

Second Stage Public Consultation on Draft County Development Plan I-LOFAR, Radio Astronomy and Radio Frequency Interference

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Second Stage Public Consultation on Draft County Development Plan

I-LOFAR, Radio Astronomy and Radio Frequency Interference

An addendum to the first stage public consultation submission, (ref. CDP PD40 and dated 27th Sept. 2019), made on behalf of the I-LOFAR Consortium* to Offaly County Council in relation to the Offaly County Development plan 2021-2027.



*The I-LOFAR consortium comprises the following institutions:

- Trinity College Dublin
- NUI Galway
- Dublin Institute for Advanced Studies
- Dublin City University
- Armagh Observatory
- University College Cork
- University College Dublin
- Athlone Institute of Technology

Introduction

The Irish Low Frequency Array (I-LOFAR; [1]) is a sensitive radio telescope located in Birr, Co Offaly. I-LOFAR is a national facility that has received nearly €3 million in support from Science Foundation Ireland, Offaly County Council, private donors and eight partner universities in Ireland and Northern Ireland. It also is a vital component of a major €150 million European radio telescope network that includes eight international partners and will soon become a European Commission European Research Infrastructure Consortium (ERIC) project.

I-LOFAR is a designated “Radio Observatory” registered with the International Telecommunication Union (ITU; [2]) to protect the service from interference [3, 4]. The telescope is used to measure radio waves in the frequency range of 10-270 MHz from faint astronomical objects that are at great distances from the Earth.

Radio astronomy, because of its passive nature and because of the sensitivity of its measurements, needs special consideration as far as terrestrial radio emissions are concerned. For transmitters on the Earth’s surface, if limits on unwanted emissions do not afford sufficient protection for radio astronomy, mitigation of interference can, in some cases, be provided, for example, through terrain shielding; by the establishment by administrations of coordination, protection or exclusion zones; and by other provisions of the International Telecoms Union Radio Regulations Articles 15 and 29 relative to radio astronomy observatories.

Radio astronomy involves the detection of the very weakest signals from very distant radio sources, often billions of light years away. **Due to I-LOFAR's extreme sensitivity, it is vulnerable to interference (even as a result of low power emissions) from terrestrial sources such as wind turbines, photo-voltaic inverters and emissions from switching electronics such as are used in LED lighting. Although such systems are not intended to be radio transmitters, they in fact emit radio energy over a broad range of frequencies causing unwanted radio noise or pollution.**

In addition to their main power generators and conversion equipment which emit radio energy as described above, wind power generators may also use computerised and networked control and telemetry equipment that may be covered by e.g. the recommendations provided in International Telecoms Union Recommendation ITU-R SM.329-12.

The I-LOFAR consortium has already made a submission on the County Development plan on 27th Sept. 2019 (ref. CDP PD40) on radio interference and the I-LOFAR radio telescope. This document is an addendum to that submission as well as comment on the Stage 2 draft of the County Development plan.

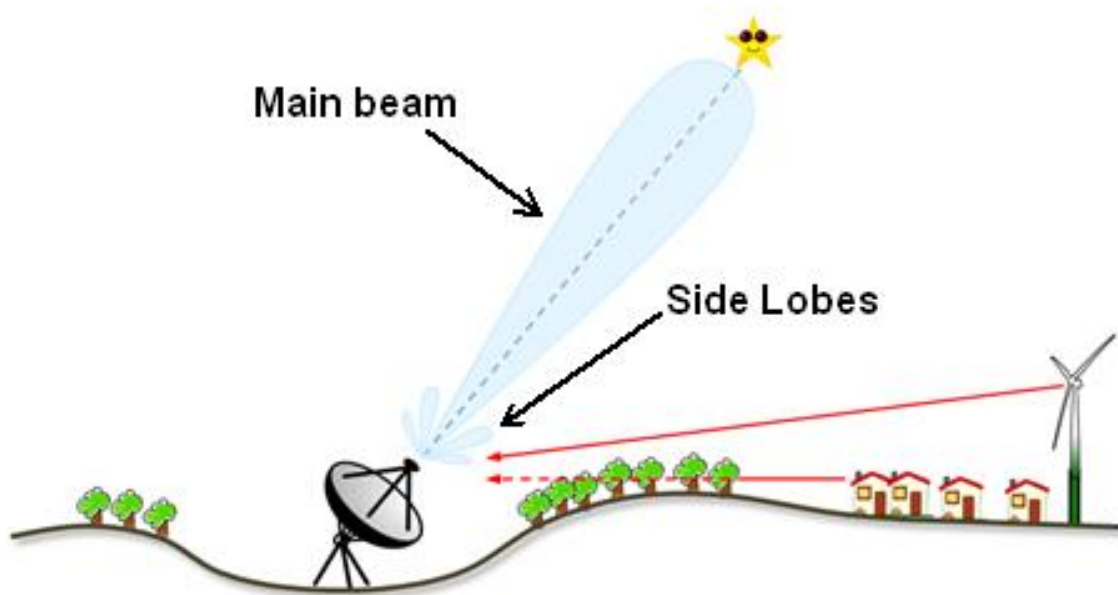


Fig. 1.1 - Direct terrestrial interference to a radio telescope from a wind turbine. The negative impacts of a wind turbine can be minimised by keeping the turbine at least 5 km away from I-LOFAR.

Interference Scenarios

Fig. 1.1 shows one interference scenario where the telescope beam¹ is pointed to an astronomical source. Any radio telescope antenna has a main beam which is where the telescope is most sensitive and several side lobes. Although the side lobes are less sensitive than the main beam, radio interference from a terrestrial source such as a wind turbine generator or a photo-voltaic inverter is at a much higher power level than any astronomical source that can be observed. This means that such terrestrial interference sources directly entering the side lobes can ruin observations.

Another possible interference scenario is where an unwanted signal is reflected from the elevated turbine structure into either the main beam or side lobes.

In both cases, separation distances as large as feasible coupled with low nacelle elevation in the case of a turbine are critical to minimise the impact of such systems.

Offaly County Development Plan 2021-2027: Draft Stage County Wind Energy Strategy

Table 3, section 7 of the current draft County Wind Energy Strategy refers to the Irish Low Frequency Array (I-LOFAR) as follows:

‘the internationally important Irish Low Frequency array (ILOFAR) in Birr Castle which is particularly sensitive to wind turbines in its vicinity due to the Doppler effect which masks the radar signal and produces backscatter.’

We feel that this statement is inaccurate and ignores the issue of direct interference from unwanted radio sources such as wind turbines. The following summary would be a more accurate statement of the problem:

‘the internationally important Irish Low Frequency Array (I-LOFAR) at Birr Castle is particularly sensitive to wind turbines, photo-voltaic converters, LED lighting regulator

¹ The term ‘beam’ is used to describe the zone/direction of maximum receiving sensitivity of a receiving antenna. Radio telescopes are passive systems (receive only) which do not transmit any power.

systems, high frequency switching electronics and conventional radio transmitters in its vicinity due to:

- 1. Emission of unwanted signals which can enter either the main beam or the sidelobes of the telescope.**
- 2. Reflection from the turbines (blades and structures) of unwanted signals (both terrestrial and astronomical) into either sidelobes or the main beam of the telescope.**

Separation distances (at least 5 km) are therefore crucial in protecting such a sensitive system from detrimental interference'

[Protection of the I-LOFAR telescope by employment of spatial planning](#)

As detailed in the I-LOFAR Consortium submission on stage 1 of the County development plan (ref. CDP PD40), we are requesting that spatial planning regulations be employed to protect this significant infrastructure as follows:

- **Zone I (Protected Zone):**
 - No further large wind farm/photo-voltaic installations are allowed within a radius of 5 km from I-LOFAR.
 - LED lighting installations to be subject to consultation with the I-LOFAR Consortium.
 - Consultation with the I-LOFAR Consortium on any other developments within a radius of 5 km (Zone I; Protected Zone) from I-LOFAR which require the use of large power inverters.
 - Consultation with the I-LOFAR Consortium on any proposed radio transmission systems in Zones I and II.
- **Zone II (Consultation Zone):**
 - Limitations on the turbine height for wind farms.
 - Consultation with I-LOFAR as to the turbine types and related equipment to be used. It has been determined that turbines from certain manufacturers are better than others from the point of view of radio interference/pollution.
 - Consultation with I-LOFAR as to equipment to be used on any photo-voltaic installations. Field tests on the equipment to determine the effects, if any, on the station should be carried out.
 - Equipment field tests to determine effects, if any, on the station should be carried out.

Fig. 2 below shows the extent of these zones on a map of the area.

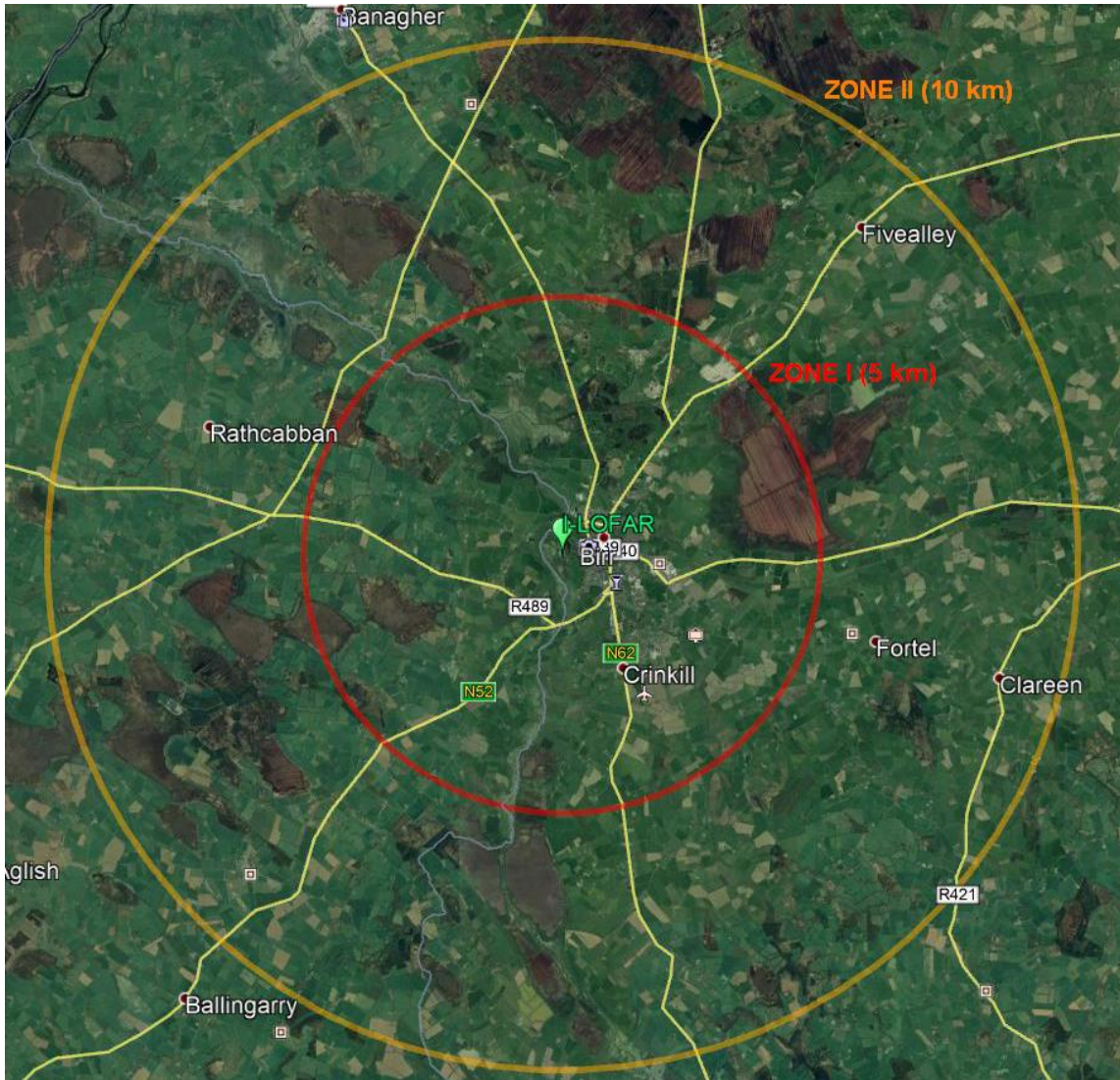


Fig. 2 – The extent of the proposed Protected Zone (Zone I) and Consultation Zone (Zone II) around the I-LOFAR telescope.

References

1. www.lofar.ie
2. https://www.itu.int/net/ITU-R/space/snl/bresult/radvance.asp?sel_ific=2848&ie=ywww.itu.int
3. ITU Recommendation, “Protection of the radio astronomy service in frequency bands shared with other services” (https://www.itu.int/dms_pubrec/itu-r/rec/ra/R-REC-RA.1031-2-200706-I!!PDF-E.pdf)
4. ITU Handbook of Radio Astronomy (https://www.itu.int/dms_pub/itu-r/opb/hdb/R-HDB-22-2013-PDF-E.pdf)

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