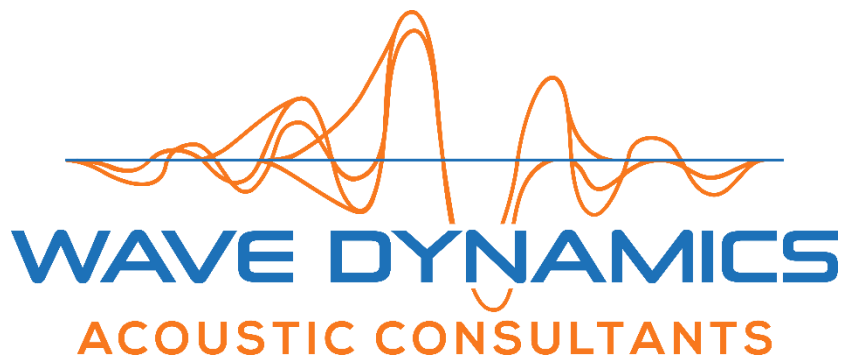




Ballyglass Grid Connection

Noise Impact Assessment
30 July 2026

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Executive Summary

Wave Dynamics were engaged by Reeve Wave Ltd to undertake a noise impact assessment for the proposed Ballyglass Grid Connection, Co. Clare.

The proposed development will consist of the provision of the following:

A 110 kilovolt (kV) Air-Insulated Switchgear (AIS) electrical substation, including 2 no. single-storey control buildings with staff welfare facilities, underground wastewater storage tank, all associated electrical plant, cabling, equipment and apparatus, and security fencing, within a substation compound with a total footprint of approximately 0.8 ha; 5.6 kilometre (km) 110kV underground cabling route, with 4.75km following the public road corridor and 0.85km along new proposed access track across agricultural grassland and private access tracks (including joint bays, communication and earth sheath link chambers and all ancillary works along the route); 1 no. temporary construction compound (including offices and staff welfare facilities); temporary construction and operational access from a new entrance from the L70382; Spoil management, landscaping and earthworks; Site drainage; All ancillary works and apparatus.

The development subject to this application forms part of grid connection and access arrangements which will facilitate the connection of the permitted Ballyglass Solar Array Phase 1 (Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23) and Phase 2 (Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25) to the national grid.

This application is accompanied by a Natura Impact Statement (NIS).

The proposed development works can be summarised as follows:

- Construction of new 110kV substation;
- Underground 110kV underground cable grid connection to the existing Ardnacrusha 110kV substation, including associated joint bays, communication chambers and earth sheath link chambers;
- Temporary construction compound;
- Provision of vehicular construction and operational entrance and access track from the L70382.
- Site drainage;
- Spoil management, landscaping and earthworks

This report outlines the project criteria, survey results, assessment, and general guidance recommendations for:

- Construction noise and vibration from the construction of the proposed substation, grid connection and nearby Ballyglass solar array (phases 1 and 2).
- Operational noise from operation of the new substation, grid connection and nearby solar array.

Based on the operational hours of the development there is potential for noise impact in both the day and night-time periods, therefore an assessment for both has been conducted. The noise impact assessment included attended and unattended noise measurements on the proposed development lands to quantify the noise environment. These included measurements of background noise at the noise sensitive locations. Appendix A outlines a glossary of the acoustic terminology used in this report.

Construction Noise and Vibration

The construction noise and vibration from the development has been predicted to the nearest noise sensitive locations (NSLs) of the substation and adjacent solar array. The construction predictions were based on the procedures outlined in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. The construction noise from the development will be of a short-term nature. The works have been assessed on the basis that they will be sequential.

Consideration was given to the construction of the substation, grid connection and adjacent solar arrays. **Based on the assessment outlined in this report it is predicted that the construction noise and vibration from the proposed substation, grid connection and associated solar array will comply with the recognised best practice standards typically adopted for such projects in Ireland.**

Operational Noise

The noise levels from the substation, grid connection and associated solar arrays were assessed using criteria set out by EPA NG4 and BS4142 2014 A1+ 2019 Methods for rating and assessing industrial and commercial sound, which predicted that there is an unlikely adverse impact at all noise sensitive receptors for the daytime, evening and night-time periods based on the assessment including the solar array mitigation measures outlined in the noise impact assessment undertaken at planning stage.

Based on the assessment outlined in this report it is predicted that the operational noise levels from the proposed substation, grid connection and associated solar array will comply with the project criteria and not produce a negative noise impact. The cumulative noise impact from the proposed substation development in combination with the Phase 1 and Phase 2 permitted developments and other nearby proposed developments has also been assessed and is predicted to comply with the project criteria.

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1 Introduction

Wave Dynamics were engaged by Reeve Wave Ltd to undertake a noise impact assessment for the proposed Ballyglass Substation and Grid Connection, Co. Clare.

Proposed Development

The proposed development will consist of the provision of the following:

A 110 kilovolt (kV) Air-Insulated Switchgear (AIS) electrical substation, including 2 no. single-storey control buildings with staff welfare facilities, underground wastewater storage tank, all associated electrical plant, cabling, equipment and apparatus, and security fencing, within a substation compound with a total footprint of approximately 0.8 ha; 5.6 kilometre (km) 110kV underground cabling route, with 4.75km following the public road corridor and 0.85km along new proposed access track across agricultural grassland and private access tracks (including joint bays, communication and earth sheath link chambers and all ancillary works along the route); 1 no. temporary construction compound (including offices and staff welfare facilities); temporary construction and operational access from a new entrance from the L70382; Spoil management, landscaping and earthworks; Site drainage; All ancillary works and apparatus.

The development subject to this application forms part of grid connection and access arrangements which will facilitate the connection of the permitted Ballyglass Solar Array Phase 1 (Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23) and Phase 2 (Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25) to the national grid.

This application is accompanied by a Natura Impact Statement (NIS).

The proposed development works can be summarised as follows:

- Construction of new 110kV substation;
- Underground 110kV underground cable grid connection to the existing Ardnacrusha 110kV substation, including associated joint bays, communication chambers and earth sheath link chambers;
- Temporary construction compound;
- Provision of vehicular construction and operational entrance and access track from the L70382.
- Site drainage;
- Spoil management, landscaping and earthworks

Site Access

The site will be accessed for both the construction and operational phases by means of a new entrance from the L70382. The entrance will be suitably splayed and has been subject to sight line and autotrack analysis, with the latter including modelling of abnormal load delivery for the transformer. Operational sightlines will be maintained by trimming back hedgerows with all necessary land within ownership.

A 4.5 metre wide compacted access track will extend from the entrance to the substation compound, approximately 330m in length. The access track material will be made of porous aggregate material to support percolation to ground. The autotrack analysis has demonstrated that delivery of the substation transformer can be safely accommodated.

Substation

The 110kV substation involves two separate compounds namely (i) the 110kV compound which will be in the ownership of ESB Network and (ii) the IPP compound which will be in the ownership of the customer. Please refer to the enclosed drawings by Reeve Wave Limited for site configuration and design layout. The main construction elements will include two substation buildings of concrete block construct with tiled roof, which will accommodate staff welfare facilities for the operational phase, High Voltage (HV) electrical equipment and

associated infrastructure including palisade fences and concrete post and rail fences. The installation of HV electrical equipment will include a Transformer (TRAFO) with associated equipment along with:

- Cable Sealing End (CSE);
- Surge Arrestor (SA);
- Earth Disconnect (DA, DB, DL, DT);
- Current /Voltage Transformer (CT/VT);
- House Transformer (HoT);
- Circuit Breaker (CB);
- Lightning Masts (LM);
- Diesel Generator;
- Harmonic filters if required by EirGrid;
- Capacitor Bank if required by EirGrid;
- Underground cable trench for the grid connection to the existing Ardnacrusha 110kV substation comprising of 3 no. power ducts, 2 no. telecom ducts and 1 no. earth continuity ducts.

The substation compound has a total area of approx. 0.8ha. Earthworks will be undertaken so the compound is level, with a finish compound level of 44m.

Connection to National Grid

In order to connect to the transmission network, it is proposed to connect the proposed 110kV substation to the existing 110kV Ardnacrusha substation by means of a 110kV underground grid connection which is approximately 5.6 km in length. The cable ducts will be installed in an excavated trench, typically to a depth of 1.30m. The cable will run west from the proposed substation through private lands for 0.33km to where it will join the local road network via the L70382. The cable will run south along the L70382 for approximately 1.3km to where it meets the R463. The cable will then run westward for circa 1.95km to where it will join the L3056. It will then travel west and south for approximately 1.45km along the L3056 until it leaves the public road corridor and enters private track. The cable continues along this track for 0.57 km before connecting with the existing Ardnacrusha substation. The exact connection point within the existing Ardnacrusha 110kV substation compound will be determined by ESB and EirGrid requirements.

Joint bays are required at approximately 750 metre intervals along the underground cable route to facilitate the jointing of cable lengths and comprise pre-cast concrete chambers (typically c. 2.5m x 6m x 2.05m) installed below finished ground level. Communication chambers and earth sheath link chambers will also be provided at each joint bay and approximately every second joint bay respectively, in accordance with ESB Networks and EirGrid requirements. All joint bays, communication chambers and earth sheath link chambers will be backfilled to finished ground level upon completion of cable installation, with no above-ground manifestation in the completed development.

All works will be carried out in accordance with international best practice and full compliance with health and safety requirements.

The underground cable route will involve five watercourse crossings. The crossing of the Blackwater River will be undertaken by means of Horizontal Directional Drilling (HDD) beneath the watercourse. The crossings of the Oakfield and West Roo watercourses will be undertaken by means of flatbed crossing methodology. All watercourse crossings will be carried out in accordance with Inland Fisheries Ireland guidelines. There is no requirement for instream works at any proposed crossing.

The construction phase of the proposed development is anticipated to take approximately 9 to 12 months to complete over an 18-month period, with construction anticipated to commence in Q3 2027 subject to the granting of planning permission. Construction activities will be carried out during normal daytime working hours of 07:00 to 19:00 hours Monday to Saturday. To ensure that optimal use is made of good weather periods or at critical periods within the programme, it may on occasion be necessary to work outside of these hours; any such out-of-hours working will be agreed in advance with Clare County Council.

Where vegetation removal is required (e.g. segments of hedgerow), this will be undertaken outside of the bird breeding season, which runs from 1st March to 31st August inclusive, in order to minimise the potential for impacts on nesting birds. Construction may commence in the September to February period so that construction activities are ongoing by the time the next bird breeding season comes around, with works continuing through that breeding season subject to the vegetation-removal restriction above.

Temporary Construction Compound

As outlined in the submitted site layout plans, it is proposed to provide a temporary construction compound west of the proposed substation, accessed from the entrance from the L70382. The temporary compound will include the following facilities at a minimum:

- Adequate canteen space to allow for all workers during the peak period;
- Office space with lighting, heating and internet facilities;
- Toilets and adequate welfare facilities for construction staff in accordance with the relevant statutory Health & Welfare guidelines;
- Parking space for both light and heavy vehicles;
- Designated skips and temporary storage areas.

Surface Water Drainage and Water Services

Surface water drainage proposals for the development have been developed to mimic the natural drainage patterns of the site and thereby be in accordance with the best management practices of Sustainable Drainage Systems (SuDS) including those set out in the SuDS Manual (C753) published by CIRIA in 2015. Specifically, this includes the following:

- The proposed access track to the substation compound will be permeable allowing rainwater to infiltrate through the stone structure to the subsoil below;
- The compound construction is formed with permeable stone thus mimicking a soakaway scenario. ESB compound stone is single sized for the first 150mm for safety purposes. It then changes to a graded 6F2 material;
- The area to be drained includes the roofs and the bunded plinths. These equate to 786.5m² which is relatively minor in comparison to the overall compound area;
- Assuming even the most basic of infiltration rates down through the permeable compound stone, it is clear that the existing greenfield situation will be easily maintained;

The surface water generated in the hardstanding and bunded areas will discharge to soakaways via a Class 1 Full Retention Oil Separator.

In relation to wastewater, a 5m³ foul holding tank is proposed as part of the operational development. These tanks are normally used in ESB substations. It will be emptied periodically, with the capacity in excess of modelled holding requirements.

The control buildings will include staff welfare facilities for the operational phase of the Proposed Development. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. Due to the specific nature of the proposed 110kV onsite substation, there will be a very small water requirement for occasional toilet flushing and hand washing, and therefore a potable water source is not required. It is proposed to either harvest rainwater from the roofs of the buildings or, alternatively, install a groundwater well adjacent to the proposed 110kV onsite substation in accordance with the Institute of Geologists Ireland, Guide for Drilling Wells for Private Water Supplies (IGI, 2007). The well will be flush to the ground and covered with a standard manhole. A pump house is not required as an in-well pump will direct water to a water tank within the roof space of the control building. Bottled water will be supplied for drinking, if required. Section 3 of the submitted Construction and Environmental Management Plan includes a detailed summary of surface water, waste water and water supply requirements for the proposed development.

Site Reprofilng

The subject site is relatively flat in nature but analysis of topographic data confirms that cutting and filling of the existing terrain will be required to establish a level platform for the substation compound. Cutting into the existing terrain and the requirement to relocate soil has been minimised by establishing the compound level to 44 m. The excavation area of the substation site is approximately 0.9 ha. It is estimated that approximately 4,600m³ of soil will need to be removed to form a level substation compound and approximately 650m³ of soil will need to be removed to build up the access track from competent strata. It is envisaged that the majority of this excavated soil will be reused on site as part of landscaping measures, including the formation of perimeter berms and reinstatement works. Any residual surplus soil that cannot be accommodated on site will be disposed of offsite at an appropriately licensed waste recovery or disposal facility, with the option of an Article 27 by-product declaration to the EPA (under the European Communities (Waste Directive) Regulations 2011, S.I. No. 126 of 2011) pursued where the material meets the relevant criteria. Similarly, the necessary amounts of fill material which must be to ESB Networks specification will be transported onto site, supplemented by suitable material won from the site excavation. This is expected to be 13,650m³.

Site Restoration and Landscaping

This will involve the reinstatement of all other excavated materials and associated landscaping works. It will include the replacement of topsoil in disturbed ground areas such as access tracks and the removal of the construction compound and other temporary work areas. The proposed landscaping is consistent with that proposed under Clare County Council and An Coimisiún Pleanála References P22-591/ ABP-316043-23 and P24-60485 / PL-500253-CE-25.

Within the boundary of the proposed development, the Proposed Ballyglass Solar Array (Phase 2) application includes for the removal of some c. 25 linear meters of existing hedgerow required to facilitate the construction of access track throughout the proposed solar parcels. Notwithstanding the above areas of removal, this will be offset by the planting of new native hedgerow (outside of the SID application boundary) and the bolstering of some c.1,400 linear metres. The removal of hedgerow to facilitate the SID substation is limited to 3 linear metres, where it is proposed to add levelling batter to the access track. Overall, there is an additional c. 175m of proposed bolstered hedgerow, with no further removal or new hedgerow planting required as part of the proposed SID substation development as it is wholly contained within the parcels that form part of the proposed Ballyglass Solar Array.

Other Planned Works

Permitted Phase 1 of Ballyglass Solar Array (Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23).

On 21st November 2023, planning permission was granted by An Coimisiún Pleanála for Phase 1 of Ballyglass Solar Array comprising:

A 10-year planning permission for a solar array at Ballyglass, Coolderry, Dromintobin North, Reanabrone, and Oakfield (townlands), Ardnacrusha, Co. Clare. The development will consist of c.265,000 m² of solar panels on ground mounted frames, 8 no. single storey control cabins with associated electrical transformer units and hardstand areas, 2 no. ring main units, underground cabling within the solar array site and within the L70382 public road to connect solar array field parcels, security fencing, CCTV, access tracks (upgrade of existing and new), upgrades to four existing agricultural field entrances on the R463, L3046 and L70382 and creation of new entrance on L70382, temporary construction compound, landscaping and all associated ancillary apparatus and development works.

Proposed Phase 2 of Ballyglass Solar Array (Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25).

Phase 2 of Ballyglass Solar Array was submitted to Clare County Council on the 4th October 2024, comprising:

A 10-year planning permission for a solar array at Coolderry, Dromintobin North, Dromintobin South, Knockbrack Lower, Knockbrack Upper, Monaskeha, Oakfield and Ruanard (townlands), Ardnacrusha,

County Clare. The development will consist of c. 330,000 m² of solar panels on ground mounted frames, 13 no. single storey control cabins with associated electrical transformer units and hardstand areas, 2 no. ring main units, underground cabling within the solar array site and within the R471 public road to connect solar array field parcels, security fencing, internal CCTV, access tracks (upgrade of existing and new), upgrade to 1 no. existing agricultural field entrance and creation of 2 no. new entrances on the R471 and 1 no. new entrance on the L70382, 2 no. temporary construction compounds (including site offices and welfare facilities), landscaping and all associated ancillary apparatus and development works.

The proposed development provides for minor modifications to the solar array permitted under Clare County Council Reference P22/591 / An Coimisiún Pleanála Reference ABP-316043-23. These modifications comprise the omission of 1 no. single storey control cabin and associated electrical transformer unit, omission of solar panels and access track, and reconfiguration of internal cabling. The solar array will connect to the national grid and will have an operational lifespan of 40 years

Clare County Council granted conditional permission on the 16th October 2025. First and Third Party appeals were submitted to An Coimisiún Pleanála regarding same, An Coimisiún Pleanála Reference PL-500253-CE-25 refers. This case was due to be decided by 17th June 2026.

1.1 Statement of Competence

The attended and unattended measurements and report were completed by Wave Dynamics, an acoustic consultancy that specialises in noise and vibration. Our consultants have extensive experience in noise impact assessments.

The site survey was conducted by Daniel Cousins | Field Engineer, Daniel has on-site experience of numerous background noise surveys for planning stage applications.

The report was completed by Sean Rocks, Director | Senior Consultant, Sean has experience of numerous planning stage assessments. Sean's qualifications include; BEng (Hons) in Mechanical and Manufacturing Engineering, Diploma in Acoustics and Noise Control (Institute of Acoustics), IOA Certificate of Competence in Environmental Noise Measurement and SITRI certified sound insulation tester. Sean is a member of both Engineers Ireland and the Institute of Acoustics.

This peer review was completed by James Cousins, Managing Director | Principal Consultant with Wave Dynamics who has extensive experience in assessing noise impacts. James is an experienced acoustic consultant. His qualifications include; BSc (Hons) in Construction Management and Engineering, Pg Cert in Construction Law and Diploma in Acoustics and Noise Control (Institute of Acoustics) and an IOA Competence Cert in Building Acoustic Measurements. James is a member of both Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA) and is the current SITRI Chairman.

2 Site Description

The substation, grid connection and solar array developments are located in the townlands of Coolderry, Dromintobin North, Knockbrack Lower and Knockbrack Upper (townlands), Ardnacrusha, County Clare. There are residential properties generally scattered throughout the lands as shown below in Figure 1. The development is generally surrounded by agricultural farmland with one off housing. The NSLs have been grouped together for the purpose of the assessment and the worst case NSL in each group has been assessed as representative of the group.

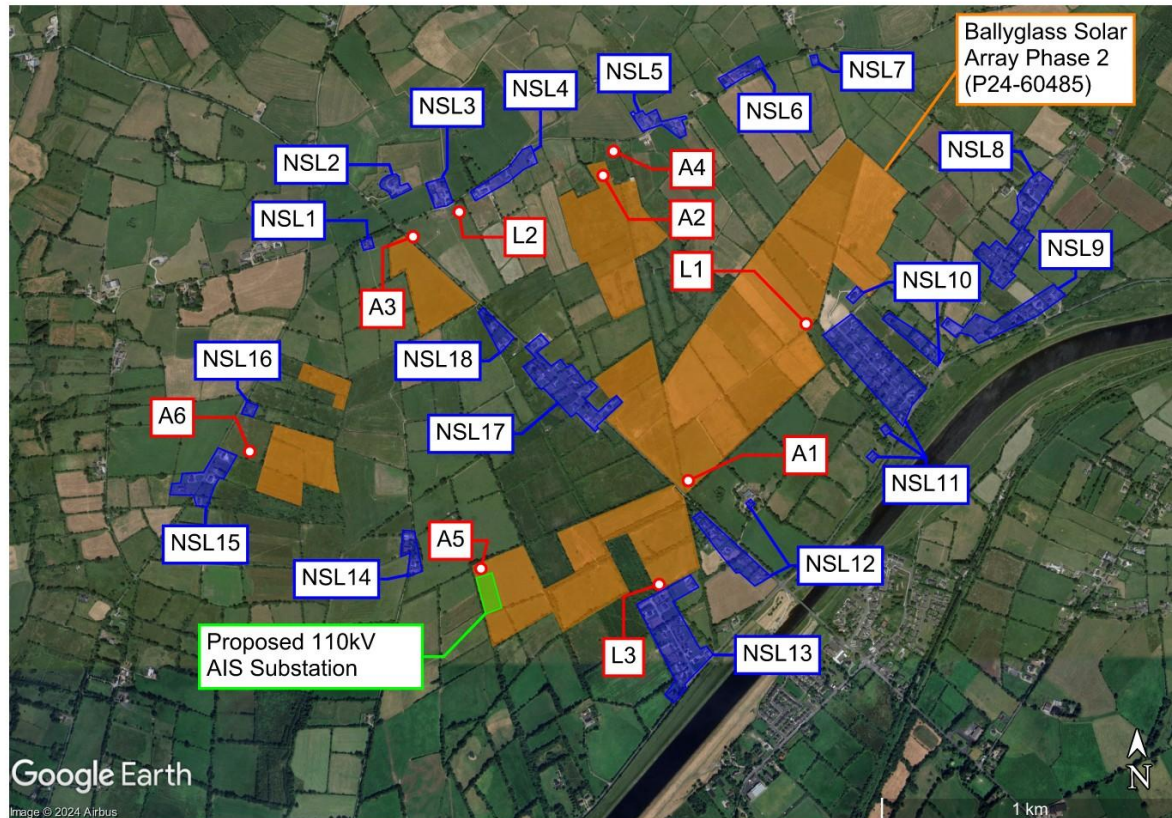


Figure 1: Site location, proposed substation & grid connection, surrounding solar arrays, measurement locations, noise sensitive locations (NSL) nearby and the surrounding area.

Table 1 below shows the respective approximate distances between the closest dwelling of each noise sensitive location (NSL) subgroup and the proposed substation and grid connection. The noise sensitive locations are shown in Figure 1 and represent those NSLs in proximity to the wider Ballyglass Solar Arrays, including the proposed substation and grid connection site which are located on the solar array lands.

Table 1: Distance between NSLs and proposed substation and grid connection.

Noise Sensitive Location	Approximate distance from closest façade of the NSL to the proposed substation / grid connection (m)
NSL1	1214
NSL2	1390
NSL3	1319
NSL4	1325
NSL5	1667

Noise Sensitive Location	Approximate distance from closest façade of the NSL to the proposed substation / grid connection (m)
NSL6	1911
NSL7	2093
NSL8	2002
NSL9	1768
NSL10	1560
NSL11	1434
NSL12	750
NSL13	520
NSL14	250
NSL15	980
NSL16	993
NSL17	664
NSL18	811

3 Project Criteria

The acoustic criteria for the project is set out in this section, the purpose of the criteria is to ensure reasonable:

- Operational noise from operation of the new substation and grid connection.
- Construction noise and vibration from the construction of the new substation and grid connection.
- Cumulative operational noise from both phase 1 (planning ref 22591) and phase 2 (planning ref 24-60485) solar array.

There will be no predicted noise from the underground cable therefore operational noise from the underground cable has been screened out. Based on our understanding of the project there are no relevant sources of vibration from the operational phase of the development to provide adequate conditions Wave Dynamics have developed the project criteria for:

- Operational noise and construction noise and vibration.

Acoustic Standards

The acoustic standards for assessing noise impact for the project have been developed from the following:

- ✓ Environmental Protection Agency NG4: Guidance note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities.
- ✓ BS4142 2014 A1+ 2019 Methods for rating and assessing industrial and commercial sound.
- ✓ ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures.
- ✓ British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- ✓ British Standard BS7385: 1993: Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration, and;
- ✓ British Standard BS5228-2: 2009 + A1: 2014: Code of practice for noise and vibration control on construction and open sites – Vibration.
- ✓ Clare County Council Noise Action Plan 2024-2028.
- ✓ Previous experience on similar projects.

3.1 Noise Assessment Criteria

3.1.1 Construction Noise Assessment Criteria

There is currently no statutory Irish guidance for construction noise requirements from noise during the construction phase of a project.

In the absence of specific noise limits, the appropriate criteria for the allowable construction noise levels may be found in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

The standard (BS5228-1:2009+A1) provides examples of acceptable limits for construction and/or demolition noise in both subjective and objective form. For example, paragraph E.2 of the standard states:

“Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut.”

Paragraph E.2 goes on to state:

“Noise levels, between say 07.00 and 19.00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- 70 decibels (dBA) in rural, suburban areas away from main road traffic and industrial noise;
- 75 decibels (dBA) in urban areas near main roads in heavy industrial areas”.

Typically, the planning authority refer to BS 5228 Part 1 as a method to control construction noise from sites on the local environment. This standard is therefore the de facto appropriate standard in the absence of regulatory guidance.

The criteria for this project will be based on the ABC method, the ABC method takes the background noise measured in the area and sets the appropriate construction noise limits for the project based on the background noise levels.

For the purpose of this assessment buildings other than dwellings which have a residential function will be considered for the lower noise limit, this includes Hotels, B&B's, Student Accommodation, Co Living Developments etc. This is in line with the guidance and definition of noise sensitive residences of EPA NG4. Table 2 below outlines the project criteria in tabular form.

Table 2: BS 5228: 1:2009+A1 threshold levels.

Assessment category and threshold value period	Threshold value, in decibels (dB) (L _{Aeq})		
	Category A ¹	Category B ²	Category C ³
Daytime (07:00 – 19:00) and Saturdays (07:00 – 14:00)	65	70	75
Evenings and weekends ⁴	55	60	65
Night-time (23:00 to 07:00hrs)	45	50	55

- 1) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
- 2) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
- 3) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category B values.
- 4) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

3.1.2 Construction Vibration Criteria

Best practice guidance is taken from British Standard BS 5228:2009 + A1 2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites - Part 2 Vibration.

The standard recommends that for a soundly constructed residential property and similar structures (in good repair), the threshold for minor or cosmetic (i.e. non- structural) damage should be taken as a Peak Particle Velocity (PPV) (in frequency range of predominant pulse) of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above. Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:

Table 3: Likely Construction Vibration Impact

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:			
Building Type	Less than 15Hz	15 to 40Hz	40Hz and above
Light framed structures/ residential buildings	15 mm/s	20 mm/s	50 mm/s

3.1.3 Operational Noise

Planning authorities can set noise limits from typical solar array developments pertaining to noise however there is currently no national policy for operational noise limits from solar array developments for planning noise assessments. Noise limits for new developments are typically sought from the planning authority's noise action plan, EPA NG4/BS 4142. On review of the Clare County Council Noise Action Plan no specific guidance has been outlined for noise limits from commercial premises and therefore the criteria from EPA NG4/BS4142 have been adopted for the project.

EPA NG4

EPA NG4 outlines that noise attributable solely to onsite activities from a licenced premises should not exceed the following limits:

- Daytime (07:00hrs – 19:00hrs) – 55dB $L_{Ar,T}$
- Evening (19:00hrs – 23:00hrs) – 50dB $L_{Ar,T}$
- Night time (23:00hrs – 07:00hrs) – 45dB $L_{Aeq,T}$

During daytime and evening periods rigorous efforts should be made to avoid clearly audible tones and impulsive noise at all sensitive locations. A penalty of 5dB for tonal and/or impulsive elements is to be applied to the daytime and evening measured $L_{Aeq,T}$ values to determine the appropriate rating level ($L_{Ar,T}$). In all cases, an assessment by a competent person will be required.

During the night-time period no tonal or impulsive noise from the facility should be clearly audible or measurable at any NSL.

EPA NG4 outlines more onerous criteria for areas which meet the background noise level threshold for "Areas of Low Background Noise". The noise limits for these areas are as follows:

- Daytime (07:00hrs – 19:00hrs) – 45dB $L_{Ar,T}$
- Evening (19:00hrs – 23:00hrs) – 40dB $L_{Ar,T}$
- Night time (23:00hrs – 07:00hrs) – 35dB $L_{Aeq,T}$

BS 4142:2014+A1:2019

The standard describes a method for the assessment of commercial, industrial and background noise to quantify its impact on persons outside of a residential dwelling. BS 4142 has become the de facto standard for compliance investigation. In addition to the specified broadband sound levels the standards provide objective and subjective methods for the assessment of the impulsivity and tonality of the sound sources. This allows for a penalty/ correction to be applied to the measured sound level of the source (L_{Aeq}) to give the rating level ($L_{Ar,T}$).

It considers the likelihood of complaints by considering the margin by which the sound in source the background noise level.

BS 4142 states that and exceedance of the noise source of the background sound by:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.,

- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context., and;
- *“The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context”*

BS4142 outlines guidance for penalty corrections to be applied to the sound sources in question should the noise source have one of the following characteristics:

- The sound contains a distinguishable, discreet, continuous tone (whine, or hum);
- The sound contains distinct impulses (i.e. bangs),
- The sound is intermittent or:
- The sound is irregular.

4 Baseline Noise Survey

4.1 Baseline Noise Survey

An attended and unattended baseline noise survey was conducted to assess the background noise levels and the typical noise sources in the area. Multiple locations were chosen to conduct the survey to establish the background noise across the full development. The attended measurements included measurements of background noise during both daytime (07:00-23:00) and night-time hours (23:00-07:00). The purpose of the attended and unattended measurements was to establish the background noise levels in the area, and to use these measurements for predicting the future noise levels from the substation, grid connection and associated solar arrays and the impact on the area.

4.1.1 Site Description and Measurement Locations

The substation, grid connection and solar developments are located in the townlands of Coolderry, Dromintobin North, Knockbrack Lower and Knockbrack Upper (townlands), Ardnacrusha, County Clare. There are residential properties generally scattered throughout the lands as shown below in Figure 1. The development is generally surrounded by agricultural farmland with one off housing. The NSLs have been grouped together for the purpose of the assessment and the worst case NSL in each group has been assessed as representative of the group.

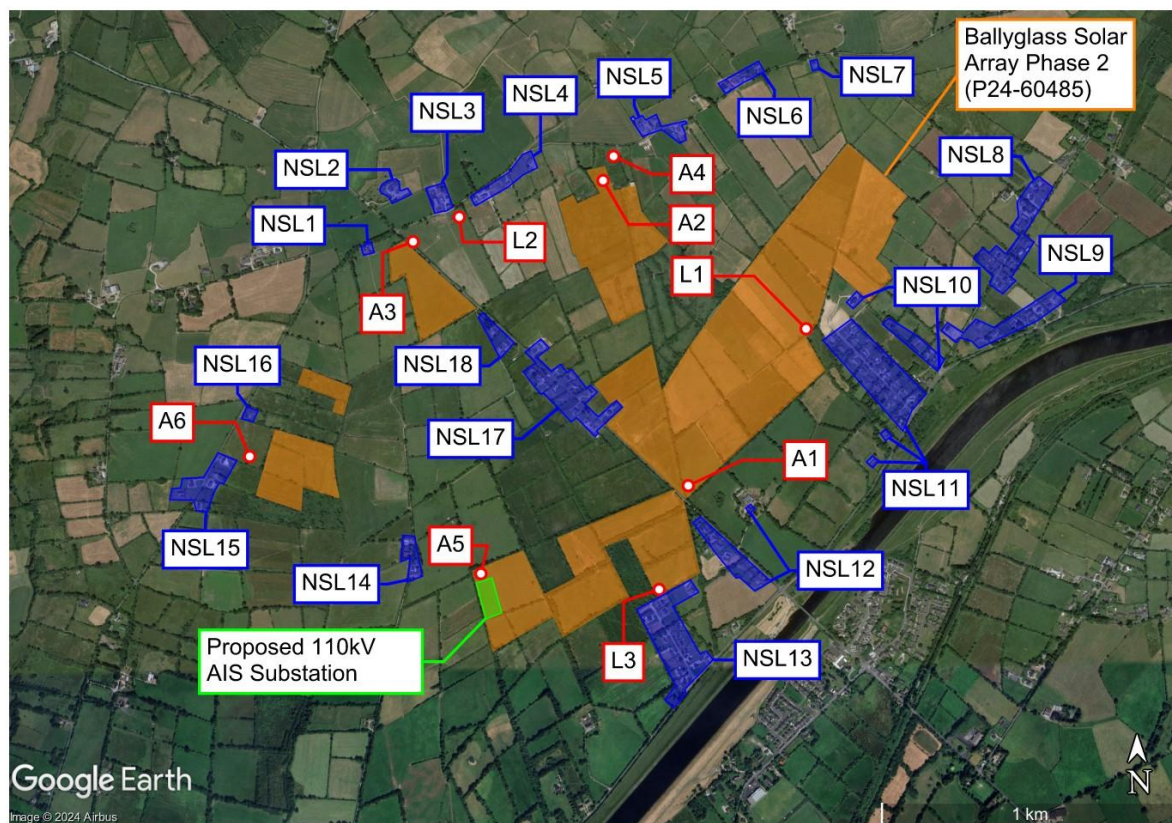


Figure 2: Site location, proposed substation and grid connection, permitted solar array, measurement locations, noise sensitive locations (NSL) nearby and the surrounding area.

4.1.2 Survey Methodology and Personnel

The attended and unattended surveys were completed by Daniel Cousins (Field Engineer).

Attended Noise Measurements

Noise measurements were undertaken in general accordance with ISO 1996-1:2016 using ISO Class 1 sound analysers. Attended measurements were taken for varying durations based on objective. Background noise measurements were taken over a 60-minute period for the daytime period and over 15 minutes for the night-time period. Care was taken to avoid any effect on the measurements, the sound level meter was positioned at approximately 1.2m above ground level.



Figure 3: Attended noise monitor setup.

Unattended Noise Measurements

Noise measurements were undertaken in general accordance with ISO 1996-1:2016 using ISO Class 1 sound analysers. An unattended noise survey was undertaken from the 11th of April to the 17th of April 2024, and from the 19th of July to the 25th of July 2024. Care was taken to avoid any effect on the measurements, the sound level meter was positioned at approximately 1.2m above ground level and securely anchored in place for the duration of the unattended survey. The data from the unattended measurements was filtered for adverse or undesirable weather conditions.

4.1.3 Survey Period

The attended noise measurements were undertaken on the 11th, 17th of April 2024 and on the 19th of July 2024. Unattended monitoring at locations L1 and L2 were started on the 11th of April 2024 and completed on the 17th of April 2024. Additional unattended monitoring at location L3 was started on the 19th of July 2024 and completed on the 25th of July 2024 by Daniel Cousins. (Field Engineer)

4.1.4 Noise Measurement Equipment

A Class 1 sound level meter/noise logger in general accordance with IEC 61672-1:2013 was used for the attended measurements. Table 4 below summarises the measurement equipment used.

Table 4: Noise Measurement Equipment

Description	WD Asset Number	Model	Serial No.	Calibration Certificate No.	Calibration Due Date
Sound Level Meter	SLM1	Nor 140	1405554	U45343/U45344 /45342	17/09/2027
Sound Level Meter	SLM2	NOR140	1406532	UCRT25/2495	20/10/2027
Sound Level Meter	SLM3	Nor 140	1403082	50651/50650	13/04/2027
Sound Level Meter	SLM6	Nor 140	1405091	U44947/ U44945	27/07/2025
Calibrator	CAL1	Nor 1251	31056	UCRT25/2481	15/10/2026
Calibrator	CAL3	Nor 1251	32096	AC250308	22/07/2026
Calibrator	CAL4	Larson Davis CAL200	21085	AC250309	22/07/2026

1) All measurement equipment had traceable calibration certificates at the time of the measurement survey.

4.1.5 Subjective Noise Environment

During the attended noise survey following noise sources were identified:

- Birds chirping,
- Distant road noise,
- Noise from farm animals,
- Distant dog barks,
- Wind on foliage,
- Distant farm machinery.

4.2 Noise Measurement Results

This section outlines the results of the attended noise measurements.

Attended Measurement Results

Table 5 outlines the results of the attended measurement survey.

Table 5: Attended Noise Measurement Results

Measurement				Measured Noise Levels (re 20μPa)		
Location	Date	Time (hrs)	Duration (mins)	L _{Aeq} dB	L _{AFmax} dB	L _{A90} dB
A2	11/04/2024	04:54	15	35	61	23
A2	11/04/2024	05:12	15	31	57	23
A3	11/04/2024	05:57	15	48	61	40
A1	11/04/2024	06:36	15	55	68	48
A1	11/04/2024	06:52	15	53	63	46

Measurement				Measured Noise Levels (re 20µPa)		
Location	Date	Time (hrs)	Duration (mins)	L _{Aeq} dB	L _{AFmax} dB	L _{A90} dB
L1	11/04/2024	08:52	15	44	61	31
A2	11/04/2024	10:25	15	48	63	41
A1	11/04/2024	11:48	15	51	66	43
A1	11/04/2024	12:18	15	51	67	43
A4	17/04/2024	08:26	60	54	94	35
A4	17/04/2024	09:26	15	54	78	35
A1	17/04/2024	10:16	60	51	71	40
A1	17/04/2024	11:20	15	32	71	41
A5	19/07/2024	10:03	60	41	55	36
A5	19/07/2024	11:08	60	45	56	38
A6	19/07/2024	12:34	60	43	65	33
A6	19/07/2024	14:08	60	46	67	33

Unattended Measurement Results

This section contains the measurement results from the unattended measurements. Table 6 displays the measurements taken from the 11th of April 2024 to the 17th of April 2024 at location L1.

Table 6: Unattended measurement results at location L1

Start Date	L _{Aeq,16hour} 07:00 - 23:00 dB	L _{night} (L _{Aeq,8hour} 23:00 - 07:00) dB	L _{den} (00:00 - 00:00) dB	L _{AF90} (23:00 - 07:00) dB	L _{AF90} (07:00 - 19:00)	L _{AF90} (19:00 - 23:00)
11/04/2024	51	36	51	35	44	40
12/04/2024	49	43	49	32	41	35
13/04/2024	47	43	51	31	40	34
14/04/2024	46	38	47	34	39	37
15/04/2024	50	42	55	35	N/A	N/A
16/04/2024	47	44	50	30	37	32
17/04/2024	49	N/A	N/A	N/A	39	N/A

Table 7 below displays the measurements taken from the 11th of April 2024 to the 17th of April 2024 at location L2.

Table 7: Unattended measurement results at Location L2

Start Date	L _{Aeq,16hour} 07:00 - 23:00 dB	L _{night} (L _{Aeq,8hour} 23:00 - 07:00) dB	L _{den} (00:00 - 00:00) dB	L _{AF90} (23:00 - 07:00) dB	L _{AF90} (07:00 - 19:00)	L _{AF90} (19:00 - 23:00)
11/04/2024	49	42	N/A	30	42	38

Start Date	L _{Aeq,16hour} 07:00 - 23:00 dB	L _{night} (L _{Aeq,8hour} 23:00 - 07:00) dB	L _{den} (00:00 - 00:00) dB	L _{AF90} (23:00 - 07:00) dB	L _{AF90} (07:00 - 19:00)	L _{AF90} (19:00 - 23:00)
12/04/2024	48	44	50	29	41	32
13/04/2024	49	43	52	27	42	33
14/04/2024	49	48	52	41	39	40
15/04/2024	51	47	57	39	N/A	N/A
16/04/2024	49	42	53	25	39	31
17/04/2024	49	N/A	N/A	N/A	35	N/A

Table 8 below displays the measurements taken from the 19th of July 2024 to the 25th of July 2024 at location L3.

Table 8: Unattended measurement results at location L3

Start Date	L _{Aeq,16hour} 07:00 - 23:00 dB	L _{night} (L _{Aeq,8hour} 23:00 - 07:00) dB	L _{den} (00:00 - 00:00) dB	L _{AF90} (23:00 - 07:00) dB	L _{AF90} (07:00 - 19:00)	L _{AF90} (19:00 - 23:00)
19/07/2024	41	35	43	26	37	32
20/07/2024	38	29	41	20	33	28
21/07/2024	38	30	40	26	31	30
22/07/2024	39	30	40	25	31	28
23/07/2024	37	34	39	26	28	26
24/07/2024	50	30	48	25	35	30
25/07/2024	36	N/A	39	N/A	31	N/A

Discussion of Measurement Results

The attended background measurements were taken on a weekday to establish the existing background noise levels. Additionally, three logger positions were selected to record continuous data to establish the background noise levels across the full site. Attended measurements were taken during both daytime (07:00-23:00) and night-time (23:00-07:00) hours. From the measurements it can be determined that NSLs 13-16 can be classified as an area of low background noise as defined in EPA NG4. All other NSLs do not meet the background noise level threshold and are therefore assessed under the “all other areas” EPA NG4 criteria.

EPA Quiet Area Screening

Based on the background noise survey outlined in this section it was determined that NSLs 13 – 16 meet the definition of an “area of low background noise” as defined in EPA. As all NSLs are located < 15km from an urban area with a population of over 10,000 people (Limerick City), the development does not meet the EPA definition of a “quiet area”, and therefore the “all other areas” criteria is applicable for all other NSLs.

EPA Areas of Low Background Noise

For all areas not identified as Quiet Areas, the existing background noise levels measured during the environmental noise survey should be examined to determine if they are located an area of low background noise, which would mean satisfying each of the following criteria:

- Average Daytime Background Noise Level ≤40dB L_{AF90}, and;
- Average Evening Background Noise Level ≤35dB L_{AF90}, and;
- Average Night-time Background Noise Level ≤30dB L_{AF90}.

If all three of the above criteria are satisfied for any of the measurement locations, then those locations are deemed to be in areas of low background noise, and reduced noise limit criteria would apply.

Unattended noise monitoring was undertaken at various land parcels of the solar array site considered to be representative of the existing background noise levels at the NSLs surrounding the proposed development and therefore have been used to assess against the “Area of Low Background Noise” criteria. Table 7 outlines the average daytime, evening and night-time noise levels at monitoring location L1, L2 and L3.

Table 9: Average Daytime, Evening and Night-time Noise Levels at Monitoring Location L1

Noise Monitoring Location	Average Daytime L_{AF90} (07:00 - 19:00)	Average Evening L_{AF90} (19:00 – 23:00)	Average Night-time L_{AF90} (23:00 - 07:00) dB
L1	40	37	33
L2	39	36	29
L3	32	29	25

Based on the noise measurement results from L3, it can be determined that the background noise levels meet the classification of “Area of Low Background Noise” according to EPA NG4 for daytime, evening and nighttime L_{AF90} measurements undertaken at this parcel of the site. Therefore, the NG4 noise limit criteria for “Area of Low Background Noise” has been applied to NSLs 13-16. All other NSLs have been assessed under the “All Other Areas” criteria.

4.3 Weather Conditions for Monitoring Period

In general, good weather conditions were noted during the attended survey, with winds typically less than 5 m/s and no rain and clear skies. The measurements were filtered to account for rain and wind where required.

5 Noise Impact Assessment

5.1 Construction Noise Assessment

Based on the location of the site, the construction works the following noise sensitive receptors have been identified. These noise sensitive receptors were chosen as they are the closest NSL's to the works from the proposed 110kV AIS Substation and associated adjacent permitted solar arrays.

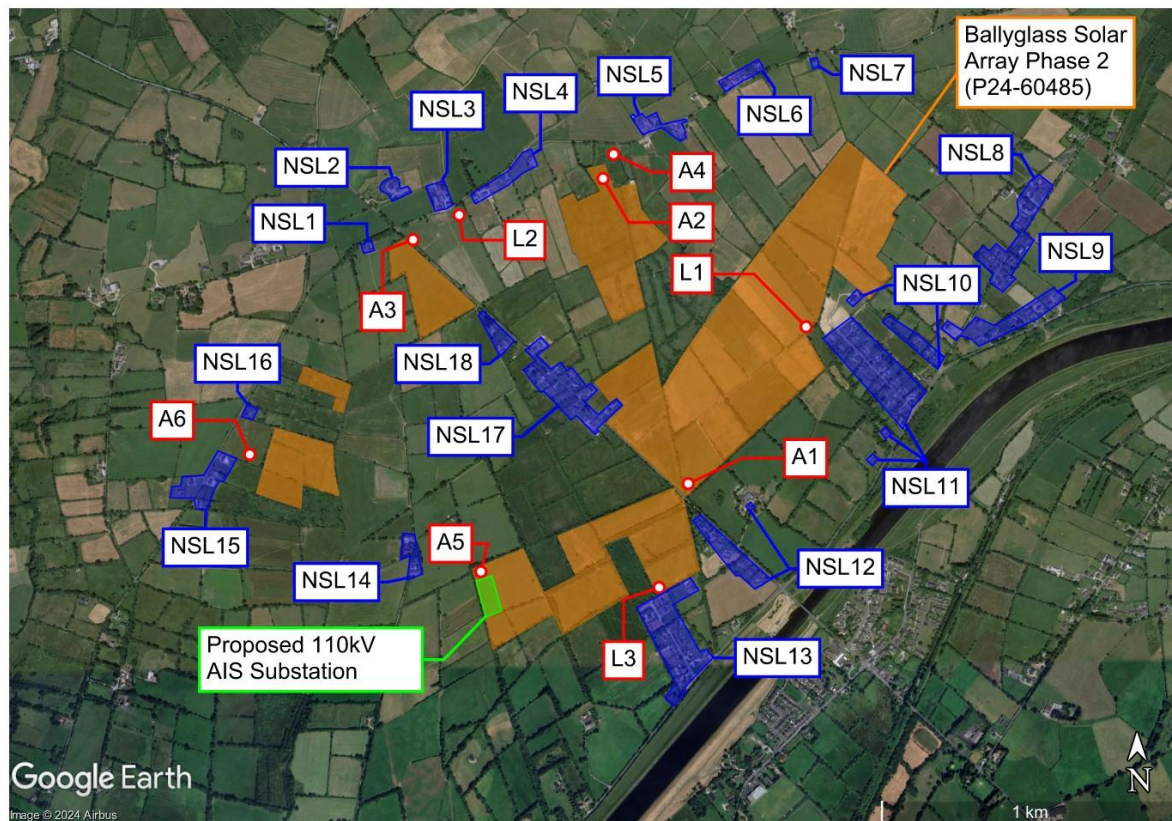


Figure 4: Site location, proposed substation and grid connection, permitted solar arrays, measurement locations, noise sensitive locations (NSL) nearby and the surrounding area.

Noise Limits

The criteria for the project based on the criteria outlined in section 3 and the background noise in the area the project criteria for construction noise is outlined below in Table 10. Reference to the baseline survey results and guidance contained in BS 5228 Part 1 for construction noise levels threshold for significance affect from construction activities is set as follows for the closest noise sensitive locations:

Table 10: Threshold of significant impact at dwellings

Assessment category and threshold Value Period (L_{Aeq})	Threshold value in decibels (dB)		
	Category A	Category B	Category C
Night-time (23:00-07:00)	45	50	55
Evening and Weekends	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

- 1) A significant effect has been deemed to occur if the total L_{Aeq} noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level.

- 2) If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total L_{Aeq} noise level for the period increases by more than 3 dB due to construction activity.
- 3) Applied to residential receptors only.

For the appropriate assessment period (i.e. daytime in this instance) the ambient noise level is determined and rounded to the nearest 5dB. If the noise generated by construction activities exceeds the appropriate category value, then a significant effect is deemed to occur. The appropriate category value for this project has been determined as Category A with a 65dBA threshold.

5.1.1 Construction Noise Predictions

Construction noise for the site has been predicted based on the information provided by the design team. A summary of the expected equipment, durations and operating times are provided for each site and works. The assessment has taken into consideration that the works are dynamic and will be conducted at different locations across the site. The prediction methodology in BS5228 has been used to calculate the noise level over a typical day for each of the main construction stages.

These predictions include the construction traffic from the site. Table 11 below outlines the plant used for the construction noise impact from works. It should be noted that construction noise is considered for both the substation and grid connection and the wider Ballyglass Solar Arrays as it is envisaged that construction activities for the developments will occur at the same time.

Table 11: Construction noise assessment for substation and solar array

Construction Phase	Item of Plant (BS 5228-1:2009+A1:2014 Ref)	Noise Level (L_{Aeq} at 10m dB(A))	On Time of 10 hr day
Enabling Works	Digger	77	3 Hours
	Dump Truck	79	2 Hours
	Power Tools	70	2 Hours
	Road Lorry	76	1 Hour
Civil & Electrical	Road Lorry	76	1 Hour
	Power Tools	70	3 Hours
	Hammer	69	1 Hour
	Telescopic Handler	71	3 Hours
	Piling	63	2 Hours
	Concrete Pump	74	2 Hours
External finishes	Hand Tools	70	5 hours
	Power Tools	70	2 hours
	Road Lorry	76	1 hour

Predicted Construction Noise

Table 12 summarises the predicted construction noise level at the noise sensitive locations. Examination of the results indicate the construction noise without mitigation is predicted to be within the noise limits set out by BS 5228-1 for all stages of the development.

The calculations set out below are based on assumed site construction works and a combination of the plant operating at the same time i.e. worst-case scenario. The predicted construction noise levels are based on the cumulative construction of the proposed grid connection and the Ballyglass solar array projects being constructed simultaneously.

Table 12: Predicted noise levels **without** mitigation for each stage.

NSL	Criteria L_{Aeq} , dB	Predicted noise level (construction noise only)		
		with no mitigation		
		L_{Aeq} , dB		
		Enabling Works	Civil & Electrical	External finishes
NSL1	65	63	62	59
NSL2	65	61	60	58
NSL3	65	62	60	59
NSL4	65	62	61	57
NSL5	65	61	60	57
NSL6	65	60	59	57
NSL7	65	62	60	58
NSL8	65	60	60	57
NSL9	65	59	58	56
NSL10	65	63	61	58
NSL11	65	60	60	55
NSL12	65	62	61	56
NSL13	65	65	63	60
NSL14	65	61	58	57
NSL15	65	62	59	58
NSL16	65	62	60	56
NSL17	65	61	60	56
NSL18	65	62	61	57

5.1.2 Predicted Cumulative Noise Impact

The predicted cumulative construction noise impact from other developments in the area as well as the underground cabling and grid connection works has been considered.

The underground cable installation works will be of short duration, transient with approximately 100m of trenching will be completed per day and will largely be within the existing road network. The grid connection route have been considered as part of the review and it is not expected based on the information provided to us that the underground cable installation works or the underground grid connection to the substation will exceed the BS 5228-1 criteria for the project.

Based on the information available and provided to us and given the location of these developments in relation to the NSLs for the Ballyglass Grid Connection the cumulative noise impact is not expected to exceed the values outlined in Table 12.

Table 13 below outlines the developments with planning in the area.

Table 13: Developments with existing planning within the wider area.

Ref. No.	Distance from Subject Site	Status	Description
24/60416 & ACP-323147-25 Castlebank Green Energy Limited	0km (GCR)	Granted by ACP (with conditions) 14/01/2026	Development consists of planning permission for a period of 10 years to construct and complete a Solar Energy development with a total site area of 36.70 hectares. The Solar Farm will be operational for 40 years. The proposed grid route will connect the substation at Ardnacrusha Power Station via 38kV underground cable (1.2km in length, 320m of within local road L3056). A Natura Impact Statement (NIS) was submitted with this application.
24/60411 & ABP-321285-24 Lackareagh wind farm	0km (GCR)	Granted by ACP 14/07/2025	The development will consist of: (i) The construction of 7 no. wind turbines. The proposed Grid Connection Route is to Ardnacrusha Power Station crossing over the Blackwater (Clare) by way of ducting alongside the existing bridge parapet. A Natura Impact Statement (NIS) was submitted with this application and details of the GCR route installation was included in the assessment.
24/60432 and 20/740 'Errina Locke' Housing Development	0.64km	24/60432 Granted 30/10/2024 20/740 Granted - 19/08/2021	24/60432 involved amendments to Housing layout approved under P20/740 to change house types and numbers with minor revision to road layout at Errina Locke including revised house boundaries & all ancillary site works. A Natura Impact Statement (NIS) was submitted as part of an RFI for the development. The NIS and the accompanying CEMP detail the pollution control measures to be implemented during construction.
23/60249 Drummin Solar Farm	0km (GCR)	Granted - 06/09/2023	Solar farm on a site of 70 hectares on Land to the west/north-west of Ardnacrusha within the townlands of Castlebank, Drummin, Glenlon North, Glenlon South and Ballykeelaun Co Clare. The solar farm will be operational for 40 years. A Natura Impact Statement (NIS) was prepared in respect of the development.
21/796	Adjacent Site	Granted – 26/01/2022	Fill the existing poor quality agricultural land with stone and soil to raise the level of the

Ref. No.	Distance from Subject Site	Status	Description
			ground, widen existing agricultural entrance, including all ancillary site works
318505 - Carrownagowan windfarm GCR	0.93km	Granted - 23/01/2025	Proposed construction of a 110kV underground grid connection cable connecting the permitted Carrownagowan windfarm to the existing 110kV substation at Ardnacrusha.
318782 - Oatfield Wind Farm	1.12km	Decision Due - 24/06/2024 (Still with ACP when reviewed in March 2026)	Planning permission to develop a Windfarm and Ancillary Infrastructure within the townlands of Ballycar (North), Belvoir, Cloghera, Cloonsheerea, Cloontra, Cloontra East, Cloontra West, Crag, Derrynaveagh, Derryvinnan, Drumsillagh, Sallybank (Meritt), Droomsillagh or Sallybank (Parker), Gortacullin, Knockbrack Lower, Knockshanvo, Kyle, Mountrice, Oatfield and Snaty, Co.Clare
318943 - Ballycar Wind Farm	4.22km	Decision Due - 25/07/2024 Limited Agenda Oral Hearing 22/01/2026	Proposed 12 turbine windfarm, located on a 140-hectare site located within the townlands of Cappateemore East, Ballycannan West, Ballycannan East, Ballycar South, Ballycar North, and Glennagross
317227 - Fahy Beg Wind Farm	0.94km	Granted - 06/03/2024	Development of a wind farm together with the development of an underground grid connection cable to the national grid. The development will consist of 8 wind turbines, a permanent meteorological mast, an onsite 38kV electrical substation, and all associated site works. An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) were submitted with the application.
320705 - Knockshanvo Wind Farm	0km (GCR)	Decision Due – 14/05/2025 – Still undecided as of March 2026	Proposed development of 9 no. wind turbines, 110kV substation and ancillary development located in the townlands of Snatty, Hurdlestown, Oatfield, Drumsillagh, Sallybank, Gortacullin, Aharinaghbeg, Knockshanvo, Cloontra, Cloghoolia, Ballycullen and others, County Clare.

Other Considerations

Additional traffic noise from the construction works is not expected to increase the traffic noise from the roads to any significant impact. The Design Manual for Roads and Bridges (DMRB) states that a 25% increase in traffic flows leads to a 1dBA increase in traffic noise levels. Construction traffic flow increases associated with the proposed development will be significantly less than 25% and therefore the noise levels from construction traffic will not increase the existing noise levels at the noise sensitive locations by more than 1dBA.

It is generally accepted that it takes an approximate 3dBA increase in noise levels to be perceptible to the average person (Ref: Planning Policy Guidance Note 24 [PPG24 - Planning & Noise]). Construction traffic noise levels associated with the Proposed Development will not have a negative impact on nearby noise sensitive locations (NSLs).

5.1.3 General Recommendations

This section of the report sets out general recommendations for the control of noise from construction works. As stated in Section 5.1 above states that no construction noise mitigation is required as all noise from construction works falls within the criteria set out by BS 5228-1.

Selection of Plant and Equipment

The noise impact of all plant and equipment should be assessed prior to selection of the plant for the project. Where an item of plant is identified as noisy with the potential to cause a negative noise impact it should be reviewed to check if there is an alternative quieter version of the same plant to undertake the same construction task.

Noise Control at Source

Where replacing a noisy item of plant is not viable or practical, consideration should be given to control that noise at source. This includes modifying the piece of plant or equipment to generate less noise, using dampening to control vibration induced noise or rattling. Example best practice mitigation measures to be considered are as follows:

- All plant and equipment to be switched off when idling.
- The use of white noise reversing alarms.
- Restriction on the dropping and loading of materials to less sensitive hours.
- The use of local screening for noisy activities or works with hand tools.
- Not dropping materials onto hard surfaces and using rubber mats etc for the dropping of materials.
- Ensure all plant and equipment is well maintained and cleaned, all lubrication should be in line with manufacturers guidelines.

Screening

Screening when used correctly can be an effective method of reducing the construction noise impact on the NSL's. The use of site hoarding and careful selection of areas for noise works, using buildings on the site, site offices and the building being constructed to screen noise from the works.

Local screening of noisy works with the use of temporary acoustic barriers, examples are provided below:

- <https://ventac.com/acoustic-products/noisebreak-acoustic-barrier/>
- <https://echobarrier.com/>



Figure 5: Temporary Construction Noise Barrier © Ventac

Construction Noise Monitoring

Construction noise monitoring will be undertaken at periodic sample periods on the boundary with the nearest noise sensitive receptors.

Noise monitoring will be conducted in accordance with the International Standard ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

5.2 Operational Phase

Following the survey, a model of the development using SoundPLAN 9.1 modelling software was developed to establish the noise levels from the development in operation in a worst-case scenario. The software implements the algorithms contained in ISO 9613-1 and ISO 9613-2. The noise model considers:

- Distance attenuation,
- Source and receptor locations,
- Barrier effects (buildings, walls etc)
- Topographical elevations,
- Ground effects and absorption,
- Source sound power levels,
- Directivity and orientation of the source,
- Atmospheric attenuation and meteorological effects.

The SoundPLAN 9.1 predictive model uses methodology via a ray tracing method, in principle the modelling follows the general principles of the following formula outlined in ISO 9613 Part 1 and Part 2: *Acoustics - Attenuation of sound during propagation outdoors*:

$$L_p = L_w - 20 \log_{10}(R) - 11 - A - B - G$$

Where:

- L_p is the sound pressure level at a particular point.
- L_w is the sound power level of the plant and equipment.
- R is the distance from the noise source at which the sound pressure level is predicted.
- 11 is a constant based on a noise source with omnidirectional directivity.
- A considers the correction reduction in noise levels via atmospheric conditions.
- B considers the correction reduction in noise levels due to noise barriers.
- G considers the correction reduction in noise levels due to ground absorption and topography.

The acoustic model for the new substation, grid connection and associated solar array development has been developed based on attended noise survey and the proposed site location and predicted noise sources. As the site has potential to create noise impact at both day and nighttime, a worst-case scenario has been developed for both predicting the noise impact at the nearest noise sensitive locations.

5.2.1 Operational Noise from Proposed Substation and Grid Connection

From discussions with the design team, it has been confirmed that the external plant and equipment at the proposed substation, grid connection and the wider Ballyglass solar arrays with the potential to generate operational phase noise consists of the proposed 110kV AIS substation transformer and the inverter/transformer stations within the permitted solar arrays.

A comprehensive whole project approach to the assessment has been completed and is outlined in Section 5.2.6. This section of the report outlines the noise impact assessment of the proposed application only (grid connection). The noise levels from the substation have been assumed based on data from the WDA library.

Noise levels at the NSLs were assessed to the height of the worst-case façades (4m for two-storey NSLs), to predict the noise levels at the first-floor bedrooms of the nearest noise sensitive receptors. Noise levels were also checked at 2m to assess the external amenity noise levels on the NSLs, and grid noise contours have been provided in Figure 6 and Figure 7 at this height.

Table 14 below outlines the sound power values for the plant and equipment used in the assessment. Equal or approved plant is suitable for the development.

Table 14: Assumed source plant and equipment noise levels

Item	Assumed Noise Level (L_{WA})	Reference Source
110kV AIS Substation Transformer Assumed (Equal or approved)	92 dB	WDA Library

5.2.2 Daytime Operations

As the substation and grid connection has the potential to generate noise with different characteristics for both the day and night-time, a model has been undertaken for both the day and nighttime operations of the proposed development. This section outlines the operational noise assessment for the daytime scenario.

The daytime situation assumes the following noise sources:

- Substation operating at full capacity continuously as per Table 14.
- Model calibrated using on-site measurements.

The nearest noise sensitive receivers in each direction were taken as part of the assessment as identified in Figure 1. This allows for a worst-case scenario assessment, NSLs further away from the development are expected to experience lower noise levels with typical conditions due to distance attenuation.

The criteria varies slightly for different receptors (NSLs 13-16) as these locations meet the criteria for "Areas of Low Background Noise" and therefore have a daytime criteria of (07:00hrs – 19:00hrs) 45dB $L_{Ar,T}$. All other locations have been assessed based on the "All Other Areas" daytime criteria of (07:00hrs – 19:00hrs) 55dB $L_{Ar,T}$. The noise emissions from the solar array have been predicted at the worst-case façade of each NSL and are outlined in Table 15. All values refer to the free field façade noise levels at 4m height.

Table 15: Model results for the noise impact from the grid connection and substation for daytime.

NSL	Criteria dB $L_{Ar,T}$	Daytime Predicted Noise dB $L_{Ar,T}$ (7:00hrs to 19:00hrs)	Compliant/Non-Compliant
NSL1	55	13	Compliant

NSL	Criteria dB L _{ArT}	Daytime Predicted Noise dB L _{ArT} (7:00hrs to 19:00hrs)	Compliant/Non-Compliant
NSL2	55	12	Compliant
NSL3	55	12	Compliant
NSL4	55	12	Compliant
NSL5	55	10	Compliant
NSL6	55	10	Compliant
NSL7	55	9	Compliant
NSL8	55	9	Compliant
NSL9	55	10	Compliant
NSL10	55	11	Compliant
NSL11	55	12	Compliant
NSL12	55	22	Compliant
NSL13	45	26	Compliant
NSL14	45	27	Compliant
NSL15	45	14	Compliant
NSL16	45	14	Compliant
NSL17	55	22	Compliant
NSL18	55	16	Compliant

Figure 6 on the next page outlines the daytime predicted noise emissions from the substation in operation for the daytime period at 2m height in the external amenity spaces.

As noted from the grid noise map all residential receptors are outside of the 45 dBA contour for daytime and therefore compliant with the more onerous of the NG4 project criteria “areas of low background noise”.

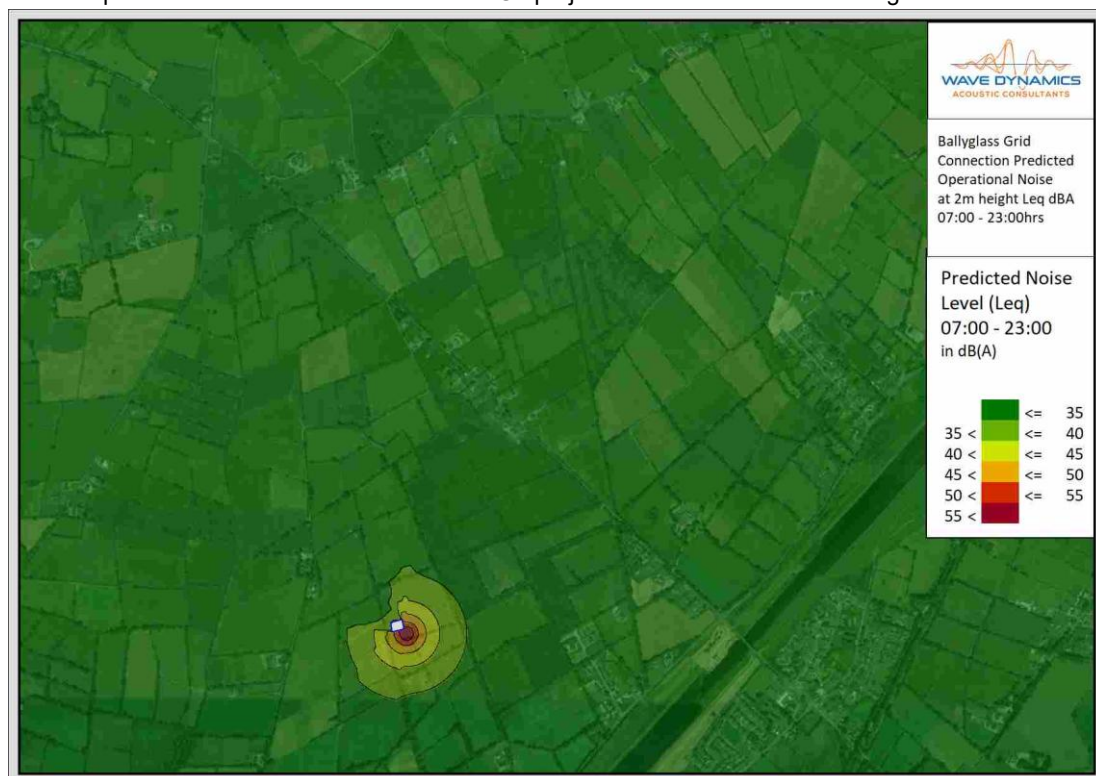


Figure 6: Noise contours for the daytime noise impact for the daytime period @2m in dBA Leq

All predicted noise levels are below the NG4 project criteria and therefore within the project requirements.

Evening Time Scenario

The noise levels for the evening time are predicted to be the same as the daytime noise levels however as per EPA NG4 criteria, a lower noise criteria of 50dB $L_{Aeq,T}$ is applicable for NSLs 1-12 and 17, 18, and 40dB $L_{Aeq,T}$ is applicable for NSLs 13-16. Based on the predicted noise levels outlined in Table 15 and shown in Figure 6, the evening time criteria is predicted to be achieved.

Consideration was also given to the BS4142 requirements, as the specific sound is below the background sound in all instances therefore no adverse noise impact is predicted as all in accordance with BS 4142.

5.2.3 Night-time Operations

The proposed substation is understood to be operational continuously throughout the night time. The night-time situation assumes the following noise sources:

- Substation operating at full capacity continuously as per Table 14.
- Model calibrated using on-site measurements.

NG4

NG4 recommends a night time criteria of 35dB $L_{Aeq,T}$ for “areas of low background noise (NSLs 13-16) and 45dB $L_{Aeq,T}$ for all other areas. The predicted operational noise levels from the proposed substation and grid connection have been modelled at the worst-case façade of each NSL and are predicted to be compliant at all noise sensitive locations as shown in Table 16. All predicted values refer to the free field façade noise levels at 4m height.

Table 16: Model results for the noise impact from the grid connection and substation for nighttime

NSL	Criteria dB L_{Aeq}	Nighttime Predicted Noise dB L_{Aeq} (23:00hrs to 07:00hrs)	Compliant/Non-Compliant
NSL1	45	13	Compliant
NSL2	45	12	Compliant
NSL3	45	12	Compliant
NSL4	45	12	Compliant
NSL5	45	10	Compliant
NSL6	45	10	Compliant
NSL7	45	9	Compliant
NSL8	45	9	Compliant
NSL9	45	10	Compliant
NSL10	45	11	Compliant
NSL11	45	12	Compliant
NSL12	45	22	Compliant
NLS13	35	26	Compliant
NSL14	35	27	Compliant
NSL15	35	14	Compliant
NSL16	35	14	Compliant
NSL17	45	22	Compliant
NSL18	45	16	Compliant

Figure 7 on the next page outlines the nighttime predicted noise emissions from the solar array and substation in operation for the daytime period at 2m height.



Figure 7: Noise contours for the night-time noise impact in dB L_{Aeq}

As noted from the grid noise map all residential receptors are outside of the 35 dBA contour for night-time and therefore compliant with the more onerous NG4 project criteria for “Areas of Low Background Noise”.

Consideration was also given to the BS4142 requirements, the specific sound is predicted to be within 5dB of the background noise level at nearly all noise sensitive locations in the area therefore no adverse noise impact is predicted as all in accordance with BS 4142. The background monitoring locations assessed were worst-case and were further from local roads than the NSLs therefore background noise is also likely to be higher at the NSLs. Context was also considered in coming to this conclusion considering the residual sound is also higher than the specific sound.

5.2.4 Modelling Assumptions

The following assumptions were made throughout the modelling and assessment:

- Assessment based on the noise measurements undertaken onsite.
- Noise source data for the assessment was based on similar inverter/transformer and substation noise levels as outlined in Table 14. Equal or equivalent approved to be used.
- Model assumes a worst-case operating scenario as outlined in Section 5 above.
- Modelling based on the drawings, layouts and information provided.
- Modelling includes the proposed Eirgrid building located to the northwest of the 110kV AIS substation transfer which will be constructed to 3.4m height to eaves and 7m height to ridge. The proposed substation and Eirgrid building layout are shown in Figure 8.
- Modelling tolerances apply +/- 3dB.
- The predictions outlined in Section 5.2.6 are inclusive of cumulative noise source of both the substation and grid connection application in combination with the Ballyglass solar arrays, references: reference
 - Ballyglass Phase 1: Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23,

- Ballyglass Phase 2: Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25.

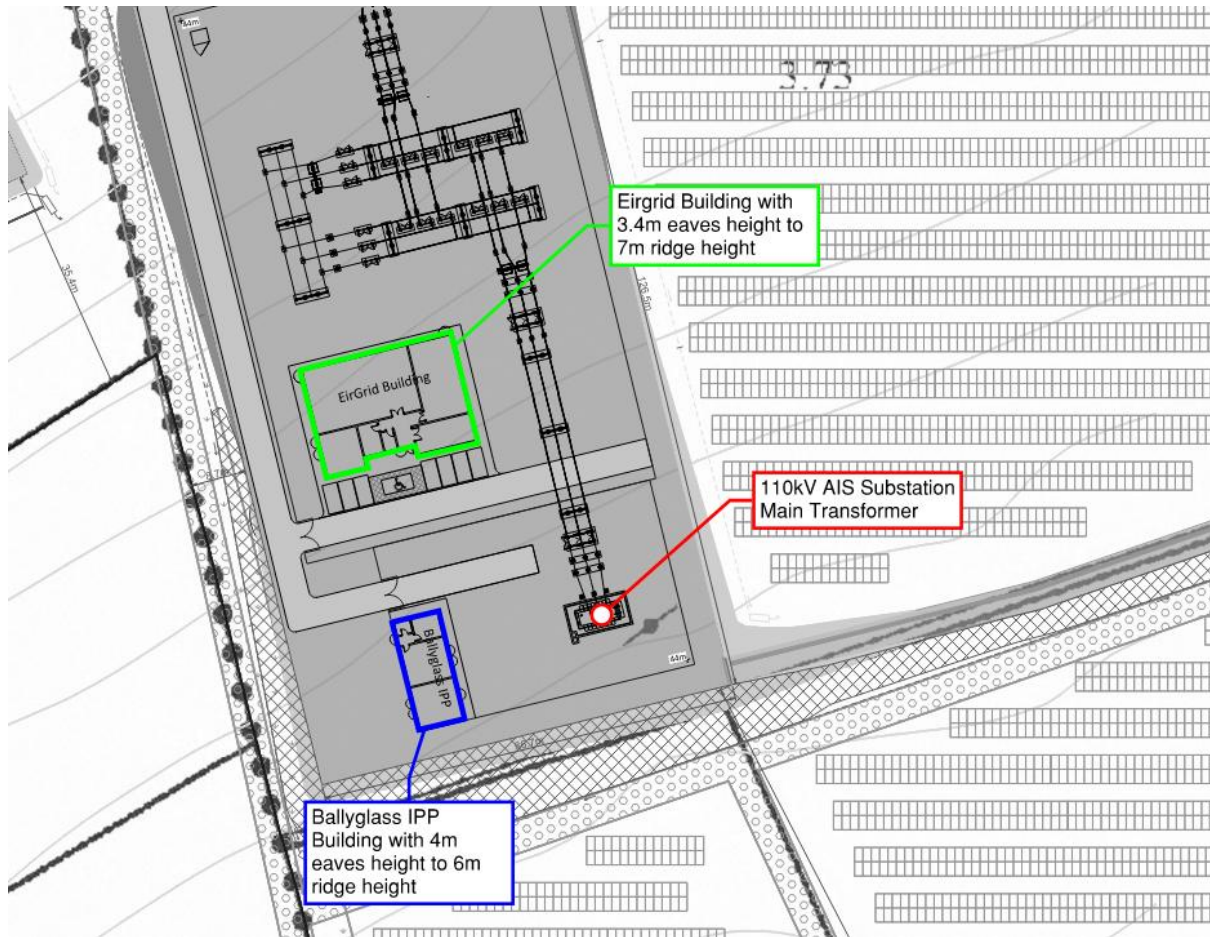


Figure 8: Substation location and EirGrid & Ballyglass IPP Building height

5.2.5 BS4142 Operational Noise Assessment

In addition to the assessment outlined above in line with EPA NG4 criteria, the substation, grid connection and associated solar array have been assessed using BS4142 criteria. The operational noise levels from the full development are predicted to be within 5 dB background noise levels in each area at the NSLs therefore it is not predicted that an adverse noise impact will occur based on the information provided and the assumptions in this report. Context has also been considered.

5.2.6 Cumulative Operational Noise Impact

The cumulative noise impact of the proposed substation, grid connection and permitted Ballyglass solar arrays in the vicinity of the NSLs as outlined in Table 13 have been assessed, the cumulative assessment includes the proposed Ballyglass (Phase 1 & 2) Solar Arrays. It should be noted that the noise impact assessment undertaken at planning stage for the phase 1 included a proposed substation to the northwest of the development. The substation is no longer proposed at this location and will be relocated as per this application and as shown in Figure 1.

Sound power data for the transformers/inverters have been adapted from the planning stage noise impact assessment reports for the solar array applications.

Noise levels at the NSLs were assessed to the height of the worst-case façades (4m for two-storey NSLs), to predict the noise levels at the first-floor bedrooms of the nearest noise sensitive receptors. Noise levels were also checked at 2m to assess the external amenity noise levels on the NSLs, and grid noise contours have been provided in Figure 6 and Figure 7 at this height.

It is understood that the inverter / transformers run at lower operating speeds during the nighttime due to the reduced levels of sunlight. Table 14 below outlines the sound power values for the plant and equipment used in the assessment. Equal or approved plant is suitable for the development.

Table 17: Assumed source plant and equipment noise levels

Item	Assumed Noise Level (L_{WA})	Reference Source
1 x Inverter/Transformer Operating at Daytime	95 dB	Manufacturer Data
1 x Inverter/Transformer Operating at Night-time	85 dB	Manufacturer Data

Predicted Cumulative Noise Levels

The predicted cumulative noise model considers the following noise sources:

- Substation operating at full capacity continuously as per Table 14.
- Inverters/transformers operating for daylight hours (5am-10pm).
- Assumed noise level in (L_{WA}) for inverter/transformers used in model as per Solar Array application noise impact assessment. Based on planning applications:
 - Ballyglass Phase 1: Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23,
 - Ballyglass Phase 2: Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25
- Inverter/transformers operating at daytime operating load as per Table 17,
- Model calibrated using on-site measurements.

Table 18 below outlines the predicted day and nighttime cumulative noise impact at the NSLs. This shows that the noise levels at all nearby noise sensitive locations comply with the EPA NG4 criteria.

Table 18: Predicted cumulative noise impact from the substation, grid connection and associated solar array and other proposed developments.

NSL	Daytime (07:00 – 19:00)			Nighttime (23:00 – 07:00)		
	Criteria dB L_{ArT}	Daytime Predicted Noise Level dB L_{ArT}	Compliant / Non-Compliant	Criteria dB L_{Aeq}	Nighttime Predicted Noise Level dB L_{Aeq}	Compliant / Non-Compliant
NSL1	55	34	Compliant	45	19	Compliant
NSL2	55	32	Compliant	45	17	Compliant
NSL3	55	32	Compliant	45	17	Compliant
NSL4	55	31	Compliant	45	16	Compliant
NSL5	55	33	Compliant	45	18	Compliant
NSL6	55	32	Compliant	45	16	Compliant
NSL7	55	32	Compliant	45	16	Compliant
NSL8	55	32	Compliant	45	16	Compliant
NSL9	55	32	Compliant	45	17	Compliant
NSL10	55	39	Compliant	45	22	Compliant

NSL	Daytime (07:00 – 19:00)			Nighttime (23:00 – 07:00)		
	Criteria dB $L_{A,T}$	Daytime Predicted Noise Level dB $L_{A,T}$	Compliant / Non-Compliant	Criteria dB L_{Aeq}	Nighttime Predicted Noise Level dB L_{Aeq}	Compliant / Non-Compliant
NSL11	55	37	Compliant	45	21	Compliant
NSL12	55	40	Compliant	45	26	Compliant
NSL13	45	38	Compliant	35	27	Compliant
NSL14	45	39	Compliant	35	32	Compliant
NSL15	45	40	Compliant	35	24	Compliant
NSL16	45	39	Compliant	35	24	Compliant
NSL17	55	40	Compliant	45	26	Compliant
NSL18	55	38	Compliant	45	23	Compliant

Figure 9 and Figure 10 below highlight the predicted day and nighttime grid noise maps for the cumulative assessment including the proposed substation outlined in this report and the Ballyglass (Phase 1 & 2) Solar Array, reference:

- Ballyglass Phase 1: Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23,
- Ballyglass Phase 2: Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25.



Figure 9: Predicted cumulative noise contours for the daytime noise impact in dB L_{Aeq}



Figure 10: Predicted cumulative noise contours for the nighttime noise impact in dB L_{Aeq}

5.2.7 Tonality & Impulsivity

The operational noise of the proposed substation, grid connection and associated solar arrays will consist of mechanical plant and equipment noise from the continuous operation of the substation in addition to the inverter / transformer units in continuous operation during sunlight hours. The operation of the development does not include activity that could create impulsive noise. It will be ensured that the selected equipment will not have any impulsive characteristics. Plant and equipment shall be maintained to ensure it operates in its normal capacity. The developer should ensure that the selected transformer does not emit tonal noise characteristics.

5.2.8 Operational Phase Conclusion

Based on the information provided, the site survey and the worst-case scenario predictions **it is predicted that noise emanating from the development will achieve the NG4 and BS4142 project criteria.**

6 Conclusion

Wave Dynamics were engaged by Reeve Wave Ltd to undertake a noise impact assessment for the proposed Ballyglass Grid Connection, Co. Clare.

The proposed development will consist of the provision of the following:

A 110 kilovolt (kV) Air-Insulated Switchgear (AIS) electrical substation, including 2 no. single-storey control buildings with staff welfare facilities, underground wastewater storage tank, all associated electrical plant, cabling, equipment and apparatus, and security fencing, within a substation compound with a total footprint of approximately 0.8 ha; 5.6 kilometre (km) 110kV underground cabling route, with 4.75km following the public road corridor and 0.85km along new proposed access track across agricultural grassland and private access tracks (including joint bays, communication and earth sheath link chambers and all ancillary works along the route); 1 no. temporary construction compound (including offices and staff welfare facilities); temporary construction and operational access from a new entrance from the L70382; Spoil management, landscaping and earthworks; Site drainage; All ancillary works and apparatus.

The development subject to this application forms part of grid connection and access arrangements which will facilitate the connection of the permitted Ballyglass Solar Array Phase 1 (Clare County Council Reference P22-591 and An Coimisiún Pleanála Reference ABP-316043-23) and Phase 2 (Clare County Council Reference P24-60485 and An Coimisiún Pleanála Reference PL-500253-CE-25) to the national grid.

This application is accompanied by a Natura Impact Statement (NIS).

The proposed development works can be summarised as follows:

- Construction of new 110kV substation;
- Underground 110kV underground cable grid connection to the existing Ardnacrusha 110kV substation, including associated joint bays, communication chambers and earth sheath link chambers;
- Temporary construction compound;
- Provision of vehicular construction and operational entrance and access track from the L70382.
- Site drainage;
- Spoil management, landscaping and earthworks

This report outlines the project criteria, survey results, assessment, and general guidance recommendations for:

- Construction noise and vibration from the construction of the proposed substation, grid connection and nearby Ballyglass solar array (phases 1 and 2).
- Operational noise from operation of the new substation, grid connection and nearby solar array.

Based on the operational hours of the development there is potential for noise impact in both the day and night-time periods, therefore an assessment for both has been conducted. The noise impact assessment included attended and unattended noise measurements on the proposed development lands to quantify the noise environment. These included measurements of background noise at the noise sensitive locations. Appendix A outlines a glossary of the acoustic terminology used in this report.

Construction Noise and Vibration

The construction noise and vibration from the development has been predicted to the nearest noise sensitive locations (NSLs) of the substation and adjacent solar array. The construction predictions were based on the procedures outlined in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. The construction noise from the development will be of a short-term nature. The works have been assessed on the basis that they will be sequential.

Consideration was given to the construction of the substation, grid connection and adjacent solar arrays. **Based on the assessment outlined in this report it is predicted that the construction noise and vibration from the proposed substation, grid connection and associated solar array will comply with the recognised best practice standards typically adopted for such projects in Ireland.**

Operational Noise

The noise levels from the substation, grid connection and associated solar arrays were assessed using criteria set out by EPA NG4 and BS4142 2014 A1+ 2019 Methods for rating and assessing industrial and commercial sound, which predicted that there is an unlikely adverse impact at all noise sensitive receptors for the daytime, evening and night-time periods based on the assessment including the solar array mitigation measures outlined in the noise impact assessment undertaken at planning stage.

Based on the assessment outlined in this report it is predicted that the operational noise levels from the proposed substation, grid connection and associated solar array will comply with the project criteria and not produce a negative noise impact. The cumulative noise impact from the proposed substation development in combination with the Phase 1 and Phase 2 permitted developments and other nearby proposed developments has also been assessed and is predicted to comply with the project criteria.

Appendix A- Glossary of Terms

Ambient Noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from all the noise sources in the area.
Background Noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μ Pa).
dB(A)	An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'-weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Hertz	The unit of sound frequency in cycles per second.
L_{A90}	A-weighted, sound level just exceeded for 90% of the measurement period and calculated by statistical analysis. See also the background noise level.
L_{Aeq}	A-weighted, equivalent continuous sound level.
L_{AFmax}	A-weighted, maximum, sound level measured with a fast time-constant - maximum is not peak
R_w	Weighted sound reduction index - a single number quantity which characterises the airborne sound insulation of a material or building element over a range of frequencies, based on laboratory measurements