequency $\pm 10\%$, respectively, then there will normally not be any problems due to load amplification arising from vibrations at or near the natural frequency’. The Code furthermore states that special attention should be given to variable-speed turbines, ‘in which cases the turbine should not be allowed to operate in a frequency interval defined as the eigenfrequency of the tower $\pm 10\%$ ’. It is also specified that the global frequency of the system should be at least $\pm 10\%$ away from operational 1P and 2P/3P frequencies.

Due to their slender nature, it is no surprise that wind-turbines are dynamically sensitive at low frequencies, the first modal frequency of the system (often less than 1Hz) being very close to the excitation frequencies imposed by environmental and mechanical loads. As an example, the predominant frequencies of wind are about 0.1 Hz whilst the rotor frequencies

are in the range from 0.15 - 0.5 Hz. Figure 6 shows the main frequencies for a three-bladed standard wind turbine. It is clear from the frequency content of the applied loads that the designer of the turbine and foundation has to select a system frequency (the global frequency of the overall wind turbine foundation system) which lies outside the range of environmental frequencies in order to avoid system resonance.

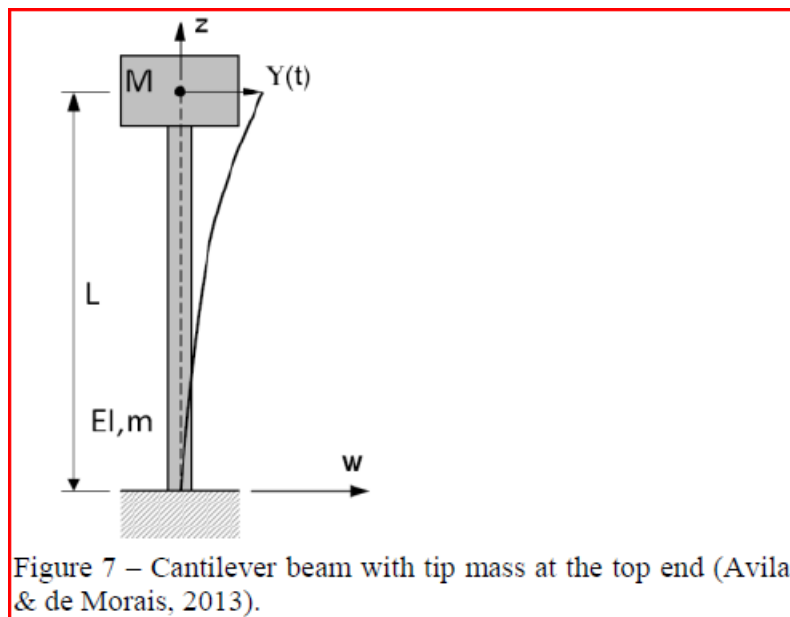
From the point of view of the first natural frequency (f_0) of the structure, three types of designs are possible (Bhattacharya, 2014):

- (1) Soft-Soft design where f_0 is placed below the 1P frequency range which is a very flexible structure and almost impossible to design for a grounded system.
- (2) Soft-Stiff design where f_0 is between 1P and 3P frequency ranges. This is generally the most commonly used design in the industry.
- (3) Stiff-Stiff designs where f_0 has a higher natural frequency than the upper limit of the 3P band which would therefore require a very stiff support structure. The usual choice for fixed wind turbines would lie in the interval between turbine and blade passing frequencies (referred to as a ‘soft-stiff’ structure). Other definitions of “soft-soft” and “stiff-stiff” can be found in Bhattacharya (2014).

4 SIMPLE DYNAMIC TOWER MODEL

It is therefore essential to perform a free vibration analysis of the structure with consideration for the flexibility of the foundation. The comparison of the natural period of the structure with the various loading frequencies (Figure 6) can provide us with useful information on the dynamic sensitivity. Often the first natural frequency of a structure is considered as the primary indicator of the dynamic responses.

A flexible wind turbine tower often presents a natural frequency that is greater than the natural frequency of the rotor but lower than the rotating rotor blades frequency. Flexible towers are typically less expensive than rigid towers, as they have less mass and require less material for their construction. Since these towers are normally exposed to complex distributions of aerodynamic loads, the risk of resonance is high. The simplified structural system is a tall, flexible and slender tower that supports at its top a nacelle and set of rotor blades. This system can be modelled as a cantilever beam with a tip mass at the end (Avila & de Morais, 2013), as shown in Figure 7.



Although the real structure is a system with infinite degrees of freedom, it can be modelled as a discrete system with multi degrees of freedom (MDOF) in a Finite Element approach.

$$M\ddot{y}(t) + C\dot{y}(t) + Ky(t) = F(t) \quad (2)$$

where M , C and K are mass, damping and stiffness matrices, respectively. $\ddot{y}(t)$, $\dot{y}(t)$ and $y(t)$ are acceleration, velocities and displacements vectors, respectively. $F(t)$ is the dynamic load vector. The generalized mass and the generalized stiffness of the tower are computed, respectively as:

$$K = \int_0^L EI \frac{\pi^4}{16L^4} \cos^2\left(\frac{\pi z}{2L}\right) dz \therefore K \frac{\pi^4}{32L^3} EI \quad (3)$$

$$M = \frac{mL}{2\pi} \left[\pi \left(3 + 2 \frac{Le}{L} \right) - 8 \right] \quad (4)$$

Where the tip mass $M = mL_e$, is defined proportionally as an equivalent length L .

Tempel and Molenaar (2002) proposed a method to carry out dynamic analysis of a flexible wind turbine system. The wind turbine is modelled as a structure

of length L , with mass per unit length m , having bending stiffness EI and a top mass M . The tower structure is assumed to be fixed at the bottom. The first natural frequency (f_1) of the system is proposed as:

$$f_1 = \sqrt{\frac{3.04EI}{(M+0.227mL)4\pi^2L^3}} \quad (5)$$

While Eqn. (5) is simple to use, it does not consider the flexibility of the foundation and stiffness softening effect due to the axial load arising from the mass of the rotor and blade system (Adhikari, S. & Bhattacharya, S. 2011).

5 EFFECTS OF SOIL CHARACTERISTICS ON THE WIND TURBINE SYSTEM

Wind turbine foundations are considered to operate within two distinct domains of soil shear strain: (1) low (<10⁻³ %) where the soil is assumed to act as an elastic material and (2) intermediate (10⁻³ to 10⁻² %) which is regarded as elasto-plastic behaviour with some stiffness degradation (Warren-Codrington, 2013).

Small scale 1-g tests reported by Bhattacharya et al (2011) and Cox et al (2011) showed that the natural frequency of a wind turbine system changes with its cycles of loading. The main reason for this change is due to the alteration of the foundation stiffness from strain-hardening or strain-softening behaviour of the soil supporting the foundation due to the loading cycles.

The main conclusions drawn from this study can be summarized as follows:

- a) For strain-hardening sites (typically- loose to medium dense sand) where the stiffness of the soil increases with cycles of loading, the natural frequency of the overall system will increase.
- b) For strain-softening sites (clay sites) where the stiffness of the soil may decrease with cycles of loading, the natural frequency of the overall system will also decrease correspondingly. This depends on the strain level in the soil next to the pile and the number of cycles.

These conclusions have been supported by evidence in limited field measurements. Cyclic element tests on soil showing stiffness increase, and cyclic tests on foundations alone have also corroborated these conclusions. The above points beg the question

- how much frequency change is acceptable?

The norm would be that high quality geotechnical testing can provide us with guidance on the nature of the site, i.e. whether it will be a strain-hardening or strain-softening under cyclic loading type site. Three cases may arise in practice:

- (a) The site is known to be strain-hardening. Theoretically, the best design for such a site is to place the natural frequency of the system 10% higher than the highest 1P frequency, leading to the maximum allowable frequency change interval spanning up to the next resonance limit at the 2P/3P frequency.

(b) The site is known to be strain-softening. Here, the designer may aim to place the natural frequency at 10% lower than the lowest 2P/3P frequency value.

(c) The site is unknown and the behaviour cannot be predicted. The design is best optimized if the natural frequency is in the centre between 1P and 2P/3P frequencies.

It has been shown that a certain amount of change in natural frequency is acceptable without seriously compromising the performance of a wind turbine. In this respect there are three challenges to the designer:

(a) The foundation stiffness needs to be estimated very accurately from the available soil data for estimation of natural frequency of the system.

(b) The potential for change in foundation stiffness with time (as a consequence of cyclic loading) must be understood so that the risk of the system frequency coinciding with a loading frequency can be minimized.

(c) While a given change in natural frequency may be acceptable over the life time of the structure, it is necessary to understand if that change is gradual or sudden. This will have a large influence in accurately estimating the corresponding response amplitudes and the structure's subsequent life expectancy.

6 LUMED STIFFNESS PARAMETER MODEL

Many pile types are designed with a reliance on skin friction effects, however piles that are subjected to vibrations can potentially lose their frictional bond with the surrounding soil (particularly with coarse grained materials). Furthermore, the presence of lateral loads to the pile shaft can also often cause compaction of the soil which also results in further diminishment of the pile frictional resistance. The recommendation therefore is that an unrestrained shaft be assumed and that the frictional resistance along the shaft should be ignored in piles that are subjected to vibrations (Tomlinson, 1987).

Under dynamic conditions, the influence of the surrounding soil medium is greatest at the beginning stages of vibration loading, but this tends to reduce with time as the soil becomes more compacted, potentially creating a gap around the shaft.

Gohnert et al, (2008) considered a simplified approach using a lumped parameter model with stiffness equations (piles as springs) that are adapted from CP 2012 (subsequently withdrawn in 2015) - the design code was for many years adopted worldwide for the design of foundations with machine vibrations. The simplified model required effective length and boundary conditions to be calculated or assumed and this relied on the calculation of four coefficients representing the pile group stiffness - the coefficient of uniform compression (c_u), the coefficient of non-uniform compression (c_o), the coefficient of uniform shear (c_r) and the coefficient of non-uniform shear (c_s). These coefficients were expressed in the same form as coefficients of subgrade reaction

In general, piles that are used in foundations with vibrations should be of the end-bearing type. To achieve minimal settlement of the toe of the pile, the pile should preferably be founded on rock, or be sufficiently far into dense/stiff stratum so that an effective length for the pile may be estimated. Shear and moment fixities for the pile toe are achieved with sufficient embedment of the toe into a sufficiently stiff stratum (1.5 diameters into the rock stratum).

7 PILE LAYOUT VS DYNAMIC RESPONSE

Ali Ahmed (2015) defined a dimensionless parameter a_o ($a_o = \omega r_o / \sqrt{G_{soil}/\rho}$) and after conducting various experiments, made the following observations in regards the dynamics of pile groups:

i) The vertical dynamic stiffness and damping of a pile group was found to depend on the pile spacing as well as the dynamic properties of the soil between the piles. The dynamic stiffness of pile groups was reduced by 50%, 33% and 25% for pile groups spaced at 2Dpile, 4Dpile and 6Dpile respectively when the dimensionless frequency parameter was increased from 0.20 to 2.0.

ii) Pile groups with a larger spacing of $6D_{pile}$ had higher stiffness and damping than pile groups spaced at $4D_{pile}$ and $2D_{pile}$ due to the larger contribution of the soil between the piles to the groups. In the case of the pile group spaced at $6D_{pile}$ (with larger soil volume), the stiffness increased as well as the damping.

iii) As the spacing between the piles was reduced, the pile group behaved like an isolated embedded foundation, i.e., the soil mass between the piles tended to vibrate in phase with the piles and so the pile group soil system responded as one block.

iv) At resonance, for weak soils, all piles carried the same load whilst for strong soils, the corner piles carried the largest loads.

8 CONCLUSION

This paper examined the limitations of various methods of dynamic analysis for a typical onshore piled wind turbine foundation. It would be suggested that both a typical soil-structure interaction model as well as a lumped parameter model be considered, given the various effects that are described above, to arrive at a lower bound/upper bound solution.

Summary of issues:

1. Wake effects create a microclimate drop of 3°C in Temperate climate areas. This wake persists for kms downwind & creates crop losses, income losses, reduced household temperatures, reduced carbon sequestration, habitat losses.

Item 10. Wake Effects (EIAR)

10.1

Please clarify if turbine wake effects would arise at dwellings, lands downwind of site due to prevailing winds, and also give consideration to wake effects on yields, livestock, and local temperature effects arising.

Turbine wake effects describe the phenomenon in which downstream of moving wind turbines a region of slower wind speeds and increased turbulence is created. As wind passes through the turbine rotor blades, kinetic energy is converted to mechanical energy, allowing for electricity generation and reducing wind speed behind the wind turbine. The wake effect is a fundamental aspect taken into consideration in wind farm layout and design in order to reduce effects on yields. [<https://vortexfdc.com/blog/wakes-and-blockage/>] Turbine wake effect is an operational consideration which has been taken into account within the design of the Proposed Project. The literature notes that, while micrometeorological effects of wind turbines have been assessed globally, there is little evidence of measured effects on biotic or abiotic receptors such as livestock or temperature. There is a distinct lack of research in this area relating to areas in Europe including the UK and Ireland. [Sander, L., Jung, C., & Schindler, D. (2024). Global Review on Environmental Impacts of Onshore Wind Energy in the Field of Tension between Human Societies and Natural Systems. *Energies*, 17(13), 3098. <https://doi.org/10.3390/en17133098>]

No body of work has been published which would link the turbine wake effect to having an impact on downstream lands, livestock or local temperature variations.

Note this statement is untrue. We attach numerous published works

Impacts of 319 wind farms on surface temperature and vegetation in the United States. Yingzuo Qin et al 2022 Environ. Res. Lett. 17 024026

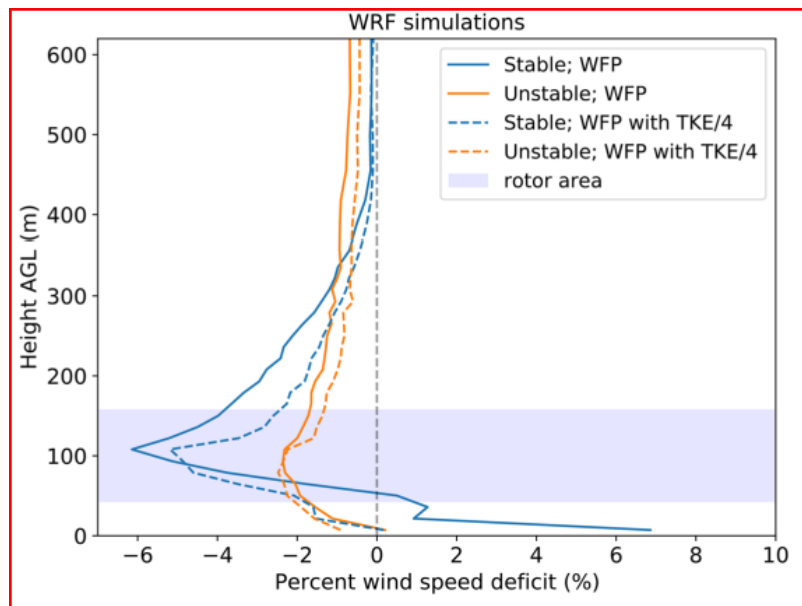
Despite the climate benefits of wind power, there is a growing concern about the environmental effects of the increased land use and land cover change for wind farms. For example, the large deployment of wind farms can adversely affect local animal habitats, and the rotary blades of wind turbines can kill birds (Bright et al 2008) and bats (Voigt et al 2012). Wind farm construction can also result in deforestation, soil erosion, and impacts on land carbon sequestration (Dai et al 2015, Armstrong et al 2016).

The modification of land surface properties by wind farms also strongly influences the local and regional climate (Kirk-Davidoff and Keith 2008, Baidya Roy and Traiteur 2010, Zhou et al 2012), which in turn will influence ecosystem processes (Armstrong et al 2016). Changes to the climate are attributable to the wind turbines increasing the surface roughness (Kirk-Davidoff and Keith 2008) with implications for turbulence (Xia et al 2016) and mixing in the atmospheric boundary layer (ABL) (Baidya Roy and Traiteur 2010). Moreover, the wind turbines remove energy from the system and decrease downstream wind speeds (Miller and Kleidon 2016).

*As for impacts on vegetation, **our results showed decreased vegetation for most wind farms**, especially those large farms. However, positive and insignificant impacts were observed as well. The decreased vegetation is mainly caused by the construction of wind farms and the associated land cover changes, limiting vegetation growth in wind farms (Tang et al 2017, Urziceanu et al 2021). The increased vegetation in wind farms may be caused by the changing microclimate conditions induced by wind farms.*

Our results from a large sample of wind farms revealed significant local warming effects at night, insignificant impacts during the daytime, and the mostly negative impacts on vegetation.

The presence of the wind plant induces a wake that varies with wind speed, wind direction, and ambient turbulence. The magnitude of the wake increases as wind speed increases toward the rated wind speed of the turbines; the wake erodes quickly in daytime convective conditions but persists for long distances downwind in stable conditions.



Supplementary Abstract

Long-term weather and climate observatories can be affected by the changing environments in their vicinity, such as the growth of urban areas or changing vegetation. Wind plants can also impact local atmospheric conditions through their wakes, characterized by reduced wind speed and increased turbulence. We explore the extent to which the wind plants near an atmospheric measurement site in the central United States have affected their long-term measurements. Both direct observations and mesoscale numerical weather prediction simulations demonstrate how the wind plants induce a wind deficit aloft, especially in stable conditions, and a wind speed acceleration near the surface, which extend c30km downwind of the wind plant. Turbulence kinetic energy is significantly enhanced within the wind plant wake in stable conditions, with near-surface observations seeing an increase of more than 30% a few kilometers downwind of the plants.

As wind flows past the rotating blades of a wind turbine, some of its momentum is devoted to moving the blades and generating electricity. As a result, the downwind flow is slower and more turbulent. Assessing the characteristics of this wake has been identified as one of the grand challenges that wind energy science needs to face to drive innovation in the sector and meet future energy demand. Wakes are particularly complex: their characteristics depend on the incoming wind speed, wind direction, and turbulence, as well as turbine operation and associated parameters. In convective conditions, wakes tend to be eroded rapidly by ambient turbulence. In stably stratified conditions with weak turbulence, wakes tend to exhibit a large wind speed deficit and persist for long distances downwind. For example, aggregated wakes from multiple turbines, i.e., wind plant wakes, can extend more than 50 km downwind of a wind plant, offshore in stable conditions. In addition to the wind speed deficit and the enhancement of turbulence at the heights above the surface corresponding to the wind turbine rotor, wakes can affect local surface conditions.

Impacts of wind turbines on vegetation and soil cover: a case study of Urla, Cesme, and Karaburun Peninsulas, Turkey Talha Aksoy, Mehmet Cetin, Saye Nihan Cabuk, Muzeyyen Anil Senyel Kurkcuoglu, Gulsah Bilge Ozturk, Alper Cabuk. Clean Technologies and Environmental Policy (2023) 25:51–68 <https://doi.org/10.1007/s10098-022-02387-x>

Wind turbines, similar to many other artificial structures such as communication masts, tall buildings and windows, power lines, and fences, are discussed in the literature as one of the sources of bird fatalities (Drewitt and Langston 2008). However, the effects of wind turbines on bird fatality are associated with various factors such as the location, season, topography, and bird species (Fernandez et al. 2007; Kuvelsky et al. 2007; Farfan et al. 2009; Sovacool 2013; Wang et al. 2015). For instance, Farfan et al. (2009) studied the impact of wind farms with a case study from southern

Spain. They concluded that the turbines did not harm passerine birds but had a negative effect on the raptors in the region.

In a study conducted in Mongolia, the vegetation change in the 50 km buffer zones around Wind Power Plants between 2008 and 2014 was monitored and assessed using NDVI analysis (Li et al. 2016). The impact of WPPs on vegetation was reported to be more significant after the operations started compared to the installation period, and the highest rate of change was detected in the 30-km buffer zone around the turbines. WPPs can have a significant impact on climate-affected vegetation due to the local climate. Tang et al. (2017) analyzed the effects of WPPs on vegetation growth and productivity in summer (June–August) in the Bashang region of North China. WPPs showed a significant inhibitory effect on vegetation growth as evidenced by decreases in leaf area index (LAI), increased vegetation index (EVI), and normalized difference vegetation index (NDVI).

Shen et al. (2017) evaluated the direct impact on the pasture lands during the construction of WPPs in China using the Landsat 8 satellite and the GF-2 HD satellite imageries. The study concluded that the construction of a single wind turbine damaged approximately 3000 m² of pasture land, and China's GF-2 HD satellite (GF-2) could accurately detect the damage in the area.

All of the research mentioned above show that wind turbines cause turbulence, wake effect, and temperature change nearby; therefore, measurable impacts on vegetation occur or are likely to occur.

Land principally occupied by agriculture, with significant areas of natural vegetation, experienced the most negative change in the 3–5% slope group. It is 1.76 times higher in the control buffer area compared to the WPP surrounding. The most degradation was observed in the northern facing aspect group, with 2.43 times higher in the control buffer zone compared to the areas closer to WPP in the northern aspect group

In natural grasslands–pasture lands, it was observed that the degradation was high in the 1–2% slope group, and it was 7.61 times higher around the Wind Power Plant compared to the control buffer zone. In addition, the south-facing aspect group experienced the most negative change, with 9.24 times higher change surrounding the WPP than the control buffer zone. So, it was inferred that areas close to the WPP are exposed to more degradation than control buffer areas.

It was determined that the highest degradation in the natural vegetation class is on the 3–5% slope and in the area far from the WPP in the north direction. There could be no analysis since at least two of the groups in the same year did not have WPP. When the same WPP in different years was examined, the slope groups were found to be 3–5% and had a north-facing aspect. As a result of the study, it is thought that the degradation in agricultural areas with natural vegetation is more prone to damage caused by WPP—in areas with 3–5% slope and north-facing aspect.

The biggest degradation in the pasture lands class was identified on a 1–2% slope and in the area closest to the WPP in the south direction. Examining the WPPs in the same years, which were divided into groups, it was found that the highest deterioration was predominantly on the 0–1% slope, but a common direction could not be determined. When the same WPPs were evaluated in various years, it was discovered that the degradation was concentrated in the 0–1% slope group, with certain groups exhibiting consistency within themselves in terms of aspect.

Turbines change the humidity and temperature in the local area, which creates a positive or negative effect depending on the vegetation type.

A new USGS report shows a link between air disturbed by wind turbines and vegetation patterns [By Communications and Publishing September 26, 2022 Denver, CO.](#) — *The trails of disturbed air produced by wind turbines—known as wakes—can alter downwind temperatures and humidity, and a new U.S. Geological Survey study has demonstrated for the first time that wakes can impact vegetation in the vicinity.*

The study's insight into the effects of wakes from wind turbines on vegetation is an important first step to understanding how wind energy affects terrestrial ecosystems. Wind energy is rapidly and globally expanding, with five-fold increases since 2010 and predictions of up to 10-fold growth over the next 30 years.

“We are just beginning to understand how the wakes from wind turbines affect both the terrestrial and offshore environment,” said USGS Research Ecologist, Jay Diffendorfer, “The next step will be to better understand where and why these effects occur.”

In the study, scientists modeled wake and non-wake zones around 17 wind facilities across the United States, to test if wakes influenced vegetation condition, which was measured using data from USGS's Landsat satellites. The study was designed to isolate the effects of turbine wakes from other factors that could affect vegetation condition around wind facilities, such as new roads or agriculture.

These wake-induced changes in vegetation condition were found for part or all of the growing season at 10 of the 17 facilities studied. Researchers found that wakes can have both positive and negative effects on vegetation greenness, a measure that is often used in remote sensing to assess vegetation density and crop health, and that the magnitude of the change in greenness depended primarily on earlier precipitation. The changes observed at some facilities were consistent with levels that other studies found can affect breeding bird clutch size, species richness, and ungulate abundance.

As wind energy expands, understanding where and when wind turbines positively or negatively affect vegetation may aid in future decisions about where to site wind energy infrastructure. For example, careful placement may benefit agriculture or grazing while minimizing unwanted reductions to the vegetation greenness in the vicinity.

Widely acknowledged environmental impacts include wildlife deaths from turbine collisions, habitat loss, and behavioural avoidance of wind facilities by some species (Allison et al [2019](#)).

A newly emerging, potential environmental impact may be the effects of turbine wakes ('wakes') on microclimates and vegetation. Wind turbines generate wakes as they remove energy from wind resulting in lower wind speeds and increased turbulence. These wakes are large enough to reduce energy generation at downwind facilities (Lundquist et al [2019](#)). They can also change air, surface, and soil temperatures, as well as humidity (Zhou et al [2012](#), Armstrong et al [2016](#), Xia et al [2016](#), Rajewski et al [2020](#)), but not always (Moravec et al [2018](#)). Field-collected and remotely-sensed surface temperature data show wakes can cause nighttime warming up to 1.5 °C–1.9 °C (Rajewski et al [2013](#), Smith et al [2013](#)) and cool daytime temperatures (Rajewski et al [2013](#), Xia et al [2016](#)), although these effects vary with wind conditions and season.

Wind farms dry surface soil in temporal and spatial variation. Gang Wang, Guoqing Li, Zhe Liu. *MethodsX* Volume 10, 2023, 102000 <https://doi.org/10.1016/j.mex.2023.102000>

Wind farms have been proved to have potential impact on the ecology. As an important ecological factor, soil moisture has a great impact on the ecosystem. Therefore, it is of great significance to explore the effect of wind farms on soil moisture. At present, the remote sensing data can be used to calculate the soil moisture of wind farm conveniently, but its spatial resolution is poor. Moreover, the measured soil moisture can't express the spatial difference. Therefore, through the effective combination of remote sensing data and measured data, this method can accurately judge the impact of wind farm on soil moisture. This method investigated wind farms located in the grasslands of China. Remote sensing images and field data were used to explore the area and extent of influence of wind farms on grassland soil moisture. We use Landsat images and field measurements to derive a linear relationship between the soil moisture and the TVDI, which was calculated based on the land surface temperature and NDVI, was developed in this work. The correlation was used to reverse spatial distribution map of soil moisture before and after the construction of wind farms. The diurnal and seasonal variation of the influence of the wind farm on the grassland soil moisture was also judged.

Ecosystem impacts during construction and operation have been widely reported, including the potential to reduce, fragment, or degrade habitat for wildlife, fish, and plants. However, the impacts on local climate, and thus longer-term impacts on ecosystems are less well understood. Soil moisture changes are important for nutrient and energy cycling in ecosystems and have a direct impact on local wildlife. Xie (2015) used the measured data to monitor the effects of wind farms on vegetation and soil in low-water, semi-arid regions. After the wind farm is built, there is no consistent trend in soil moisture based on wind direction or distance from the wind farm (0–100 m). Armstrong et al. (2016) used observation data from a wind farm in Scotland to judge the impact of wind turbine operation on the local climate in podzolic soil. They found that there was no significant trend in changes in soil moisture (to a depth of 10 cm) caused by the operation of wind turbines, which may be related to the high water table at the wind farm. Tang et al. (2017) used 0.25° × 0.25° climate change initiative (CCI) soil moisture data derived from MODIS data to judge the impact of wind

farms on vegetation in Texas and Illinois, USA. By comparing the annual soil moisture difference between the wind farm and non-wind-farm regions, it was found that the wind farm soil moisture reduced by 0.3% after construction in the desert and yellow-brown soils. With remote sensing data, although the soil moisture before and after a wind farm has been built can be calculated, the spatial resolution of the data is low and cannot be effectively combined with field-measured data. Therefore, many difficulties remain in accurately judging the impact of wind farms on soil moisture. Therefore, this paper investigated wind farms located in the grasslands of China. Remote sensing images and field data were used to explore the area and extent of influence of wind farms on grassland soil moisture.

Conclusions

We used remote sensing and field-measured data to analyze changes in soil moisture before and after the construction of wind farms. We found that wind farms significantly reduce soil moisture to different extents according to season and wind direction. We obtained the following main conclusions;

- (1) Wind farms significantly reduced soil moisture within the wind farms and in the upwind and downwind directions. Compared with the upwind and downwind directions, the decrease in soil moisture within the wind farms was the most, and the annual decrease in soil moisture within wind farms reached 4.4%.
- (2) Wind farms have different influences on the soil moisture in the upwind and downwind directions in each season. Reductions are greatest in the upwind direction in spring and the downwind direction in summer and autumn.
- (3) The wind farm reduced the soil moisture most significantly downwind of the wind farm throughout the day, with an average value of up to 2.85%. The decrease in the soil moisture upwind was the least significant, only by 0.21%.

A Review on State-of-the-Art Reviews in Wind-Turbine- and Wind-Farm-Related Topics : Sawant, M.; Thakare, S.; Rao, A.P.; Feijóo-Lorenzo, A.E.; Bokde, N.D. *Energies* 2021, 14, 2041. <https://doi.org/10.3390/en14082041>

WA Wind Turbine extracts wind's kinetic energy and converts it into mechanical energy. During this process, the WT reduces the wind speed behind the rotor, which creates a wind shadow or wakes effect, as shown in Figure 9.

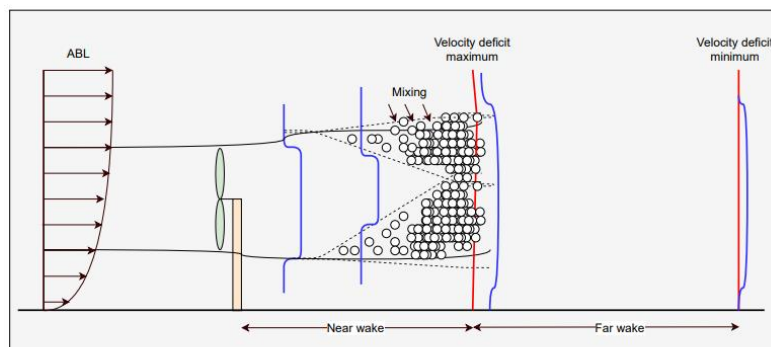


Figure 9. The velocity profile behind WT [85].

Due to the wake effect, the downstream WTs receive wind with lower speed and higher turbulence level, which reduces the energy yield. In Figure 10, u_0 is the direction of wind, T1 to T7 are WT locations, and it is clear that the downstream WTs receive modified wind; hence, it affects the energy yield.

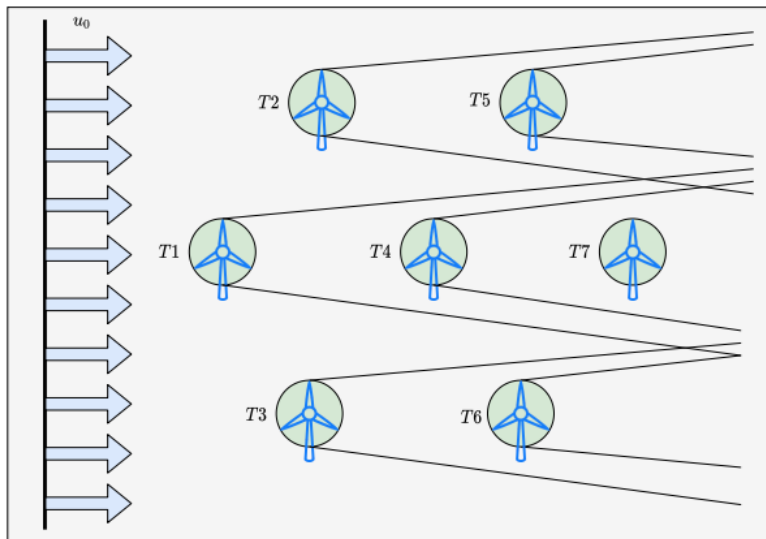


Figure 10. Wake effect in a wind farm (WF) [73].

The parameters that influence the wake effect are Wind Farm size and layout, number and size of WTs, wind speed and direction, and turbine blade design . General impacts of the wake generated by WTs are a mechanical failure, extra maintenance cost, and reduction in power.

Eolization 2024 : A project on spatial auralization of wind farm noise Jules Colas, Loïc Alexandre. INTER-NOISE and NOISE-CON Congress and Conference Proceedings · October 2024 DOI: 10.3397/IN_2024_4225

Results: First, the results from the propagation simulations are briefly presented for the scenarios studied. In Fig. , the overall sound pressure level (OASPL) fields average over one rotation are plotted in the plane $z = 2$ m for the two cases. For a single wind turbine (Fig. 5a), the OASPL presents a dipolar shape which is characteristic of a wind turbine. Cross-wind extinction zones (on the line $x = 1500$ m) and an upwind shadow zone ($x < 1000$ m) are observed and a small focusing induced by the wake downwind ($x > 2000$ m) is also discernable. When two wind turbines are present (Fig. 5b) the same features are present but superimpose on each other. No additional refraction patterns that could be induced by the wake of the turbines are visible in this case. The average OASPL is typically low in wind turbine noise application and amplitude modulation (AM) must also be considered as it is responsible for annoyance at resident locations. Fig. 6a shows the AM field at $z = 2$ m for one wind turbine. AM is defined as the difference between minimum and maximum OASPL computed during one rotation of the rotor. For the single wind turbine case some classical features are again recovered with this method. In the cross-wind direction ($x = 1500$ m) high amplitude modulation is found due to the blade approaching and receding from the receiver. Upwind, at the limit of the shadow zone ($x = 1000$ m), AM also increases as already shown by various authors [11, 19]. AM also increases downwind ($x > 3000$ m) due to the wake effect [14, 20]. As sound sources move inside the wake the refraction pattern is modified and the amplification at the ground changes. The same features are present in the two wind turbine case (Fig. 6b) but AM decreases slightly downwind and crosswind because of the source superposition.

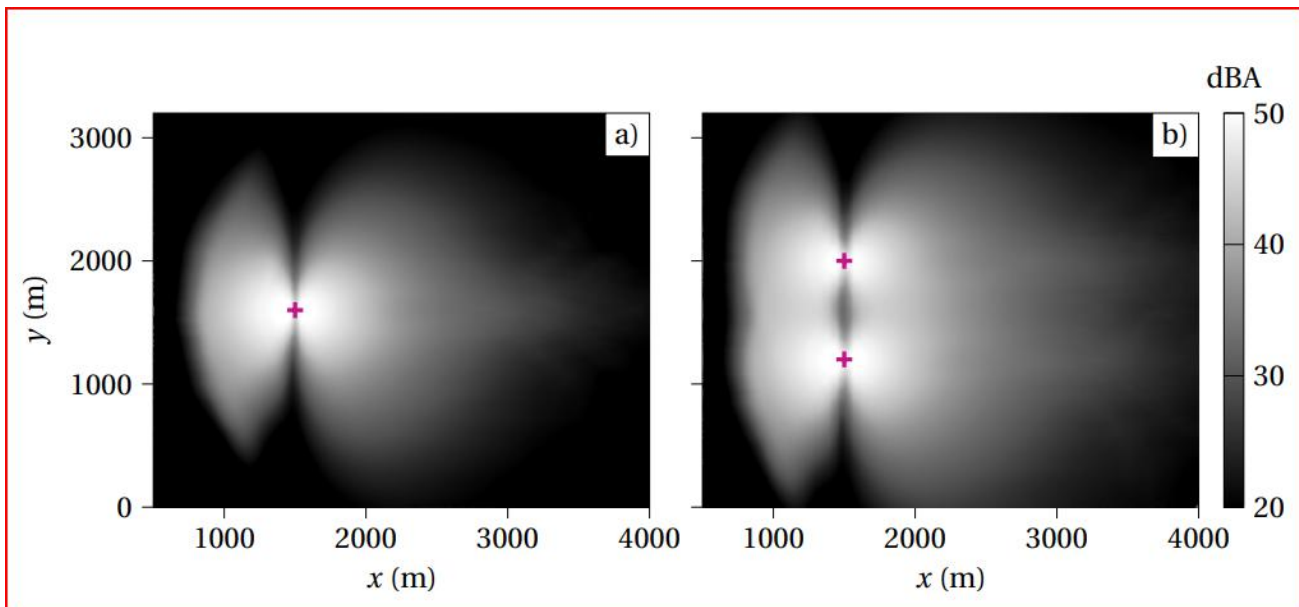


Figure 5 : Average OverAll Sound Pressure Level (ASPL) over one rotation at $z = 2\text{ m}$ for a) single wind turbine case and b) two wind turbine cases. Wind turbine hub positions are indicated with crosses.

Note the upwind and downwind noise effects up to 50Dba for distances over 2km.

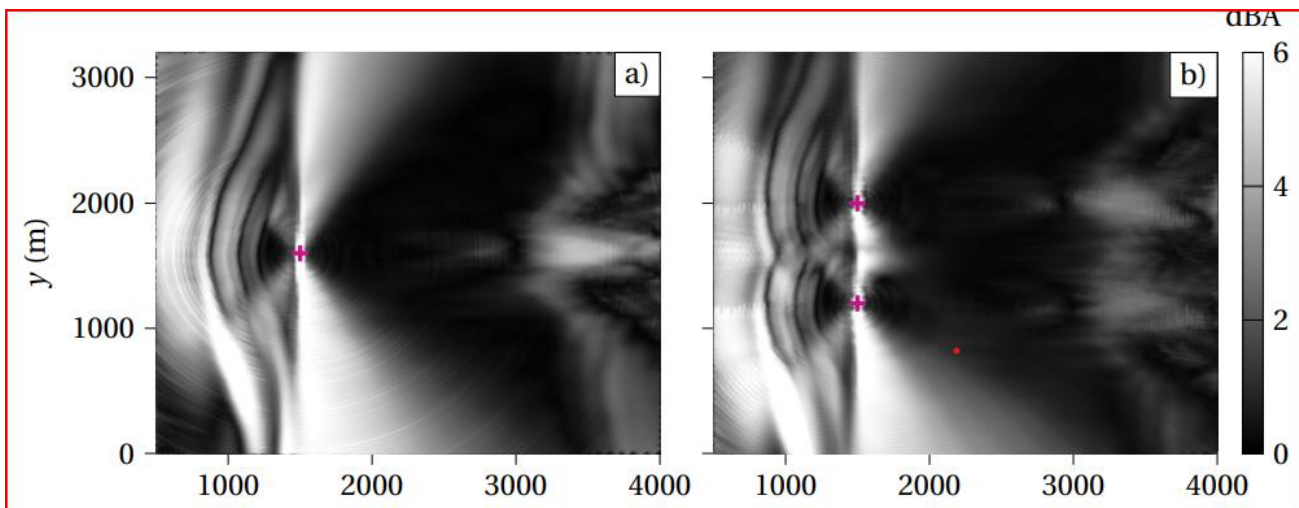
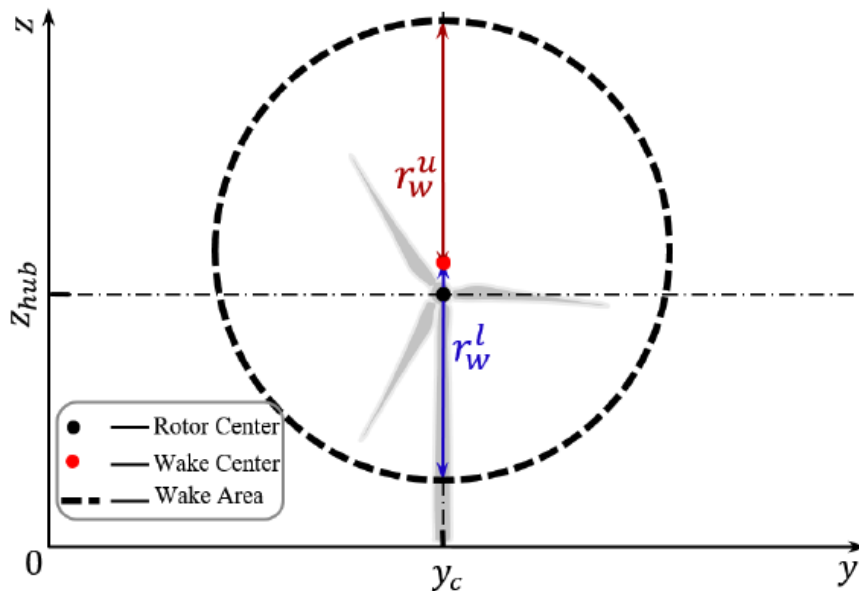


Figure 6: AM at $z = 2\text{ m}$ for a) single wind turbine case and b) two wind turbine case. Wind turbine positions are indicated with crosses. and $(x, y) = (2500\text{ m}, 1600\text{ m})$ for the two scenarios considered.

Upward Shift of Wind Turbine Wakes in Large Wind Farms. Zewei Wang and Xiaolei Yang.
<https://doi.org/10.3390/en16248051>. Published: 14 December 2023 Energies 2023, 16, 8051.

Larger upward shifts of the wake center are observed for wind turbines in further downstream rows and wind turbines installed on the ground with higher roughness, for which the wake expands at a higher rate. Regarding turbulence intensity, it is higher around the top tip of the turbine compared to the bottom tip at intermediate wake locations



Schematic of the wake area in the streamwise plane, which are indicated as wider & higher than the blades. The potentially 100m higher levels above the blades bring much colder air down to ground level.

Impacts of wind turbine characteristics on wake turbulence. Shifeng Wang, Sicong Wang. *Energy Storage and Conversion* 2025, 3(1), 1956. <https://doi.org/10.59400/esc1956>.

The enhanced wake turbulence generated by wind turbine has remarkable effects on the power generation and fatigue loads of wind farm and the environment. The turbulence can sustain strength and distance for several miles before fully dissipating.

Wind turbine impact on near-ground air temperature, *Renewable Energy* Volume 123, August 2018, David Moravec , Vojtěch Barták , Vladimír Puš , Jan Wild . <https://doi.org/10.1016/j.renene.2018.02.091>

“Impacts on local climate are especially crucial in situations where allocating more turbines is justified by reducing carbon emissions, because these effects could have subsequent impacts on the carbon cycle in the affected area. Wind farms can affect local climates in two main ways. The first is by extracting kinetic energy, which slows wind flow. The second is by further heightening turbulence flow downwind. Turbulence can be generated in the wake of rotors and also by the shear between the non-affected faster air layer below the turbine and the upper air layer slowed by the turbine .

The generated turbulence has a secondary effect by enhancing vertical mixing of air. Several studies showed that enhanced turbulence produced by wind farms has impact on heat and moisture exchange between the surface and the atmosphere. In stable atmospheric conditions, when a warm air layer is present above cooler air, increased turbulence results in a warming near the surface by transferring thermal energy from higher levels to the lower. On the other hand, when unstable atmospheric conditions are present, i.e. cool air lying above a warmer layer, enhanced turbulence leads to mixing the layers and provides a cooling effect on the ground. These impacts depend on the ratio of natural turbulence to turbulence generated by the wind turbine. The stability of atmospheric layers can also influence a wind farm’s impacts. The effect of vertical mixing can be 10–15% stronger when a wind turbine is present in the atmospheric boundary layer.”

“Theoretical models have been tested in wind tunnel experiments. The outcomes of these experiments have shown that the effect of the wake can be found up to a distance of 20 rotor diameters . A computational study has suggested this to be a shorter still distance of 15 diameters . Maximum turbulence has been found at a distance of 4–4.5 rotor diameters above rotor hub height in neutral cases of atmospheric layers and 3–6 diameters in stable cases. Heightened turbulence intensity is associated with strong shear of layers and turbulent kinetic energy produced by regional features or wind farm layout .”

The effect of the turbine: For every 1,000ft you ascend, the temperature drops approximately 3.5-5 degrees Fahrenheit.[1.94- 2.77 degrees Centigrade]..The proposed windfarm will reduce temperatures by a minimum of 4 degrees Centigrade & a maximum of 6 degrees Centigrade. The Meteorological Maps indicate the effect on the Wake area. Basically pasture lands & crops will be dramatically affected as will carbon sequestration.

Wind turbine wakes can impact down-wind vegetation greenness Jay E Diffendorfer, Melanie K Vanderhoof and Zach H Ancona United States Geological Survey, Geosciences and Environmental Change Science Center, Denver, CO 80225, United States of America *Environ. Res. Lett.* 17 (2022) 104025 <https://doi.org/10.1088/1748-9326/ac8da9> 26 September 2022

Global wind energy has expanded 5-fold since 2010 and is predicted to expand another 8–10-fold over the next 30 years. Wakes generated by wind turbines can alter downwind microclimates and potentially downwind vegetation. However, the design of past studies has made it difficult to isolate the impact of wake effects on vegetation from land cover change. We used hourly wind data to model wake and non-wake zones around 17 wind facilities across the U.S. and compared remotely-sensed vegetation greenness in wake and non-wake zones before and after construction. We located sampling sites only in the dominant vegetation type and in areas that were not disturbed before or after construction. We found evidence for wake effects on vegetation greenness at 10 of 17 facilities for portions of, or the entire growing season. Evidence included statistical significance in Before After Control Impact statistical models, differences >3% between expected and observed values of vegetation greenness, and consistent spatial patterns of anomalies in vegetation greenness relative to turbine locations and wind direction. Wakes induced both increases and decreases in vegetation greenness, which may be difficult to predict prior to construction. The magnitude of wake effects depended primarily on precipitation and to a lesser degree aridity. Wake effects did not show trends over time following construction, suggesting the changes impact vegetation greenness within a growing season, but do not accrue over years. Even small changes in vegetation greenness, similar to those found in this study, have been seen to affect higher trophic levels. Given the rapid global growth of wind energy, and the importance of vegetation condition for agriculture, grazing, wildlife, and carbon storage, understanding how wakes from wind turbines impact vegetation is essential to exploit or ameliorate these effects.

Observations of wind farm wake recovery at an operating wind farm Raghavendra Krishnamurthy¹, Rob K. Newsom¹, Colleen M. Kaul¹, Stefano Letizia², Mikhail Pekour¹, Nicholas Hamilton², Duli Chand¹, Donna Flynn¹, Nicola Bodini², and Patrick Moriarty. *Wind Energ. Sci.*, 10, 361–380, 2025 <https://doi.org/10.5194/wes-10-361-2025> ©Author(s) 2025.

Wind turbine wakes, i.e., velocity deficits due to extraction of the kinetic energy from an operating wind turbine, are observed to extend several kilometers during stable atmospheric conditions both onshore and offshore (Hirth et al., 2012; Banta et al., 2015; Krishnamurthy et al., 2017; Fernando et al., 2019; Ahsbabs et al., 2020; Zhan et al., 2020). Wind farm wakes from a large cluster of wind turbines in mesoscale model simulations, and offshore observations **can reach over 50km downwind** under stable atmospheric conditions (Platis et al., 2018; Lundquist et al., 2019, Schneemann et al., 2020). Large-eddy simulations of large wind farms also show that wind farm wakes can alter the surface momentum and heat fluxes (Calaf et al., 2011). Wind farm wakes are known to impact the local meteorological conditions by, for instance, increasing or decreasing the temperature and enhancing turbulence downwind of a wind farm (Baidya Roy et al., 2004; Smith et al., 2013; Siedersleben et al., 2018; Miller and Keith, 2018, Bodini et al., 2021), although the intensity of the impact depends on atmospheric stability, local atmospheric processes, orientation of the wind farms, downwind distance, and the number and operative regimes of wind turbines.

In operational wind farms, intra-farm wakes can result in significant power losses, and it is important to understand the dissipation of wakes within a wind farm. The effect of a wind turbine is to decrease the mean velocity and increase the turbulent kinetic energy above the rotor layer (the layer from the bottom of the wind turbine blade tip to the top of the blade tip; VerHulst and Meneveau, 2014). The turbulent transport term in a steady-state filtered-energy equation includes the entrainment of the mean momentum due to turbulence and the entrainment of the turbulent kinetic energy due to fluctuating velocities (Allaerts and Meyers, 2017).

Today's wind turbines operate within the lowest 300m of the atmospheric boundary layer (ABL), and in offshore or stable atmospheric conditions the ABL can be lower than 300m (Shaw et al., 2022). Although wind farms operate within 300m above ground level, their impacts can be observed through the entire depth of the boundary layer.

Therefore, to accurately assess such impacts, observations of mean and turbulent characteristics of wind and temperature should extend up to the top of the ABL.

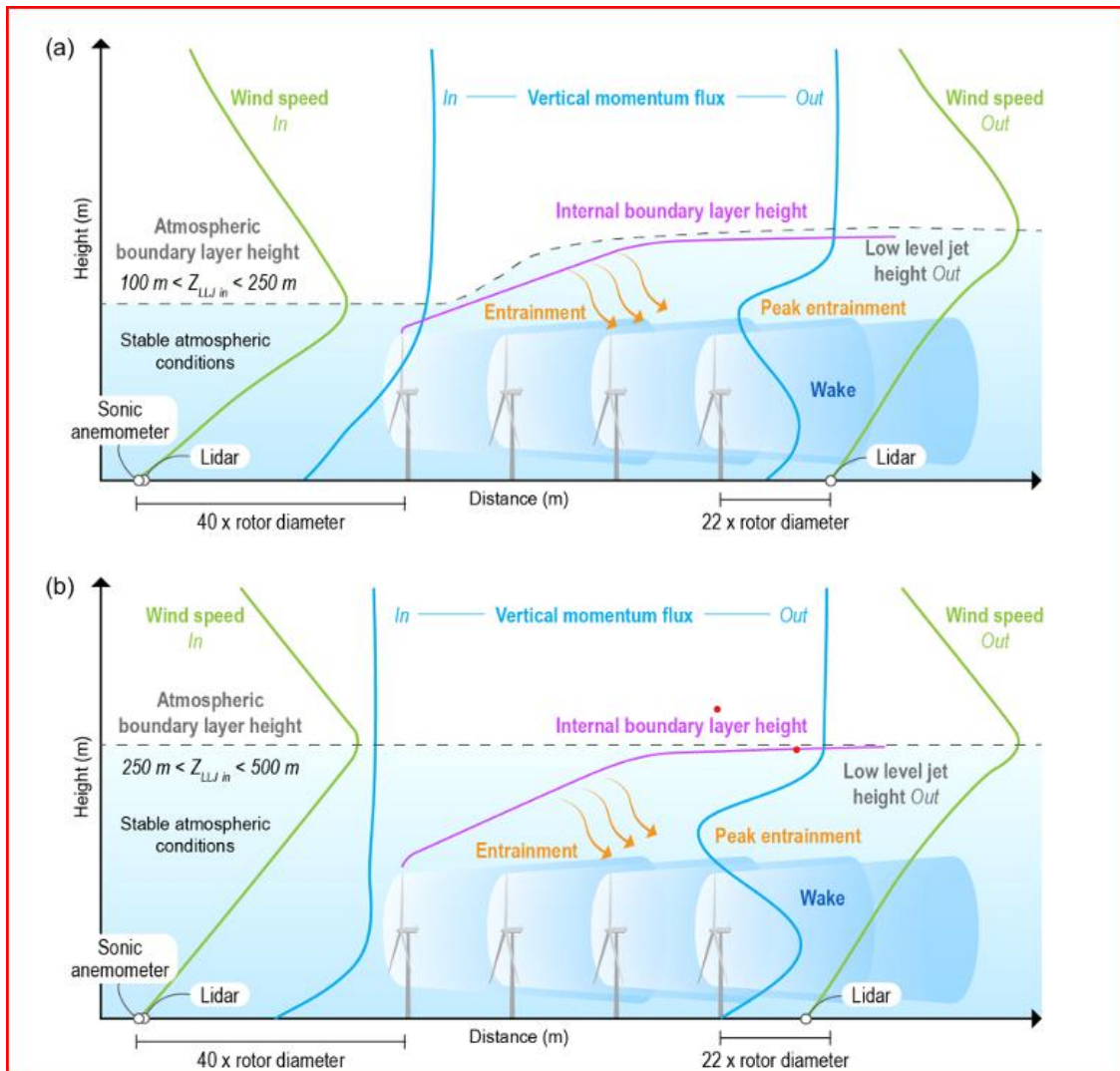


Figure: Schematic of the impact of LLJs on a wind farm boundary layer when (a) $100\text{m} < Z_{LLJ} < 250\text{m}$ and (b) $250\text{m} < Z_{LLJ} < 500\text{m}$.

Note the Wake distance of 22 times rotor diameter which equates to 3.575km for a 162.5m diameter. Negative wind shear during non-LLJ cases show short wake propagation at 22 Rotor Diameters downwind of a wind turbine.

Atmospheric stability effect on wind farm flow and performance. Marwa Souaiby and Fernando Porte-Agela, *Phys. Fluids* 37, 095152 (2025); doi: 10.1063/5.0280027. 11 September 2025

Large-eddy simulations are used to investigate how surface-layer stability (from strongly stable to strongly unstable) and free-atmosphere stratification influence wind farm flow and power output. Increased stability reduces turbulence intensity (TI), limiting wake recovery and decreasing power to downstream turbines. These effects are amplified under strong free-atmosphere stratification, which confines the internal boundary layer, suppresses vertical mixing, and reduces momentum entrainment, leading to stronger velocity deficits and greater power losses. Blockage effects, including entrance-region wind speed reduction, also intensify with increasing stratification—more so in the free atmosphere than in the surface layer. In strongly stratified cases with low Froude numbers ($Fr_1 < 2$), pronounced standing gravity waves form, accelerating the flow in the exit region and near wake, but slowing wake recovery further downstream due to reduced ambient TI. While wake recovery is generally delayed under stronger stratification, wind speed recovers more slowly than TI, particularly when free-atmosphere stratification is strong. Overall, the results highlight the need to consider both surface-layer and free-atmosphere stability when assessing wind farm aerodynamics and performance.

How far the wake of a wind farm can persist for? Guodan Dong, Zhaobin Li, Jianhua Qin, Xiaolei Yang. Theoretical and Applied Mechanics Letters 12 (2022) 100314.

With the increased penetration of wind energy in our nation's energy portfolio, wind farms are placed in a way close to each other. Thus, their wakes have to be fully considered in the design and operation of a wind farm. In this study, we investigate the wake of a wind farm using large-eddy simulation with wind turbine rotor modelled by the actuator disk model. The simulated results show that the wake of a wind farm can persist for a long distance in its downstream. For the considered wind farm layout, the velocity in the wake recovers 95% of that of the undisturbed inflow at 55 rotor diameters downstream from its last row, suggesting that the wake of a wind farm should be fully considered in the optimal design and operation for its downstream wind farms.

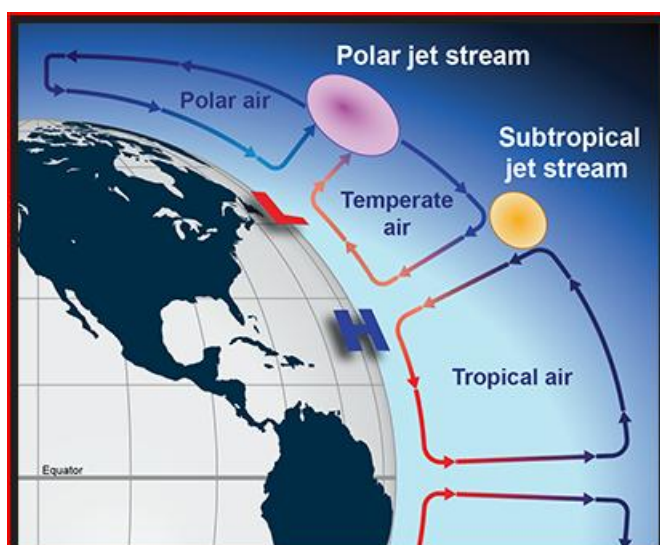
The simulated results show that the streamwise velocity recovers 95% of the undisturbed incoming wind speed at 55 D downstream of the last row of the wind farm. The influences of wind turbine wakes persist for a very long distance, which are still observed even at 165 $Diameters$ downstream of the last row of the wind farm.

For a 162.5m rotor diameter wind turbine, $55D = 8.937\text{km}$ & $165D = 26.812\text{km}$. Thus houses & farms are subject to property losses, agricultural output losses over these distances, temperature losses & heating costs without their consent.

Climatic Impacts of Wind Power. Miller & Keith, Joule 2, 2618–2632 December 19, 2018. 2018 Elsevier Inc. <https://doi.org/10.1016/j.joule.2018.09.009>

Climatic impacts due to wind power extraction were first studied using general circulation models (GCMs). These studies found statistically significant climatic impacts within the wind farm, as well as long-distance teleconnections, with impacts outside the wind farm sometimes as large in magnitude as impacts inside the wind farm. Note that such impacts are unlike greenhouse gas (GHG)-driven warming, as in some cases wind power's climatic impacts might counteract such GHG warming—at least four studies have found that mid-latitude wind power extraction can cool the Arctic. However, these studies often used idealized or unrealistic distributions of turbines installed at unrealistic scales. Model simulations of geometrically simple, isolated wind farms at smaller scales of 3,000–300,000 km² (10- to 1,000 times larger than today's wind farms) in windy locations found substantial reductions in wind speed and changes in atmospheric boundary layer (ABL) thickness, as well as differences in temperature, precipitation, and vertical atmospheric exchange.

In central USA, The warming is greatest in an N-S corridor near the center of the wind turbine array, perhaps because of an interaction between wind turbines and the nocturnal low level jet (LLJ). The LLJ is a fast nocturnal low-altitude wind (>12 m/s at 0.5 km) common in the US Midwest, which occurs when the atmosphere decouples from surface friction, resulting in a steep vertical temperature gradient —meteorological conditions that might be sensitive to perturbations by wind turbines.



The climatic impacts of wind power may be unexpected, as wind turbines only redistribute heat within the atmosphere, and the 1.0 W m² of heating resulting from kinetic energy dissipation in the lower atmosphere is only about 0.6% of

the diurnally averaged radiative flux. But wind's climatic impacts are not caused by additional heating from the increased dissipation of kinetic energy. Impacts arise because turbine-atmosphere interactions alter surface-atmosphere fluxes, inducing climatic impacts that may be much larger than the direct impact of the dissipation alone.

As wind turbines extract kinetic energy from the atmospheric flow and slow wind speeds, the vertical gradient in wind speed steepens, and downward entrainment increases. These interactions increase the mixing between air from above and air near the surface. The strength of these interactions depends on the meteorology and, in particular, the diurnal cycle of the atmospheric boundary layer(ABL).

Observed Thermal Impacts of Wind Farms Over Northern Illinois. Lauren M. Slawsky, Liming Zhou, Somnath Baidya Roy, Geng Xia, Mathias Vuille and Ronald A. Harris. *Sensors* 2015, 15, 14981-15005; doi:10.3390/s150714981

The 2025 Operating Turbines in Illinois have a c80 m hub-height with rotor diameters of about 80 m & an electrical power output capacity of c1.5 Mw before 2015 & far less than 7.2Mw. These turbines do not operate continuously over 12 month periods.

The **Climate of Illinois** describes the weather conditions, and extremes, noted within the state of Illinois, United States, over time. This is not comparable to Ireland's climate.

Köppen Climate Types of Illinois



Data sources: 1991-2020 climate normals from PRISM Climate Group, Oregon State University, <https://prism.oregonstate.edu>; Outline map from US Census Bureau

Köppen climate types of Illinois (with counties overlaid), using 1991-2020 climate normals.

Because of its nearly 400-mile (640 km) length and mid-continental location, Illinois has a widely varying climate. Most of Illinois has a humid continental climate (Köppen climate classification *Dfa*) with hot, humid summers and cool to cold winters. However, the southern half of the state, from about Springfield southward, has a humid subtropical climate (Köppen *Cfa*) with winters becoming more moderate as one travels south. Average yearly precipitation for Illinois varies from 48 inches or 1,220 mm at the southern tip to 35 inches or 890 mm in the northern portion of the state. Normal annual snowfall exceeds 38 inches or 0.97 m in Chicago, while the southern portion of the state normally receives less than 14 inches or 0.36 m. The highest temperature recorded in Illinois was 117 °F (47.2 °C), recorded on July 14, 1954, at East St. Louis, while the lowest temperature was -38 °F (-38.9 °C), recorded on January 31, 2019, at Mount Carroll.

Monthly average high and low temperatures in Fahrenheit for various Illinois cities

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cairo	41/25	47/29	57/39	69/50	77/58	86/67	90/72	88/69	81/61	71/49	57/39	46/30

Monthly average high and low temperatures in Fahrenheit for various Illinois cities

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chicago	31/16	35/20	47/29	59/39	70/48	80/58	84/64	82/63	75/54	62/43	48/32	35/21
Edwardsville	36/19	42/24	52/34	64/45	75/55	84/64	85/59	86/66	79/58	68/46	53/35	41/25
Moline	30/12				73/50	83/60	86/64	84/62	76/53	64/42	48/30	34/18
Peoria					73/51	82/60	86/65	84/63	77/54	64/42	49/31	36/20
Rockford					71/48	81/58	84/63	82/61	75/52	62/40	47/30	33/17
Springfield					74/53	83/62	86/66	84/64	78/55	67/44	51/34	38/23

Basically, a tip height of 120m & not comparable to Laurclavagh at 185m & 7.2Mw, nor is the weather. Using 10-year-old scientific papers for non-comparable windfarm size is not objective.

“Most modeling studies indicate that the presence of large groups of wind turbines is expected to have noticeable climatic impacts from local to regional scales, and likely at global scales as well.”... The effect of wind farms on meteorology is essentially an atmospheric boundary layer (ABL) problem. The detailed physical processes of ABL-turbine interactions remain mostly unknown because of the complexity and heterogeneity of turbulence over different regions.”

“Turbulence decreases farther downwind from the rotor blades, and a distance of ten rotor diameters downstream is enough for the flow to recover from the turbulence caused by the rotor blades. For example, the 1.5 MW GE wind turbines have a rotor diameter of ~80 m, meaning 10 rotor diameters away would be 800 m.”

Illinois Plant Name	State	Summer Capacity (MW)	Operating Month	Operating Year	Number of Turbines	Size of Turbines (Mw)	Predominant Turbine Manufacturer	Predominant Turbine Model Number	Design Wind Speed (mph)	Wind Quality Class	Turbine Hub Height (metres)
Alta Farms II Wind Project, LLC	IL	200.5	5	2023	100	2	Siemens Gamesa	SG 5.0-145	23.0	2	32.8
Sapphire Sky Wind Energy LLC	IL	259.8	2	2023	64	4	Vestas	V150-4.2	18.3	2	117.0
Moraine Sands Wind Power	IL	165.0	12	2023	38	4	Vestas	V150-4.2	16.8	3	120.1
Shady Oaks Wind 2	IL	108.3	10	2023	22	5	Vestas	V150-4.2	17.5	3	105.0
Midland Wind	IL	105.5	12	2023	28	4	Vestas	V150-4.2	22.0	1	104.9
Ford County Wind Farm LLC	IL	121.3	3	2022	43	3	GE	2.82-127	18.1	1	89.0
Lincoln Land Wind	IL	302.0	11	2021	107	3	GE	2.82-127	17.4	3	114.0
Bennington Wind	IL	93.0	10	2021	33	3	GE	2.82-127	17.5	2	88.5
Glacier Sands Wind Power, LLC	IL	185.0	11	2021	43	4	Vestas	V150-4.2	16.8	3	104.9
Blooming Grove Wind Energy Center	IL	250.0	12	2020	94	3	GE	2.82-127	17.2	2	89.0
Cardinal Point Wind	IL	150.0	3	2020	60	3	GE	2.82-127	17.0	2	89.0
Lone Tree Wind, LLC	IL	79.0	12	2020	32	2	GE	2.5-127	17.4	3	89.0
Whitney Hill Wind Power LLC	IL	65.0	3	2020	24	3	GE	2.82-127	13.0	2	126.8

Sugar Creek Wind One LLC	IL	202.0	11	2020	114	2	Vestas	V150-4.2	15.6	3	120.0
Harvest Ridge Wind Farm	IL	202.0	7	2020	48	4	Vestas	V150-4.2	17.0	2	105.2
Otter Creek Wind Farm LLC	IL	150.0	3	2020	42	4	Vestas	V136-3.45	16.1	3	82.0
Green River Wind Farm	IL	194.3	11	2019	74	3	Gamesa	G126-2.5	15.7	3	84.0
Bright Stalk Wind Farm I	IL	205.2	12	2019	57	4	Vestas	V136-3.45	18.2	3	99.1
Hilltopper Wind Project	IL	185.0	12	2018	74	3	GE	2.5-100	25.0	2	115.8
Bishop Hill III	IL	119.0	6	2018	53	2	GE	2.3-116	27.0	2	90.0
Walnut Ridge Wind Farm	IL	212.0	12	2018	106	2	Vestas	V100-2.0	15.7	3	95.1
Radfords Run Wind Farm	IL	278.0	12	2017	139	2	Vestas	V110-2.0	14.5	4	95.0
Kelly Creek Wind Project	IL	184.0	12	2016	92	2	Vestas	V100-2.0	19.0	2	80.0
Pilot Hill Wind Farm	IL	175.0	8	2015	103	2	GE	1.7-100	19.0	3	80.0
Hoopeston Wind LLC	IL	98.0	3	2015	49	2	Vestas	V100-2.0	17.0	2	94.8
Minonk Wind Farm	IL	192.3	11	2012	100	2	Gamesa	G90-2.0	18.3	2	100.0
California Ridge Wind Energy LLC	IL	200.0	12	2012	134	1	GE	1.6-100	18.1	3	100.0
Bishop Hill Energy LLC	IL	200.0	6	2012	133	2	GE	1.6-97	16.1	2	100.0
Bishop Hill II Wind Farm	IL	81.0	10	2012	50	2	GE	1.6-100	16.8	3	100.0
Shady Oaks Wind Farm	IL	109.5	5	2012	71	2	Goldwind	GW 82/1500	17.0	3	100.0
Heartland Community College	IL	1.7	6	2012	1	2	Vestas	V82-1.65	14.5	3	79.9
Settlers Trail Wind Farm LLC	IL	150.4	10	2011	94	2	GE	1.6 XLE	16.6	2	80.0
Pioneer Trail Wind Farm, LLC	IL	150.4	12	2011	94	2	GE	1.6 XLE	17.4	2	80.0
White Oak Energy LLC	IL	150.0	6	2011	100	2	GE	1.5 XLE	16.8	3	80.0
Brown County Wind Turbine	IL	1.5	9	2011	1	2	VENSYS	VENSYS77	16.5	2	85.6
Big Sky Wind LLC	IL	239.4	2	2011	109	2	Vestas	V120-2.0	19.0	2	84.5
Streator Cayuga Ridge South	IL	300.0	3	2010	150	2	Gamesa	G87-2.0	16.1	3	78.0
Blackstone Wind Farm II LLC	IL	200.0	8	2010	132	2	GE	1.5 SLE	19.0	2	79.9
EcoGrove Wind LLC	IL	100.5	7	2009	67	2	Acciona	AW82/1500	16.8	3	80.0
FPL Energy Illinois Wind LLC Hybrid	IL	217.5	12	2009	145	2	GE	1.5 XLE	17.9	2	80.0
Blackstone Wind Farm LLC	IL	106.0	10	2009	68	2	GE	1.5 SLE	19.0	2	79.9
Rail Splitter Wind Farm	IL	100.5	8	2009	67	2	GE	1.5 SLE	19.0	2	79.9
Grand Ridge Wind Energy Center	IL	51.0	12	2009	34	2	GE	1.5 SLE	17.2	2	80.2
Grand Ridge Wind Energy Center	IL	49.5	12	2009	33	2	GE	1.5 SLE	17.2	2	80.2
Grand Ridge Wind Energy Center	IL	10.5	12	2009	7	2	GE	1.5 SLE	17.2	2	80.2
Geneseo	IL	1.5	9	2009	1	2	VENSYS	VENSYS77	18.0	2	61.0
Geneseo	IL	1.5	10	2009	1	2	VENSYS	VENSYS77	18.0	2	61.0
Providence Heights Wind LLC	IL	72.0	8	2008	36	2	Gamesa	G87-2.0	15.7	3	78.0

Grand Ridge Wind Energy Center	IL	99.0	10	2008	66	2	GE	1.5 SLE	18.3	2	80.2
Com Adam 1WF-1	IL	2.5	10	2007	1	3	Clipper	Liberty C96	17.0	3	100.0
Com Adam 1WF-1	IL	2.5	10	2007	1	3	Clipper	Liberty C93	17.0	3	80.0
GSG LLC	IL	80.0	6	2007	40	2	Gamesa	G87-2.0	19.0	2	78.0
Camp Grove Wind Farm	IL	150.0	12	2007	100	2	GE	1.5 SLE	15.5	2	79.9
Agrivind	IL	8.4	7	2007	4	2	Suzlon	S88-2100	15.9	2	80.0
Old Trail Wind Farm	IL	213.8	12	2007	120	2	Vestas	V82-1.65	19.0	2	79.9
High Trail Wind Farm LLC	IL	210.9	3	2007	120	2	Vestas	V82-1.65	19.0	2	79.9
Crescent Ridge	IL	53.0	12	2005	28	2	NEG-Micon	NM82/1650	21.0	2	78.0
Pike County Wind Power	IL	1.7	5	2005	1	2	Vestas	V82-1.65	13.7	2	71.6
Mendota Hills, LLC	IL	76.2	11	2003	29	3	Gamesa	G126-2.5	18.0	2	83.8
				TOTAL no. Turbines	3,777						

Note the small sizes of Turbines in Illinois & their reduced monthly usage with those highlighted yellow before 2015.

Applicant Reference: Vortex Blog: wakes and blockage

The importance of taking into account wake and blockage effects when assessing wind farm energy production.

Elies Campmany

Since DNV published the consequences of neglecting blockage and its impact on energy production [1], and Orsted presented an update of its long-term financial targets taking into account the blockage and wake effects [2], these two effects have become one of the hottest topics in the wind industry. The recent Wind Europe Workshop held in Dublin dedicated two sessions to this topic [3].

Wake Effect

The wake effect refers to the phenomenon where wind turbines create a region of slower wind speeds and increased turbulence downstream from their rotor blades. As wind passes through a turbine, some of its kinetic energy is converted into mechanical energy for electricity generation, resulting in a reduction in wind speed behind the turbine. This disturbed area, known as the wake, not only experiences reduced wind speeds but also increased turbulence.

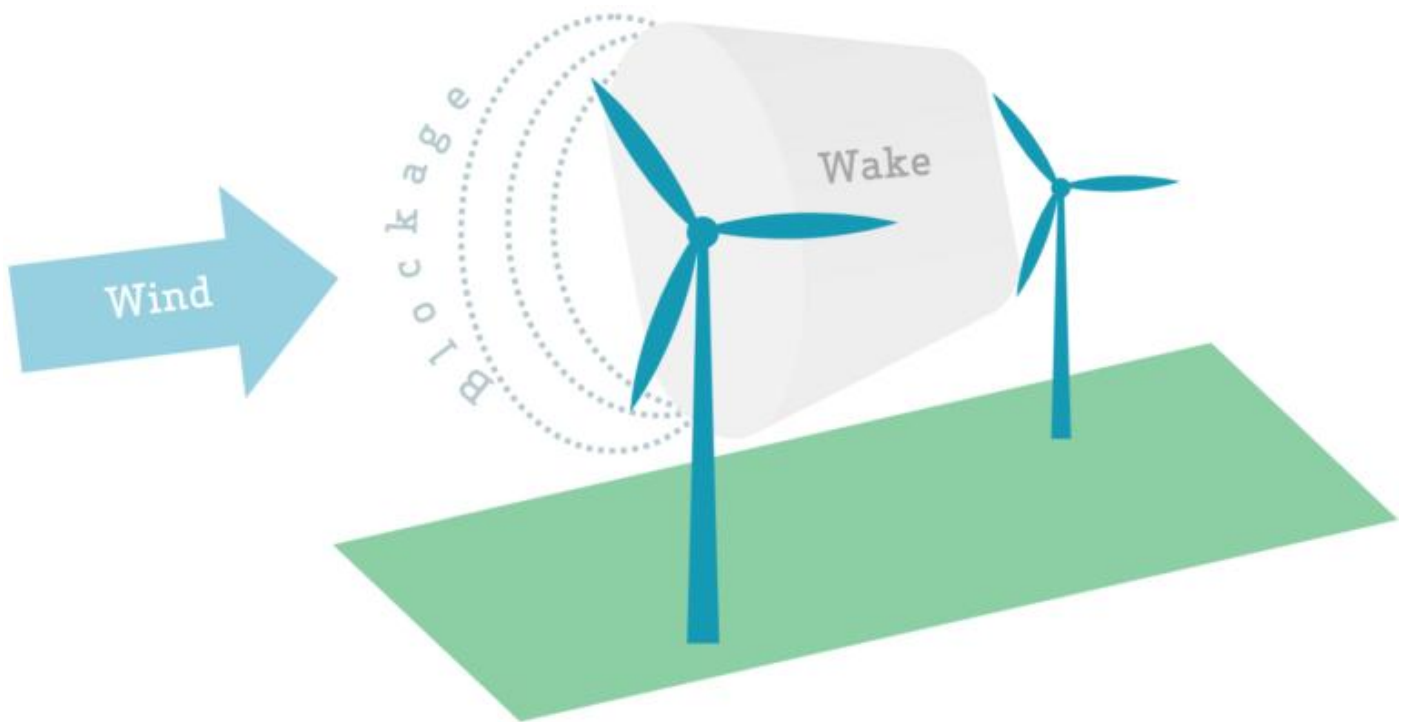
This effect can impact the efficiency and energy output of turbines located downwind, as they receive less kinetic energy from the wind. The increased turbulence within the wake can cause additional mechanical stress on these downstream turbines, potentially leading to higher maintenance needs and a shorter operational lifespan.

Because of these impacts, the wake effect is a crucial consideration in the design and layout of wind farms. Proper spacing between turbines is necessary to minimize the negative effects on overall energy production and turbine durability. Additionally, in areas with multiple wind farms, the wake from one farm can influence the performance of neighboring farms, making comprehensive planning even more important.

Blockage Effect

The blockage effect of a wind turbine refers to the disruption of airflow caused by the presence of the turbine, resulting in a decrease in wind speed and an increase in pressure upstream of the rotor. As wind approaches the turbine, it slows down due to the obstruction presented by the rotor, creating a high-pressure zone directly in front of the turbine. To conserve mass and momentum, some of the wind flow is diverted around the turbine, which can cause an increase in wind speed on the sides of the rotor.

This decrease in wind speed directly in front of the turbine, caused by the blockage effect, can influence turbine performance. The high-pressure zone in front of one turbine can impact the performance of neighboring turbines, particularly those situated directly upstream, affecting the overall layout and efficiency of wind farms. Understanding and mitigating the blockage effect is crucial for optimizing the efficiency of wind farms.



A scheme of the wake and blockage effect. The first turbine disrupts the airflow, so the second turbine will have a lower power output and more turbulence. The blockage produces a deceleration of the flow upstream of the turbine.

The Fitch Scheme

Computational Fluid Dynamics (CFD) tools provide detailed insights into the aerodynamic interactions between wind turbines and their environment, making them good candidates for studying the effects of wakes. However, they are not the only option. The **WRF model** includes a wind turbine drag parameterization scheme that represents sub-grid effects of specified turbines on wind and TKE fields: the Fitch Scheme [4].

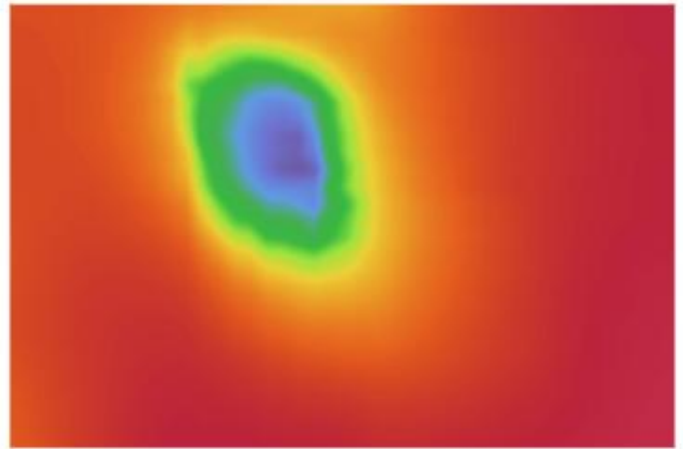
In the **Fitch scheme**, wind turbines are modeled as sinks of momentum and sources of TKE. This parameterization does not consider the rotation of rotor blades, so it is not recommended for high-resolution simulations (higher than 3 times the rotor diameter). Therefore, it is useful in offshore sites, where the horizontal variability is smaller than in onshore sites, and for simulations with a spatial resolution of 1 km.

Mean Wind Speed - Horizontal Anomaly (%)

WRF Regular
parametrization



WRF Fitch Wakes
parametrization



Item 11 Cultural Heritage (EIAR)

11.1

The Department of Housing, Local Government and Heritage outline underwater cultural heritage represented within the proposed development area may encompass riverine heritage structures and features that lie within rivers/streams and on their banks. In light of potential for the development to have adverse effects on underwater cultural heritage, a programme of preconstruction underwater archaeological assessment should be undertaken as follows: Submit an Underwater Archaeological Impact Assessment (UAIA) to include:

11.2

A desktop assessment that addresses the underwater cultural heritage (including wrecks, archaeological objects, built heritage, riverine and industrial heritage) of the proposed development area.

11.3

The UAIA shall include a licensed dive/wade assessment accompanied by handheld metal detection survey centred on any area where works are proposed to the foreshore, to be undertaken by suitably licenced and experienced underwater archaeologist.

Tobar Archaeological Services Ltd prepared the archaeology and cultural heritage chapter, Chapter 13, of the EIAR which accompanied the planning application for the Proposed Wind Farm and have prepared a response to item 11 of the FIR as it relates to cultural heritage. Item 11 of the FIR has requested an Underwater Archaeological Impact Assessment (UAIA) of the proposed development as per the recommendation of the Department of Housing, Local Government and Heritage (DHLGH). In response to the request for the completion of an UAIA, it is noted that no watercourses are located within the Proposed Wind Farm site. In this regard it is not possible to undertake an UAIA of the Proposed Wind Farm site given the absence of any watercourses requiring assessment. Four watercourses are located along the Proposed Grid Connection underground cabling route utilising a number of crossing options as follows:

WC1 – Double concrete pipe crossing – Option A: Crossing using standard trefoil formation WC1 – Double concrete pipe crossing – Option A: Crossing using standard trefoil formation WC1 – Double concrete pipe crossing – Option A: Crossing using standard trefoil formation WC1 – Double concrete pipe crossing – Option A: Crossing using standard trefoil formation Further details on the proposed watercourse crossings are included in Appendix 4-9 Watercourse Crossings of the Report. As stated in the EIAR, in stream works are not required at any of the four watercourse crossing locations which means that there is no potential for direct effects to any riverine cultural heritage items or archaeological objects. HDD is proposed to be utilised at WC2, Cloonmore Bridge, while flatbed formation or standard trefoil formation crossings will be utilised at the other three crossings with all works taking place in the existing public road at those three locations. The entry and exit pits to facilitate the HDD at WC2 will be located within the existing public road (EIAR Addendum Report Appendix 4-8a Drawing no 210627-11a) and are not located on the riverbank or in close proximity to same which removes the potential for direct effects to any sub-surface archaeological features or structures located on or within the bank. Given the absence of watercourses within the Proposed Wind Farm site, the lack of instream works at any of the four water crossings on the Proposed Grid Connection underground cabling route and all associated works taking place in the public road network it is considered that an UAIA is not necessary for the Proposed Project. In light of the above no likely potential effects to underwater archaeological or cultural heritage items will occur as a result of the Proposed Project.

Item 12. Landscape (EIAR)

12.1

You are requested to consider the impact on historical landscape value and the proposals compatibility with the European Landscape Convention 2004, with attention paid to the Landscape Directive.

Section 14 of the Report considers has considered the potential impacts of the Proposed Project on the historical landscape value of the Proposed Project site and its compatibility with the principles set out in the European Landscape Convention and the landscape directive.

Barnwell Manor Wind Energy Limited Appellant - And – Respondents.

(1) East Northamptonshire District Council

(2) English Heritage

(3) National Trust

(4) The Secretary Of State For Communities And Local Government

Case No: C1/2013/0843 Neutral Citation Number: [2014] Ewca Civ 137 In The Court Of Appeal (Civil Division)

On Appeal From The High Court Of Justice Queen's Bench Division Administrative Court The Hon. Mrs Justice Lang Co/4231/2012

*“Likewise in my view, paragraph 196, which says that “[where] a development proposal will lead to less than substantial harm to the significance of a designated heritage asset, **this harm should be weighed against the public benefits of the proposal** ...”, falls within the reach of paragraph 11d)i. This policy must be read together with the policy in paragraph 194 that “[any] harm to, or loss of, the significance of a designated heritage asset (from its alteration or destruction, or from development within its setting), should require clear and convincing justification”. Like paragraphs 172 and 173, it allows for an appropriate balancing exercise to be undertaken. It is inherent in the policy **that if the harm to the heritage asset is not outweighed there may be a “clear reason” for refusing planning permission**. Here again, the policy does not prescribe the outcome of the balancing exercise in a particular case. That is for the decision-maker to resolve by applying the policy appropriately, in accordance with the relevant principles.”*

Summary of Issues :

1. The weight of the Blades or Nacelle are not provided.
2. Microplastic shedding from turbine blades, known as Leading Edge Erosion, is a great concern to manufacturers who are forced to repair the damage that occurs after only a couple of years. The particles eroded from blades include epoxy which is 40% Bisphenol-A (BPA), a frequently banned endocrine disruptor and neurotoxin. Academic research has shown the potential for 137 pounds of epoxy microparticles to be shed per turbine per year. Recent reports from Germany and other countries have highlighted a disturbing issue: the degradation of wind turbine rotor blades. These blades, made from composite materials such as carbon-fibre-reinforced polymers (CFRP), are not only prone to breaking but also to releasing fine, respirable fibres—referred to as “nasty fibres”—into the air. According to experts, these fibres are as carcinogenic as asbestos. The problem doesn’t stop with human exposure. Animals and the broader environment are also at risk. In incidents where turbine blades have snapped or caught fire, fine fibres have been scattered across surrounding areas, contaminating soil and potentially entering the food chain. The long-term effects of this contamination are still unknown, but the potential for widespread ecological harm is significant.
3. PFAS are of concern.
4. Cutting up of blades on site is an issue. Disposal to a local recycling centre, without any knowledge of the recycling risks is negligent.
5. The area of the site is too small for 8 turbines
6. Equine risks not evaluated

Item 13. Other Matters (EIAR & NIS)

13.1

In relation to blasting, the Noise and Vibration, and Land, Soil and Geology chapters of the EIAR, and the AA Screening Report and NIS should be updated to confirm no blasting is to occur at construction stage, as outlined in your response to the submissions.

Blasting was assessed in the Noise chapter on a precautionary basis, however based on the assessments and the site investigations carried out to date, it is not envisaged that rock blasting will be required at the site, and so was not considered further in the EIAR. This has been updated in relevant sections of the Report.

13.2

Relevant EIAR chapters including Noise and Vibration, Land, Soil and Geology, Water should be updated, by way of addendum to the EIAR, to clearly detail the proposed developments compliance with Gas Networks Irelands guidelines given the siting of the proposed development relative to the gas pipeline.

13.3

Clarity should be outlined on the weight of the transportation loads traversing the gas pipeline at construction stage. While details submitted outline the internal roads which will cross over the pipeline have been designed in accordance with the GNI Code of Practice and design specifications requested, these GNI design specifications requirements should be clearly outlined on plans, and the proposed vehicle weight loadings to be accommodated at these locations relative to GNI required specifications should be outlined.

Section 8.5.2.8 of the Report considers the potential effects on Land, Soils and Geology from works near underground gas pipelines Section 15.3.1 of the Report contains further information, in addition to information provided in Section 3.2.5.2.2 of Chapter 3 and Section 15.1.1.4 and 15.3.1 of Chapter 15 of the EIA on the Proposed Project's compliance with Gas Networks Ireland and Health and Safety Authority guidance on works within the vicinity of underground gas transmission services.

Note that the weight of the Blades or Nacelle are not provided. From various Wind Turbine Brochures, it seems that the Nacelle can weigh up to 400tonnes. No structural analysis was provided for the Clare River Bridge in Claregalway on the N83. The Clare River Bridge would not be capable of carrying such loads.

13.4

Treatments /recycling of turbine blades at post decommissioning stage should be outlined.

Section 4.10 of the Report and Section 2.4.2 of EIA Addendum Appendix 4-7a Addendum Decommissioning Plan have been updated to provide further detail on the recycling of turbine blades during the decommissioning stage of the Proposed Project.

EIA Addendum Appendix 4-7a – Addendum Decommissioning Plan

3.7.3 Waste Arising from Decommissioning

The treatment and recycling of blades will be in accordance with best practice at the time of decommissioning. Turbines onsite will be removed from site in accordance with Developer policy, whereby all elements of the turbines will be recycled and reused, and no components will be sent to landfill. Current methodology for the decommissioning of the turbine blades is set out below:

- Blades will be segmented into approximately 9 pieces using an excavator mounted shear;

What? Shearing hazardous waste with a blade on site?

- Technicians will remove root rings and any other associated metal for recycling;
- The construction crew will ensure that there are no contaminants present (e.g. oils, brake dust, grease rubber hoses);

How?

- Blade segments will then be lifted via telehandler to a suitable container for transport (e.g. 40 cubic yard RORO skips and/or trailer mounted articulated bulk carriers);
- Segments will then be transported to suitable licenced processing facilities, such as Barna Recycling Transfer Station (W0106), The City Bin Co. Recycling Centre (W0148) or Galway Metal Company Ltd. (P1006) to be shredded;

Provide evidence of previous experience in disposing of such waste?

- The shredded output will be used in a suitable licenced cement co-processing or a waste-to-energy facility.

Where?

The blades will then be decommissioned following the methodology set out in Section 4.3.1.1 The turbine components will be separated and removed offsite. The turbine materials will be transferred to a suitable recycling or recovery facility.

13.5

Technical chapters of the EIAR should be updated by way of an addendum to detail the volumes of wastes arising, where applicable.

Section 3.8 of Appendix 4-5 Construction Environmental Management Plan (CEMP) as submitted, details the waste management plan (WMP) which outlines the best practice procedures for the minor volumes of waste which may be produced during the excavation and construction phase of the Proposed Project. The WMP outlines the waste prevention methods of waste prevention and minimisation by recycling, recovery, and reuse at each stage of construction of the Proposed Project. Disposal of waste will be seen as a last resort.

Clarify if SF6 gas is to be used as an insulant for electrical equipment. Relevant safeguards should be outlined, if/where applicable.

EirGrid have released Technical Specification Documents in April 2025 [EirGrid (April 2025). 110 / 220 / 400 kV Gas Insulated Switchgear (GIS) Connected to the Transmission System - XDS-GFS-25-001-R5. Available at: <https://cms.eirgrid.ie/sites/default/files/publications/XDS-GFS-25-001-R5-110-220-400kV-GIS.pdf>] in response to updates due to EU Directive 2024/573 on fluorinated greenhouse gases. The use of SF6 is to be phased out of use in Gas Insulated Switchgear (GIS) and a number of manufacturers have entered the market with alternative systems, with more in development. Depending on the timing of the Proposed Project and availability of these alternatives at that time, SF6 may not be used in future substations for Circuit Breakers. As described in the EIAR, the 'Proposed Grid Connection' relates to the on-site 110kV substation and temporary construction compound and underground cabling connection to the existing Cloon 110kV Substation. The Proposed Grid Connection will facilitate the connection of the Proposed Wind Farm to the national electricity grid and will be subject of a separate planning application under Section 182A of the Planning and Development Act 2000, as amended. EirGrid requirements with regard to 110kV Switchgear details that, unless it is otherwise approved by EirGrid, the insulating medium to be used shall be an SF6-Free medium.

Microplastic shedding from turbine blades, known as Leading Edge Erosion, is a great concern to manufacturers who are forced to repair the damage that occurs after only a couple of years. The particles eroded from blades include epoxy which is 40% Bisphenol-A (BPA), a frequently banned endocrine disruptor and neurotoxin. Academic research has shown the potential for 137 pounds of epoxy microparticles to be shed per turbine per year.

Recent reports from Germany and other countries have highlighted a disturbing issue: the degradation of wind turbine rotor blades. These blades, made from composite materials such as carbon-fibre-reinforced polymers (CFRP), are not only prone to breaking but also to releasing fine, respirable fibres—referred to as “nasty fibres”—into the air. According to experts, these fibres are as carcinogenic as asbestos.

Asbestos, once widely used in construction for its heat-resistant properties, was later discovered to cause serious respiratory illnesses, including lung cancer and mesothelioma. The material's dangers became so apparent that its use was eventually banned in many countries. Now, the similarities between asbestos and the fibres released from wind turbine blades are raising alarms. Like asbestos, these carbon fibres are chemically non-reactive and difficult to break down in the lungs, posing long-term health risks to those exposed.

The problem doesn't stop with human exposure. Animals and the broader environment are also at risk. In incidents where turbine blades have snapped or caught fire, fine fibres have been scattered across surrounding areas, contaminating soil and potentially entering the food chain. The long-term effects of this contamination are still unknown, but the potential for widespread ecological harm is significant.

What makes this situation even more concerning is the apparent lack of regulatory oversight. There are no strict guidelines in place to manage the risks associated with these fibres. In some cases, local fire brigades have been tasked with clearing debris from damaged turbines without proper protective gear or awareness of the hazards involved. This lack of preparedness is reminiscent of the early days of asbestos use when the dangers were either unknown or deliberately downplayed.

Moreover, the issue of recycling turbine blades adds another layer of complexity. Unlike other materials, CFRP is difficult to recycle, often ending up in landfills where it can continue to pose risks. The sheer volume of blades that will need disposal in the coming years is staggering, and without effective recycling solutions, we could be facing a significant environmental disaster.

Asbestos found in wind farm lift brake pads prompts safety response : Tamara Clark, ABC Wimmera · 20 Nov 2025 · abc.net.au ~~~

The discovery of asbestos-ridden lift brake pads has sparked an urgent safety response at wind farms across the country. WorkSafe Victoria and renewable energy company Goldwind Australia, a subsidiary of Chinese firm Goldwind Science and Technology Co. Ltd, said white asbestos was found in brake pads used in wind turbine lifts at its facilities. The brake pads were supplied by 3S Industry, a major Chinese-based supplier to Australia. 3S Industry is one of a few brake pad suppliers to Australia, meaning a significant percentage of the country's wind turbines could be affected. Interstate regulators have united to form a coordinated safety response. The importation of asbestos, or goods containing asbestos, has been illegal in Australia since 2003.

Microplastics Emission from Eroding Wind Turbine Blades: Preliminary Estimations of Volume Leon Mishnaevsky, Jr., Antonios Tempelis, Yauheni Belahurau and Nicolai Frost-Jensen Johansen. *Energies* 2024, 17, 6260. <https://doi.org/10.3390/en17246260>

In this article, the volume of removed plastic due to the leading-edge erosion of wind turbine blades is evaluated using different approaches. A probabilistic model of material removal due to successive rain droplet impacts was developed and applied to the determination of the volume loss of blades due to erosion. As a result, it was shown that for the case of an average tip speed of 90 m/s, 1000 mm of rain annually, and a mean rain intensity of 1 mm/h, the volume loss is at the level of 15 mm³/cm² per year. For the area 10 m×50mm (full leading-edge surface), it leads to 75 cm³ or 75 g per blade per year.

INQUIRY INTO INQUIRY INTO PFAS CONTAMINATION IN WATERWAYS AND DRINKING WATER SUPPLIES THROUGHOUT NEW SOUTH WALES Name: Date Received: Mr Ian McDonald 10 December 2024. Select Committee on PFAS Contamination in Waterways and Drinking Water Supplies Throughout New South Wales

All epoxy resins contain BPA or similar bisphenol components. Epoxy resins are used in almost every part of our daily life (BPA *in a confined state*) such as paints, plastic drink bottles, flooring etc and in the manufacture of wind turbine blades. Epoxy resins are also used in the manufacture of wind turbine blades. The blades, however, wear and then shed a fine dust of BPA throughout their life. This dust is spread wide and far by wind and if only one gram of it gets into dam or town storage waters, 10 million litres of water is polluted and then rendered unusable. This dust (BPA *in an unconfined state*) from eroding blades has already covered large areas of our planet in proximity to wind farms and BPA is leaching into soils and waterways. Furthermore, the process is accelerated when the blades are cut up, dumped (on-site) and buried.

The wind industry openly admit that any wind turbine will emit in excess of 60kg of microplastics containing '*forever chemicals*' per year into the atmosphere which will find their way into soil profiles and waterways. That is the equivalent of about 50 tonne of pure unadulterated BPA pollutants over 20 years finding their way into water catchments from a typical 100 turbine wind farm. 9.6 tonnes in the Laurclavagh case.

Select Committee on PFAS (per and polyfluoroalkyl substances)- Submission 105. Submission on PFAS: Environmental and Health Impacts in Renewable Energy Infrastructure. Submission to: Federal Senate Inquiry into PFAS Standards. Author: Dr Anne S. Smith, Rainforest Reserves Australia

This submission outlines the pervasive environmental and health challenges posed by per and polyfluoroalkyl substances (PFAS) within renewable energy infrastructure, such as solar panels, wind turbines, and batteries. PFAS, often termed "forever chemicals" due to their extreme resistance to environmental degradation, represent an escalating global crisis. These chemicals, essential for certain industrial applications, are increasingly recognized for their role in long-term environmental contamination, bioaccumulation, and biomagnification in food chains.

In renewable energy technologies, PFAS are used in coatings, composites, and cooling systems to enhance performance and durability. However, their persistence creates contamination risks during production, operation, and disposal. Evidence links PFAS exposure to serious human health impacts, including cancer, immune suppression, endocrine disruption, and neurodevelopmental issues. Furthermore, the contamination of ecosystems— affecting soil, water, and wildlife— has significant socio-economic repercussions.

Key Findings from International Research

International research has provided critical insights into PFAS contamination, its impacts, and strategies for mitigation. These findings can inform Australia's policy and regulatory responses.

1. Human Health Risks:

o **Cancer and Endocrine Disruption:** Studies by **Barry et al. (2013)** and **Blake et al. (2015)** have linked PFAS exposure to kidney and testicular cancer, as well as hormonal disruption affecting reproductive health.

o **Immune Suppression:** Research by **Grandjean & Clapp (2015)** indicates that PFAS exposure reduces vaccine efficacy, increases infection susceptibility, and compromises overall immune function.

2. Environmental Persistence:

o PFAS' extreme resistance to degradation, as documented by **Vierke et al. (2012)**, complicates cleanup efforts and ensures long-term environmental contamination.

o **Ahrens et al. (2015)** further highlight PFAS' ability to travel globally, contaminating even remote ecosystems.

3. Economic Impacts:

o Cleanup costs for PFAS-contaminated sites in the United States exceed \$1 billion annually, according to the U.S. Environmental Protection Agency (EPA). The financial burden on industries, governments, and communities is substantial and underscores the importance of preventive measures.

Environmental Impacts

The environmental impacts of per- and polyfluoroalkyl substances (PFAS) are far-reaching, with significant consequences for soil, water, ecosystems, and biodiversity. The persistent and bio-accumulative nature of PFAS exacerbates their effects, making remediation efforts challenging and often cost-prohibitive.

Contamination of Soil and Water

PFAS contamination is a pressing concern for soil fertility and water quality. Due to their chemical stability and resistance to natural degradation, PFAS remain in the environment for decades, continually cycling between soil and water systems.

• **Impact on Agriculture:** PFAS contamination in soil alters its chemical composition, reducing fertility and crop yields. **Banzhaf et al. (2017)** documented how PFAS interfere with soil structure and nutrient availability, negatively impacting agricultural productivity. Farmers in contaminated regions often face reduced economic output and loss of livelihood due to restrictions on using contaminated land for cultivation.

• **Threat to Aquifers:** PFAS leach into groundwater systems, contaminating aquifers that serve as critical drinking water sources. Contaminated water supplies pose a direct risk to human health and the environment. Aquifers with high PFAS levels can become unusable for decades, as remediation technologies like activated carbon filtration are expensive and labor-intensive.

• **Disproportionate Effects on Rural Communities:** Rural communities that rely heavily on local aquifers for drinking water and irrigation are disproportionately affected. Indigenous populations, in particular, face compounded risks due to their close cultural and economic ties to the land. **O'Neill et al. (2019)** highlights the inequities in PFAS management, with rural and Indigenous communities often receiving delayed support and inadequate remediation.

Impact on Flora and Fauna

PFAS disrupt critical ecological processes, affecting both plant and animal species across terrestrial and aquatic environments.

- **Impact on Plants:** PFAS exposure alters soil chemistry, negatively impacting plant growth and nutrient cycles. Navarro et al. (2021) found that PFAS interfere with microbial communities essential for nitrogen fixation and organic matter decomposition. This disruption reduces crop yields and increases soil salinity, further impairing agricultural productivity.

- **Impact on Wildlife:** PFAS bioaccumulate in aquatic and terrestrial species, with significant consequences for reproduction, growth, and survival. Hansen et al. (2020) demonstrated that PFAS exposure in amphibians and fish led to developmental abnormalities and reduced reproductive success. Apex predators, such as polar bears and raptors, are particularly vulnerable due to biomagnification, which increases PFAS concentrations at higher trophic levels.

- **Ecosystem-Level Consequences:** PFAS contamination affects entire ecosystems by disrupting food webs and reducing biodiversity. Predatory species experience declines due to reduced prey availability and reproductive challenges, leading to imbalances in ecosystem dynamics.

Long-Term Consequences

The long-term persistence of PFAS in soil and water compounds their environmental impact. Kotthoff et al. (2021) highlighted that even decades after initial contamination, PFAS residues can hinder ecosystem recovery by disrupting natural nutrient cycles and regeneration processes. Furthermore, the high cost and technological complexity of remediation methods, such as soil excavation and advanced filtration systems, make long-term solutions challenging to implement.

Global Implications:

Due to PFAS' ability to travel long distances via air and water currents, their contamination is not confined to local environments. Ahrens et al. (2015) documented PFAS in Arctic ecosystems far from industrial sources, illustrating their global reach and the need for international cooperation to address their impacts.

Human Health Impacts

PFAS contamination presents a significant risk to human health through multiple exposure pathways. Communities near contamination hotspots, such as renewable energy facilities, landfills, and industrial sites, are particularly vulnerable to these risks. The long-lasting nature of PFAS in biological systems and the environment compounds their potential for harm, leading to severe health effects that persist across generations.

4.1 Exposure Pathways

Humans are exposed to PFAS primarily through:

1. Contaminated Water:

PFAS are highly water-soluble, allowing them to infiltrate groundwater and municipal water supplies. Communities located near industrial facilities, firefighting training sites, or renewable energy projects are at greater risk. For instance, solar panel coatings and battery separators may release PFAS into surrounding water systems during production or disposal. A study by Banzhaf et al. (2017) identified PFAS in aquifers serving rural and urban populations, highlighting the challenges of providing clean drinking water.

2. Food Contamination:

PFAS accumulate in crops irrigated with contaminated water, livestock exposed to polluted feed or water, and seafood from contaminated rivers or coastal areas. Navarro et al. (2021) found that PFAS persist in agricultural soils, entering food chains and disproportionately affecting subsistence farmers and rural populations. Bioaccumulation in fish and seafood poses a direct risk to human health, particularly in coastal communities reliant on fishing for sustenance and economic livelihood.

3. Airborne Particles:

PFAS are released into the air during manufacturing processes, the degradation of renewable energy components, or improper disposal of waste materials. Vierke et al. (2012) highlighted that PFAS can travel long distances through atmospheric currents, contaminating areas far removed from their original source. Inhalation of PFAS particles during production or maintenance of renewable energy infrastructure may pose occupational hazards to workers.

4. Household Products and Dust:

PFAS are found in everyday items such as non-stick cookware, stain-resistant fabrics, and personal care products. Indoor exposure to PFAS from household dust is an under-recognized pathway, particularly for children who are more likely to ingest dust through hand-to-mouth contact.

5. Disproportionate Impact on Vulnerable Communities:

Indigenous populations and rural communities face heightened risks due to their reliance on local water and food sources, which are often directly affected by nearby contamination. O'Neill et al. (2019) emphasized that these populations frequently lack the resources and infrastructure necessary to mitigate exposure, compounding existing health disparities. For example, limited access to alternative water supplies or healthcare exacerbates the long-term impacts of PFAS exposure in these groups.

Health Effects

The health effects of PFAS are extensive, with scientific studies consistently linking exposure to a range of acute and chronic conditions. Key health impacts include:

1. Cancer:

o PFAS exposure has been strongly associated with an increased risk of kidney and testicular cancers. **Barry et al. (2013)** conducted longitudinal studies in communities exposed to PFAS-contaminated water, finding higher incidences of these cancers compared to non-exposed populations. These cancers are thought to result from PFAS' ability to disrupt cellular signaling and promote tumor growth.

2. Immune System Impairment:

o Chronic PFAS exposure compromises immune function, reducing the body's ability to fight infections and respond to vaccines. **Grandjean & Clapp (2015)** found that children with elevated PFAS levels had lower antibody responses to vaccines, leaving them vulnerable to preventable diseases. This immune suppression also increases the likelihood of chronic inflammation, autoimmune diseases, and longer recovery times from infections.

3. Neurodevelopmental Disorders:

o Prenatal and early childhood exposure to PFAS has been linked to cognitive delays and developmental abnormalities. **Braun et al. (2014)** demonstrated that children exposed to PFAS in utero scored lower on tests measuring memory, attention, and language skills. These effects are particularly concerning as they impact future generations and exacerbate educational and socio-economic inequalities.

4. Endocrine Disruption:

o PFAS interfere with hormone regulation, leading to reproductive and developmental disorders. **Blake et al. (2015)** documented hormonal imbalances in individuals exposed to PFAS, including reduced fertility, early puberty, and thyroid dysfunction. These disruptions may increase the risk of metabolic conditions, such as obesity and diabetes.

5. Cardiovascular Risks:

o Elevated cholesterol levels and hypertension have been observed in populations with high PFAS exposure. Studies by **Lind et al. (2020)** indicate that PFAS alter lipid metabolism, increasing the likelihood of cardiovascular diseases such as atherosclerosis and stroke.

6. Mental Health Impacts:

o Living in PFAS-contaminated areas can cause significant psychological stress due to concerns about health risks, property devaluation, and social stigma. **Ebi et al. (2020)** highlighted the mental health burden on communities dealing with PFAS-related crises, noting increased rates of anxiety, depression, and community tension.

Long-Term and Intergenerational Effects

PFAS exposure during pregnancy and early development has profound long-term consequences. Prenatal exposure has been linked to:

- **Reduced Birth Weights:** Studies by **Darrow et al. (2013)** found that infants exposed to PFAS in utero had lower birth weights, which are associated with increased risks of chronic health conditions later in life.
- **Epigenetic Changes:** PFAS may cause changes to DNA expression that are passed down to subsequent generations. Research into epigenetic impacts is ongoing, but early findings suggest that PFAS exposure may contribute to inherited health vulnerabilities.

Socio-Economic Implications

The economic burden of PFAS-related health conditions is significant. Healthcare costs, reduced productivity, and loss of property values in contaminated areas exacerbate financial disparities, particularly in already disadvantaged populations. Affected communities often face years of legal battles to secure compensation and cleanup efforts, as seen in cases such as Oakey, Queensland, and Wilmington, North Carolina.

Renewable Energy: Wind Turbine Blades

Research by **Henne et al. (2021)** found that PFAS used in wind turbine blade coatings degrade over time, releasing microplastics and chemical residues into surrounding ecosystems. This case exemplifies the environmental trade-offs associated with renewable energy technologies.

Conclusion on PFAS and the Need to Cease Its Use

The continued use of PFAS in renewable energy infrastructure, such as solar panels, wind turbines, and batteries, poses an unacceptable risk to the environment, human health, and ecosystems. These "forever chemicals" resist natural degradation, bioaccumulate in living organisms, and travel long distances through air and water, ensuring widespread and longterm contamination.

Evidence demonstrates the catastrophic impacts of PFAS contamination:

1. Environmental Degradation: PFAS contamination has been found in critical ecosystems, including soil, water, and marine environments. It disrupts food webs, reduces biodiversity, and weakens ecosystems' resilience. This contamination persists for decades, making recovery both costly and complex.

2. Human Health Risks: PFAS exposure is strongly linked to serious health conditions such as cancer, immune suppression, endocrine disruption, and developmental disorders. Vulnerable populations, particularly those in rural and Indigenous communities, face compounded risks due to their reliance on contaminated local water and food sources.

3. Economic Burdens: The cleanup of PFAS-contaminated sites is prohibitively expensive, often exceeding billions of dollars annually, while communities suffer property devaluation and lost livelihoods. These economic impacts disproportionately affect disadvantaged populations.

4. Global Contamination: PFAS are not confined to local environments; their presence in remote Arctic ecosystems highlights the global scale of this crisis. International studies reveal PFAS in apex predators and marine life, further endangering global biodiversity.

The use of PFAS in renewable energy, though advantageous for durability and performance, introduces unacceptable trade-offs. The degradation of turbine blades, improper disposal of solar panels, and contamination from battery

components release toxic PFAS compounds into the environment. These risks undermine the sustainability goals that renewable energy seeks to achieve.

13.7

The grade of aggregate, steel and concrete utilised should be outlined for the proposed development.

Section 4.7.1.2.1 of the EIAR states that the access roads will be constructed using well-graded imported granular fill, spread and compacted in layers typically of 200mm and a suitable capping layer to provide a homogeneous running surface. The thickness of layers and amount of compaction required will be subject to detailed design by Project Engineer in consultation with the Construction Manager based on the characteristics of the material and the compaction plant to be used. Section 4.3.3.1 of the EIAR details the volume of stone required to build the Proposed Project infrastructure, while Section 4.4.2.1 details the locations of quarries from which rock and hardcore material could potentially be sourced from in order to facilitate the construction of the Proposed Project. As detailed in Section 15.1.2.3 of the EIAR, stone, sand and cement required for the construction of the Proposed Wind Farm and the Proposed Grid Connection infrastructure will be sourced from local, appropriately authorised quarries. Potential quarries, with a 20km radius of the wind farm site are shown on Figure 4-24 of the EIAR. Quarries are located to the north and south of the site and all materials provided by these quarries will enter the site via the temporary road, off the N83. The specific grade of aggregate, steel and concrete which will be used in the construction of the Proposed Project cannot be specifically defined at this time, as this will likely be informed by manufacturer specific requirements at the time of construction. The level of detail in the Application is commensurate to current wind farm applications.

13.8

All EIAR chapters should clearly outline the indirect/potential indirect effects arising, which should be addressed by way of an addendum.

Section 1.2 and 1.6 of Chapter 1 Introduction of the EIAR and Section 1.6 of the Report detail the purpose and scope of the EIAR. The EIA is the assessment carried out by the competent authority, which includes an examination that identifies, describes and assesses in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect significant effects of the Proposed Project. Throughout the EIAR, the likely significant direct and indirect effects related to the Proposed Project have been identified and described in accordance with all of the guidance documents and legislation as identified in Section 1.1.1 of Chapter 1 of the EIAR, including the EPA Guidelines. Where the potential for likely significant indirect effects was identified in the EIAR, these effects were robustly considered and assessed in their respective chapters.

13.9

The Interactions chapter, EIA NonTechnical Summary, CEMP and relevant plans should be updated by way of an addendum to take the request for further information into account, where applicable.

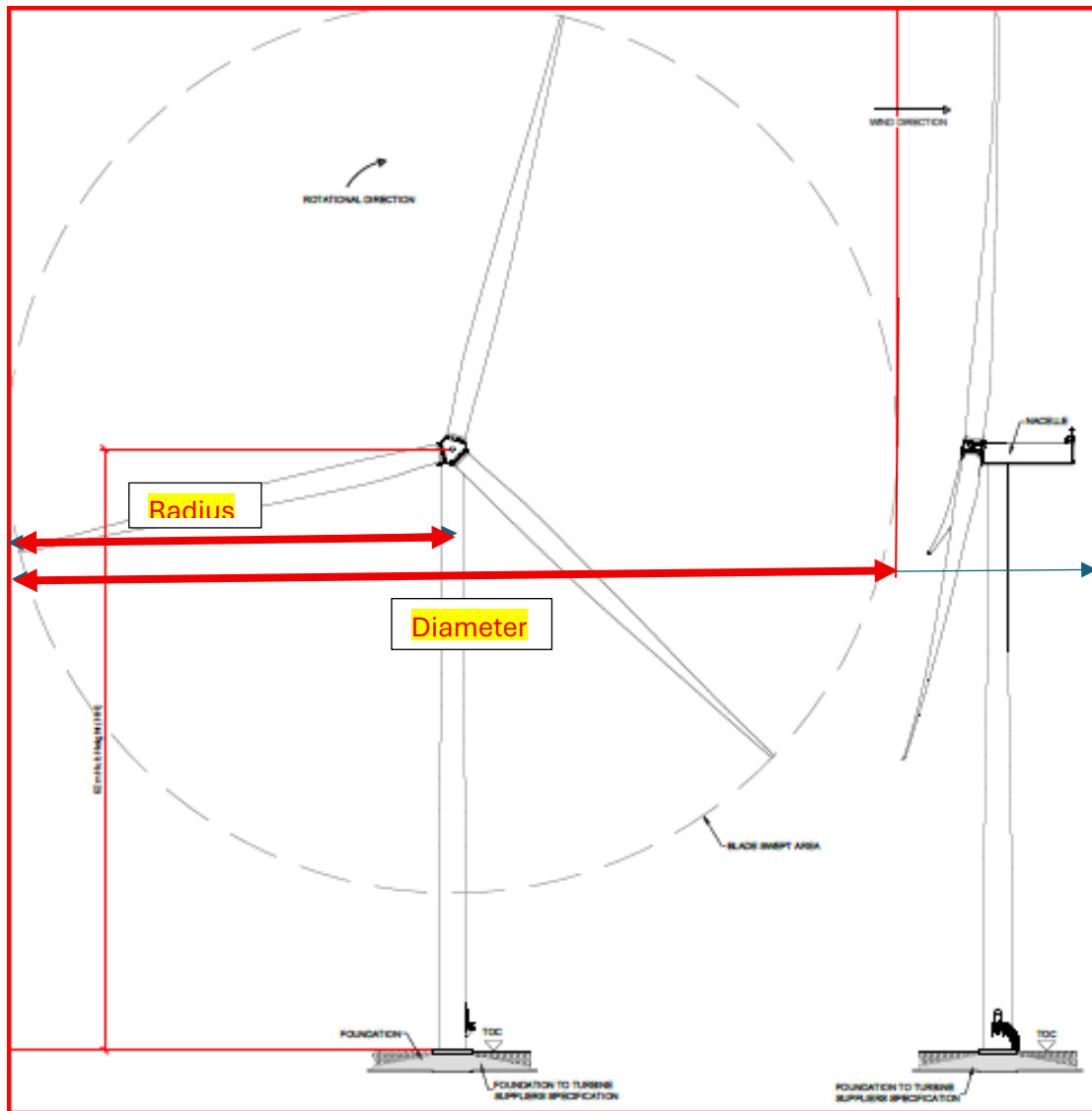
As detailed in the Response to FI Cover Letter, An EIA Addendum Report (the Report) has been prepared in order to update the EIA and associated appendices, where appropriate, taking the ACP FI Request into account, in order to allow ACP to complete a robust environmental impact assessment of the Proposed Project. Where items have already been addressed in the documentation on file, the relevant section and document is referenced, and the material is not repeated in the EIA Addendum or revised NIS as appropriate.

13.10

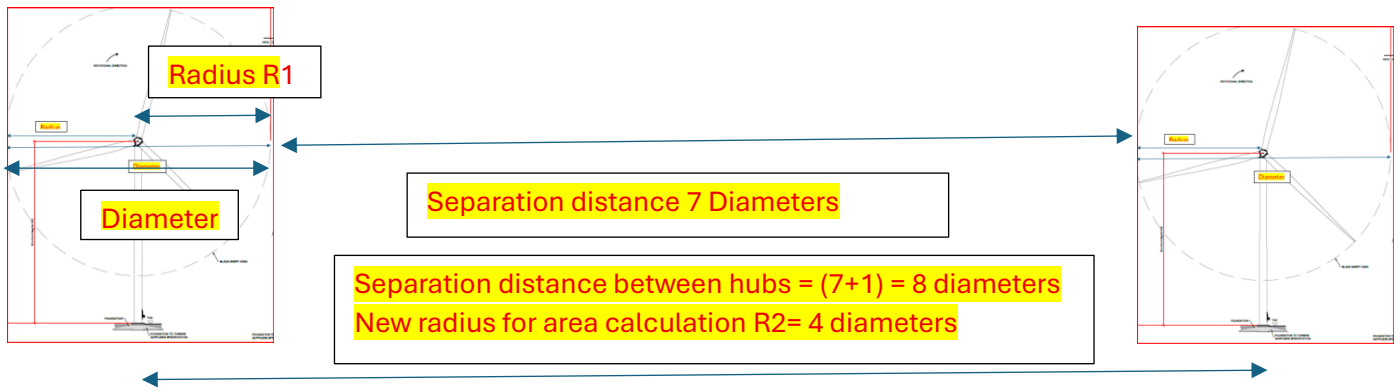
Please clarify details in relation to the project site size (in hectares) and proposed turbine coordinates outlined.

As stated in Section 1.1.1 of the EIAR, the Proposed Project is located within the EIAR Site Boundary or the 'Site' and measures approximately 944 hectares (ha). The permanent footprint of the Proposed Project measures approximately 13.8 hectares, which represents approximately 1.46% of the Site. The Grid Reference coordinates of the proposed turbine locations are listed in Table 4-1 of Chapter 4 of the EIAR. On review of the EIAR in response to the ACP FI Request, typographical errors were found in Chapters, and the Response to Submissions document submitted to ACP in March and August 2024 respectively. The Proposed Project site size and proposed turbine locations are reiterated in Section 4.3.1 and Section 4.3.1.1.1 of the Report for clarity.

Laurclavagh Wind turbine area calculation Rule of Thumb



Wind Energy Guidelines 2006 & Draft Wind Energy Guidelines 2019 state that Separation distance should be a minimum 7 times diameter. Therefore, distance from hubs should be $7 \text{diameter} + \text{diameter} = 8 \text{ diameters}$ to cater for radius to tip of blades. Therefore the new radius equals 4 times the wind turbine diameter.



Area of this separation distance is thus πR^2 as the separation distance is required by each turbine. From below, it is obvious that one 162.5m diameter turbine requires an area of 406.49ha. For 8 number 162.5m diameter turbines, the minimum area is 3,251.9Ha. Yet the Laurclavagh site area is only 944ha. Thus it is 2,307.9ha too small to accommodate 8 turbines. The Applicant could have included circles around his turbines on a map to show his compliance.

Rule of thumb to calculate the minimum area required for various diameter wind turbines to comply with minimum WEGs 2006 & 2019.

Diameter of Turbine m	Separation distance =7Rotor Diameter	Radius ²	3.14159 Radius ²	1/10000 Ha per turbine
162.5	1,137.5m	1,293,906.25m ²	4,064,922.94m ²	406.49Ha

Note total site area measures Ha & it cannot accommodate

RESDM: Wind Turbine Spacing: Why Distance Matters in Wind Farms

Proper spacing between wind turbines is crucial primarily because of the wake effect. When a turbine generates power, it slows down the wind and creates turbulence in its wake – much like a boat leaves a wake in water. Any turbine positioned too closely downwind will sit in this disturbed air, receiving reduced wind speed and increased turbulence. The result is a drop in efficiency and power output for the downwind turbine. In fact, studies have shown that when turbines are spaced very tightly, the power deficit can be substantial, whereas spacing turbines further apart (e.g. ~10 rotor diameters apart downwind) makes wake losses “almost negligible”. Wake turbulence can also put extra stress on turbine components, potentially increasing wear and maintenance needs.

Environmental Impact: The space between turbines can influence how a wind farm interacts with wildlife and the landscape. For example, **if turbines are extremely tightly packed, a wind farm may present a large wall-like barrier for birds.** Newer wind farms with larger spacing are “less likely that birds perceive rows of turbines as impenetrable walls”, potentially reducing bird collision risks as raptors and other birds can more easily fly between widely spaced turbines.

13.11

Consideration should be given to potential impacts on equine facilities/businesses/breeding operations, arising from the construction stage impacts and siting of the wind farm. Please provide a map delineating existing equine facilities/businesses/breeding operations in the vicinity of the proposed wind farm site. You are requested to also provide an assessment as to whether significant impacts will arise from the proposed development on such facilities, which is to include horse and Connemara Pony breeding operations, and this should take into account guidance in British Horse Society 'Wind Turbines and Horses- Guidance for Planners and Developers' 2015.

Section 5.3.7 and Section 12.3.6.1 of the Report details further consideration which has been given to Equine Facilities within the vicinity of the Proposed Wind Farm.

5.3.7.1 Equine Industry

There are a number stud farms, stables, bloodstock farms and equestrian facilities identified within the wider vicinity of the Proposed Wind Farm. The closest registered equestrian facilities to the Proposed Wind Farm are detailed in Table 5-1 below. Figure 5-7 below shows equestrian facilities within the vicinity of the Wind Farm.

Table 5-1 Equine Facilities within the vicinity of the Proposed Project

Equestrian Facility Name	Distance to Nearest Proposed Turbine (Direction)
Connolly Stud Farm (CSF) (Indicative location H96)	1.38km from T08 (East)
Clonboo Riding School	6.9km from T01 (Southwest)
Monard Equestrian Centre	9.1km from T08 (Southeast)
Grangeview Stables	10.3km from T08 (Southeast)
Duffy's Equestrian Centre	12.5km from T06 (South)
Connemara Equestrian Escapes Moycullen	12.9km from T01 (Southwest)
Marley Stables Tuam	13.1km from T08 (northeast)
Clydagh Stud Farm – Connemara Ponies	13.2km from T01 (West)
Galway Bay Stud	15.1km from T01 (South)

A submission on the application made by a third party identifies Connolly Stud Farm or CSF as a proximate farm to the Proposed Project, along the L61461, however the exact location of the stud farm is unavailable. In the absence of the exact location, the identified dwelling in the submission is assumed for the purposes of the precautionary assessment. The property selected is approximately 1.38km west of the closest proposed turbine and is identified as property 'H096' in the shadow flicker and noise assessment tables.

There have been no known studies carried out in Ireland on the impacts of wind farms on the equine industry. In 2014 Marshall Day Acoustics published a document entitled 'Summary of research of noise effects on Animals'. The Marshall Day study specifically assessed the impacts of varying levels of noise on horses in three differing behavioural settings. The three behavioural settings studied included horses in stables, breeding mares and racing horses.

Wind turbines and horse husbandry in France. Translated from french by : Karen DUFFY - Agata RZEKĘĆ - Gwenaëlle GRANDCHAMP-RENARD

A wind turbine produces neither infectious nor chemical agents, but does produce physical phenomena. There are four types of physical effects :

- Acoustic vibration phenomena, i.e. audible sound and infrasounds produced by the movements of the blades and the electric generator.

- Ground vibrations.
- Electromagnetic fields resulting from converting the mechanical power of the wind to an electric current, and the transfer of this current.
- Parasitic electrical current, induced by the electromagnetic fields, but also linked to current leakage, to couplings between electrical and mechanical elements, and faulty earthing.

Horses are not as sensitive to infrasounds as humans, or even as cattle (Heffner and Heffner, 1983)

Scale of sound frequencies in several animal species and in humans (according to Heffner (1998))				
Animal species	Low frequency limit (Hz)	High frequency limit (Hz)	Ideal sensitivity (dB)	Ideal frequency (Hz)
Cattle	23	37 000	-11	8 000
Human	20	20 000	-10	4 000
Pigs	42	40 500	9	8 000
Horses	55	33 500	7	2 000
Cats	55	79 000	-10	8 000
Dogs	67	44 000	-1	8 000
Laboratory rats	530	70 500	0	8 000
Laboratory mice	900	79 000	5	15 000

The persistence of audible sounds does not appear to affect animal behaviour, unlike some people suffering from hyperacusis.

However, infrasound remains controversial in the equine sector. In an expert study conducted in Portugal, there was a suspicion of consequences on joint tissue in Lusitano horses (Branco *et al*, 2005). The results of this expert study have however not been confirmed by the Lisbon University veterinary thesis (Costa, Pereira e Curto 2012) which analysed the afore mentioned cases

Ground vibrations

Ground vibrations are produced by the wind turbine itself, like any building with foundations and wind. The transmission of vibrations through the ground depends on the nature and structure of the ground they go through. The mechanical waves through the ground, produced by wind turbines, are essentially surface vibrations (Saccorotti G. *et al*, 2011). There is very little data regarding the level of the vibrations for local residents, produced by wind turbines. The few studies conducted show that when further than 300 metres (Lubw, 2016) to 700 metres away from a wind turbine (internal study by Cerema), the vibrations merge into the background noise of the site (vibration speeds below 0,07mm/s).

Electromagnetic fields

The study of electromagnetic fields revolves around three themes:

- Behaviour and neurophysiology
- Zootechnical and sanitary impact
- Cellular and physiological impact

Behaviour and neurobiology

There is little information regarding perception of electromagnetic fields, and our knowledge is mainly related to wildlife. Likewise, there is no data as to whether electromagnetic fields produced by various structures (wind turbines, high voltage power lines...) have an influence on perception. There are no effects noted on the behaviour of farm animals, only on laboratory animals (rats and mice).

Zootechnical and sanitary impact

With regard to cattle, the results of experiments conducted in the field differ from those of experiments in a controlled environment. In an experimental environment, a decrease in the quantity of milk produced and in the percentage of fat was noticeable, as was an increase in the quantity of feed ingested. The field studies showed no changes.

With regard to poultry, electromagnetic fields presented a teratogenic effect (affecting the embryo, and causing malformation) with a window effect (non-linear effect, i.e. the negative effect of electromagnetic fields is lesser for the weaker and the stronger fields).

Cellular and physiological impact

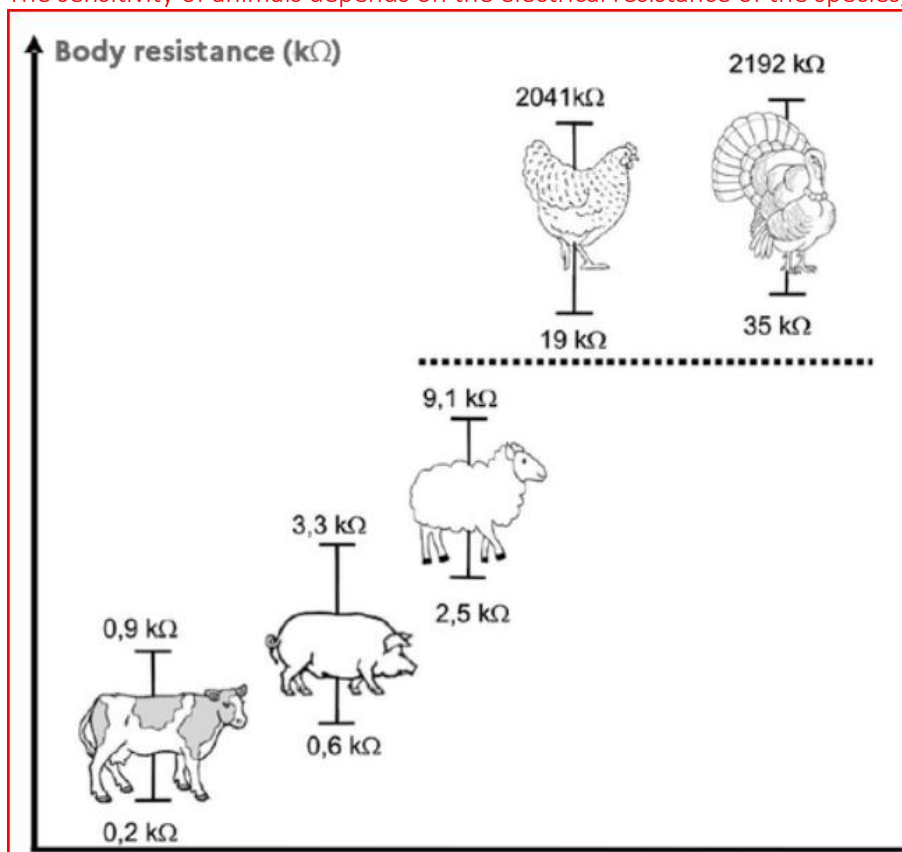
Studies conducted *in vitro* show a genotoxic effect (capacity to compromise the structure or the functioning of the genome) of electromagnetic fields. Moreover, these fields amplify the action of chemical products which have an effect on DNA. Cells submitted to electromagnetic fields are more sensitive to oxidative stress, i.e. there is a higher count of DNA lesions, therefore more frequent cell death. Electromagnetic fields also have an effect on the circadian cycle («the internal clock » of an organism) by modifying the release patterns of melatonin, or through other mechanisms yet to be discovered. However, electromagnetic fields have no effect on immunity and physiological stress (ways in which the organism copes with real or presumed aggression).

Parasitic current

Parasitic current is derived either from electromagnetic fields, or from electrical current (cables...). Parasitic currents can cause different types of voltage :

- **Contact voltage** (contact with a metallic element such as a drinking trough) \Rightarrow the current goes through the animal and back to earth through the legs.
- **Pace voltage** \Rightarrow Current goes from the front legs to the rear legs.

The sensitivity of animals depends on the electrical resistance of the species, of the individual and on living conditions.



Animals are more sensitive than humans. Parasitic currents cause pain, leading to physiological stress which can modify behaviour (avoidance, refusing to drink, memory and training issues...) and the state of health (weight loss, decrease in immunity, higher risk of gastric ulcers and colic, genetic alterations in the long term...). An animal's sensitivity to parasitic current can be increased due to its living conditions.

A horse stabled in a building with a lot of metallic structures and/or in a box with damp bedding, is more at risk of being a conductor of parasitic current.

To summarize

Wind turbines produce sounds and infrasound, vibrations, electromagnetic fields and parasitic current
To date, only parasitic currents are a real issue for horses, but vigilance is required nevertheless, due to our lack of knowledge.

Racehorses & Stud farms

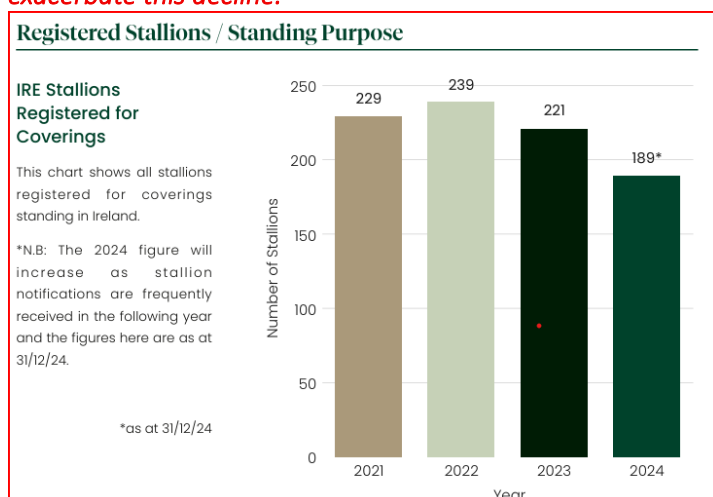
Renewable Energy Developments have to be balanced with equine facilities & this requires informed policy frameworks. Recent statements from Planning Authorities indicate the growing tension between renewable energy expansion and the protection of rural sensitive agricultural sectors, which includes racehorses & stud farms. Thoroughbred horses, horse racing & the industry itself are an integral part of our national identity. Ireland is recognised as the world horse industry leader. Ireland is the third largest producer of thoroughbred foals in the world. Only the USA & Australia have more foal births. Ireland exceeds the combined totals of the UK & France. The UK's Secretary of State for Communities & Local Government acknowledged, in one of the reasons given for refusing permission for a proposed development of 9 wind turbines, that the proposed development would have a potential significant adverse impact on three nearby equine businesses (stud farms) and that *"considerable weight should be attached to this."*

The Planning Inspector who reported to the Secretary of State on this case noted that *"There are three particular aspects of wind turbines that have a very significant detrimental effect on horses & riders that compromises their safety. Firstly, the movement of the blades when they suddenly come into view from the road, the gallops or a paddock. Secondly, the shadow flicker which has been known to spook a horse. Lastly, the noise from a group of very large turbines, particularly at start up and on a crowded site such as the southern group of 6, could have a very serious effect."*

The Planning Inspector's report acknowledged that thoroughbred horses are *"high value, highly strung & volatile"* and that *"where turbines would suddenly appear in the view"* or where shadows thrown by turbines are visible *"there is the potential for spooking the highly strung & volatile horses."*

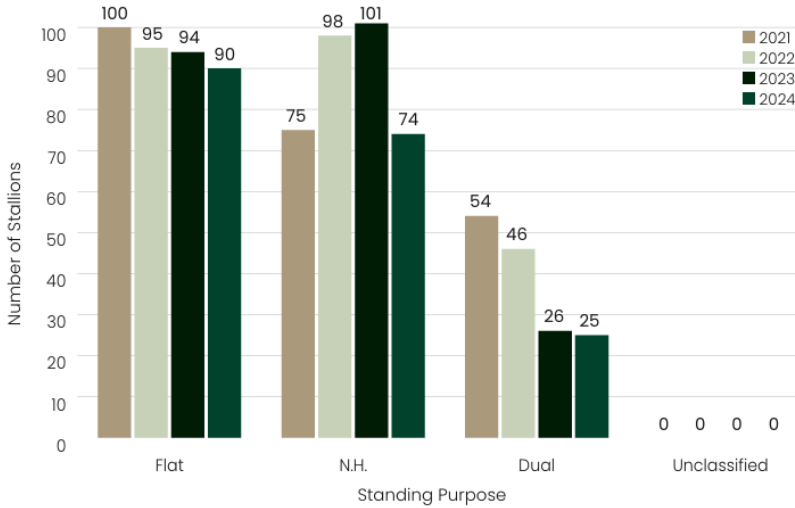
The Planning Inspector's report continued by stating that *"Whilst not every horse would be startled & as a result injures itself or its rider, some would. In my view this happening would exist over and above the normal risks these stables experience in dealing with this type of horse. These horses represent a significant investment. Thus, every horse owner who uses these stables & every potential client will believe that their valuable investment will be at risk and as such will go elsewhere. The horse racing industry is highly competitive and one where perception and reputation are significant drivers in choosing a trainer and yard. Thus, it strikes me as inevitable that the businesses would decline and given the particular impact of the windfarm would unlikely be replaced with anything similar."*

2024 Weatherby's Fact Book: The tables indicate a serious decline in the Stud farm industry & Windfarms will exacerbate this decline.



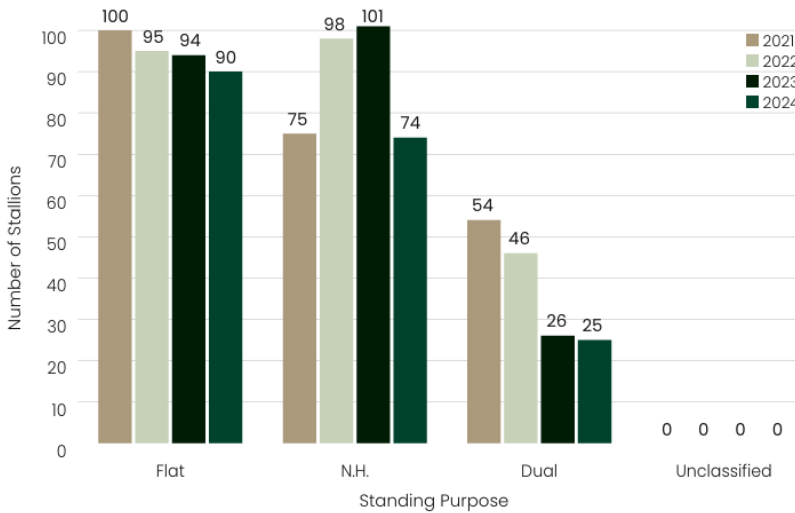
IRE Stallions Standing Purpose

The proportion of stallions standing for National Hunt purposes was higher than those standing for Flat purposes in 2022 and 2023, compared to 2021 when there were 11% less stallions standing for National Hunt purposes than for the Flat. We expect further stallion registrations for 2024 as noted above.



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Breeders by County

This table shows the distribution of the 6,354 breeders of Thoroughbreds between 32 Irish Counties. It also highlights the number of mares owned and number of foals produced by those mares. The largest number of individual breeders are found in County Cork, but the largest concentration of mares are in County Kildare.

Included in this data is a figure for breeders not resident in an Irish county, but which have breeding stock permanently domiciled in Ireland. This has been categorised as "Other".

County	Breeders	Mares	Foals	County	Breeders	Mares	Foals
Co. Cork	810	1,611	1,021	Co. Armagh	46	68	33
Co. Tipperary	799	1,783	1,088	Co. Antrim	44	97	44
Co. Kildare	707	1,936	1,170	Co. Mayo	39	60	27
Co. Wexford	555	1,040	601	Co. Kerry	37	64	43
Co. Meath	440	1,033	575	Co. Louth	35	68	37
Co. Kilkenny	425	1,080	662	Co. Tyrone	33	53	25
Co. Waterford	254	609	340	Co. Longford	23	38	19
Co. Limerick	242	574	343	Co. Monaghan	22	28	16
Co. Galway	203	368	187	Co. Cavan	19	27	13
Co. Down	181	367	220	Co. Sligo	11	17	9
Co. Westmeath	180	713	479	Co. Fermanagh	9	15	6
Co. Wicklow	148	351	192	Co. Donegal	8	11	7
Co. Laois	145	251	138	Co. Leitrim	8	12	5
Co. Carlow	137	414	252	Co. Londonderry	8	20	8
Co. Offaly	117	289	165				
Co. Dublin	105	182	112	Sub Total	5,932	13,446	7,978
Co. Clare	82	152	82	Other	422	972	565
Co. Roscommon	60	115	59	Total	6,354	14,418	8,543

Number of IRE Broodmares Owned per Breeder

This table shows the distribution of Irish broodmares between breeders by county, with 92% of breeders owning fewer than 5 broodmares.

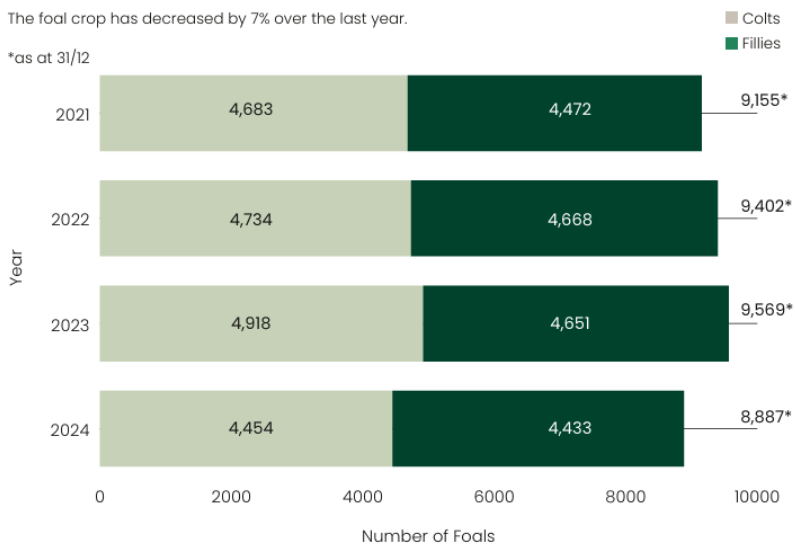
Included in this data is a figure for breeders not resident in an Irish county, but which have breeding stock permanently domiciled in Ireland. This has been categorised as "Other".

County	1-2	3-4	5-10	11-20	21-30	31+	Total	County	1-2	3-4	5-10	11-20	21-30	31+	Total
Co. Cork	669	84	46	7	3	1	810	Co. Armagh	41	3	2	0	0	0	46
Co. Tipperary	654	82	42	15	3	3	799	Co. Antrim	35	3	4	2	0	0	44
Co. Kildare	556	78	48	16	2	7	707	Co. Mayo	36	2	1	0	0	0	39
Co. Wexford	453	68	29	5	0	0	555	Co. Kerry	31	4	2	0	0	0	37
Co. Meath	352	48	32	4	2	2	440	Co. Louth	28	3	4	0	0	0	35
Co. Kilkenny	339	47	26	10	1	2	425	Co. Tyrone	29	2	2	0	0	0	33
Co. Waterford	201	31	16	2	1	3	254	Co. Longford	21	1	1	0	0	0	23
Co. Limerick	193	28	14	5	0	2	242	Co. Monaghan	21	1	0	0	0	0	22
Co. Galway	173	22	5	3	0	0	203	Co. Cavan	16	3	0	0	0	0	19
Co. Down	142	27	10	2	0	0	181	Co. Sligo	9	1	1	0	0	0	11
Co. Westmeath	131	24	18	3	0	4	180	Co. Fermanagh	8	0	1	0	0	0	9
Co. Wicklow	120	13	12	2	0	1	148	Co. Donegal	8	0	0	0	0	0	8
Co. Laois	125	9	10	1	0	0	145	Co. Leitrim	7	1	0	0	0	0	8
Co. Carlow	113	15	3	2	0	4	137	Co. Londonderry	6	0	2	0	0	0	8
Co. Offaly	85	21	8	2	1	0	117								
Co. Dublin	92	9	3	0	1	0	105	Sub Total	4,805	651	352	81	14	29	5,932
Co. Clare	65	11	6	0	0	0	82	Other	333	43	36	8	1	1	422
Co. Roscommon	46	10	4	0	0	0	60	Total	5,138	694	388	89	15	30	6,354

IRE Foals Born 2021-2024

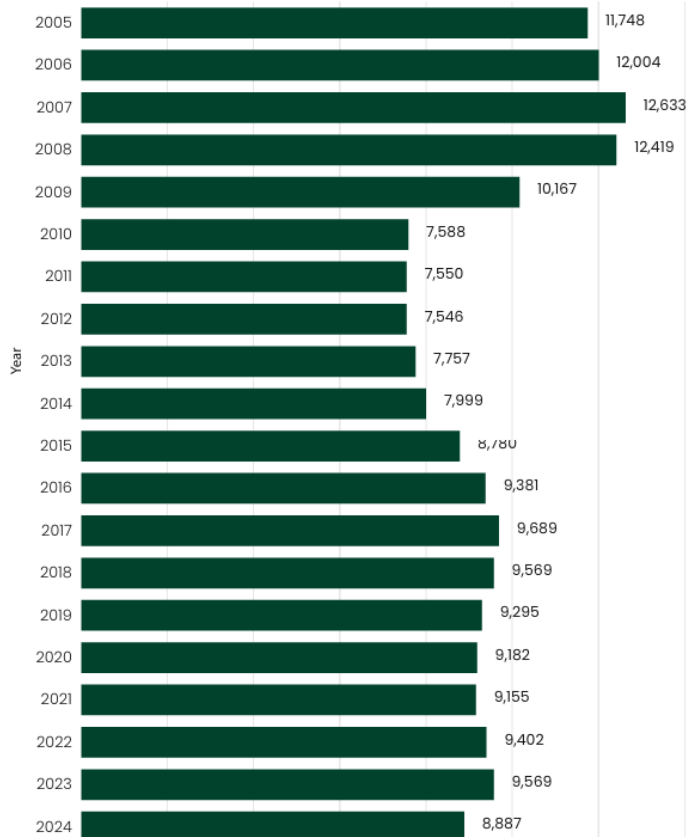
The foal crop has decreased by 7% over the last year.

*as at 31/12



Historical Foal Crops

IRE Foal Crop 2005 - 2024



Horses have been shown to have significant right forebrain dominance – they are exceptionally adept at processing sensory stimuli (Johnson et al. 2019). Because they are a prey species, the sensory systems of horses have evolved to enable a prompt detection of potential danger through a combination of visual, auditory and olfactory cues (Christensen et al. 2006, Saslow 2002, Tierartzliche Praxis 1997) and unexpected & hitherto unknown noises cause rapid flight reactions more frequently (Christensen et al. 2005, Algiers 1984). Horses are most easily scared by noise that arises outside their field of binocular vision. Hearing ability is thus very important to the survival for horses over the centuries and a horse's ears can pick up sound at a lower level & at a greater distance than that detected by

humans (Saslow, 2002). A horse's range of hearing is greater than a humans to higher frequencies >33kHz while the range for humans is under 20kHz.

Horses can show unpredictable anxiety behaviours during any noise producing events, which include sweating, trembling, escape attempts, which may cause severe accidents for the horse and the rider/handler. More than 84% of horses show immediate avoidance and/or attempts to flee after perceived threats (Scopa et al. 2018).

Injury to riders/handlers, etc., is a significant occupational hazard and can extend to thousands of accidents with associated fatalities (Holler 1984, Gimsing 2001). Dealing with an anxious or fearful horse exacerbates this risk. There is a high rate of incidence of injury (26%) among horses rated as either anxious or very anxious in the face of noise and/or light related flashes, and simply moving horses to adjacent paddocks was found to be ineffective in 37% of cases (Gronqvist 2016) Noise has also been shown to elicit restlessness, vocalisation & colic/gastro-intestinal disturbances (Dai et al. 2020)

“Noise aversion” or “noise anxiety” are terms used when an animal overreacts to noise. Unpredictable noise causes the greatest fear reactions. These noises can have long lasting effects and have been reported to adversely affect food intake, growth and production rates (Broucek 2014. Tracy et al. 2007. Head et al. 1993).

Severe noise anxiety is reported to cause serious welfare consequences, impacting both the physiology and behaviour of the horse (Riva et al. 2022). Very anxious horses showed signs of noise reactivity and their reactions did not improve with time (they do not habituate with time). Very severe injuries can occur as a result of the unpredictable & very severe anxiety. Riva et al. have also shown that the effects of noise-related anxiety can persist for hours/days after the noise event. It is noteworthy that compared to visual and olfactory stimuli, unexpected unknown noises can cause rapid flight reactions.

Highly sensitive mares & newborn foals are particularly vulnerable to environmental stressors. O'Connor & Walsh (2021) emphasised that pregnant mares exhibit heightened sensitivity to noise and light fluctuations, which may interfere with gestation & increase the risk of premature birth or behavioural distress. Smith et al. (2020) reported that foals exposed to elevated noise levels during early development showed signs of sleep disruption, increased startle responses, and reduced social bonding behaviours. Green et al. (2021) noted that neonatal horses are especially susceptible to visual flicker and tonal noise, which can impair rest cycles and contribute to development instability. Chronic exposure to such stimuli may result in heightened stress responses, altered behaviour, and compromised physiological stability as evidenced by Jones et al (2019). They also noted increased agitation, visual stress, reduced rest patterns and avoidance behaviours in horses exposed to nearby wind farms.

Many management strategies are used to try to reduce the effects of noise and have been shown to be ineffective (Gronqvist, 2016). Placing horses in stables is unsatisfactory as those in single stables exhibit even stronger reactions to unknown stimuli with an increased risk of accidents and adverse effects on welfare, which can include long-term behavioural abnormalities (Lesimple et al. 2020). Sedation can often give disappointing results and cause undesirable side effects (Dai et al. 2020) & long-term sedation and or stabling is impractical & inhumane.

2025 Planning Authority Statements underscore the growing tension between renewable energy expansion and the protection of sensitive agricultural sectors, including equine studfarms. An Bord Pleanála (2025) reported that of the 69 energy cases reviewed in the period 2023 – 2024, several windfarms were refused as a result of objections citing proximity to studfarms. In several decisions, the Board cited concerns over elevated noise levels and their potential impact on equine welfare. The Board emphasised the need to balance strategic infrastructure development with environmental and agricultural sensitivities.

It is noted that ABP 23-225138 on appeal from Tipperary County Council 07/111 refused planning permission for a biogas & biodiesel production facility at Castleblake, Rosegreen, County Tipperary for the following reason:
“The site of the proposed development is located in open countryside in an area of national importance for the bloodstock industry alongside a major horse training establishment. It is the policy of the planning authority, as set out in the current South Tipperary Development Plan, to support the equine industry. It is also the policy of Government to support the equine sector. It is considered that the proposed development of this large scale industrial type facility at this location, employing the particular technology on the scale proposed, having regard to its nature, scale and visual impact, would be incompatible with equine related activities in the vicinity and would be prejudicial to the viability of the equine industry in this area(including undermining confidence therein). Notwithstanding the desirability of providing such facilities, it is considered that the proposed development would seriously injure the amenities of the

area and property in the vicinity, would be incompatible with the surrounding land uses, and would, therefore, be contrary to the said Development Plan objectives and to national policy and to proper planning and sustainable development of the area.”

“The equine industry and in particular the bloodstock industry is a highly competitive commercial industry, which needs a high quality in relation to environmental standards and what could best be described as a clean image. The area of County Tipperary has developed a niche industry comparable with other bloodstock areas as for example Newmarket & Kentucky with major financial benefits to the area and any consideration of permitting development must have consider policy ENV11, for proposals for non-agriculture related development.”

The Planning Inspector Derek Daly noted that it could be necessary and appropriate to invoke the Precautionary Principle *“as we are not talking about just any agricultural operation, but one of the international leaders, a business that carries Ireland’s reputation in the bloodstock industry and one which the local economy benefits well beyond the level were it to be on only local, or minimal standing.”*

The Planning Inspector’s report also noted that it should be a consideration in the planning process if one successful enterprise of benefit to an area’s economy is placed at risk by a development, which is not by its nature locationally tied to the area. The Planning Inspector stated that *“the onus is on any new development in the rural area and in particular non-agricultural development, which for reasons already outlined is not specifically locationally dependent to a rural area to demonstrate that it will not have a negative impact on the viability of existing stud farms or stables and that it is reasonable to consider the development in this context.”*

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Perceptions of Fear and Anxiety in Horses as Reported in Interviews with Equine Behaviourists. Suzanne Rogers and Catherine Bell. *Animals* 2022, 12, 2904. <https://doi.org/10.3390/ani12212904> <https://www.mdpi.com/journal/animals>

One of the key welfare concerns for horses in the United Kingdom is lack of recognition of fear in horses. This study aimed to gain an understanding of how well horse care givers recognise fear and/or anxiety in horses by interviewing equine behaviourists (who interact with large numbers of horse care givers and talk to them about this topic routinely). The experiences of Animal Behaviour and Training Council (ABTC)-registered equine behaviourists working with horse caregivers were examined, including the ability of clients to recognise fear and/or anxiety in horses, how clients respond when discussing fear as the reason for their horse's behaviour, and what explanations the participants use to explain fear and anxiety. Semi-structured interviews were conducted with nine participants and analysed using thematic analysis before being written up to reflect the discussion points. When asked how well horse caregivers recognise fear and/or anxiety in horses, three key response themes emerged: caregivers are extremely poor at recognizing fear and anxiety in horses; some clients do recognise behavioural signs indicating fear and/or anxiety but only the overt signs (e.g., rearing, running away) rather than the more subtle signs (e.g., tension in face, subtle avoidance behaviours such as a hesitant gait); and fear and/or anxiety behaviour is often misinterpreted or mislabelled. These key themes recurred throughout several other interview questions. This study has provided initial insights into the lack of recognition of fear and anxiety of horses by their caregivers in the United Kingdom as well as tried and tested approaches to conversations to change this. Such synthesis of experience and techniques across the equine behaviour sector, together with the information gained regarding perception of equine caregivers, could be a valuable approach to improve the effectiveness of behaviour consultations and welfare initiatives.

Equine Welfare Under Environmental Challenges. Olena Lesnovska¹, Lyudmila Lytvyschenko, Larysa Ulko, Liudmyla Zlamaniuk, Olena Bezalychna, Volodymyr Liskovych, Lyudmila Mykolaichuk, Roman Mylostyvyi. *Journal of Animal Health and Production* 2025 | Volume 13 | Special Issue 1 | Page 442. DOI <https://dx.doi.org/10.17582/journal.jahp/2025/13.s1.442.452>. ISSN (Online) | 2308-2801.

Current understanding of equine welfare under environmental challenges is based on the integration of physiological, behavioural, environmental and management-related factors, which interact within a complex adaptive system. Heat stress, as the leading environmental threat, exerts systemic effects on the equine body, disrupting thermoregulation, cardiovascular homeostasis, reproductive function and immune reactivity. Behavioural and physiological indicators (such as body temperature, respiratory rate, heart rate variability and cortisol levels), when combined with modern monitoring technologies (including infrared thermography, surface electromyography and microsensors), provide accurate assessments of animal condition and enable timely detection of stress loads. Adaptive mechanisms, including heat acclimatisation, selection based on resilience traits and nutritional optimisation, play a key role in reducing horses' vulnerability to adverse conditions. However, the effectiveness of these strategies depends on individual variability, age, breed and housing conditions. Sustaining equine welfare requires a systemic approach that integrates precise monitoring, personalised interventions and interdisciplinary perspectives within the context of global environmental change.

13.12

Please clarify if the proposed development would impinge on access to lands under folio GY45478. Mapping and ownership details for this area of the site/lands under the control of the applicant should be outlined. In the event of any access being impinged, relevant consents should be outlined, if/where applicable.

All roads and access will be maintained throughout all phases of the Proposed Project. As stated in Section 3.2.3 of the EIAR the Site was identified, taking into consideration the avoidance of direct impacts on access, among a number of other constraints. As stated in Section 5.10.2.2.1 of the EIAR, public safety will be addressed by restricting Site access during construction. Fencing will be erected in areas of the Site where uncontrolled access is not permitted. This restricted access during the construction phase is solely in relation to areas within the Proposed Project footprint as shown in Drawing No 210627-10 of the Planning Drawings as submitted. Section 15.1.9 of the EIAR details the measures to ensure local road connections within internal access roads crossing are maintained. There are various locations where the Proposed Wind Farm internal access road crosses existing local farm access roads. During the construction phase these locations will be attended by site staff and existing farm access retained at all times. On the completion of the construction phase, the Proposed Wind Farm access road will be gated at either side of these locations, and priority retained for farm access at all times. Any access tracks which lead to other areas within or in the vicinity of the site will not be impinged upon, such as the access track which leads to folio GY45478.

13.13

The NIS has referred to Appendix 6-1 of the EIAR which relates to a botanical survey. This appendix should be included within the NIS appendices. EIAR documentation referenced within the NIS should be included in the NIS documentation.

Appendix 6-1 of the EIAR (Botanical Study) details results of relevés undertaken within the footprint of Proposed Wind Farm infrastructure. Given that the Proposed Wind Farm is located completely outside of any European Site, the results of the detailed botanical surveys have no bearing on and are not relevant to the Appropriate Assessment of the Proposed Project. Notwithstanding this, the revised NIS has been updated to include the botanical study as an appendix.

Item 14. Response Format & Timeframe

14.1

The above points of further information should be addressed by way of an addendum to the EIAR, and a revised NIS including the AA Screening Report as relevant and should clearly indicate where changes to the original documents are made. The Traffic and Transport Impact Assessment should comprise a standalone document.

As detailed in the Response to FI Cover Letter, an EIAR Addendum Report (the Report) has been prepared in order to update the EIAR and associated appendices, where appropriate, taking the ACP FI Request into account, in order to allow ACP to complete a robust environmental impact assessment of the Proposed Project. The Report should be read as an appendix to the overall Response to Further Information Document. The Report presents relevant updates or changes to the previously submitted EIAR and EIAR Appendices where appropriate. It is not intended that the Report replaces the submitted EIAR, rather the Report is read in conjunction with the submitted EIAR. For Chapters where the Project team have confirmed that no relevant updates or changes are necessary, this is outlined under the relevant chapter heading of the Report. Where best practice with respect to Chapter structure has evolved since the original submission (March 2024), to ensure maximum clarity and transparency the whole chapter has been updated, to include removal of text in red strikethrough and insertion of text in green are outlined. This approach has been taken with respect to Chapter 11: Climate. Chapter 11 Climate has been included as an Appendix to the EIAR Addendum Report, rather than included within the Report, as a result of this approach. A revised NIS has been prepared as an update to the NIS (the revised NIS) submitted with the initial planning application. Updates to the NIS are included throughout this document as green text. The purpose of the revised NIS is to allow for the inclusion and consideration of the results of additional ecological surveys (including bird surveys) which were undertaken between 2024 and 2025, and to allow consideration of additional collision risk modelling and cumulative assessments carried out in response to the FIR, in order to allow ACP to undertake a robust Appropriate Assessment of the Proposed Project. Other updates to the NIS have also been incorporated according to additional items raised in the FI Request, including an assessment of the potential for impacts on the Qualifying Interest (QI) lesser horseshoe bat roost, assessment of the Decommissioning Phase of the Proposed Project, and full assessment of methodologies proposed for construction of the Proposed Grid Connection. The NIS and its appendices should be read in conjunction with the EIAR Addendum Report. A standalone Traffic and Transport Impact Assessment has been provided as Appendix 5 to the Response to FI. The TTIA summarises a road assessment undertaken on the N83 / L-61461 / L-6146 junction. A number of traffic management measures are recommended to be implemented however, overall, the junction will operate well within its capacity during both the construction and operational phases of the Proposed project.

System impacts of wind energy developments: Key research challenges and opportunities

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ENVIRONMENTAL IMPACTS

Impacts on ecosystems and wildlife

Onshore wind power deployment primarily affects bird and bat populations, even though wind turbines may also disturb and displace terrestrial mammals. **Although there are no global estimates of yearly bird and bat fatalities caused by wind turbines, in the United States, with an installed capacity of 112 GW as of 2021, bird fatalities from turbine collisions number in the several hundreds of thousands annually.** Species at higher risk are typically migratory, soaring raptors, or bats; the additional mortality due to collisions can be particularly relevant for populations of long-lived and slow-reproducing species, and collision with rotor blades and wind turbine towers might further endanger species already threatened with extinction. However, there are fewer bird collisions with wind turbines than with other structures like buildings, power lines, and communication towers, though some of these structures are also associated with infrastructure for wind turbines. From 2000 to 2020, wind farms had no discernible impact on bird counts in the US, whereas shale gas wells reduced numbers by 15%. But the displacement effect of new installations may in fact be specific to some species. Although previous research suggested bat fatalities caused by barotrauma, more recent studies identify direct blade and tower collisions as the main cause of fatalities.

Despite the growing body of literature on bird strikes in open landscapes, there is a significant lack of research on these impacts in shrub- and woodland environments.

Furthermore, noise pollution from wind turbine operations can negatively affect birds, bats, and non-volant and marine mammals, disrupting their nesting, breeding, and movement patterns, which may result in population decline and displacement. Some species avoid wind turbines due to noise, specifically during construction, whereas others avoid areas with shadow flicker (see section health and annoyance). Although not a bat attractant, low-frequency noise emissions can disorientate bats, which makes hunting difficult. Land transformation related to the construction of wind farms can also affect habitat suitability for wildlife species. Landscape connectivity between habitats can become disrupted if wind farms are built in existing dispersal corridors. Already-isolated populations can face a reduced gene flow if areas in the vicinity of wind farms are avoided and alternative dispersal corridors are rare. In addition, direct mortality due to collisions with wind farms can affect population dynamics on a large scale. Some species might be able to adapt to altered habitat conditions after wind farm construction, whereas others might not become habituated. However, effects on population trends are difficult to assess because effects are highly site and species specific and long-term studies are rare. Adequate siting of wind farms is a promising approach to reduce impacts on wildlife, but because many species' habitat requirements change in the course of a year, it remains a challenging task, especially when considering ecological corridors and stepping stones. Micro-siting to avoid areas with high collision risk can reduce risks for birds, but it is more challenging for bats. A promising solution for on-site impact mitigation is to increase the cut-in wind speed from 3 to 4 m/s to 6 and 8 m/s for bats and soaring birds, respectively, as these animals have the highest flight activities at low wind speeds, while the production losses would remain modest. Temporary shut-downs triggered by visual or radar observations are also effective solutions to minimize collisions. Visual cues like painting at least one rotor blade black to reduce motion-smear have had limited testing but have shown promising results.⁸¹ Lastly, ultrasonic deterrent systems can reduce bat fatalities, though effectiveness can vary by species and environmental conditions.

Impacts on wind resources and weather

The increasing number and size of wind farms can affect local weather and climate patterns, though the magnitude of these effects is debated. There is broad evidence based on photographs, satellite imagery, measurements, and modelling. Wind turbines extract kinetic energy from the wind flowing through their rotors, replenished downstream of the flow above the wind farm. In large wind farms, the latter process cannot supply enough energy to compensate for lowered wind speeds, especially offshore. Hence, a large wind farm can significantly lower the wind speeds in its vicinity, up to a distance of tens of kilometres, thereby suppressing generation from nearby wind farms, as shown in Figure 1 for a possible 2030 wind farm scenario for the North and Baltic seas. The figure shows a possible 2030 scenario of wind farm development in the North Sea and the potential reduction in wind capacity factor induced by these wind farms. Early modelling studies argued that wind farm extractable energy was finite and limited to about 1 MW/km² for massive wind farm clusters (i.e., of several gigawatts capacity spanning several thousands of km²). Still, recent research demonstrated that this limit can be considerably larger (up to 4 MW/km²) when wind speeds are high and persistent and turbulence can mix energy down from the free atmosphere above. Confirming these findings is challenging due to scarce observations and the limited sizes of presently operating wind farms. These impacts can be mitigated by strategically planning wind farm locations and sizes and limiting their capacity densities as well as during the operational phase within wind farms by so called wake steering. Thus, future wind energy development, particularly offshore, should consider potential wakes and efficiency losses and implement comprehensive international strategies for developing energy-abundant regions such as the North Sea. However, the growth of wind power will likely be restricted by economic or environmental factors rather than global geophysical limits. The operation of wind farms can also cause weather conditions to change locally. This can take the form of shifts in surface temperature (often leading to warmer surface temperatures at night and other weather parameters, such as precipitation and evaporation). The local temperature increases are occasional and typically confined to less than 1 °C when they occur and are limited to a few kilometers from the wind farm. Offshore wind farms could also affect waves, ocean currents, and sea surface temperatures. Although there is no definitive solution to mitigate the effects on the weather, it is crucial to acknowledge that, on average, they remain limited and much less significant than the global impacts of climate change. In sensitive areas, good spatial planning and coordinated approval processes can minimize the effects on weather and wind resources if they are expected to affect human activities.

SOCIAL, ECONOMIC, AND HEALTH IMPACTS

Land tenure (in)security

The transition to higher shares of wind power boosts the demand for land. The private appropriation of public land to secure access to and control over renewable (including wind) energy production has been referred to as “green grabbing.” This can come at the cost of prior land users and increase the vulnerability of traditional rural communities and Indigenous groups in particular due to the use of public land without free, prior, and informed consent, unfair contractual arrangements, and various forms of dispossession, including the prevention of access by legal means and physically by fencing. The impact of wind energy development on land tenure insecurity, especially for undesignated public and common lands, is addressed in several qualitative studies—in both the Global North and South. For instance, the installation of large-scale wind power in Norway has been described by Sa’ mi representatives as a form of “green colonialism,” pinpointing that these developments could intensify the continuation of historical struggles over land rights and territorial autonomy due to the non-recognition of Indigenous peoples. Similarly, in Brazil, a large share of wind corridors is in undesignated public lands, historically occupied by traditional communities struggling to regularize the ownership and use of common lands. The proposal of individual land leasing contracts for installing turbines in an already ill-defined communal land tenure system has also sparked conflict between Zapotec farmers, the government, and wind farm operators in the Isthmus of Tehuantepec in Mexico as well as in North Africa and the Middle East.

The diverse impacts of wind power development on land appropriation and control, which affect the rights of traditional communities or Indigenous people to territory and livelihoods, need to be linked to a set of compliance rules. These include procedural aspects such as securing their free, prior, and informed consent, addressing information asymmetries about the project’s specific local impacts, and offering fair and legally approved land leasing contracts as well as legal advice on land use. The issue of land ownership and rights is a key challenge to a just energy transition, particularly in recognizing the historical communal use of land by traditional communities and Indigenous

people. Increasing the focus of spatial energy planning on land tenure issues, as well as integrating participatory and collaborative planning, can be helpful approaches for renewable projects to better consider local community needs, interests, and rights and to provide fair compensation and manifest co-benefits for immediately affected residents.

Landscape visual impacts

Another public concern is that wind turbines negatively impact the perception of landscapes, particularly untouched nature. This visual landscape impact is one of the main reasons for local opposition to onshore and offshore wind installations.

Acceptance of wind turbines is higher when they are placed in already unattractive landscapes, far from viewpoints, and with a limited number of turbines, but the cumulative effects may vary by location. Several studies have employed national datasets of landscape aesthetic quality (so-called “scenicness”), based on survey-based ratings of representative landscape photographs, to quantify the costs incurred to power systems when excluding onshore wind potentials in landscapes with high aesthetic quality, showing a large range of impacts between countries

In addition, viewshed analyses, in which a three-dimensional space (the viewshed) within which one or more hypothetical wind turbines are visible, can aid in understanding the potential visual impact on sensitive receptors; however, these disregard people’s visual preference for certain landscapes over others. They may, therefore, be combined with measurements of visual features of landscapes, as a correlation between such metrics and rated landscape qualities has been found. Moreover, RE infrastructure such as wind turbines and power lines strongly influence the rated landscape coherence. Quantifying the landscape impact of wind turbines to improve placement decisions requires that both visibility and landscape quality are considered. Whereas the latter refer to changes in landscape quality and character, visibility impacts relate to (perceived) changes in views (of the landscape) and how these affect people. Approaches based on geographical information systems (GISs) have been proposed to estimate landscape coherence and wilderness using indicators calculated from datasets such as land cover, topography, and remoteness.

Similar approaches can be combined with visual impact assessments to develop robust, reliable, and scalable methods and tools for landscape impact assessments.

Health and annoyance

Noise emissions and the “flicker” of the rotating shadow from wind turbines are frequently discussed as negative impacts of wind farms. Although current evidence suggests that noise emissions from wind farms do not have a significant direct impact on nearby populations’ health, some studies have noted a correlation between noise-related annoyance and potential indirect effects on quality of life, such as sleep disturbance, increased stress, and related health concerns (e.g., elevated blood pressure and psychological distress). However, the causality and directionality of these effects remain unproven and require further research. The perception of noise seems higher in rural areas and around flat terrains. Although low-frequency noise emissions cannot be heard, they may still lead to annoyance, but the link between wind turbines and low-frequency noise has not yet been established. In addition, many studies show that only a small fraction of the population living near wind farms is disturbed by shadow flicker. Shadow flicker exposure does not necessarily lead to self-reported annoyance but rather subjective factors such as project appearance and general annoyance. However, the disturbance attributed to wind turbine noise emissions should be evaluated compared with other routine noise sources. In a controlled study, although subjects reported annoyance from the acoustic emissions of nearby wind turbines, health-related effects were specifically attributed to noise pollution from road traffic.

Noise impacts can be mitigated by appropriate wind farm planning and simulations, and it is suggested that a certain noise threshold be respected (e.g., 35–45 dB(a)), as is currently enforced in some countries. Likewise, for cases where high levels of modelled shadow flicker exposure and self-reported annoyance correlate, easy-to-implement solutions exist, such as curtailment after specific exposure thresholds. However, the probability of that correlation occurring is low because detailed shadow flicker simulations are an integral part of planning processes for wind farms and permission might not be granted in case thresholds would be exceeded (see, e.g., the German BImSchg). Nevertheless,

the studies leading to that regulation were performed over 20 years ago when turbines were considerably smaller than today and were capable of generating a flickering effect of higher frequency.

Wind Farms & Health Literature Review- Chapman 2015: EIAR Appendix 5.1

Summary of main conclusions reached in 25 reviews of the research literature on wind farms and health.

Compiled by Prof Simon Chapman, School of Public Health and Teresa Simonetti, Sydney

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Updated 10 April 2015.

The following Response is from the Australian Parliament in a reference to Health issues from windfarms.

Select Committee on Wind Turbines: Final report. August 2015. ISBN 978-1-76010-260-9

Wind turbines and ill-health

2.7 The committee has taken evidence from a number of people who reside in proximity to wind turbines who have complained of a range of adverse health impacts. These include tinnitus, raised blood pressure, heart palpitations, tachycardia, stress, anxiety, vertigo, dizziness, nausea, blurred vision, fatigue, cognitive dysfunction, headaches, nausea, ear pressure, exacerbated migraine disorders, motion sensitivity, inner ear damage and worst of all, sleep deprivation.

2.8 Dr Sarah Laurie told the committee:

The human cost of the failure to protect people from excessive noise pollution, especially at night, is terrible. I have personally helped to prevent a number of suicides of people who were utterly desperate because of the consequences of excessive noise pollution and who reached out for help.

From my experience there is a subset of people who are terribly impacted very early on. Those people are the ones who tend to present with acute vestibular disorder type of symptoms—dizziness and motion sickness, which can be accompanied by extreme anxiety. Those people often just cannot last very long, and they move if they can.

2.9 Ms Janet Hetherington, an adjacent landholder to the Macarthur wind farm in south-west Victoria, relayed her own experience:

At my farm, I experience severe adverse health effects such as vibration, heart palpitations, tinnitus, head pressure, headaches, sleep deprivation, anxiety, night sweats, nausea, itchy skin, cramps, and ear, nose and throat pain. Twice now I have experienced horrendous pain in my chest stabbing through to my backbone in between my shoulder blades. I contemplated calling an ambulance both times but could not move to do so because of the severity of the pain. Ten minutes later it had dissipated, leaving me with great stress and anxiety and feeling washed out. All these sensations leave me drained in the morning. I find it very hard to start work that day.

2.10 Ms Anne Gardner also attributed her and her husband's ill health to the nearby Macarthur wind farm. She described the following symptoms:

My husband experienced bolts of pressure which tallied up with pressure peaks measured by Les Houston (sic) 86 per cent of the time while my husband was blind to the acoustic measurements of the time. Refer to his recap statement. I suffer day and night from headaches, nose and ear pressure, nausea, heart palpitations and chest burning from vibrations through the floor, couch, chair and in bed all night.⁶

2.11 Mr Clive Gare and his wife host 19 towers from the North Brown Hill wind farm located 17 kilometres from Jamestown in South Australia. Mr Gare told the committee:

After a short period of living with an operating wind farm, we had these products installed. I find that, because I work and reside in close proximity to the wind farm, I suffer sleep interruption, mild headaches, agitation and a general

feeling of unease; however, this occurs only when the towers are turning, depending on the wind direction and wind strength. My occupation requires that I work amongst the wind towers during the day which means I suffer the full impacts of noise for days at a time without relief. The impacts are that we are not able to open our windows because of the noise at night and we are not able to entertain outside because of the noise.

In conclusion, if we did not have soundproof batts in VLam Hush windows [special window laminate designed to dampen noise], our house would not be habitable. In my opinion, towers should not be within five kilometres of residences, and I would personally not buy a house within 20 kilometres of a wind farm.

2.12 The committee notes that the Gares have received payment of \$2 million over five years to host turbines and have reported serious adverse impacts. The committee notes, therefore, that their evidence is an 'admission against interest' and as such represents highly reliable evidence.

2.13 Mr John Pollard, a resident of Glenthompson near the Oaklands Hill wind farm in Victoria, told the committee:

The wind farm guidelines on health issues of this very serious problem have to be assessed. They will not acknowledge infrasound. I will relate one incident that happened in our home one night. My wife was sleeping in the chair beside me and I was watching television. This is after they had turned the turbines off. She was dead to the world and I was just watching the television. All of a sudden she woke up, completely startled and disorientated, and I was really worried about her because I thought she had had a stroke or something. Eventually she came to her senses and she said the turbines must be on. I said, 'No, they're not. It's 10.30. They turn off at nine o'clock.' I went outside and they were still running. So I thought that next day I would ring AGL. When I was about to ring, they rang me and said, 'I'm sorry, John. We forgot to turn the turbines off last night.'

2.14 Waubra resident Mr Donald Thomas identified hearing difficulties from the nearby Waubra wind farm turbines.⁹ He claimed that these difficulties disappeared when he left the area:

I went to the doctor with what I kept saying was a lot of ear pressure and earaches. I went to see a specialist, and my ears came back as being in good health and functioning pretty well, even though I have lost a lot of hearing. Basically, my left ear does not work too good... My ears—especially when I go to my Stud Farm Road property, I have ear pressure that can develop into a headache and rapid heartbeat. If I leave that area and go back to one of my other properties, that can settle back down.

2.15 Mr Peter Jelbart, a 25 year old who had lived with his family nearby the Macarthur wind farm in south-west Victoria, noted the difficulty of sleeping in the family home. He told the committee he had worked and slept unaffected in noisy environments outside of the family home in Victoria:

While I was working in Western Australia I used to do three weeks on, one week off and come home for a week. Over in Western Australia I was sleeping at times on the sides of busy highways and in the back of trucks with ice packs running... At home, I noticed pretty much from day one that there is a serious problem there. Something is completely different when sleeping. I would wake up after a couple of hours of sleep—at times, not even after a couple of hours—and have disrupted sleep that I have had nowhere else. There is a proper problem... Whether it is low-frequency noise and the infrasound combining with it, it seems worse when it is quiet. Around our house the yard is pretty well protected by trees. When it is relatively quiet around the house yard there is still a really soft drone that comes through and just gets into you. It is pretty hard to explain. There are probably a lot of people going through the same thing who will have the same trouble trying to explain it, especially to people who have not experienced it. The problem with it is, it also seems to affect different people over different periods of time.¹¹

2.16 The committee has had the opportunity to take evidence from researchers in the United States and Canada who expressed their concern with the health effects of turbines. Ms Lilli-Ann Green is the Chief Executive Officer of a healthcare consulting firm in the United States. In 2012, Ms Green and her husband conducted interviews with people living near wind turbines in 15 different countries. As she told the committee: We have interviewed people on three continents who live more than five miles from the nearest wind turbine and are sick since wind turbine wind turbines need to be sited from people in order to do no harm. People report to us that over time their symptoms become more severe. Many report not experiencing ill effects for some time following wind turbine construction, meanwhile their

spouse became ill the day the wind turbines nearby became operational. They speak of thinking they were one of the lucky ones at first, but after a number of months or years they become as ill as their spouse. Not one person who stayed near wind turbines reported to us that they got used to it or got better; they all became more ill over time... I really believe that we just do not have enough information yet. But throughout the interviews, country by country, people described the same symptoms. Many times they used the same phrases to describe them and the same gestures—and they were not speaking English. There is a common thread here.

2.17 Dr Jay Tibbetts, a medical practitioner and vice chair of the Brown County Board of Health in Wisconsin, drew the committee's attention to the board's October 2013 finding that the Shirley wind farm was a 'human health hazard'. Dr Tibbetts described how the declaration came about:

The [Board of Health] has been studying adverse health effects for the past 4 ½ years in the Shirley Wind Project. We have reviewed many peer reviewed studies, at least 50 medical complaints including ear pain, pressure, headache, tinnitus, vertigo, nausea, chest pain, chest pressure, loss of concentration, sleep deprivation and more, as well as more than 80 other complaints from citizens of Shirley Wind. There have been 2 formal studies of infrasound/low frequency noise by acousticians in 2012 and 2014. The latter study revealed symptom generating [Infrasound/Low Frequency Noise] at a distance of 4 ½ [miles].

2.18 The committee also heard of detailed research by Professor Emeritus Robert McMurtry from Western University in Ontario, Canada. Professor McMurtry made a number of points to the committee:

- adverse health effects have been reported globally in the environs of wind turbines for more than 30 years with the old design of turbines and the new;
- the wind energy industry has denied adverse health effects, preferring to call it 'annoyance'. Annoyance is recognised and was treated by the World Health Organization as an adverse health effect, which is a risk factor for serious chronic disease including cardiovascular and cancer;
- the regulations surrounding noise exposure are based upon out-of-date standards ETSU-97, which fail to evaluate infrasound and low-frequency

Professor Chapman and his critics

2.19 Professor Simon Chapman AO, Professor of Public Health at the University of Sydney, has been an outspoken critic of those who suffer ill-effects from wind turbines. In both his written and oral submissions, Professor Chapman cited many of his own publications in support for his view that:

...the phenomenon of people claiming to be adversely affected by exposure to wind turbines is best understood as a communicated disease that exhibits many signs of the classic psychosocial and nocebo phenomenon where negative expectations can translate into symptoms of tension and anxiety.

2.20 Several highly qualified and very experienced professionals have challenged this argument. Dr Malcolm Swinbanks, an acoustical engineer based in the United Kingdom, reasoned:

The argument that adverse health reactions are the result of nocebo effects, ie a directly anticipated adverse reaction, completely fails to consider the many cases where communities have initially welcomed the introduction of wind turbines, believing them to represent a clean, benign form of low-cost energy generation. It is only after the wind-turbines are commissioned, that residents start to experience directly the adverse nature of the health problems that they can induce.

2.21 The committee highlights the fact that Professor Chapman is not a qualified, registered nor experienced medical practitioner, psychiatrist, psychologist, acoustician, audiologist, physicist or engineer. Accordingly:

- he has not medically assessed a single person suffering adverse health impacts from wind turbines;
- his research work has been mainly—and perhaps solely—from an academic perspective without field studies;

- his views have been heavily criticised by several independent medical and acoustic experts in the international community; and

- many of his assertions do not withstand fact check analyses.

2.22 Professor Chapman has made several claims which are contrary to the evidence gathered by this committee. First, he argues that the majority of Australia's wind turbines have never received a single complaint. There are various problems with this statement:

(i) wind turbines located significant distances from residents will not generate complaints;

(ii) many residents suffering adverse health effects were not aware of any nexus between their health and the impact of wind turbines in order to make a complaint;

(iii) just because residents do not lodge a formal complaint does not mean they are not suffering adverse health effects;

(iv) data obtained by Professor Chapman from wind farm operators of the numbers of complaints lodged cannot be relied upon; and

(v) the use of non-disclosure clauses and 'good neighbour agreements' legally restricts people from making adverse public statements or complaints.

2.23 Second, Professor Chapman has argued that complaints of adverse health effects from wind turbines tend to be limited to Anglophone nations. However, the committee has received written and oral evidence from several sources directly contradicting this view. The German Medical Assembly recently submitted a motion to the executive board of the German Medical Association calling for the German government to provide the necessary funding to research adverse health effects. This would not have happened in the absence of community concern. Moreover, Dr Bruce Rapley has argued that in terms of the limited number—and concentrated nature—of wind farm complaints:

It is the reporting which is largely at fault. The fact is that people are affected by this, and the numbers are in the thousands. I only have to look at the emails that cross my desk from all over the world. I get bombarded from the UK, Ireland, France, Canada, the United States, Australia, Germany. There are tonnes of these things out there but, because the system does not understand the problem, nor does it have a strategy, many of those complaints go unlisted.

2.24 Third, Professor Chapman has queried that if turbines are said to have acute, immediate effects on some people, why were there no such reports until recent years given that wind turbines have operated in different parts of the world for over 25 years. Several submissions to the committee have stated that adverse health effects from wind turbines do not necessarily have an acute immediate effect and can take time to manifest.

2.25 Fourth, Professor Chapman contests that people report symptoms from even micro-turbines. The committee heard evidence that once people are sensitised to low frequency infrasound, they can be affected by a range of noise sources, including large fans used in underground coal mines, coal fired power stations, gas fired power stations and even small wind turbines. As acoustician Dr Bob Thorne told the committee:

Low-frequency noise from large fans is a well-known and well-published issue, and wind turbines are simply large fans on top of a big pole; no more, no less. They have the same sort of physical characteristics; it is just that they have some fairly unique characteristics as well. But annoyance from low-frequency sound especially is very well known.

2.26 Fifth, Professor Chapman contends that there are apparently only two known examples anywhere in the world of wind turbine hosts complaining about the turbines on their land. However, there have been several Australian wind turbine hosts who have made submissions to this inquiry complaining of adverse health effects.

Paragraphs 2.11–2.12 (above) noted the example of Mr Clive Gare and his wife from Jamestown. Submitters have also directed attention to the international experience.

In Texas in 2014, twenty-three hosts sued two wind farm companies despite the fact that they stood to gain more than \$50 million between them in revenue. The committee also makes the point that contractual non-disclosure clauses

and 'good neighbour' agreements have significantly limited hosts from speaking out. This was a prominent theme of many submissions.

2.27 Sixth, Professor Chapman claims that there has been no case series or even single case studies of so-called wind turbine syndrome published in any reputable medical journal. But Professor Chapman does not define 'reputable medical journal' nor does he explain why the category of journals is limited to medical (as distinct, for assertion). However, the committee does note that a decision to publish—or not to publish—an article in a journal is ultimately a business decision of the publisher: it does not necessarily reflect the quality of the article being submitted, nor an acknowledgment of the existence or otherwise of prevailing circumstances. The committee also notes that there exist considerable published and publicly available reports into adverse health effects from wind turbines.

2.28 The committee also notes that a peer reviewed case series crossover study involving 38 people was published in the form of a book by American paediatrician Dr Nina Pierpont, PhD, MD. Dr Pierpont's *Report for Clinicians* and the raw case data was submitted by her to a previous Australian Senate inquiry (2011) to which Dr Pierpont also provided oral testimony. Further, at a workshop conducted by the NHMRC in June 2011, acoustical consultant Dr Geoffrey Leventhall stated that the symptoms of 'wind turbine syndrome' (as identified by Dr Pierpont), and what he and other acousticians refer to as 'noise annoyance', were the same. Dr Leventhall has also acknowledged Dr Pierpont's peer reviewed work in identifying susceptibility or risk factors for developing wind turbine syndrome / 'noise annoyance'. Whilst Dr Leventhall is critical of some aspects of Dr Pierpont's research, he does state:

Pierpont has made one genuine contribution to the science of environmental noise, by showing that a proportion of those affected have underlying medical conditions, which act to increase their susceptibility.³⁰

2.29 Seventh, Professor Chapman claims that no medical practitioner has come forward with a submission to any committee in Australia about having diagnosed disease caused by a wind farm. Again, Professor Chapman fails to define 'disease'.

Nonetheless, both this committee, and inquiries undertaken by two Senate Standing Committees, have received oral and written evidence from medical practitioners contrary to Professor Chapman's claim.

2.30 Eighth, Professor Chapman claims that there is not a single example of an accredited acoustics, medical or environmental association which has given any credence to direct harmful effects of wind turbines. The committee notes that the semantic distinction between 'direct' and 'indirect' effects is not helpful. Dr Leventhall and the NHMRC describe stress, anxiety and sleep deprivation as 'indirect' effects, but these ailments nonetheless affect residents' health.

2.31 Finally, Professor Chapman queries why there has never been a complainant that has succeeded in a common-law suit for negligence against a wind farm operator.

This statement is simply incorrect. The committee is aware of court judgements against wind farm operators, operators making out of court settlements or withdrawing from proceedings, injunctions or shutdown orders being granted against operators, and properties adjacent to wind turbines being purchased by operators to avoid future conflict. The committee also reiterates its earlier point that contractual non-disclosure clauses have discouraged legal action by victims.

Balancing nature and economic interests in the European Union: On the concept of mitigation under the Habitats Directive. Lorenzo Squintani. c 2019 The Author. *Review of European, Comparative & International Environmental Law* Published by John Wiley & Sons Ltd. wileyonlinelibrary.com/journal/reel. DOI: 10.1111/reel.12292

"THE FOUR CRITERIA TO ESTABLISH A MITIGATION MEASURE"

3.1 | Mitigation measures in context

Article 6 of the Habitats Directive gives teeth to the Directive by establishing proactive, preventive and procedural requirements for the conservation of Natura 2000 sites. This provision refers to three kinds of measures: conservation,

preventive and compensatory measures. It does not refer to mitigation measures. Before discussing what the latter measures are, it is important to briefly explain what the former three measures are, in order to distinguish between them.

Conservation measures are covered by Article 6(1) of the Directive. These measures focus on positive and proactive interventions to maintain and improve the status of conservation of a Natura 2000 site. Any measure leading to deterioration therefore falls outside the realm of this concept.

Preventive measures are envisaged under Article 6(2) of the Directive and aim at avoiding deterioration, similarly to conservation measures. Yet these kind of measures do not need to take the form of positive action, as in the context of Article 6(1). Non-action is also a form of preventive measure, if it prevents damage from occurring. What matters under this provision is avoiding disturbance that is likely to affect the objectives of the Directive significantly, particularly its conservation objectives in relation to Natura 2000 sites.

Compensation measures are mentioned in Article 6(4) of the Directive, which establishes an exception to the obligation contained in Article 6(3). Together, Articles 6(3) and 6(4) describe a two-step – or, in case the derogation clause is used, a three-step – procedure for granting development consent to plans or projects likely to have a significant effect on a Natura 2000 site, based on a ‘first come, first serve’ approach. The concepts of ‘plan’ (such as land-use plans, sectoral plans, etc.) and ‘projects’ (such as construction works or other interventions in the natural environment) have to be interpreted broadly, and include also developments outside a Natura 2000 site, which are likely to have a significant effect on it (the so-called ‘external effect’). In light of the precautionary principle, the assessment of the effects of plans of projects inside or outside Natura 2000 sites – either individually or in combination with other plans or projects (so-called cumulative impacts) – is based on the likelihood of effects, not on their certainty. If the screening phase indicates the presence of a potentially significant negative effect, an appropriate assessment needs to be performed, in light of the site’s ecological functions and conservation objectives. A negative outcome should lead to the refusal of authorization.

Yet, Article 6(4) of the Directive specifies that if, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, a Member State must take all compensatory measures necessary to ensure that the overall coherence of a Natura 2000 site is guaranteed. All the constitutive elements of this derogation clause have to be interpreted restrictively, for balancing environmental protection and economic development. In particular, the concept of compensation measures entails, typically, the designation of like-for-like replacement habitat. In the view of the European Commission, what matters is that the function performed by the affected site is successfully recreated elsewhere.

Adequate implementation and enforcement of Article 6 of the Directive strengthens nature conservation. Yet the complex relationship between Articles 6(3) and 6(4) has led to uncertainty as to what ‘adequately implemented and enforced’ means, and where ‘gold-plating’ starts. In particular, in certain Member States questions have arisen on the extent to which measures adopted to avoid damage can be taken into account in concluding that no significant adverse effect will occur.

It is here that the concept of mitigation measures enters into the legal discussion under Article 6 of the Directive, creating much uncertainty, and potential abuses.

Thanks to the judgments in the Waddenzee, Sweetman, Briels and Orleans cases, it can confidently be established that **mitigation measures are allowed under the Habitats Directive only if four cumulative requirements are met:**

- (i) the measure aims at preventing the damage caused by a specific plan/project (functional linkage criterion);
- (ii) the measure must ensure that this damage (specificity criterion);
- (iii) will be prevented (prevention criterion); and
- (iv) that there is no doubt about this preventive effect (no-doubts criterion).

In *Sweetman*, the Court clarified that the specificity criterion refers to each individual conservation objective, justifying the designation of that site in the list of Sites of Community Importance (SCIs) in accordance with the Directive. Similarly, from *Briels* it is clear that, under the prevention criterion, measures provided to replace a damaged area with another cannot be taken into account in the assessment of the implications of a project provided for in Article 6(3). In the judgment under review, the Court confirmed both criteria by stating: the case-law relating to Article 6 of the Habitats Directive requires a distinction to be drawn between protective measures forming part of the plan or project at issue and intended to avoid or reduce any direct adverse effects caused by it, in order to ensure that that plan or project does not adversely affect the integrity of the sites concerned, which are covered by Article 6(3), and measures which, in accordance with Article 6(4), are aimed at compensating for the negative effects of the plan or project on that site and cannot be taken into account in the assessment of the implications of that plan or project on that site ...

Moreover, according to the Court's case-law, it is only when it is sufficiently certain that a measure will make an effective contribution to avoiding harm to the integrity of the site concerned, by guaranteeing beyond all reasonable doubt that the plan or project at issue will not adversely affect the integrity of that site, that such a measure may be taken into consideration in the 'appropriate assessment' within the meaning of Article 6(3) of the Habitats Directive

The use of the adverb 'likely' in Article 6(3) of the Directive was clearly linked to the precautionary principle by the Court of Justice already in the *Waddenzee* case. Since then, the requirement that there should be no scientific doubt about the ability to prevent the specific damage of a specific project has gained clarity. The Court of Justice made clear that there are two ways of complying with this criterion.

First, a proposed measure can qualify as a mitigation measure under Article 6(3) of the Directive if, at the moment of the authorization of the plan or project, 'the procedures needed to accomplish the alleged mitigation measures have already been carried out'. Clearly, the implementation of a mitigation measure makes it easier to analyse whether the significant negative effects of a plan or project have been avoided or not.

The concept of 'project' must be interpreted broadly. The *PAS* (Dutch Programma Aanpak Stikstof 2015–2021, *PAS*) judgment clarifies that this concept is probably even broader than originally thought. Indeed, not only the Court of Justice defines this concept without linking it to that used in the EIA Directive, that is, by covering activities not covered by the EIA Directive. Most importantly, the Court defines it by linking its meaning to the effects of the activities on the protected site. Indeed, the Court states that it is important to examine whether such activities are likely to have a significant effect on a protected site. This is an effects-based test, which is capable of covering any kind of activity, even the spreading of fertilizers.

In the context of the establishment of mitigation measures, following *Briels*, it remained unclear whether mitigation measures have to be 'functionally' linked to a project development, that is, whether the proposed measures are part of the scrutinized project or of a mitigation scheme or restoration programme that does not take into account the specific project under scrutiny. Following *Orleans*, the present judgment confirms that a proposed mitigation measure must aim at avoiding the damage caused by the plan or project under scrutiny specifically. Management plans and generic restoration measures taken under Articles 6(1) and 6(2) of the Habitats Directive can be taken into account under the concept of mitigation measures when scrutinizing a specific project only if they specifically address the negative effects of that project.

What matters is that there is no reasonable scientific doubt as to the absence of adverse effects of each plan or project on the integrity of the site concerned. Therefore, there is no de-linking effect, meaning that the conservation goals of the Directive can be used to review the appropriateness of the assessment of a specific plan, differently than in other fields of EU environmental law, such as under the Nitrates Directive

The approach to the no-doubts criterion is a very stringent one. It stems from the *Orleans* case, in which the Court of Justice ruled that only those measures which are completed at the moment of the appropriate assessment can be taken into account as mitigation measures. *Orleans* concerned the development of a large part of the port of Antwerp (Belgium), affecting a Natura 2000 site. The Court found that the Belgian Regional Development Implementation Plan allowing the project only did so after the sustainable establishment of habitats and habitats of species in core ecological areas. Second, the Court ruled that a decision would have to declare that habitats in the nature reserves had

in fact been sustainably created, and the application for a planning permit relating to implementing the intended use of the area concerned would also have had to include that decision. Accordingly, the negative effects would have taken place only after that certainty regarding the effectiveness of the positive effects had been proven.

Yet, the Court ruled that such certainty would have been acquired only after the plan had been adopted, and thus that the proposed measures could not qualify as mitigation measures under Article 6(3) of the Directive.

The second way in which a measure could qualify as a mitigation measure under Article 6(3) of the Directive is when there is no scientific doubt about the effectiveness of the proposed measure.

This means that, even when a measure has not been carried out yet, it is still possible to speak of a mitigation measure. What matters is that there is scientific certainty about the effectiveness of such a measure, thus avoiding the significant damage that would otherwise occur. This criterion is clearly less demanding than the previous one. Still, the question is when scientific certainty exists about the effectiveness of a measure. This criterion could therefore be more difficult to fulfil in practice than it seems. It is still unclear what burden of proof the Court would consider to be sufficient under this approach. In the present judgment, the Court left this matter to the national court to decide, in an exercise of judicial subsidiarity. Yet, it cannot be discounted that the Court of Justice will formulate some guidance in future case law if called upon to clarify this issue

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Operational Envelope and Performance Guidelines

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3.3 Operational Envelope – Conditions for Power Curve and C_t Values (at Hub Height)

Consult Section 6, p. 10 for power curves and C_t values.

Conditions for Power Curve and C_t Values (at Hub Height)	
Wind Shear, α	0.00-0.30 (10 minute average)
Turbulence Intensity, I	6-12% (10 minute average)
Blades	Clean
Rain	No
Ice/Snow on Blades	No
Leading Edge	No damage
Terrain	IEC 61400-12-1
Inflow Angle (Vertical)	$0 \pm 2^\circ$
Grid Voltage	Nominal Voltage $\pm 2.5\%$
Grid Frequency	Nominal Frequency ± 0.5 Hz
Grid Active Power (at LV-side of turbine transformer)	As per tabulated values in Sections 6 and 7
Grid Reactive Power (at LV-side of turbine transformer)	Power Factor 1.0

Table 3-4: Conditions for power curve and C_t values

Environmental Impact of Wind Farms. Bošnjaković, M.; Hrkać, F.; Stoić, M.; Hradovi, I. *Environments* 2024, 11, 257. <https://doi.org/10.3390/environments11110257>

Toxicity

The toxicity of substances to humans can be expressed in different ways and is often expressed in CTUh (Comparative toxic unit for human). Onshore wind farms have an average of around 3.9 CTUh/TWh.

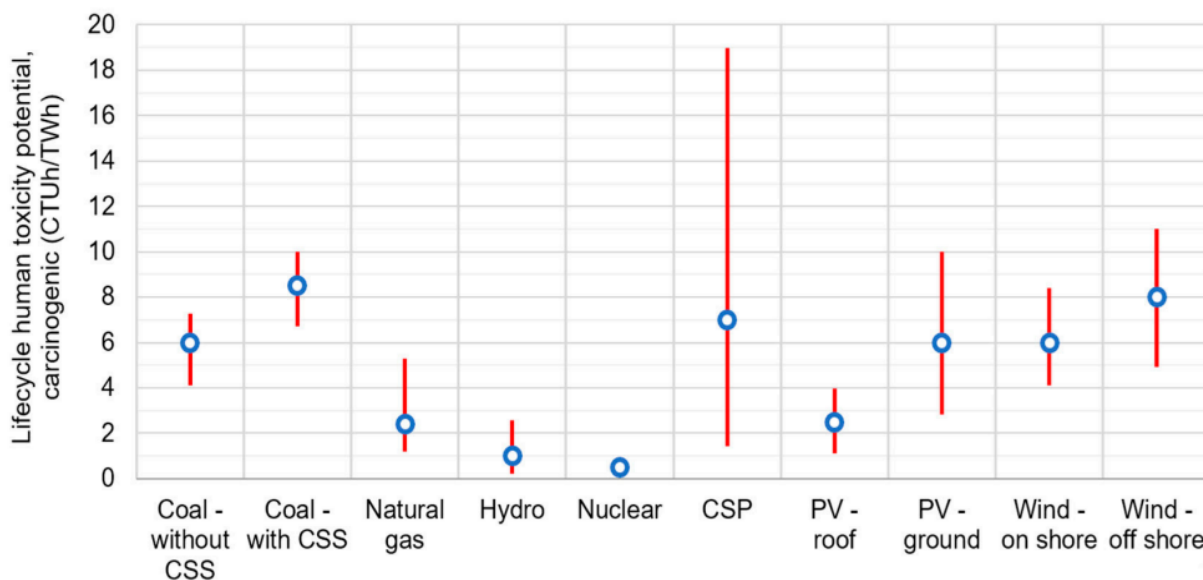


Figure 4. Lifecycle human toxicity potential, carcinogenic. The red line represents the range and the circle represents the median.

Danger of Ice Flying off the Blades

Ice build-up on the rotor blades of wind turbines can pose a serious threat to people and objects in the immediate vicinity. It is, therefore, important to assess the dangers associated with ice shards falling and flying from the rotor blades. Icing can also lead to the failure of wind turbines because the structural integrity is impaired. The hazard posed by ice depends on the severity of the icing, the type of icing, the wind, the rotor speed and other environmental conditions. A piece of ice with a weight of 0.2 kg and a density of 500 kg/m³ falling from a height of 30 to 50 m is considered fatal if the impact has a kinetic energy of more than 40 J.

Danger of Blade Parts Flying Off

A "blade failure" can have a number of causes and can result in either whole blades or parts of blades being thrown from the turbine. A total of 537 separate incidents have been recorded. It has been documented that parts of the blades have travelled up to 1.6 km. In Germany, parts of the blade penetrated the roofs and walls of nearby buildings. For this reason, a law was passed in Germany (Bavaria) in 2016 requiring a minimum of two kilometers to be kept between dwellings or workplaces and wind turbines, and Ireland is considering a similar measure.

Impact on Radio Waves and Air Traffic

Offshore wind turbines can interfere with radar systems on board ships and on land as well as radars used to monitor air traffic. Wind farms located near weather radars can cause false echoes that can be misinterpreted as weather phenomena such as precipitation or thunderstorms. The reason for the interference lies in the structure of the turbines, the height of the turbines and the displacement of the rotors, which can reflect radar signals. In addition, telecommunication and data transmission signals can be weakened when wind turbines are in the line of sight (LOS) for radio communications. In general, two types of effects of wind farms on radar systems can occur:

- Formation of radar shadows behind wind turbines, which can result in lower targets being poorly recognised or not recognised at all. The relatively high frequencies used by the radar are attenuated when the signal passes through the wind farm, i.e., they shorten the range of the radar.
- Reflection of the radar beams from the wind turbines can lead to false radar targets (false echoes).

Radar systems work by recognising weak reflections that are often in motion. In addition, the rotor blades of wind turbines produce false reflections in the direction of the receivers, causing the radar to misinterpret the signals. While the wind farm industry is growing rapidly, they are causing serious interference problems in critical civil and military radio systems, degrading radar detection range and increasing the complexity of air surveillance and navigation missions.

Habitat Destruction

Based on 84 studies of onshore wind farms in 22 countries, (Tolvanen et al). presented data on the average distance of habitat displacement from the edge of wind farms. The predominant height of wind towers in the studies was 50–99 m.

For birds, bats and mammals, habitat displacement accounted for 63%, 72% and 67% of cases, respectively. Cranes, owls and semi-wild reindeer showed consistent habitat displacements of up to 5 km on average. Gallinaceous birds showed movements of up to 5 km on average, but “no movement” was reported in 40 cases. Bats were displaced by an average of up to 1 km in most cases. Waders, birds of prey, sparrows and black-winged stilts moved their habitats by up to 500 m on average.

Furthermore, human-caused forest landscape fragmentation may lead to a rise in the number of predators (Pasanen-Mortensen and Elmhagen, 2015). For instance, infrastructure like buildings and maintenance roads could attract fox activity (Hradsky et al. 2017), so the risk of predation may be higher near wind farms. Grouse are known to be sensitive to human disturbance (Coppes et al 2017). Many grouse species are site-loyal and therefore highly vulnerable if their habitat overlaps with areas that are suitable for wind turbine installation, particularly in the absence of another suitable habitat (Braunisch et al. 2015).

Collision with a Wind Farm

For some bat species, the installation of wind turbines creates new habitats because there are more insects to feed on in the vicinity of the wind turbines. **Direct causes of bat death at wind turbines are well recognised and include barotrauma (Rollins et al. 2012) and collisions with rotating blades (Horn et al. 2008) or a combination of both.**

The potential threats of wind farms to birds are well documented in the literature, for example. Research suggests that mortality rates (although they may be relatively high in certain areas) are highly variable and depend on a number of factors such as the bird species, the size and the location of the wind farm and others. (Barclay et al. 2007) reported a mortality rate of 0.00–9.33 birds per year per turbine and a mortality rate of 0.00–42.7 for bats.

The selective shutdown of wind farms along the bird migration route using radar is very effective in reducing collision rates (Tomé et al 2017).

Noise Onshore Wind Farm

Noise pollution has a negative impact on wildlife as it disrupts mechanisms that are crucial for their survival. According to studies, noise can result in the following:

- Result in physiological trouble, such as genuine hearing loss or persistently elevated stress hormone levels.
- Be viewed as a direct danger, which would lead to an increase in predatory behaviour at the expense of foraging or the departure of the afflicted region, which would result in the loss of habitat.
- Distract attention during foraging and reduce foraging efficiency.
- Interfere with animal communication by reducing the distance from which the signal can be perceived and lowering the quantity of information that can be taken out of the signal, such as the sound of a predator or approaching potential prey.
- Influence the reproductive process. Taubmann et al. reported that noise disturbs grouse up to a distance of 865m. Increasing turbine noise, turbine visibility, and turbine shadow during the breeding season reduced the likelihood of selecting a breeding site.

The roles that these processes play in determining the effects of noise pollution on different species are not mutually exclusive. Different species respond differently to noise as they have different sensitivities to noise. In general, noise pollution alters animal communities. The effects of noise can contribute to the reduction in biodiversity and also threaten the sustainability of local ecosystems.

The Effects of Vibrations from Wind Turbines on the Ecological System

The impact of vibrations is one of the aspects to be considered when analysing the impact of wind turbines on the environment. Vibrations are mechanical oscillations that can be caused by the operation of the wind farm and its components. In this chapter, the effects of vibrations on the environment are analysed, taking into account the possible consequences for living beings, structures and the surrounding space.

The source of vibrations in wind farms is the rotating parts of the turbines, such as rotor blades and generators. The rotation of these parts generates periodic vibrations that are transmitted to the ground via the foundations of the wind farm. These vibrations can have a negative impact on the animals in the surrounding area, especially on their sensitive acoustic perception. A study by Estefania Velilla and colleagues from 2021 shows how vibrations from wind farms

affect the abundance of earthworms in the soil. The relative intensity of vibrations in the soil was measured and the results showed a decrease in the number of earthworms near the wind turbines, which is considered a negative impact on soil organisms. A decrease in earthworms was found in a radius of about 200 m around the wind turbines, where the noise level decreased by an average of 23 ± 7 dB. Earthworms are considered important engineers of the ecosystem, and interference with their abundance, survival and reproduction can indirectly affect important processes such as water filtration, nutrient cycling and carbon sequestration. In addition, the vibrational noise generated by the wind turbine can mask the vibrational signs of approaching moles, making earthworms in noisy areas more vulnerable to predation (Dominoni et al. 2020).

Wind farms generate noise that can have harmful effects on humans and animals, especially in the vicinity of the wind farm. Problems noted in humans include insomnia, headaches and the like. For animals, there is a wide range of potential impacts: from possible hearing damage to interference in foraging, predator marking, habitat abandonment and more. The moving rotor blades of the wind farm can pose a risk of collision and death for birds and bats.

THE HIGH COURT

[2023] IEHC 417

[Record No. 2021/3588P]

BETWEEN

DROMADA WINDFARM (ROI) LIMITED

PLAINTIFF

AND

DENIS CREMINS

DEFENDANT

JUDGMENT of Mr Justice Mark Sanfey delivered on the 14th day of July 2023.

Introduction

1. This case concerns an issue in relation to high voltage cables servicing the plaintiff's windfarm which have been laid in the grass verge alongside a public road which abuts the defendant's land. The plaintiff now accepts that the cables are in fact laid on ground which is the property of the defendant. Put at its simplest, the main issue this Court has to decide is whether orders should be made preventing the defendant from interfering with the cables, and allowing them to remain in situ – in which case the plaintiff accepts that the defendant would be entitled to monetary compensation for what is in effect a trespass on his land – or whether the court should order the plaintiff to remove the cables, which the plaintiff submits would result in it incurring a wholly disproportionate loss in circumstances where it alleges that the

cables do not interfere with the defendant's present use of the land in any material way.

2. The cables were laid in or about 2009. The question of trespass by the plaintiff on the defendant's land was first raised by solicitors acting on the defendant's behalf in November 2016. The trespass was denied by the plaintiff, and this led to proceedings entitled "The High Court, Record No. 2017/8323P, between Denis Cremins plaintiff and Dromada Windfarm (ROD) Limited defendant" ("the 2017 proceedings") being issued by the defendant. These proceedings were not progressed by the defendant. However, the defendant from June 2019 onwards mounted what could justly be described as a campaign of correspondence, mainly with the plaintiff's parent company, in which he threatened to remove the cables himself, repeatedly pointing out to the plaintiff that if injuries or fatalities occurred as a result, such occurrences would be the responsibility of the plaintiff or its parent.

3. Prolonged correspondence and meetings between representatives of the plaintiff and the defendant did not resolve the matter, and ultimately the present proceedings were issued on 5 May 2021. There was an immediate application for an interim injunction, the court (Allen J) granting an order which effectively restrained the defendant from interacting with the cables. An interlocutory order in the same terms was made on 18 May 2021 by Allen J with the acquiescence of the defendant, who represented himself in court.

4. Mr Cremins delivered a document that he drafted himself on 31 August 2021 by way of response to the plaintiff's statement of claim. It is effectively a defence and counterclaim, in which he seeks orders for the removal of the cables and damage for "interference with my land". The court must now decide what is to be done with the

cables, and what consequences must flow from them either remaining where they are, or being removed.

5. Fortunately, there was no material dispute between the parties as to the facts of the matter, although it will be necessary to set them out in some detail, so that the exercise of the court's discretion can be seen in context. Likewise, the parties are generally agreed as to the legal principles which govern the dispute. There is however major divergence between the parties as to the inferences to be drawn from the facts, and as to the appropriate course of action the court should take.

Background

6. The plaintiff is a company incorporated in the State, and is part of the SSE group of companies. The plaintiff is one hundred percent owned by SSE Renewables Wind Farms (Ireland) Limited which is one hundred percent owned by SSE Renewables Holdings Limited. That company is in turn a subsidiary of SSE plc. The court was told in evidence that SSE entities operate 26 windfarms in Ireland.

7. The defendant is a farmer and, together with his wife Sheila Cremins, is the registered owner of lands comprised in folio 3305F County Limerick ('the lands'). The defendant acquired the lands in or around 2006.

8. The plaintiff is the operator of Dromada Windfarm ('the windfarm'), which comprises of 19 turbines and ancillary developments located at lands at Clash South, Athea, County Limerick. Planning permission was obtained for the windfarm in 2004, but on the basis that twenty-three wind turbines would be erected, along with the substation, including a control building, the construction and upgrading of site entrances, site tracks and associated works. Permission was subject to 17 conditions.

9. When planning permission was obtained, it was on the basis that three of the 23 permitted turbines would be constructed on lands now owned by the defendant and

the defendant's wife, pursuant to a lease arrangement. In that regard, the plaintiff's predecessor in title had entered into an option agreement ('the option agreement') with the previous owners of the lands for the construction of part of the windfarm on their lands, and those lands were included in the planning application on that basis.

10. The defendant acquired the lands in folio 3305F subject to the option agreement for the construction of the turbines and in knowledge of that agreement. When purchasing the lands, the defendant entered into an agreement to be bound by the terms and conditions of the option agreement.

11. It was contended by the plaintiff, and in fact confirmed by the defendant in his evidence before the court, that he has significant experience of dealing with windfarm developments and entering into commercial arrangements regarding the use of lands for windfarm turbines. The defendant has been involved in litigation with another windfarm operator, apparently in relation to the proper construction of an option agreement relating to other lands owned by him. This case was heard in this Court and on appeal in the Court of Appeal. While it appears that Mr Cremins was unsuccessful in those outings, he acknowledged in cross-examination during the hearing that he told Mr Ciaran Maguire, a representative of the plaintiff who spent some time in negotiation with Mr Cremins, that he had obtained compensation of €4m from one windfarm and €6m from another windfarm.

12. The Athea holding of the defendant consists of approximately 150 acres, 50 of which are afforested and the remaining 100 of which have no particular use or function at the moment. It is some significance to note that Mr Cremins resides at some distance from the Athea holdings in Knocknagoshel, Co. Kerry.

13. The option agreement expired in or around May 2007, but negotiations continued between the plaintiff and the defendant with a view to putting a new lease

option in place. However, no agreement was reached, and the windfarm was constructed without the intended three turbines on the defendant's lands being constructed before planning permission expired.

The laying of cables

14. The windfarm has been operational since February 2010 and supplies electricity to the national grid pursuant to contractual arrangements which exist between the plaintiff and EirGrid. This is done *via* 110 KV high voltage cables which connect the windfarm to the national grid.

15. Mr Ciaran Maguire is onshore wind operations manager of SSE Renewables. Mr Maguire swore the grounding affidavit on behalf of the plaintiff for the interim and interlocutory injunction applications, and gave evidence on behalf of the plaintiff before this Court. Mr Maguire indicated in evidence that he has overall responsibility for the 26 windfarms in Ireland owned by SSE entities. In his evidence to the court, Mr Maguire referred to maps and photographs of the area in question. His evidence was that cables connecting nine of the windfarm's turbines to the national grid pass along a section of the public road. He stated that approximately 3km of cable was laid adjacent to the public road, and that 250m of this distance was at or outside Mr Cremins' lands [Transcript, Day 2 pp 12-13].

16. The road is a small rural road with a grass verge on either side. The photographs show that Mr Cremins' land is fenced off with wire and fence posts. From this "fence" the grass verge extends to the edge of the road, and the evidence of Mr Maguire was that the cable was laid between the "fence" and the edge of the road. One might have thought that the "fence" erected on Mr Cremins' lands marked the boundary of those lands, and that therefore cable laid in the grass verge between the fence and the roadway would not have impinged upon those lands. However, as we

shall see, the plaintiff now accepts that the cables are in fact laid in ground which belongs to Mr Cremins. The evidence of Mr Maguire is that the plaintiff had originally intended running the cables through the defendant's lands, but when the defendant refused to agree commercial terms to allow the three turbines to be built on his lands, the plaintiff took the decision to lay the cables in the grass verge alongside the public road.

17. By letter of 9 February 2009, Limerick County Council wrote to Roadbridge Limited, a contractor which had applied for a road opening licence to facilitate the installation of the cables, indicating that the Council had no objection providing there was compliance with an attached list of conditions. The application form indicates the exact location of the proposed opening as "CoolEast/Clash South, Dromada, Athea, County Limerick", and suggests that the length over which the cables were to be installed was in excess of 3,000m, with 2,630m of cabling to be installed in a "grass verge". The average depth of the pipe was expressed to be 1.5m.

18. Mr Maguire stated that the thinking in relation to running the cable alongside a road was that a road was an "ideal avenue to run a cable along...the road was an artery through the countryside where...a cable could be laid properly and without problem". [Transcript, Day 2, p.15, lines 16-23]. He stated that SSE believed that it was entitled to do this at the time. SSE's position as regards planning permission is set out at para. 22 of the statement of claim, which is as follows:

"22. When the cables were laid in 2009, it was the plaintiff's understanding that planning permission was not required for the laying of electricity cables and that same were exempted development, having regard to class 26 of the First Schedule, Second Part of the Planning and Development Regulations 2001 (as amended). The general understanding in that regard changed

following the decision of the High Court in *O’Grianna v An Bord Pleanála* and in subsequent court decisions, culminating in a decision of *Daly v Kilronan Windfarm Limited*. However, from a planning perspective, the development would have been immune from attack under s.160 of the Planning and Development Act 2000 (as amended) when the Defendant’s proceedings issued in 2017, and certainly, by the time the Defendant’s letter dated 13 June 2019 was sent”.

19. Mr Maguire stated in his evidence to the court that his concern was “to provide sites where people can go to work safely and come home from work to their family safely...”. He was unequivocal in his evidence that the cables on the defendant’s lands were safe:

“...[F]irst of all, they are designed safely. Second of all, we maintain them, like we look after them. We carry out maintenance, we carry out surveys, you know, we have a schedule of maintenance to ensure that the balance of plant network, which includes the cable, is being looked after correctly and it will operate as required. And specifically in the case of the cables and the condition they were in, the cables were buried...they were covered”. [Day 2, p.17, lines 20-29].

The 2017 proceedings

20. By a letter of 24 November 2016, Messrs O’Connell & Clarke, the firm of solicitors on record for the defendant in the present proceedings, wrote to the plaintiff raising various points in relation to the development of the windfarm. In particular, the letter stated that “our client has carried out searches and has been unable to identify any grant of planning permission in respect of the grid connection works. Accordingly the grid connection and internal [cabling] works are unauthorised

development as these works do not benefit from the exempted development provisions...”. Significantly, the letter went on to state that “...we are instructed that the [cabling] works trespass on our client’s lands. Our client has not provided any consent to the laying of cables on or over his lands and he has instructed us to request that same are removed forthwith...”. The letter pointed out that “T14 and T23 are in immediate proximity to our client’s boundary and are interfering with our client’s ability to use and development [sic] his own lands”.

21. A substantive response was sent by an in-house lawyer for SSE on 1 February 2017 by email. In particular, the email stated that “...my client has confirmed that there are no cables for Dromada Windfarm located on your client’s land and there is no trespass on your client’s land...”. In response to a reply from O’Connell & Clarke, by email of 16 February 2017, the same author stated “...regarding the alleged trespass, we are satisfied from our inspections that there is no such trespass...”.

22. A plenary summons on behalf of Mr Cremins against Dromada Windfarm (ROD) Limited issued on 18 September 2017. The general endorsement of claim, which was signed by counsel, sought:

“1. A declaration that the plaintiff owns land comprising of folio LK3305F at Dromada, County Limerick and that the defendant has no estate or interests in the said lands and, in particular, has no entitlement to lay pipes, cables or conduits in the lands comprising the said folios.

3. [sic] An order, restraining the defendant its servants or agents from the laying of underground cables/ducting/or other equipment on the plaintiff’s lands at Dromada, County Limerick without his consent or otherwise;

4. Damages for nuisance and trespass...”.

23. An appearance was entered on 20 September 2017 by solicitors representing Dromada Windfarm (ROI) Limited. However, it is accepted by the defendant herein that he did not advance these proceedings, and no statement of claim was ever served.

Correspondence from June 2019 to date

24. Mr Cremins appears to have written the following letter on 13 June 2019:

“To whom it may concern, I, Denis Joseph Cremins, am giving SSE Airtricity Dromada Windfarm until 15 July 2019 to remove the cable that is buried on my lands. Folio no: LK3305F. If the cable is not removed by this date I will have it removed myself. Should any injuries or fatalities occur to either me or my workers as a result of your failure to remove the cable, that you installed by trespassing on my land, you will be held responsible. I will be forwarding a copy of this warning letter to my family and solicitor, should I have to remove the cable myself. You, Airtricity, buried the cable on my lands without planning permission. I am again warning you, Airtricity Dromada Windfarm, should any loss of life occur after 15-07-2019 as a result of your failure to remove the cables my family and solicitor will be able to hold you responsible as you have been put on notice by this official warning letter. I can guarantee the cable, which is buried on my lands, will be removed regardless.

Yours faithfully,

Signed.

Denis Cremins”.

25. A further letter from Mr Cremins suggests that this letter was “posted to Airtricity on 13 June 2019”, and to “Mr Philips-Davies CEO of SSE (the parent company for Airtricity)” by the said letter of 4 July 2019.

26. A letter was written on behalf of SSE to Mr Cremins on 8 July 2019. The letter stated as follows:

“Dear Mr Cremins,

We refer to the above matter and to your letter of 13th June 2019 in which you state that you intend to remove the underground electrical cable which you state is buried on your lands. The health, safety and welfare of staff and the general public is of paramount importance to SSE. The cable you refer to is a live cable and contact with this cable may cause electrocution and result in fatal injuries. Please find attached a copy of the Code of Practice for Avoiding Danger from Underground Services. This code of practice is a result of a joint initiative between the Health and Safety Authority, the Construction Industry Federation, Irish Congress of Trade Unions, key utilities companies/service providers and local authorities that are involved in the provision and maintenance of vital underground services.

SSE takes any claim or intention to interfere with electrical plant and equipment extremely seriously. We urge you not to take any such action given the extreme danger involved in interfering with live underground cables. In addition to risking your own life and the lives of contractors with any such interference you would also be endangering the safety of members of the public and of SSE staff. In this regard please note that SSE has notified the Gardaí of the contents of your letter.

SSE has investigated the claim in your letter that the cable which you refer to is buried on your lands and is satisfied that the cable is not located on your lands but located under the public road. We further note that you have, through your solicitors O’Connell Clarke, issued High Court proceedings against SSE

under record 2017/8323P in respect of this cable and any issues or concerns which you may have in respect of the location of the cable should be raised in the context of those proceedings. In this respect we have copied both your solicitor and the solicitors acting for SSE in these proceedings.”

27. Over the course of the next two years, the parties exchanged correspondence in relation to the removal of the cables. The plaintiff’s position was that any issues would be determined in the course of the 2017 proceedings, and emphasised the risk inherent in any attempt to remove the cables by Mr Cremins. Mr Cremins however continued to intimate his intention to remove the cables himself, and continually raised the prospect of injury or loss of life occurring as a result. By way of example, in his letter to Mr Alistair Philips-Davies, CEO of SSE, of 23 October 2019 Mr Cremins indicated that, if the cables were “not removed by 10 November 2019 then I will remove them after this date and SSE Dromada Windfarm and the Health and Safety Authority will be held responsible should any danger or even death happen to me as a result of your failure to act. I would rather take that chance than have somebody like SSE trespass on my title without my consent. So please have the cable removed by the above date otherwise any fatality will be in the hands of SSE and the Health and Safety Authority. You have been warned.”

28. It then transpired that, in December 2020, the defendant exposed some of the plaintiff’s cable ducting on the grass verge of the public road, having used a digger to access the area from his lands. When it learnt of this event, the plaintiff sent operatives out to the road to cover the exposed section of cable ducting with stone chippings and to put up additional marker posts to warn road users of potential danger. By letter of 16 December 2020, SSE wrote to Mr Cremins indicating that, “interfering with live cables...is extremely dangerous and could cause serious injury

to you or any person undertaking such works...”, and stated that “...[i]t is imperative that you cease any such works immediately for your own safety and the safety of others. In the event that you cause any further interference with the cable we will be left with no option but to proceed to make an application to the High Court for an injunction to prevent you from interfering with these cables. We urge you to bring this matter to the immediate attention of your solicitors”.

29. Mr Maguire then organised a meeting with Mr Cremins on the site on 7 January 2021. By a letter of 22 January 2021, Mr Maguire wrote to Mr Cremins setting out the plaintiff’s position, which in essence was that any issues Mr Cremins had with the cable should have been raised in the 2017 proceedings. The response to this was a further letter from Mr Cremins of 1 February 2021 to senior officials of SSE giving until 14 February 2021 to either remove the cables or switch off the power to them, failing which Mr Cremins would be “left with no alternative but to undertake these works myself. SSE Airtricity will be held responsible for any and all injuries, up to and including death, that might ensue as a result of your failure to remove or cut the power to this cable...”.

30. Mr Maguire met Mr Cremins on site on a number of occasions in February and March 2021 with a view to attempting to resolve the differences between the parties. However, there were further intimations in April 2021 by Mr Cremins and a firm of solicitors acting on his behalf that he would remove the cable himself if certain requirements of his were not met. By a letter of 19 April 2021, a firm of solicitors – not O’Connell & Clarke – wrote to “SSE Airtricity” enclosing a copy of an engineer’s report by Ms Nora Curtin indicating the cables were laid on Mr Cremins’ lands. This met with a robust response from the plaintiff’s solicitors of 20 April 2021. The letter stated, inter alia, that ...[i]n respect of the cables which you

state have been built on your client's lands, these cables were in fact laid in the verge of the public road, some 12 years ago...". The letter did not however go so far as to deny that trespass had taken place, and made "an offer suggesting mediation to your client in respect of all claims arising out of the [2017 proceedings] ...".

31. Ultimately, a meeting with the defendant took place at Barack Obama Plaza carpark – due to pandemic restrictions – on 29 April 2021, attended by Mr Maguire and another representative of SSE. The statement of claim in the present proceedings records that:

"Safety markings to identify the location of the cables, which the Plaintiff's workmen had put over the cables after the defendant attempted to interfere with the cables in December 2020 had been removed. The Defendant confirmed that he had removed the safety markings the previous week. The Defendant demanded that (i) the Plaintiff either remove the cables from the lands, (ii) pay him compensation of €4.5m to leave the cables where they were or (iii) go through a fresh planning process to move the cables to the other side of the road but to de-energise the cables during the currency of that process".

[Paragraph 35].

32. It appears that the plaintiff's counterproposals were unacceptable to Mr Cremins, who sent further emails to senior executives of SSE plc confirming his intention to remove the cables himself.

The present proceedings

33. It was in these circumstances that the plaintiff issued the plenary summons in the present proceedings on 5 May 2021. Mr Maguire swore a grounding affidavit, and an application for an interim injunction was made to Allen J who made the following order:

“IT IS ORDERED that the Defendant his servants or agents or any persons aiding abetting or acting in concert with him and any person having notice of the making of the Order be restrained until after 18th day of May 2021 or until further order in the meantime from interfering with and/or digging up and/or accessing in any way (whether with machinery or otherwise) the Plaintiff’s electrical plant and equipment including high voltage cables which are connected to the Dromada Windfarm which were laid in the verge of the public road abutting the Defendant’s lands at Keale Athea County Limerick in or around 2009”.

34. The hearing of the interlocutory application took place on 18 May 2021. Due to the Covid-19 Pandemic, the plaintiff’s lawyers attended remotely, but Mr Cremins, who was not represented by lawyers, attended in person. It appears from the order of the court of that date that Mr Cremins did not object to the continuance of the order made on an interim basis against him.

35. Mr Cremins continued to assert that the cables were laid on his property, and to this end swore an affidavit on 14 May 2021 attaching a report by an engineer, Nora Curtin, of 19 April 2021, in which Ms Curtin asserted that “the grid cable is laid within the folio lands of Denis Cremins LK3305F”.

36. Mr Maguire swore two affidavits in the matter on behalf of the plaintiff. The first affidavit of 4 May 2021 sets out the background to the matter in detail much as I have set it out above, emphasising the necessity to prevent unauthorised interference with potentially lethal cables, while maintaining that any issues in relation to location of the cables could be dealt with in the 2017 proceedings. It is notable that neither of Mr Maguire’s affidavits asserts unequivocally that the cables are not situated on Mr Cremins’ land, although there is a passing reference at the start of para. 41 of Mr

Maguire's grounding affidavit to the grass verge being "outside the defendant's lands". At para. 48 of that affidavit, he avers as follows:

"I say that the balance of convenience clearly favours the granting of an interlocutory injunction. *If the Defendant is correct in asserting that he is suffering a trespass by reason of the installation of the cables some 12 years ago, any wrong which he has suffered is capable of being compensated in monetary terms for the reasons already outlined.* Having regard to the terms of the Defendant's correspondence dated 24 February 2021, which I set out above, it is clear that the Defendant's real motivation is to obtain monetary compensation from the Plaintiff. There are legal proceedings in being in which those issues may be determined. However, if the Defendant interferes with the cables and suffers injury or even death, the consequences to the Defendant will be irreparable". [Emphasis added].

37. Mr Maguire swore a second affidavit on 17 May 2021, the day before the hearing of the interlocutory injunction. At para. 24 of that affidavit, he avers as follows:

"...The Plaintiff is of the view that even if the Defendant is correct in establishing that he owns the lands on which the cables are laid and that he did not give permission for their installation, his remedy is limited to damages for reasons including the length of time the cables are in situ, the failure of the Defendant to raise any complaint about the cables for eight years after their installation, the fact that the cables are laid on the public road and that any trespass that the defendant might establish is technical in nature and the fact that the Plaintiff's prejudice in having to remove the cables is significantly

greater than any prejudice to the Defendant if the cables remain where they are”.

38. This theme is continued in the statement of claim which was delivered on 9 August 2021. The plaintiff alleges at para. 44 that the defendant is estopped by a number of matters from seeking the removal of the cables, and the succeeding paragraph is as follows: -

“45. In any event, if the Defendant has suffered an alleged trespass as a result of the cables being laid in the grass verge outside the lands, same is capable of being compensated in monetary terms”.

39. Mr Cremins delivered what is in effect a defence and counterclaim on 31 August 2021 at a time when he did not have legal representation. In the reliefs he claims, he seeks “damages for interference with my land” at para. 6. In its reply and defence to counterclaim, the plaintiff responds to this claim as follows:

“8. With regard to the reliefs sought at para. 6, the Plaintiff’s position is (as pleaded in the statement of claim) that if this Honourable Court determines that the Plaintiff’s cables are laid under the Defendant’s lands, albeit that such lands form part of the public road, and this Honourable Court determines that the Defendant should be compensated in that regard, this Honourable Court should assess the compensation to which the Defendant is entitled on the basis that the cables are to remain in situ”.

The legality of the laying of cables

40. The hearing of the matter took three days. During a lengthy opening in which the background to the matter was set out at length, the question of the ownership of the land adjacent to Mr Cremins’ fenced-off land along which the cables had been laid was addressed. The plaintiff’s counsel, Rossa Fanning SC, in addressing the reliefs

sought by the plaintiff, referred to the third paragraph of the reliefs in the statement of claim, which is as follows: -

“3. A declaration that if the defendant is entitled to any relief as a result of the plaintiff’s electrical plant and equipment, including high voltage cables connected to the windfarm, being laid in the verge of the public road abutting the lands at Keale, Athea, County Limerick in or around 2009, same is limited to damages in the High Court proceedings which he has commenced, by reason of his delay in seeking any equitable relief and, if appropriate, measuring such damages (if any) to which the defendant may be entitled in that regard”.

41. Mr Fanning commented on this relief in his opening to the court as follows:

“And that’s a central issue, Judge, now, that the court will have to take a view on. That to the extent that we have trespassed, and there is no longer any contest in truth that we have as a result of our reading of Ms Justice Baker’s judgment in *Daly v Kilronan*, which is referred to in my submissions and in the book of authorities, we accept there is a technical trespass here.” [day 1, p99, lines 18-25]

42. Counsel for the defendant, Oisín Collins SC, immediately interjected to complain that the defendant had come to court to “defend his ownership of the lands and to establish a trespass”. Counsel submitted that the proceedings were based on an entitlement to lay the cables in the grass verge; if counsel for the plaintiff was “...now conceding [that the plaintiff] has no entitlement to be there, it is difficult to see what future his case has at all” [day 1, p.99, line 26 to p.100, line 16].

43. In answer to a direct question from the court, counsel for the plaintiff confirmed that the plaintiff had resiled from the position that it had expressed in

correspondence. Counsel accepted that the laying of the cables on Mr Cremins' land was a "technical trespass", but one that "doesn't actually prejudice Mr Cremins in any respect... [Mr Cremins] can't, as a matter of law... dig [the roadway] up himself... it is a criminal offence to dig up a public road, other than with a licence, which we did have in 2009 when we did these works, but which Mr Cremins has never had... [the plaintiff's] objective in these proceedings... consistent with the reliefs I have sought, is to ensure that Mr Cremins cannot interfere with my cable and to obtain a court order to that effect" [day 1, p.132, lines 17 to p.134, line 25].

44. The legal principles in relation to ownership of the public road are set out at some length in the written submissions of the plaintiff, which were delivered on the first day of the hearing, *i.e.*, not in advance of the trial. The plaintiff notes, *inter alia*, a number of cases establishing the principle that the owner of land beside a public road or river "owns the soil to the middle part of the road or river unless the soil has been acquired by the local authority..." [Kenny J in *Holland v Dublin County Council* [1979] 113 ILTR 1 at 2: see para. 44 of written submissions]. The plaintiff now accepts that the application of this principle confirms that Mr Cremins "owns the soil to the middle part of the road", and that accordingly in the present case, the grass verge between the fence posts and the middle of the road is part of Mr Cremins' lands.

45. The plaintiff's submissions also note that s.13(10) of the Roads Act 1993 provides, *inter alia*, that a person who damages or excavates a public road "without lawful authority or the consent of a road authority... shall be guilty of an offence". The submissions note the requirement, pursuant to s.254 of the Planning and Development Act 2000 for a licence granted by a planning authority for the placement of a "cable, wire or pipeline... under, over or along a public road..."; it is contended however that

the plaintiff is a “statutory undertaker” as defined in s.2 of the Planning and Development Act 2000, to which s.254 does not apply.

46. The plaintiff however suggested that a significant change in the legal position had occurred with the delivery of the judgment of Baker J in *Daly v Kilronan Wind Farm Limited* [2017] IEHC 308. As the plaintiff put it at para. 49 of the written submissions:

“49. The judgment of Baker J in *Daly v Kilronan Wind Farm Limited*, [2017] IEHC 308, clarified that a road opening licence does not confer a right or interest in the soil, as the purpose of the licence is to provide consent for an action which would otherwise be an offence under the Roads Act 1993. In that case, which involved an application under s.160 of the PDA, Baker J held that even though it formed part of the public road, the grass verge was *prima facie* the property of the applicant and no consent to enter had been given. Thus, *prima facie*, there was a trespass, and the road opening licence did not of itself amount to authorisation or permission to enter upon private land. In the event, Baker J proposed making a limited order prohibiting the continuation of the laying of cables, but she made no order that the works already completed be removed or that the land be restored.”

47. Having quoted excerpts from the judgment, the plaintiff went on to state as follows:

“51. Until this judgment, it had not generally been understood that the road opening licence, coupled with the fact that the laying of cables was exempted development, was not all that was required. Indeed, it might be suggested that the defendant himself laboured under this mistake, given that the judgment of Baker J was delivered on 11 May 2017 and the defendant’s 2017 proceedings

subsequently issued on 19 September 2017, when the cables had by that point already [been] in place for eight years. The applicant in Daly and the Defendant were both represented by O’Connell & Clarke Solicitors. It may be that the Defendant had the good fortune to be advised by solicitors who became alive to the point at some stage in 2016, as it was in their letter of 24 November 2016 that they first made the complaint of trespass on behalf of the Defendant.”

48. The plaintiff then went on in the written submissions to contend that s.48 of the Electricity Regulation Act 1999 “would have provided a mechanism whereby the plaintiff would have been able to lay the cable without the defendant’s consent”. Under that section, “[t]he power to lay electric lines..., may, with the consent of the Commission [for the Regulation of Utilities], also be exercised by the holder of an authorisation” within the meaning of the section. The plaintiff contended that it was the holder of such an authorisation in respect of a generating station connected with the windfarm. The plaintiff also submitted that it might have been possible to apply to the Commission for the Regulation of Utilities for an order providing for the compulsory acquisition of the land.

49. Mr Fanning accepted that “the issue fundamentally really is whether the remedy for Mr Cremins ought to sound in damages or whether it ought to sound in removal of the cable” [day 1, p.146, lines 6 to 8]. It was suggested that this issue should be determined first, with the question of compensation of the defendant by the plaintiff – if it were decided that the cables should stay in the ground – to be the subject of a further module. Counsel also said that the plaintiff would in that event agree to an arbitral process to decide the issue of compensation.

50. Mr Collins accepted that the first issue to be resolved was whether the cables should remain in the ground, submitting that they “should be removed forthwith”. He made sustained complaint about the way in which the plaintiff had approached the proceedings, stating that it was “absolutely clear that the plaintiff has approached this on the basis that the cable is not in fact on my lands” [day 1, p.151, lines 3 to 5]. Counsel also submitted that “the interlocutory injunction that was obtained in this case was obtained on the basis that this cable was laid outside my client’s lands”, pointing to para. 41 of Mr Maguire’s grounding affidavit, which commences with the averment “...the cables located in the grass verge *outside the defendant’s lands* serve nine of the turbines in the windfarm...” [emphasis added]. Mr Collins accepted that “some level of modularisation” was required “...because the [plaintiff’s] case has changed so fundamentally from the case that was brought, that it needs now to be reconstituted and brought properly...” [day 1, p.155, lines 7 to 14].

51. In addressing the way in which the plaintiff had approached the present proceedings in general and the injunctive applications in particular, Mr Fanning stated that the plaintiff wasn’t “overly keen to acknowledge a trespass...we were perhaps a little bit coy in the way we were putting it”. He submitted however that the way the case was being presented at hearing could not be seen as constituting “a significant change of position”, pointing out that s.48 of the grounding affidavit referred to the possibility that the defendant “is correct in asserting that he is suffering a trespass by reason of the installation of the cables...”, in which case “...any wrong he has suffered is capable of being compensated in monetary terms for the reasons already outlined”.

52. Counsel also points to letters written by the plaintiff’s solicitors to Mr Cremins suggesting arbitration in relation to compensating him. In its letter of 12 May 2021, in

between the grant of the interim injunction and the hearing of the interlocutory application, Messrs Mason Hayes & Curran on behalf of the plaintiff stated as follows:

“However, given the long history of the matter and the numerous failed negotiations between the parties, we are of the view that the best way to proceed would be to appoint an independent arbitrator to determine the issue of compensation on the basis that the electrical cables remain where they are. The arbitrator’s decision on compensation would be a legally binding decision on both parties. The advantages of arbitration is [sic] that it would be conducted in private and it is capable of facilitating a speedy decision making process in order to bring this matter to a close. As a gesture of good faith, our client has offered to reimburse reasonable legal fees incurred by you during the course of the arbitration process, to ensure that you would have adequate legal advice and that you are fairly represented”.

53. This offer was repeated by the plaintiff’s solicitors in letters of 18 May 2021 – the date of the grant of the interlocutory injunction – 28 May 2021 and 16 September 2021. The letters do not concede that there had been a trespass; counsel submits however that it is clear that the plaintiff’s approach was to accept that Mr Cremins was entitled to compensation as the price of the cables being left in the ground, the position that it ultimately adopted at the hearing.

Mr Maguire’s evidence

54. Mr Maguire gave evidence in relation to the matter generally and in particular in relation to a series of meetings he had with Mr Cremins in early 2021, after Mr Cremins had excavated the grass verge in December 2020, thereby removing the markers and exposing the cable. At that time, it appears that Mr Cremins was still

hopeful that the three turbines which were originally to be built on his land could still be erected. At a meeting on 25 March 2021, Mr Maguire confirmed to Mr Cremins that this could not be done. Mr Maguire stated that Mr Cremins told him that, in that case, the plaintiff had two choices: “You compensate me or you take the cable out of the ground”. The quantum of the compensation was then discussed, with Mr Cremins estimating damages in the region of €7m, and explaining the basis for the calculation [see day 2, pp. 39 to 41].

55. The negotiations were conducted without rancour or the aggressive tone adopted by Mr Cremins in his correspondence. In fact, Mr Cremins went out of his way in his evidence to compliment Mr Maguire on his approach to the negotiations. However, they did not bear fruit, and the plaintiff ultimately applied for injunctive relief in May 2021 as we have seen.

56. On cross-examination, Mr Maguire accepted that “it was only...during the creation of the affidavit that technically [sic] trespass was discussed ...up to that point, I didn’t know whether it was a trespass or not a trespass. I knew there was greyness now because of the case in 2017, but my understanding of what trespass was or wasn’t in this case, I didn’t know” [day 2, p.122, lines 3 to 9]. However, Mr Maguire subsequently acknowledges that “...[o]n advice, it was decided that this is a technical trespass and it needs to go into the affidavit” [day 2, p.122, lines 15 to 19].

57. Mr Maguire stated that he had informed Mr Cremins at their third meeting in March 2021 that the cable could be removed, but that this would involve obtaining planning permission, an environmental impact study would probably have to be commissioned, and that legal advice in relation to the entire operation would have to be procured. He states that Mr Cremins’ reaction was to say “...and I’ll object, I’ll object...” [day 2, p.138, line 25 to p.139, line 3]. Mr Maguire stated that removal of

the cable would “disrupt the operation of the windfarm”, and referred to figures relating to the disruption set out at para. 41 of his grounding affidavit. He also referred to the possible “knock-on” effect of other landowners insisting on removal of the cable from their lands, not only in the 3km along which this particular cable was laid, but potentially in respect of cables laid along the roadside in every windfarm operated by the plaintiff.

Mr Cremins’ evidence

58. Mr Cremins gave evidence in relation to his involvement with Mr Maguire (“a lovely person to deal with”) and to his correspondence in which he constantly sought an acknowledgement that trespass had taken place. He stated that the first time that this was acknowledged to him was on the first day of the hearing. He referred in detail to an email he sent to Mason Hayes & Curran on 6 May 2021 – the day after the grant of the interim injunction – which summarised Mr Cremins’ position at the time. As it is of some significance, and essentially represents Mr Cremins’ current position, I will quote it in full:

“1. I want SSE Airtricity to admit the grid cable under dispute, part of the Dromada Wind farm at Keale, Co. Limerick, is in Denis Cremins’ land.

Mason Hayes & Curran Solicitors who represent Dromada Windfarm have already, inadvertently, admitted this by putting the subject of their correspondence to me as ‘lands at LK3305F at Keale, Athea, County Limerick. This land folio title is under my name, Denis Cremins.

2. I want SSE Airtricity to confirm that they will immediately seal off the grid cable situated on my land, with my permission of course, either with high security fencing or by having a security firm engaged on the site so that no one gets injured or killed. As you can see from my engineer’s report yesterday

(5/5/21) which I have already emailed to you, she says this is an extremely dangerous site as a result of the live cables.

3. I would like you to confirm that you will immediately apply for planning for these grid cables on my land. However, should Dromada Windfarm fail to receive such a planning within twelve months (up until the end of April 2022) I want you to promise that you will remove the cables from land folio LK3305F.

If your answer is yes to the above three questions then we will secure the site immediately, you will apply for planning and subsequently remove the grid cable if the planning has not been granted on or before the 30th April 2022.

Provided that we are in agreement with all the above then:

1. I, Denis Cremins, will give permission for Dromada Windfarm to enter my land, folio no.: LK3305F to erect security fencing. A copy of the indemnity insurance will be required before entering.

2. I give my word that I will not object to any planning application for the grid cable that is on my land to any relevant authority, including but not limited to Limerick County Council and An Bord Pleanála.

3. I also give my word that I will not interfere with the grid cables located on my land (folio no.: LK3305F) and I will make this clear to the court as well.

As my engineer reported on 5 May 2021, this is an extremely dangerous site and it needs the full cooperation of both myself, Denis Cremins [sic] and SSE Airtricity to make it safe as soon as possible. Therefore, to protect the lives of people who may be coming on to the site now, partly as a result of the publicity this injunction has caused, please try to have the answers to the above three questions answered by the end of today, the 6th of May 2021. This

is not a time for playing games because I am getting extremely worried that someone might get killed as a result of this unauthorised grid cable. Again, I beg of you, Dromada Wind Farm Ltd to switch off the power, immediately, while we await a satisfactory outcome to the worrying ordeal that you have brought upon me.

Regards”

[Emphasis in original]

59. On cross-examination, it was put to Mr Cremins that the existence of the cable had no impact whatsoever on how he chose to use his lands between 2009, when they were laid, and 2016, when Mr Cremins discovered their existence. Mr Cremins stated that, had he known in 2009 that the cables were there, “...we’d have been probably in the courts in 2009 in relation to this” [day 3, p.54, lines 1 to 6]. He accepted that complaints he had made to Limerick County Council in 2012 in relation to the planning situation were for the purpose of bringing the plaintiff back to the negotiation table. He also agreed that “section 160 proceedings” had never been brought by him in relation to any perceived breach of planning laws, nor had the Council ever commenced any such action against the plaintiff.

60. Mr Cremins was asked about the 2017 proceedings. He accepted that the reliefs included a claim for damages, that the plenary summons did not seek an order that the cables be removed, and that the proceedings have not been progressed in any way. He accepted that he “took [matters] into his own hands” by writing letters rather than getting on with the 2017 litigation. However, he did not agree that his threats to dig up the cable were “unnecessary and inappropriate, or intended to escalate matters to put pressure on the plaintiff...” [day 3, p.83, lines 3 to 23]. He accepted that he was

trying to get the plaintiff's attention in the correspondence ("of course I wanted attention").

61. Towards the end of the cross-examination of Mr Cremins, counsel specifically asked Mr Cremins whether his "repeated threats to personally dig up the cable were 'unnecessary and unsafe and inappropriate'". Mr Cremins said "...they were unsafe but they weren't unnecessary because I was left with no other option to bring you to the table..." [day 3, p.109, lines 1 to 13].

Evidence of Nora Curtin

62. Ms Nora Curtin gave evidence on behalf of Mr Cremins. She stated that she was a civil engineer in Newmarket, County Cork, and had been in private practice for "about eighteen years". Ms Curtin averred that she had a "planning business" which she had operated for eighteen years, submitting planning applications on behalf of individuals to planning authorities.

63. She averred to having attended the property in October 2016 and to having seen the cable. She stated that Mr Cremins wanted her to confirm that the cable was within his folio. Her evidence was that she had ordered Land Registry maps and satisfied herself that these maps gave ownership to Mr Cremins "to the centre of the public road". It is notable that the first allegation of trespass on the part of the plaintiff came in a letter from O'Connell & Clarke Solicitors of the following month on behalf of Mr Cremins.

64. Ms Curtin was again instructed in 2021, at which point she caused a satellite survey to be carried out. In a report of 19 April 2021 which was exhibited to Mr Cremins' affidavit in opposition to the interlocutory injunction application, she expressed herself as "extremely taken aback when [Mr Cremins] informed me he had exposed the electric cable and that SSE Airtricity had come back to his property and

unloaded stone on top of the recently exposed high voltage cable without his consent”.

65. In truth, Ms Curtin’s evidence was adduced primarily for the purpose of establishing that the cables were laid within Mr Cremins’ lands, a matter which had been conceded by counsel for the plaintiff in his opening of the case. Her report is quite cursory, and it does not seem to me that it is of much assistance to the court in relation to the issue of whether or not the cables should be removed.

Legal principles

66. The facts give rise to an important and interesting issue: where a party has tortiously interfered with the land of another, is it ever appropriate to grant the tortfeasor injunctive relief to preserve the effect of the tort, and if so, in what circumstances?

67. In *Patterson v Murphy* [1978] ILRM 85, the plaintiffs, who were musicians, instituted proceedings for damages and an injunction arising from the operation of a nearby quarry. Having heard the evidence, Costello J (as he then was) found that the plaintiffs had established acts of nuisance to a serious degree arising from the emanation of noise and dust from the quarry and from the emanation of noise and dust from a laneway along which lorries travelled to and from the quarry. The plaintiffs “were, in effect, driven out of their home”...and “were not displaying any exaggerated degree of sensitivity in acting as they did” [p. 95].

68. The defendants contended that, even if the plaintiffs’ rights had been infringed, the court had a discretion to award damages in lieu of an injunction, and should do so in that case. Costello J accepted that the court had a discretion whether or not to grant relief by way of injunction, but stated that there were “well established principles” in this regard, which he summarised as follows:

“1. When an infringement of the plaintiffs’ right and a threatened further infringement to a material extent has been established the plaintiff is *prima facie* entitled to an injunction. There may be circumstances however, depriving the plaintiff of this *prima facie* right but generally speaking the plaintiff will only be deprived of an injunction in very exceptional circumstances.

2. If the injury to the plaintiff’s rights is small, and is one capable of being estimated in money, and is one which can be adequately compensated by a small money payment, and if the case is one in which it would be oppressive to the defendant to grant an injunction, then these are circumstances in which damages in lieu of an injunction may be granted.

3. The conduct of the plaintiff may be such as to disentitle him to an injunction. The conduct of the defendant may be such as to disentitle him from seeking the substitution of damages for an injunction.

4. The mere fact that a wrong-doer is able and willing to pay for the injury he has inflicted is not a ground for substituting damages. (See: *Shelfer v City of London Electric Lighting Company* [1895] 1 Ch 287; and Kerr on Injunctions 6th Edition pp. 656, 657).”

69. In *Shelfer v City of London Electric Lighting Company* [1895] 1 Ch 287, to which Costello J made reference, an electric lighting company erected powerful engines and other works on land near a house which was subject to a lease. Due to excavations for the foundations of the engines, and to vibration and noise emanating from them, structural injury was caused to the house, and annoyance and discomfort to the lessee, who brought an action against the company for an injunction and damages. The trial judge accepted that there was a continuing nuisance as regards the

lessee, and structural injury to the house, but he held that the lessee – and the reversioners, who also sued – were entitled to damages but not an injunction.

70. The plaintiffs appealed, and the Court of Appeal held that the refusal of the injunction by the trial judge was unwarranted, and that the appeal must be allowed. In his judgment Lindley LJ referred at p.315 to Lord Cairns' Act (21 & 22 Vict C27) – an Act of 1858 which conferred on the Court of Chancery in Ireland the jurisdiction to award damages in lieu of specific performance: in this regard see the dicta of Laffoy J. in *McGrath v. Stewart* [2016] 2 IR 704, para. 31 – s.2 of which “conferred upon the Court of Chancery jurisdiction which it had not before to award damages in lieu of an injunction”. In relation to the exercise of the jurisdiction, Lindley LJ commented as follows (at pp.315-316):

“The jurisdiction to give damages instead of an injunction is in words given in all cases...there appears to be no limit to the jurisdiction. But in exercising the jurisdiction thus given attention ought to be paid to well settled principles; and ever since Lord Cairns' Act was passed the Court of Chancery has repudiated the notion that the legislature intended to turn that court into a tribunal for legalising wrongful acts; or in other words, the court has always protested against the notion that it ought to allow a wrong to continue simply because the wrongdoer is able and willing to pay for the injury he may inflict. Neither has the circumstance that the wrongdoer is in some sense a public benefactor (e.g., a gas or water company or a sewer authority) ever been considered a sufficient reason for refusing to protect by injunction an individual whose rights are being persistently infringed...[w]ithout denying the jurisdiction to award damages instead of an injunction, even in cases of continuing actionable

nuisances, such jurisdiction ought not to be exercised in such cases except under very exceptional circumstances...”.

71. In his judgment, AL Smith LJ commented at p.321 of the judgment that “...there is no suggestion of any conduct on the Plaintiff’s part depriving him of his prima facie right to an injunction”. He went on to state as follows (at p.322):

“Many judges have stated, and I emphatically agree with them, that a person by committing a wrongful act (whether it be a public company for public purposes or a private individual) is not thereby entitled to ask the Court to sanction his doing so by purchasing his neighbour’s rights, by assessing damages in that behalf, leaving his neighbour with the nuisance, or his lights dimmed, as the case may be.

In such cases the well-known rule is not to accede to the application, but to grant the injunction sought, for the plaintiff’s legal right has been invaded, and he is prima facie entitled to an injunction.

There are, however, cases in which this rule may be relaxed, and in which damages may be awarded in substitution for an injunction as authorised by this section.

In any instance in which a case for an injunction has been made out, if the plaintiff by his acts or laches has disentitled himself to an injunction the court may award damages in its place. So again, whether the case be for a mandatory injunction or to restrain a continuing nuisance, the appropriate remedy may be damages in lieu of an injunction, assuming a case for an injunction to be made out.

In my opinion, it may be stated as a good working rule that –

(1) if the injury to the plaintiff’s legal rights is small,

- (2) and is one capable of being estimated in money,
- (3) and is one which can be adequately compensated by a small money payment,
- (4) and the case is one in which it would be oppressive to the defendant to grant an injunction:
then damages in substitution for an injunction may be given...

It is impossible to lay down any rule as to what, under the differing circumstances of each case, constitutes either a small injury, or one that can be estimated in money, or what is a small money payment, or an adequate compensation, or what would be oppressive to the defendant. This must be left to the good sense of the tribunal which deals with each case as it comes up for adjudication...".

72. Reference was also made to *Shelfer* in the judgment of Feeney J in *McKeever v Hay & Ors.* [2008] IEHC 145. In that case, pipes had been laid across the verge of a public road off the main Carrickart to Downings road in County Donegal which cut across the plaintiff's lands. The purpose of the pipes was to provide a water supply to houses on Island Roy, a small island off the coast of County Donegal. The plaintiff was an owner of one of the folios in "The Commonage", the name under which the land along which the pipes were laid was locally known, and she issued proceedings seeking an injunction and damages in respect of what she alleged was a trespass upon her lands without her consent.

73. At p.15 of the judgment, Feeney J commented that "...the plaintiff...created a situation where the group [of which the defendants were representatives] was able to proceed on a misapprehension that all consents could be obtained. The facts of this case do not demonstrate a wanton interference with the plaintiff's rights nor were the

group's actions oppressive or vindictive. They carried out the works at a time when they truly had a belief that the plaintiff would ultimately consent".

74. However, it was clear that the placing of the waterpipes resulted in a continuing trespass, notwithstanding that the pipes were laid on behalf of Donegal County Council. The Council had instituted compulsory purchase procedures that would result in the land where the pipes were situated being acquired compulsorily. Accordingly, Feeney J awarded damages for €7,500 for trespass up to the date of compulsory acquisition. Feeney J stated at p.31 that the court

"...is satisfied that no injunction should be granted until the final completion of the compulsory purchase process and then only if that process does not result in final orders. That process has the capacity to ensure that legal permission and authorities in place for such pipes to remain and that appropriate and proper compensation has been identified and paid. This Court is satisfied that the implementation of any injunction must be postponed to allow and permit that process proceed to completion...if the compulsory purchase order process does not result in the way-leaves being obtained then a period of time would still be required to ensure that the residents of the Island Roy could arrange alternative water supply. This Court must recognise that to grant an injunction which would come into effect without providing adequate time to provide alternative water supplies would be oppressive".

75. In his judgment, Feeney J cited the principles set out by Costello J in *Patterson* set out at para. 68 above, and confirmed that, notwithstanding that *Patterson* was a nuisance case, those principles were "also relevant for the purpose of this case". The court confirmed that "...the starting point for consideration by this Court is that the plaintiff is *prima facie* entitled to an injunction. In such

circumstances the plaintiff will only be deprived of her entitlement to such injunction if very exceptional circumstances are identified. This is particularly so where the infringement is in the form of trespass rather than nuisance". [p. 25].

76. In addressing the principle enunciated by Costello J that if the injury to the plaintiff's rights is small and is capable of being estimated in money and can be adequately compensated by a small payment, Feeney J – significantly in the context of the present case – stated as follows: -

“...However, the mere fact that damage is small is not of itself decisive. If a court comes to the conclusion that the plaintiff's property will remain substantially as useful to the plaintiff as before the act complained of, and does not take the property away from him and the injury can be compensated by money, then an injunction need not necessarily be granted. The court may still grant an injunction if the facts are such as to indicate that the court should exercise its discretion to do so...” [pp. 26-27].

77. Feeney J indicated his intention to follow “the well-established principles” identified by Costello J in *Patterson v Murphy* and reiterated by Millett LJ in *Jaggard v Sawyer & Anor* [1995] 1 WLR 269:

“When the plaintiff claims an injunction and the defendant asks the court to award damages instead, the proper approach for the court to adopt cannot be in doubt. Clearly the plaintiff must first establish a case for equitable relief, not only by proving his legal right and an actual or threatened infringement by the defendant, but also by overcoming all equitable defences such as laches, acquiescence or estoppel. If he succeeds in doing this, he is prima facie entitled to an injunction. The court may nevertheless in its discretion withhold injunctive relief and award damages instead” [p.287].

78. There is no significant disagreement between the plaintiff and the defendant in the present case that the principles set out above govern their dispute, although they differ as to the application of those principles. There is therefore a roadmap for this Court as to the factors to be considered as to what should be done with the cables. However, the plaintiff draws attention to the following dicta of Millett LJ in *Jaggard v Sawyer*:

“Reported cases are merely illustrations of circumstances in which particular judges have exercised their discretion, in some cases by granting an injunction, and in others by awarding damages instead. Since they are all cases on the exercise of a discretion, none of them is a binding authority on how the discretion should be exercised. The most that any of them can demonstrate is that in similar circumstances it would not be wrong to exercise the discretion in the same way. But it does not follow that it would be wrong to exercise it differently...” [p. 288]

Analysis

79. In the plaintiff’s statement of claim, the plaintiff claims declaratory relief that the defendant be prevented from interfering with or damaging the plaintiff’s plant and equipment (reliefs 1 and 2), and reliefs 4 to 6 seek injunctive relief in this regard. The third paragraph of the reliefs is as set out at para. 40 above, *i.e.*, a declaration that, if the defendant is entitled to relief in relation to the cables, that the relief be limited to damages.

80. The defendant drafted his own defence which, as I have previously commented, is effectively a defence and counterclaim. While expressed as “declarations”, the first three reliefs clearly seek injunctive relief directed at the removal of the cables from the defendant’s land:

“1. A declaration that the plaintiff removes the 20000 KV live cable within my land in folio No.: LK3305F immediately as these live 20000 KV cables were laid on my land without my knowledge or permission.

2. A declaration that the plaintiff will reinstate my land to its original habitat.

3. A declaration that the plaintiff will reapply for planning for the Drommada windfarm [sic] as a number of the turbines built are as a result of having an option over my lands at the time when planning was granted in 2003. These turbines are now only 60 metres from my boundary. This would not have been possible without my land being a part of the original planning permission. These turbines are causing massive noise and shadow flicker as a result of being so close to my property.”

81. The plaintiff has now accepted that the cables are laid in the plaintiff’s land, and that it has committed what it calls a “technical trespass”. Applying the principles approved by Costello J in *Patterson*, the defendant is therefore *prima facie* entitled to the injunction he seeks. It falls to this Court however to determine whether there are circumstances which should cause this Court to exercise its discretion to refuse the defendant an injunction. As the third principle set out by Costello J makes clear, the conduct of both parties must be examined in the exercise of the court’s discretion.

The Conduct of the Parties

82. The defendant appears only to have become aware of the existence of the cables in 2016, some seven years after they had been installed. He instructed solicitors who, from their first letter of 24 November 2016, clearly intimated that the cabling works constituted trespass. When the trespass was repeatedly denied by the defendant, the defendant issued proceedings in September 2017: see paras. 20 to 23 above. If those proceedings had been prosecuted by the defendant, the issues in the present

proceedings might well have been resolved, whether by agreement or order of the court, by this stage.

83. However, for whatever reason, having issued the 2017 proceedings, the defendant made no attempt to progress them, and there does not appear to have been any significant contact between the parties until June 2019, when Mr Cremins wrote the letter of 13 June 2019, the text of which is at para. 24 above. This was followed by repeated emails to the plaintiff and to officials of its ultimate parent company in which the defendant repeatedly threatened to remove the cables, and stated that the plaintiff or its affiliates would be responsible for any injuries or fatalities that would occur.

84. What might have seemed an idle threat on the part of the defendant took on a different aspect when, in December 2020, the defendant excavated the verge using a digger and exposed some of the plaintiff's cable, so that the plaintiff had to send out operatives to cover up the cable with stone chippings and erect additional marker posts. This led to a number of meetings between representatives of the plaintiff and Mr Cremins until Mr Cremins renewed his threats to remove the cables, which in turn led to the plaintiff's application for injunctive relief.

85. At the point of issue of the proceedings in 2017, Mr Cremins' conduct had been appropriate and even commendable. He correctly asserted that the plaintiff was trespassing on his land; when this was denied by the defendant, he issued proceedings, although it is notable that the 2017 proceedings did not seek the removal by the plaintiff of the cables. However, instead of progressing these proceedings, he embarked, from June 2019 onwards, on a campaign of emails which did him no credit. His evidence in court was that he wanted to get the plaintiff's attention; it is very clear that what he was trying to do was to avoid the legal process altogether, and

to force the defendant to negotiate with him on his terms. He did so by means of threats to remove the cables in the knowledge that such a manoeuvre was extremely dangerous, and would be seen as such by the plaintiff; that he acknowledged in his emails the possibility of injury or fatality arising, yet repeatedly asserted his intention to go ahead with the removal, shows his intention to intimidate and coerce the plaintiff into negotiation. The threats became all the more serious when he exposed the cables in December 2020.

86. This course of action ultimately forced the plaintiff into seeking the injunctive relief it was granted by Allen J. As counsel for the plaintiff pointed out, the plaintiff is not a “natural” plaintiff in the current circumstances, having committed trespass; the 2017 proceedings more accurately reflect the respective positions of the parties. However, it is difficult to criticise the decision of the plaintiff to seek injunctive relief, given the actions of the defendant.

87. Although the defendant did not seek removal of the cables by the plaintiff in the 2017 proceedings, seeking “damages for nuisance and trespass” instead, he now seeks an order in this regard by way of counterclaim. Whether the defendant actually wants the cables removed, and perhaps re-routed in another direction, must be open to doubt. The defendant has consistently attempted to agree monetary compensation with the plaintiff, and his contention is that compensation would amount to a substantial seven-figure sum. It is difficult to avoid the conclusion that money is what the defendant wants, particularly given the complete lack of evidence that the installation of the cables has impeded his use or inhibited his enjoyment of the lands in any way. An order that the plaintiff remove the cables – a situation which would cause serious problems for the plaintiff – would improve his bargaining power considerably.

88. However, as Costello J pointed out in *Patterson*, the conduct of both parties must be taken into account. There are reprehensible aspects to the conduct of the plaintiff also. It is not known whether the plaintiff sought legal advice on receipt of the correspondence, from November 2016 onwards, from O'Connell & Clarke, a well-known firm of solicitors specialising in environmental matters, intimating that Mr Cremins owned the land in which the cables were laid. One would have thought that the receipt of the 2017 proceedings at least would have caused it to do so.

Likewise, one assumes that the legal position would have been reviewed on the receipt of a barrage of emails from Mr Cremins from mid-2019 onwards, asserting that the plaintiff had trespassed on his lands. In particular, the receipt of Ms Curtin's report by a solicitor's letter of 19 April 2021, to which I have referred at para. 30 above, must have caused the plaintiff to review its position, if it had not done so already.

89. By the time the plaintiff initiated the present proceedings, it is in my view clear that the plaintiff was aware that the cables constituted a trespass on Mr Cremins' lands. Mr Maguire all but acknowledged this in his oral evidence: see para. 56 above. While his affidavit did not explicitly address the question of ownership, the averment at para. 41 of the grounding affidavit of Mr Maguire, to which I have referred above, suggested that Mr Cremins did not own the grass verge. It set out all the steps taken by the plaintiff to prepare for the installation, and gave a clear impression that all appropriate steps had been taken by the plaintiff. The farthest the affidavit went as regards acknowledging a possible right on the part of Mr Cremins was in para. 48 of Mr Maguire's first affidavit, and para. 24 of his second affidavit: see paras. 36 and 37 above.

90. Counsel for the plaintiff conceded that the approach of the plaintiff in relation to the question of ownership was “coy” and “jesuitical”; counsel attributed this attitude to the fact that “Mr Cremins is the sort of litigant, unfortunately...if you give him an inch he tends to take a mile...” [day 1, p.159, lines 14 to 17]. In fairness to the plaintiff, the correspondence in which Mr Cremins vigorously asserted that a trespass had occurred was exhibited to Mr Maguire’s first affidavit, and the court was therefore apprised by the plaintiff of Mr Cremins’ position that a trespass had taken place. While it was perhaps understandable for tactical reasons to wish not to make concessions to Mr Cremins until it was absolutely necessary to do so, this led to an approach in the affidavits grounding the injunction which, it must be said, did not “front up” about the position regarding ownership, was less than frank, and skirted the boundary of misleading the court. Indeed, it seems extraordinary that the first occasion on which the plaintiff conceded that it had trespassed on Mr Cremins’ lands was the first day of the hearing before this Court.

Are the plaintiff’s proceedings still viable?

91. As the open concession that trespass had in fact occurred was made by the plaintiff for the first time at the hearing, counsel for the defendant submitted vehemently that the plaintiff’s proceedings, which he contended were based on the plaintiff’s entitlement to lay the cables in the grass verge, could not now be maintained and would have to be “reconstituted and brought properly”: see para. 50 above.

92. The first two reliefs sought in the plaintiff’s plenary summons and statement of claim are for declaratory reliefs in relation to the issue of whether or not the defendant should be prevented from interfering with or damaging the cables. The third relief, set out at para. 40 above, sought a declaration that any claim the plaintiff might

have be limited to damages. The fourth, fifth and sixth reliefs sought specific injunctive orders restraining interference with the cables or the windfarm generally.

93. Paragraphs 7 and 8 of the statement of claim – corresponding to para. 8 and 9 of the plenary summons, which has no para. 7 – contain the substantive causes of action on which the plaintiff relies, and are as follows:

“7. Damages for interference or threatened interference with the plaintiff’s property, and with the plaintiff’s economic interests.

8. Damages for nuisance”.

94. The plaintiff submits that, even if the cables constitute a trespass on the defendant’s land, the defendant is not entitled to interfere with the cables and, in the words of the plaintiff, has “no entitlement to avail of self-help remedies” [written submissions para. 59]. The plaintiff relies in this regard on the decisions of the Court of Appeal of England and Wales in *Arthur v Anker* [1997] QB 564 and *Vine v Waltham Forest LBC* [2000] 1 WLR 2383, both of which concerned clamping of motor vehicles which were trespassing on private lands. In the latter case, the Court of Appeal found that the act of clamping a car, in circumstances where there was no statutory basis for doing so and where it could not be shown that the owner of the car had consented to or willingly assumed the risk of being clamped, was a tortious act of trespass to the car owner’s property, notwithstanding the original trespass by the car owner.

95. The plaintiff in the present case maintains that it had operated on a mistaken basis, in laying the cables in the grass verge, that it was not infringing on the defendant’s lands, and that in those circumstances, the interference by the defendant with the cables in December 2020 and his campaign of threats to interfere with the

cables unless the plaintiff negotiated with him constituted an actionable interference with the plaintiff's economic interests.

96. It seems to me that, even if the defendant had not threatened to remove the cables or interfered with them in December 2020, but had sought an order in his own proceedings that the plaintiff remove the cables, it would have been open to the court, while acknowledging the defendant's *prima facie* right to an injunction to restrain trespass, to refuse the injunction and confine the plaintiff to a claim in damages. It would seem to follow therefore that the defendant did not have the right to take matters into his own hands and threaten and indeed partially implement a course of action which could have had dangerous and life-threatening consequences, even leaving aside the economic damage to the plaintiff that removal of the cables would inflict.

97. I accept that there will of course be occasions on which a landowner who is the victim of a trespass or nuisance may take reasonable steps to abate or reduce the effect of any such actions with a view to asserting his rights and minimising his loss, or making his land safe. In the present case, there is no evidence whatsoever of any actual loss suffered by the defendant. Between 2009 and 2016, he was unaware of the existence of the cables, which did not interfere in any way with his use or enjoyment of the land. Even when he did discover their existence, and after raising the issue of trespass and finding it denied by the plaintiff, he issued the 2017 proceedings, and did not seek an order of removal of the cables, but sought damages instead. It is clear to me that his interference with the cables and threats to remove them were for the purpose of – as he characterised it himself – getting the attention of the plaintiff so that a settlement could be negotiated by a non-legal route.

98. In the circumstances, it seems to me that, even though a trespass by the plaintiff has occurred, the plaintiff has a stateable cause of action against the defendant which is capable of grounding an application for a permanent injunction. As counsel for the plaintiff has commented – see para. 43 above – the plaintiff’s objective is to ensure that Mr Cremins cannot interfere with the plaintiff’s cable and to obtain a court order to that effect. I do not accept that the plaintiff’s acceptance that a trespass has occurred is fatal to its proceedings, although the circumstances in which this concession was made are a matter which have a bearing on the exercise of the court’s discretion. Of course, it must be reiterated that Mr Cremins, as the “trespasee”, has a *prima facie* right to restrain the trespass and seek the removal of the cables.

Exercise of the court’s discretion

99. Both parties accept that the pressing issue that must be decided is whether or not, as the plaintiff urges, the cables be left where they are, or whether, as the defendant contends, the plaintiff be ordered to remove them. In the former case, the plaintiff accepts that it must compensate the defendant, and envisages quantifying the compensation in a further module in these proceedings, or by mediation or arbitration. However, the plaintiff essentially asks the court to permit the continuance of its trespass.

100. The fourth of the principles set out by Costello J in *Patterson* emphasises the unwillingness of the courts to countenance a wrongdoing simply because the wrongdoer is in a position to pay damages in compensation. As the High Court stated in *Allied Irish Banks plc v Diamond* [2012] 3 IR 549, the courts have always sought to guard property rights, particularly in the context of interlocutory injunctions. Clarke J (as he then was) vividly set out the rationale for this principle:

“Even though there may be a sense in which it may be possible to measure the value of property lost, declining to enforce property rights on the basis that the party who has lost its property can be compensated in damages would amount to a form of implicit compulsory acquisition. If someone could take over my house and avoid an injunction on the basis that my house can readily be valued and he is in a position to pay compensation to that value (even together with any consequential losses), then it would follow that that person would be entitled, in substance, to compulsory acquire my house. The mere fact that it may, therefore, be possible to put a value on property rights lost does not, of itself, mean that damages are necessarily an adequate remedy for the party concerned is entitled to its property rights instead of their value”. [P. 590].

101. In my view, the circumstances of the present case are quite distinct from the sort of situation envisaged by Clarke J in this passage. I do not think the actions of the plaintiff in laying the cables in land owned by the plaintiff could be characterised as wilful or reckless. The plaintiff attempted to negotiate a situation where three turbines and the cables could be placed on the defendant’s lands. This negotiation proved unsuccessful. Mr Maguire set out the plaintiff’s reasons for laying the cables along the roadside, and to steps taken to ensure that this was done in accordance with what the plaintiff considered to be appropriate measures, e.g. obtaining the consent of the road authority pursuant to s.13(10) of the Roads Act 1993. Mr Maguire testified as to the genuine belief of the plaintiff that it had adopted the proper procedures to progress the development. I have no reason to doubt his evidence in this regard, nor is there any basis in evidence to suspect that the plaintiff laid the cables where it did in an opportunistic fashion, knowing that it was committing a trespass in doing so. In the

words of Feeney J in *McKeever v. Hay* “there was no wanton interference with the [defendant’s] rights”.

102. The defendant complained of the trespass for the first time in 2016, some seven years after the cables had been installed. On receiving an unsatisfactory response from the plaintiff, he initiated the 2017 proceedings, but did not, as part of the reliefs set out in the summons, seek an order directing the plaintiff to remove the cables. These proceedings were not advanced in any way, and the defendant did not seek an order in this regard until service on 31 August 2021 of what is effectively his defence and counterclaim.

103. The plaintiff contends that this inaction on the part of the defendant constitutes laches, which should result in a refusal of the claim by him for an order that the cables be removed. Whether or not that is the case, I am of the view that the failure to prosecute the 2017 proceedings and the campaign waged by the defendant from June 2019 onwards make it clear that the intention of the defendant was to force the plaintiff to the negotiating table so that a monetary settlement could be concluded. I do not accept that the defendant had genuine concerns about safety issues relating to the location of the cables, which had been undisturbed and, it appears, unnoticed between 2009 and 2016.

104. It also seems to me to be the case that the only issues in relation to safety arose because of the threats by the defendant and his action in exposing the cables in December 2020. The unopposed evidence of Mr Maguire suggests that the cables pose no threat as regards safety if left underground. The trespass undoubtedly constituted an interference with Mr Cremins’ rights; however, there was no evidence of any practical consequences for the use or enjoyment by him of land which was either afforested or unused.

105. As against that, there is reason to be sharply critical of the manner in which the plaintiff conducted itself in its dealings with Mr Cremins. It incorrectly asserted, in the initial correspondence of Mr Cremins, that there was no trespass. This evolved into a more equivocal stance, culminating in an application for injunctive relief in which the plaintiff never clarified its position as to whether or not it had committed a trespass. If Mr Cremins had forced the issue and contested the interlocutory injunction, rather than acquiescing in it, the plaintiff would have had to acknowledge the trespass openly, and the court might well have had hard things to say about the manner in which the plaintiff approached the application.

106. There have been aspects of the behaviour of both parties which have been unattractive, to say the least. While I deprecate the manner in which the plaintiff approached the issue of trespass in the injunction application, I do consider that Mr Cremins' behaviour in threatening to interfere with the cables required action, and to that extent I accept that the plaintiff's application was justified. The issue now is as to whether the order made on an interlocutory basis should be continued.

107. As regards the second of the principles set out by Costello J in *Patterson* – see para. 68 above – the injury to Mr Cremins' rights could be said to be small, in the sense that there has been little or no interference with his use or enjoyment of the lands. As against that, there has been a significant trespass on his land, with the laying of high voltage cables across it. This Court has no evidence to assist it as to whether a “small money payment” would adequately compensate Mr Cremins; he is vehemently of the view that he is entitled to substantial compensation.

108. The court must also consider whether it would be oppressive to the plaintiff to order that the cables be removed. The evidence before the court of Mr Maguire in this regard is set out at para. 57 above; that the cable could indeed be removed, but that

this would involve obtaining planning permission, an environmental impact survey, and legal advice, with very substantial costs accruing daily. The Order would likely render the plaintiff in breach of its contractual obligations to EirGrid.

109. There is no indication before the court of how long all of this would take.

However, it is clear that removal of the cable would cause enormous disruption to the operation of the windfarm while a route around the 250m of Mr Cremins' property was found, in addition to the significant financial losses. Also, the "elephant in the room" – to use that hackneyed phrase – is the possibility of other landowners along the 3km route also insisting on removal of the cables from their respective portions of the grass verge in the hope of exerting pressure on the plaintiff with a view to negotiating substantial compensation, and also the calamitous possibility of similar orders being sought and made in each situation in which a windfarm – whether owned by the plaintiff or not – has laid a cable along a public road.

Conclusions

110. As the case law makes clear, each case must be decided on its own facts. The conduct of neither party in the present case has been beyond reproach. It seems to me however that the appropriate and just result is that no order should be made directing the plaintiff to remove the cables, but that appropriate orders should be made with a view to establishing the compensation to be paid to the defendant by the plaintiff for its admitted trespass.

111. I am particularly influenced in this conclusion by four overarching factors:

- (i) it does not appear to me that the plaintiff was aware that it was trespassing on the defendant's land when it laid the cables in 2009;
- (ii) the defendant has not been able to point to any particular interference with his use or enjoyment of the lands;

- (iii) the motivation of the defendant has always been to extract maximum compensation from the plaintiff, rather than any serious concern over safety;
- (iv) there would be profoundly disproportionate consequences for the plaintiff if the removal of the cables were ordered.

112. The defendant is the victim of trespass, and deserves to be compensated. This Court expresses no view as to whether that compensation should be large or small. However, both parties agree that, in the event that the court does not order removal of the cables, a mechanism or further module must be put in place to assess compensation. It also seems to me that any such module would have to address the issue of the terms upon which the cables would remain on Mr Cremins' land, and the respective rights and obligations of the plaintiff as the owner of the cables, and the defendant as the owner of the land in which they are laid.

113. I will therefore allow the parties a period of 10 days from the date of delivery of this judgment to give them an opportunity to make written submissions of not more than 2000 words in relation to the orders to be made, in particular addressing:

- (a) the issue of whether the interlocutory order, which remains in place for the moment, should be made permanent;
- (b) the issue of whether an order should or can be made granting access to the plaintiff to the cables for the purpose of matters such as repair or maintenance, and if so, on what terms;
- (c) the arrangements for a further module in relation to compensation, or
- (d) agreed directions as to mediation or arbitration; and
- (e) the costs of the proceedings.

114. The parties must observe the word limit set out above; longer submissions will not be accepted, nor will any attempt to reargue any of the issues addressed above. I

reserve the right to convene a hearing in relation to the orders to be made if I deem it necessary, but my intention is that any such hearing would take place before the end of this term.