

13.0 NOISE & VIBRATION

13.1 INTRODUCTION

This section of the Environmental Impact Statement evaluates and discusses the potential noise and vibration impact arising from the construction and operation of the proposed gas-fired power plant at Lumcloon, Co. Offaly. The assessment considered the existing noise environment, the predicted noise impact, possible noise mitigation and the residual impact of the proposed power plant.

13.2 METHODOLOGY

The methodology for the assessment and evaluation of the noise impact arising from the proposed power plant involved the following:

- Baseline Noise Survey – day and night time noise monitoring at three residential receivers in the vicinity of the proposed power plant. The purpose of the baseline noise monitoring survey was to evaluate the existing noise environment. Current noise sources and the background noise level have been evaluated during the noise survey.
- Development of a computational noise model to represent the proposed power plant and subsequently predict the noise impact at nearby residential receivers. Noise data for equipment and machinery to be used in the proposed power plant were input to the model to predict the noise levels at nearby residential receivers.
- Comparison of the predicted noise impact on residential receivers with the existing noise climate, the relevant EPA IPPC noise limits and the World Health Organisation (WHO) *Guidelines for Community Noise. BS4142 Method for Rating Industrial Noise affecting mixed residential and industrial areas (1997)* was also referenced.
- Recommendations for mitigation measures to minimise the noise impact on nearby sensitive receivers.
- Discussion of the residual noise impact on residential receivers after mitigation measures have been taken into account.

13.2.1 Noise Monitoring Methodology

All noise measurements were conducted according to the British Standard *BS 7445 Description and Measurement of Environmental Noise* and the EPA *Environmental Noise Survey Guidance Document*. The measurements were made using a Norsonic Nor140 Sound Level Meter which is a Type 1 meter according to IEC 651. The sound level meter was orientated towards the dominant noise source during all measurements at a height of 1.5m above ground level. A wind shield was used on the microphone throughout the survey and the sound level meter was calibrated before and after the noise survey. The Time Weighting used was Fast and the Frequency Weighting was A-weighted.

The primary measurement parameter recorded was the equivalent continuous A-Weighted sound pressure level, $L_{Aeq, T}$, during the daytime and nighttime monitoring periods. A statistical analysis of the measurement results was also completed so that the percentile levels $L_{A90, T}$ was also recorded. The percentile levels recorded represent the noise level in dB(A) exceeded for 90% of the measurement time, i.e. the background noise level.

Sound pressure levels were measured and recorded in 1/3rd octave bands from 6.3Hz to 20 KHz to establish the presence of tonal noise if any at each of the three monitoring locations. All noise sources were noted, recorded and where possible, identified during the course of the survey.

13.2.2 Noise Modelling Methodology

Noise predictions were made for the operational phase of the proposed power plant using Cadna_A Version 3.72 noise modelling software by DataKustik GmbH. The Cadna_A noise modelling software generates predicted noise levels for noise sensitive receivers in the vicinity of the proposed development. This noise prediction model incorporates appropriate noise calculation methodologies. The Cadna_A computational model develops a visual and mathematical representation of the predicted noise environment in the vicinity of the proposed development.

The proposed power plant was represented in the noise model and the resulting noise level at residential receivers was predicted. The ten most significant noise sources at the proposed power plant were implemented to the noise model and an appropriate sound insulation value for the proposed building elements was included. All buildings and natural screens were implemented to the model to maintain an accurate representation. The noise level was predicted at each of the three nearest residential receivers and the model was also used to

identify the particular element at the plant site contributing most to the noise level at receivers.

In relation to the calibration and validation of the noise model, where a monitored and modelled noise level is within approximately +/- 3dB, the location can be deemed to be well validated in relation to monitored and modelled noise levels (i.e. a "Good" level of validation). WYG has validated the local noise climate in the noise model in terms of existing traffic noise levels versus the measured noise levels to a "Good" level of validation.

13.2.3 Noise Impact Assessment Criteria

An IPPC license as issued by the Environmental Protection Agency (EPA) will be required given the power generation capacity of the proposed power plant. According to the EPA document *Guidance Note for Noise in Relation to Scheduled Activities*, 2nd Edition 2006, the following noise limits are recommended:

- Daytime (8am to 10pm) – 55dB $L_{Ar,T}$ free field
- Night time (10pm to 8am) – 45 dB $L_{Aeq,T}$ free field

These noise limits are related to the recommended noise levels as outlined in the WHO *Guidelines for Community Noise*.

To assess the noise impact from the proposed power plant, guidance from BS4142 *Method for Rating Industrial Noise affecting mixed residential and industrial areas (1997)* is taken into account. According to BS4142:

Apply a 5dB correction if one or more of the following features occur, or are expected to be present for new or modified noise sources:

- the noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum, etc.);

The proposed power plant will produce a "hum" noise. Noise that can be described as a hum or constitute a definable note can be defined as "tonal" in character. Noise which is tonal in character is defined in ISO 1996 *Description and measurement of environmental noise (1987)* as noise where the sound pressure level in any one 1/3rd octave band is 5dB above the sound pressure levels in each adjacent 1/3rd octave band. Therefore, the noise impact from the power plant has been rated according to the guidelines set out in BS4142 and as such, a 5dB correction has been added to the predicted noise level due to the power plant at each of the

three residential receivers. This level is deemed the Rated Noise Level, $L_{Ar,T}$ and has been compared directly to the EPA defined limits as outlined above.

The likely future perceived impact of change in noise level at the noise sensitive properties adjacent to the proposed Lumcloon energy Ltd. development site has also been determined. In addition to the assessment of noise impact in accordance with the EPA document *Guidance Note for Noise in Relation to Scheduled Activities*, the perceived impact of change in noise level has also been reported for the noise sensitive properties. The perceived impact rating and the subjective response to changes in noise levels have been determined based on the subjective assessment of changes in noise levels, in terms of perceived change and loudness outlined in Table 13.1. The prediction of the perceived impact of change in traffic noise level may result in a noise sensitive property being classified as potentially suffering from a “no change”, “negligible”, “noticeable”, “clearly noticeable”, “substantial” or “very substantial” subjective change in noise level.

Table 13.1 Subjective assessment of changes in noise levels, in terms of perceived change and loudness.

Change in Noise Level	Impact Rating	EPA Glossary of Impacts	Subjective Reaction	Subjective Change
0	No change	n/a	n/a	No change
<3 dB(A)	Not Significant	Neutral, Imperceptible or Slight Impact	Barely perceptible	Negligible
3 – 5 dB(A)	Minor	Significant Impact: Positive or Negative	Perceptible	Noticeable
6 – 10 dB(A)	Moderate		Up to a doubling of loudness	Clearly Noticeable
11 – 15 dB(A)	Major		Over a doubling of loudness	Substantial
>15 dB(A)	Severe	Profound Significant Impact: Negative only	---	Very Substantial

Note Based on an extract from Morris, Peter and Therivel, Riki, Methods of Environmental Impact Assessment 2nd Edition, 2001.

13.3 RECEIVING ENVIRONMENT

13.3.1 Noise Monitoring Survey Results

An attended noise monitoring survey was carried out at the three closest residential receivers to the proposed development on the 4th and 5th of March 2009 during daytime and night time hours. Daytime noise monitoring was carried out over a period of 1 hour at each location. Nighttime noise monitoring was carried out over a period of 15 minutes at each location. The noise monitoring locations are shown on Figure 13.1. The noise levels recorded at each monitoring location during daytime and nighttime are displayed in Table 13.2 and Table 13.3. The L_{A90} is representative of the background noise level at each monitoring location. Weather conditions were clear, dry and cold when noise measurements were taken during daytime hours and night time hours. Measurements were taken between 6.3 Hz and 20 KHz. The normal maximum audible range is from 20 Hz to 20 KHz.

Table 13.2 Daytime Noise Monitoring Survey Results

Noise Sensitive Receiver	Measured Noise Level		Description of Noise Environment	Description of Location
	LAeq dB	LA90 dB		
NSR2	72.6	38.8	Predominant noise sources comprised approximately 60 cars, 3 vans, 2 tractors. No other significant noise sources.	Beside gateway to residence 3m off R357
NSR3	47.6	28.9	Predominant noise sources comprised dogs barking, bird song and 4 cars passed during measurement.	In garden of residence off R437 within 5m of front façade of house

Note: Daytime noise levels at NSR1 not recorded due to technical fault. The daytime noise levels recorded at NSR 2 are representative of the daytime noise levels at NSR1 as the noise levels at both locations are dominated by road traffic on the R357.

Table 13.3 Nighttime Noise Monitoring Survey Results

Noise Sensitive Receiver	Measured Noise Level		Description of Noise Environment	Description of Location
	LAeq dB	LA90 dB		
NSR1	63.4	18.8	The only significant noise source included 8 cars passing during the measurement.	Within 3m of front façade of house off R357
NSR2	60.8	21.0	The only significant noise source included 8 cars and 1 van passing during the measurement.	Beside gateway to residence 3m off R357
NSR3	37.2	25.2	Audible noise comprised very distant cars travelling on R357, no noise in immediate area.	In garden of residence off R437 within 5m of front façade of house

13.3.2 Description of the Noise Environment

The existing noise environment in the vicinity of the proposed site was observed to be typical to that of a rural area. The predominant noise sources noted were road traffic along the R357 and R437. Other noted noise sources included birdsong and agricultural activity. Previously, there was an ESB power plant on the site of the proposed development. Typically this would have resulted in an audible hum at each of the three receivers. As with any power plant, this audible hum would contribute to the background noise environment in an area.

13.4 IMPACT ASSESSMENT

13.4.1 Construction Phase

13.4.1.1 Construction Noise

Construction activity will include the operation of large machinery such as earth movers, bulldozers, trucks, cranes, steel work assembly and fixing. In order to minimise the potential for a construction noise impact on the three nearby residential receivers, the noise limits outlined in Table 13.4 should be adhered to during the construction of the proposed development. In order to limit disturbance from construction noise, it is recommended that construction noise be assessed and managed in accordance with BS5228 *Noise Control on Construction and Open Sites*. No national construction noise limits are referencable. Therefore, it is recommended that the construction noise limits outlined by The National

Roads Authority in its "Guidelines for the Treatment of Noise and Vibration in National Roads Schemes" should be adhered to at the three nearby residential receivers during construction..

Table 13.4 Maximum Permissible Noise Levels at the Façade of Dwellings during Construction (NRA Guidelines, October 2004)

Days & Times	LAeq (1hr) dB	LAMax dB
Monday to Friday - 07.00 to 19.00	70	80[Note1]
Monday to Friday - 19.00 to 22.00	60[Note1]	65[Note1]
Saturday - 08.00 to 16.30	65	75
Sundays and Bank Holidays - 08.00 to 16.30	60*	65*

Note 1 Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant local authority.

13.4.1.2 Construction Traffic

During construction, there will be approximately 30 HGV movements per day. Construction site employee traffic volumes will result in approximately 400 vehicle movements per day assuming a vehicle occupancy of two. Existing AM and PM peak hour flows on the R357 are in the order of approximately 200 to 220 vehicle movements per day. Therefore, as a doubling of road traffic volume results in an approximate 3 dB increase in noise level at adjacent properties, the noise impact from traffic during the construction phase will be negligible.

13.4.1.3 Construction Vibration

The nearest residential receiver to the proposed power station is approximately 400m away with the other two receivers located approximately 600m away. Therefore, a vibration impact during construction is most unlikely to occur. However, if in the unlikely event that complaints related to vibration impact are received from nearby residential receivers, vibration monitoring will be carried out at existing properties in the vicinity of the proposed development site during the construction phase.

If there is a requirement to undertake vibration monitoring, the following guidance on vibration monitoring (monitoring of peak particle velocity) should be followed;

- The instrumentation should monitor three orthogonal components of peak particle velocity (p.p.v) and the trigger values / limits are set based on the maximum of these (the peak component particle velocity) as follows:

- Amber level = 7.5 mm/s (Operatives should be notified if this level is reached; work may continue but with caution – review of working method should be considered).
- Red level = 10 mm/s: work should be stopped if this level is reached and working method reviewed; revised method of working to be agreed prior to works proceeding again; Site Foreman & Operatives to be notified immediately.
- Visible & audible alarms should form part of the monitoring system so that it is easily established when the trigger / alarm levels are reached.

13.4.2 Operational Phase

As stated above, the noise generated by a power station is perceived as a constant “hum” due to the cyclic nature of the machinery used. The noise impact on the nearby residential receivers from the proposed development was determined and where noise mitigation is required this has been recommended and input into the noise model. All major noise sources proposed for use at the power station are included in the noise model to determine the noise level at nearby residential receivers. The most significant noise source types only were taken into account as any noise source of less significance will result in a negligible difference in the overall noise level at any of the nearest residential receivers.

There will be no expected vibration sources from the operation of the proposed development.

All sound power levels shown above were provided to WYG by Lumcloon Energy Ltd. There was no available sound power data for the Air Cooled Condenser Fans (ACC Fans) when the noise impact assessment was carried out. Therefore a realistic sound power level of 100dB L_w per ACC Fan was input into the noise model.

Table 13.5 Sound Power Levels for the Nine Most Significant Noise Sources

Plant Item	Source Type	Source Location	Sound Power L _w dB	Number	Height
Bypass stack	Point	On roof of open cycle power building	115	4	4.0
Closed Cooling	Point	Inside power generation building	99	2	4.0
Enclosed Ventilation Inlet GT	Point	On roof of open cycle power building	90	4	19.6
Enclosed Ventilation Outlet GT	Point	On roof of open cycle power building	89	4	14.0
GT Air Intake	Point	On roof of open cycle power building	94	4	26.4
HRSG Stack	Point	On HRSG building roof	99	4	43.0
Transformer	Point	Outside, at side of open cycle power hall	86	6	4.0
ACC Fans	Point	Outside between power generation building and diesel storage bund	100	18	15.0
Gas & Steam Turbine	Point	In power generation building	98	2	8

The sound pressure levels predicted to arise due to the operation of the proposed Lumcloon Energy Ltd. power plant are as outlined in Table 13.6.

Table 13.6 Predicted Noise Levels at Residential Receivers due to Operation of Plant

Receiver	Predicted Noise Level L _{Aeq} dB	Rated Noise Level (+5dB) L _{ART} dB
NSR1	38.6	43.6
NSR2	37.3	42.3
NSR3	38.9	43.9

The highest noise level as a result of the operation of the proposed power station has been predicted to be 39dB L_{Aeq} at NSR 1 and NSR 3. When expressed as a rated noise level, this equates to approximately 44dB L_{AR} at NSR 1 and NSR 3. The operation of the proposed power plant will result in higher background noise levels at the nearest residential receivers as the power plant will operate on a 24/7 basis.

As stated above, an IPPC license will need to be issued by the Environmental Protection Agency (EPA) for the proposed development to operate. On the basis of the predicted noise

levels at the surrounding receiver locations, the EPA noise limits of 55dB $L_{Ar,T}$ during daytime (8am to 10pm) and 45 dB $L_{Aeq, T}$ during night time (10pm to 8am) will be achieved.

Although the predicted noise levels are not in excess of the specified guideline values at the nearest noise sensitive receiver locations, the perceived impact of the proposed development on the nearby noise sensitive receivers has also been assessed in accordance with the criteria outlined in Table 13.2. For the assessment of perceived impact on the nearest residential receivers the predicted noise levels due to the proposed power plant have been compared with the existing background noise levels in the area, i.e. the measured L_{A90} noise levels. Therefore, the modelling results indicate negligible subjective change in perceived noise levels during daytime at NSR1 and NSR2, i.e. along the R357. At NSR3 during the daytime, there will be an increase of approximately 10dB which constitutes a clearly noticeable subjective change in perceived noise levels. In comparison to the measured background nighttime noise levels, the increase in predicted noise levels during nighttime will result in a substantial to very substantial increase in perceived noise level at the nearest noise sensitive receiver locations. However, as stated above, the EPA IPPC noise limits will not be exceeded which are based on the World Health Organisation (WHO) *Guidelines on Community Noise*.

The WHO Guidelines on Community Noise state that *'To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq} . These values are based on annoyance studies, but most countries in Europe have adopted 40 dB L_{Aeq} as the maximum allowable level for new developments (Gottlob 1995). Indeed, the lower value should be considered the maximum allowable sound pressure level for all new developments whenever feasible. At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax} so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB'*. The proposed development will achieve the WHO recommended noise levels.

Site traffic due to employees entering and leaving the site will give rise to a less than 20% increase in traffic flows and therefore, an insignificant traffic noise impact in the vicinity of the proposed development site. Table 13.7 outlines the proposed traffic flows that the development will generate. The increase in traffic flow along local routes can be considered negligible in terms of a road traffic noise impact on nearby sensitive receivers.

Table 13.7 Generated Traffic for the Operational Phase of the proposed development

Location	Existing AM Peak	Existing PM Peak	Total Vehicle Movements – Operational Phase
R357 and R437 staggered crossroads	227	235	21
Local Road T-junction onto R357	190	208	21
R357 at Proposed Junction	189	203	30

13.5 MITIGATION MEASURES

This section details the proposed methodology by which potential impacts resulting from the proposed power plant development during the construction and operational phases may be mitigated.

13.5.1 Construction Phase Mitigation Measures

General guidelines for limiting the potential noise impact during the construction phase of the proposed power plant are outlined below:

- Limit noisy construction works to 8am to 6pm weekdays with Saturday working from 8am to 1pm (relatively quiet construction activities could be carried out outside these hours, subject to strict controls).
- Use modern, silenced and well-maintained equipment conforming to EU directives.
- Shut down equipment when not in use, where practicable.
- Maintain site semi-static equipment such as generators, mixers, and compressors as far away as possible from sensitive locations and ensure that the orientation is the optimum for low noise.
- Utilise buildings under construction as screening between the construction site and residential receivers, where possible.
- Ensure that all workers are given training with respect to minimising noise and disturbance.
- Consider quieter working methods; for example use vibratory-driven piles instead of impact driven piles.
- Design of haul routes within the site to ensure maximum distance from noise sensitive locations.

- The utilisation of localised acoustic screening should be provided for specific fixed location items of plant throughout the site. Items such as generators, pumps and compressors should be provided with localised screening in the form of a noise barrier or actual enclosure to reduce noise emissions.
- Maintain ongoing contact with local residents to ensure any complaints relating to construction phase noise for the project from local residents can be addressed. Also, prior to any particularly noisy activities, local residents should be contacted in order to minimise the perceived noise impact.
- WYG recommend that the Construction Management Plan for the project is inclusive of a recommendation for a suitably qualified construction noise expert to visit the site on a regular basis and carry out an audit of site work practices in order to ensure that every effort is made to reduce noise breakout from site. This should be inclusive of noise monitoring at appropriate agreed and repeatable locations. WYG recommends that the three nearby residential receivers as previously identified in this report be considered as '*Construction Noise Monitoring Locations*'.

13.5.2 Operational Phase Mitigation Measures

13.5.2.1 Building Envelope

The predicted noise levels at the three residential receivers as detailed above are based on a specific transmission loss performance for the cladding and roof elements of buildings housing high noise generating power plant equipment. In order to achieve the predicted values set out above and meet the previously discussed EPA noise limits for this facility, the sound insulation values for building elements outlined in Table 13.8 are required of the cladding and roof systems used in the power plant building envelopes. The sound transmission loss coefficients assumed for the CCGT and OCGT areas of the power plant building assume an average absorption coefficient of 0.25 at 500Hz.

Table 13.8 Assumed Transmission Loss Octave Band Values for Power Plant Buildings

Building Element	Octave Spectrum (dB)									
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz	Rw
Combined Cycle Building	7	13	19	25	31	38	38	38	38	35
Open Cycle Building	10	16	22	28	34	41	41	41	41	38

13.5.2.2 Power Plant Equipment Isolation

Due to the noise levels generated by the gas and steam turbine / generator in particular, it is recommended that all major plant items are sufficiently isolation mounted to minimise noise transmission through to the building structure and the concrete floor. The vibration isolation employed must be specifically selected to suit the weight, frequency of oscillation and isolation efficiency of the plant item being considered. Otherwise, if noise is transmitted to the structure, the building envelop itself will become vibration excited and as a result emit excessive noise into the surrounding environment.

13.6 RESIDUAL IMPACTS

The closest residential receiver to the power station is approximately 400m away with two residential receivers located approximately 600m away. The distance of the proposed power plant from the nearest residential receivers allows for significant noise attenuation due to distance. When all major noise sources on the proposed site were modelled, it was found that the noise impact at the three residential receivers is predicted to be below the EPA noise limits of 55dB $L_{A,r,T}$ during daytime (8am to 10pm) and 45 dB $L_{Aeq,T}$ during night time (10pm to 8am). As the power station will be operation on a 24 hour basis, the night time scenario defines the actual noise limit on the power station. It is concluded that the noise impact due to the power station will not result in an exceedance of the relevant EPA limit values and the recommended daytime and nighttime noise levels in the World Health Organisation (WHO) *Guidelines for Community Noise*.

13.7 REFERENCES

- Guidelines for Community Noise
- World Health Organisation (WHO): 2000
- Method for Rating Industrial Noise affecting mixed residential and industrial areas
- BS4142: 1997
- Environmental Noise Survey Guidance Document
- Environmental Protection Agency (2003)
- ISO 1996 Acoustics – Description and Measurement of Environmental Noise – Part 1 & 2

- International Standards Organisation
- BS7445: Description and measurement of Environmental Noise – Part 1 & 2
- British Standard (2003)