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NOISE IMPACT ASSESSMENT FOR A PROPOSED K2 DATA CENTRE AT KINGSWOOD DRIVE AND KINGSWOOD ROAD, WITHIN THE CITYWEST BUSINESS CAMPUS, NAAS ROAD, DUBLIN 24

Technical Report Prepared For

K2 Strategic Infrastructure Ireland Limited

Technical Report Prepared By

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EXECUTIVE SUMMARY

This report presents the assessment of the likely noise and vibration impacts associated with the proposed data centre (which the current amendment application seeks alterations to) during the construction and operational stages on its surrounding environment.

The construction noise assessment has shown that in accordance with the 'significance' thresholds presented in the *British Standard BS 5228 – 1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Noise* impacts during construction will be moderate to major at residential locations and will be controlled to operate within the relevant noise criteria.

Guidance from relevant noise standards relating to environmental noise in addition to the prevailing noise levels measured have been used to set appropriate noise limits at the nearest noise sensitive locations to the proposed development.

The assessment has concluded that noise emissions from building services plant can achieve the adopted criteria at the façade of the nearby noise sensitive locations.

The operational noise assessment of fixed plant associated with the proposed development has shown that the predicted change in background noise level due to current application is the order of 2 dB to 3 dB during the quietest night-time periods resulting in a 'not significant' to 'slight' noise impact. Ambient noise levels are and will continue to be dictated by road traffic noise in the area while a low level of plant noise is expected to be audible during lulls in other sources (e.g. distant traffic noise).

The operational noise assessment of vehicle movements associated with the site has shown that in accordance with the scale in the '*Guidelines on the Information to be contained in Environmental Impact Statements*' there will be an imperceptible impact at noise sensitive locations considering existing traffic volumes on the local road network.

CONTENTS

1.0 INTRODUCTION

This noise impact assessment report has been prepared to assess the application for the proposed Data Centre development located at Kingswood Drive and Kingswood Road within Citywest Business Campus, Naas Road, Dublin 24.

The nearest residential locations are at distances of the order of 400m to the north and south. Buildings at closer distances to the north and south and those to the west are commercial in nature. The location of the subject site The subject site is illustrated in Figure 1 below.

Figure 1 Site Red Line Boundary and Site Context

The development of the data centre building (to which the current amendment application relates) will include air handling units (AHU's) located in a 'plant well' on the roof which is screened from the surroundings by a partly of the second floor of the development and partly by a roof parapet. Standby generators to the east of the building are also proposed.

2.0 METHODOLOGY

2.1 Outline Methodology

The following methodology has been adopted for this assessment:

- A review of appropriate guidance, typical local authority planning conditions, etc. in order to identify appropriate noise criteria for the site operations has been undertaken;
- Baseline noise monitoring has been undertaken at locations representative of the nearest noise sensitive properties/boundaries) to identify existing levels of noise in the vicinity of the development;
- A detailed 3D noise model of the proposed development has been undertaken to predict noise levels at the nearest noise sensitive locations for a range of different operational scenarios; and
- The predicted levels have been assessed against the appropriate criteria and existing noise levels to determine the requirement for noise mitigation measures (if any).

Appendix A of this document presents a glossary of the acoustic terminology used throughout this document.

2.2 Forecasting Methods

The following forecasting methods have been adopted for the key potential noise sources and scenarios associated with the proposed development:

- Construction noise calculations have been conducted generally in accordance with BS 5228: 2009+A1:2014: *Code of practice for noise control on construction and open sites - Noise.*

- Prediction calculations for building services noise have been conducted generally in accordance with ISO 9613 (1996): *Acoustics – Attenuation of sound outdoors – Part 2: General method of calculation.*

- Changes in road traffic noise on the local road network have been considered using prediction guidance contained within *Calculation of Road Traffic Noise (CRTN)* issued by the Department of Transport in 1988.

3.0 RELEVANT CRITERIA

3.1 Significance of Impacts

The Environmental Protection Agency (EPA) Guidelines on the Information to be contained in Environmental Impact Assessment Reports, (May 2022) and the Draft EPA Advice Notes for Preparing Environmental Impact Statements (2015), see Tables 1 to 3 below. As these guidelines do not quantify the impacts in decibel terms further reference has been made to the '*Guidelines for Environmental Noise Impact Assessment*'[a] produced by the Institute of Environmental Management and Assessment Working Party (2014).

With regard to the quality of the impact, ratings may have positive, neutral or negative applications where:

[a] IEMA Guidelines for Environmental Noise Impact Assessment 2014

Quality of Impact	Definition
Negative	A change which reduces the quality of the environment (e.g. by causing a nuisance).
Neutral	No effects or effects that are imperceptible, within the normal bounds of variation or within the margin of forecasting error.
Positive	A change that improves the quality of the environment (e.g. by removing a nuisance).

Table 1 Quality of Potential Effects

The significance of an effect on the receiving environment are described as follows:

Significance of Impact on the Receiving Environment	Description of Potential Effect
Imperceptible	An effect capable of measurement but without significant consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends.
Significant	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters a sensitive aspect of the environment.

Table 2 Significance of Effects

The duration of effects as described in the EPA Guidelines are:

Duration of Impact	Definition
Momentary	Effects lasting from seconds to minutes
Brief	Effects lasting less than a day
Temporary	Effects lasting one year or less
Short-term	Effects lasting one to seven years
Medium-term	Effects lasting seven to fifteen years
Long-term	Effects lasting fifteen to sixty years
Permanent	Effects lasting over sixty years
Reversible	Effects that can be undone, for example through remediation or restoration

Table 3 Duration of Effects

3.2 Construction Phase Guidance

3.2.1 Criteria for Rating Noise Impacts

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the *British Standard BS 5228 – 1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Noise*.

Relevant Noise Criteria 'ABC' Method

The approach adopted in BS5228 – 1 calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a significant noise impact is associated with the construction activities.

BS5228 – 1 sets out guidance on permissible noise levels relative to the existing noise environment. Table 10.1 sets out the values which, when exceeded, signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These are construction noise levels only and not the cumulative noise level due to construction plus existing ambient noise.

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

Table 4 Example Threshold of Significant Effect at Dwellings

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

It should be noted that this assessment method is only valid for residential properties.

For the appropriate periods (i.e. daytime, evening and night-time) the ambient noise level is determined and rounded to the nearest 5dB. Baseline monitoring carried out as part of this assessment would indicate that the categories detailed in Table 10.2 are appropriate in terms of the nearest noise sensitive locations being considered in this instance.

Period	Baseline Noise Category	Construction Noise Threshold Value $L_{Aeq,1hr}$ (dB)
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	A	65
Evening (19:00 to 23:00hrs)	A	55
Night time (23:00 to 07:00hrs)	A	45

Table 5 Rounded Baseline Noise Levels and Associated Categories

See Section 6.1 for the construction noise assessment in relation to this site. This assessment process determines if a significant construction noise impact is likely.

Fixed Limits

When considering non-residential receptors, such as those sharing a boundary with the proposed development, reference is made to BS 5228-1:2009+A1:2014, which gives several examples of acceptable limits for construction noise, the most simplistic

being based upon the exceedance of fixed noise limits. For example, paragraph E.2 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".*

Proposed Threshold Noise Levels

Taking into account the proposed documents outlined above and making reference to the baseline noise environment monitored around the development site (see Section 9.3), BS 5228-1:2009+A1:2014 has been used to inform the assessment approach for construction noise.

The following Construction Noise Threshold (CNT) levels are proposed for the construction stage of this development:

- For residential NSLs it is considered appropriate to adopt 65 - 75 dB(A) CNT depending on existing noise level. Given the baseline monitoring carried out, it would indicate that Category A and C values are appropriate using the ABC method.
- For non-residential NSLs it is considered appropriate to adopt the 70 dB(A) CNT, given the urban environment in which the community centre resides, in line with BS 5228-1:2009+A1:2014 Annex E2.

Interpretation of the CNT

In order to assist with interpretation of CNTs, Table 6 includes guidance as to the likely magnitude of impact associated with construction activities, relative to the CNT. This guidance is derived from Table 3.16 of DMRB: Noise and Vibration and adapted to include the relevant significance effects from the EPA Guidelines (EPA 2022).

Table 6 Construction Noise Significance Ratings

Guidelines for Noise Impact Assessment Significance (DMRB)	CNT per Period	EPA EIAR Significance Effects	Determination
Period	Baseline Noise Category	Construction Noise Threshold Value $L_{Aeq,1hr}$ (dB)	Depending on CNT, duration & baseline noise level
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	A	65	
Evening (19:00 to 23:00hrs)	A	55	
Night time (23:00 to 07:00hrs)	A	45	

The adapted DMRB guidance outlined will be used to assess the predicted construction noise levels at NSLs and comment on the likely impacts during the construction stages.

3.2.2 Criteria for Rating Vibration Impacts

There are two aspects to the issue of vibration that are addressed in the standards and guidelines: the risk of cosmetic or structural damage to buildings; and human perception of vibration. In the case of this development, vibration levels used for the purposes of evaluating building protection and human comfort are expressed in terms of Peak Particle Velocity (PPV) in mm/s.

There is no published statutory Irish guidance relating to the maximum permissible vibration level. The following standards are the most widely accepted in this context and are referenced here in relation to cosmetic or structural damage to buildings:

- British Standard BS 5228-2 (BSI 2014); and
- British Standard BS 7385-2 (BSI 1993)

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Table 7 Transient vibration guide values for cosmetic damage
Note 1: Values referred to are at the base of the building.
Note 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

Furthermore, BS 5228-2 and BS 7385-2 state that minor structural damage can occur at vibration magnitudes greater than twice those in Table 7 and major structural damage can occur at vibration magnitudes greater than four times those in Table 7.

BS 5228-2 also provides guidance relating to the human response to vibration. Guidance is again provided in terms of PPV in mm/s since this parameter is routinely measured when monitoring the structural effects of vibration. The potential human response at different vibration levels, as set out in BS 5228-2, is summarised in Table 8.

Vibration level Note A) B) C) (mm/s)	Effect
0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3	Vibration might be just perceptible in residential environments.
1.0	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

Table 8 Transient vibration guide values for cosmetic damage

A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.

B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

3.3 Operational Phase Guidance

The relevant local authority, South County Council (SDCC), does not have any standard noise conditions listed in the Dublin Agglomeration Environmental Noise Action Plan December 2018 – July 2023 - Volume 4 - South Dublin County Council .

However, within section 2.5 IPPC Licensing of that document, the following comment is made regarding sites which require IPC/IED Licencing:

> *Certain activities that are required to be licensed may be subject to controls relating to sound emissions. The relevant guidance is set out in the EPA document, „Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)" was originally published in April 2012 and was updated in 2016. This revised Noise Guidance Note (NG4) is intended to assist licensed sites with the assessment of their potential and actual noise impact on the local environment. It recommends a "Best Available Technique" approach to the assessment and mitigation of noise pollution.*

Therefore, guidance in the EPA NG4 document has been considered in this environmental noise assessment.

3.3.1 EPA – NG4

In order to establish whether the noise sensitive locations in the vicinity of the site would be considered 'low background noise' areas as defined in the Environmental Protection Agency (EPA) publication Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4 2016) guidance, the noise levels measured during the environmental noise survey need to satisfy the following criteria:

- Arithmetic Average of L_{A90} During Daytime Period ≤40 dB L_{A90}, and;
- Arithmetic Average of L_{A90} During Evening Period ≤35 dB L_{A90}, and;
- Arithmetic Average of L_{A90} During Night-time Period ≤30 dB L_{A90}.

Determining Appropriate Noise Criteria

Table 9 below outlines the noise emission limit criteria detailed in the NG4 document.

Scenario	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night Noise Criterion, dB L_{Aeq} (23:00 to 07:00hrs)
Areas of Low Background Noise	45 dB	40 dB	35 dB
All Other Areas	55 dB	50 dB	45 dB

Table 9 NG4 Approach for Determining Appropriate Noise Criteria

As these nearest noise-sensitive locations are not identified as areas of low background noise as per the NG4 guidance, a 45 dB $L_{Aeq,T}$ night time criterion applies. Note if buildings were designed to this level, plant noise would be clearly audible and the dominant background source of noise at a number of noise sensitive locations in the vicinity of the development.

3.3.2 BS 4142:2014

BS 4142:2014+A1:2019: Methods for rating and assessing industrial and commercial sound is the industry standard method for analysing building services plant sound emissions to residential receptors. BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident. It should also be noted that the EPA NG4 document indicates that this assessment methodology should be used in the assessment of complaints associated with a site's operations. While the current site will not be licenced, the guidance contained therein needs to be given due regard.

For an appropriate BS 4142 assessment it is necessary to compare the measured external background sound level (i.e. the LA90,T level measured in the absence of plant items) to the rating level (LAr,T) of the various plant items, when operational. Where sound emissions are found to be tonal, impulsive, intermittent or to have other sound characteristics that are readily distinctive against the residual acoustic environment, BS4142 advises that penalties be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal sound characteristics outlined in BS 4142 recommends the application of a 2 dB penalty for a tone which is just perceptible at the receptor, 4 dB where it is clearly perceptible, and 6dB where it is highly perceptible. In relation to intermittency, BS 4142 recommends that If the intermittency us readily is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied. The following definitions as discussed in BS 4142 as summarised below:

"*ambient sound level, $L_{Aeq,T}$*" equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at any given time, usually from many sources near and far, at the

	assessment location over a given time interval, T.
"*residual sound level, $L_{Aeq,T}$*"	equivalent continuous A-weighted sound pressure level of the residual sound (i.e. ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound) at the assessment location over a given time interval, T.
"*specific sound level, $L_{Aeq,T}$*"	equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.
"*rating level, $L_{Ar,T}$*"	specific sound level plus any adjustment for the characteristic features of the sound.
"*background sound level, $L_{A90,T}$*"	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels.

In order to establish an initial estimate of impact, BS 4142 states the following:

Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level, and consider the following.

a. *Typically, the greater this difference, the greater the magnitude of the impact.*
b. *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
c. *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.*
d. *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.*

   Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

The assessment methodology described above (i.e. comparison of rated sound level to background sound level) is quoted in BS4142 as representing a methodology to 'obtain an initial estimate' of impact. It is important to note that BS4142 also comments that 'Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration'. BS4142 provides a list of potential

pertinent factors that can influence the 'initial estimate'. The plant noise assessment conducted in the following sections has been carried out with consideration of the guidance contained in BS4142 as summarised above.

3.3.3 Noise Planning Condition SD18A/0301

Similar to the methodology in BS4142, the previous planning grant on site placed conditions on noise levels due to the site at noise-sensitive locations, based on the background noise levels:

> *6(c)(ii) Noise due to the normal operation of the proposed development, expressed as Laeq over 15 minutes at the facade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and shall not exceed the background level for evening and night time. Clearly audible and impulsive tones at noise sensitive locations during evening and night shall be avoided irrespective of the noise level.*

3.3.4 Commercial Properties

A number of commercial / industrial properties are located in the vicinity of the site. In terms of noise emissions from the site it is considered that an appropriate noise criterion at these locations is 55 dB $L_{Aeq,15min}$.

3.3.5 Emergency Operation

In order to provide continuity of service a number of stand by generators are present on site and will be added to as part of the current proposal. These generators will only operate in a situation where there is a failure in the electricity supply from the national grid. Section 4.4.1 of the Environmental Protection Agency (EPA) document "Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities" (NG4 - 2016) contains the following comments in relation to emergency plant items:

> *'In some instances, ...sites will have certain items of emergency equipment (e.g. standby generators) that will only operate in urgent situations (e.g. grid power failure). Depending upon the context, it may be deemed permissible for such items of equipment to give rise to exceedances in the noise criteria/limits during limited testing and emergency operation only. If such equipment is in regular use for any purposes other than intermittent testing, it is subject to the standard limit values for the site'.*

On the understanding that generator testing will take place during daytime hours only, the proposed noise criterion of 55 dB $L_{Aeq,T}$ on these emergency units is appropriate. Generators will be designed and mitigated in order to achieve this design goal at nearby residential noise sensitive locations.

3.3.6 Recommended Criteria

Following review of relevant guidance, the following noise criteria are proposed for the development:

Day to Day Operation (Noise Sensitive) – 35-40 dB $L_{Aeq,15min}$
Day to Day Operation (Commercial) – 55 dB $L_{Aeq,15min}$
Emergency Operation – 55 dB $L_{Aeq,15min}$
Generator Testing – 55 dB $L_{Aeq,15min}$

Note plant noise emissions are to be designed such that they are not tonal and do not have impulsive characteristics at the nearest noise sensitive locations.

3.3.7 Assessment of Significance

The IEMA '*Guidelines for Environmental Noise Impact Assessment*' (2014) have been referenced in order to categorise the potential effect of changes in the ambient noise levels during the operational phases of the proposed development.

The guidelines state that for any assessment, the potential significance should be determined by the assessor, based upon the specific evidence and likely subjective response to noise. Due to varying factors which effect human response to environmental noise (prevailing environment, noise characteristics, time periods, duration and level etc.) assigning a subjective response must take account of these factors.

The scale adopted in this assessment is shown in Table 10 and is based on an example scale within the IEMA guidelines. The corresponding significance of impact presented in the Draft '*Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (EPA, 2017) is also presented.

Noise Level Change dB(A)	Subjective Response	Impact Guidelines for Noise Impact Assessment Significance (Institute of Acoustics)	Impact Guidelines on the Information to be contained in EIS's (EPA)
0	No change	Negligible	Imperceptible
0.1 – 2.9	Barely perceptible		Not Significant
3.0 – 4.9	Noticeable	Minor	Slight - Moderate
5.0 – 9.9	Up to a doubling or halving of loudness	Moderate	Moderate - Significant
10.0 or more	More than a doubling or halving of loudness	Major	Significant - Profound

Table 10 Noise Impact Scale

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 10dB(A) change in noise represents a doubling or halving of the noise level. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level.

It is considered that the criteria specified in the above table provide a good indication as to the likely significance of changes on noise levels in this case and have been used to assess the impact of operational noise. The following section presents a review of significance criterion in relation to construction noise.

4.0 EXISTING RECEIVING ENVIRONMENT

4.1 Baseline Noise Survey Locations

An environmental noise survey has been conducted at the site in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise*.

The noise measurement locations were selected to represent the noise environment at the NSLs surrounding the proposed development.

The monitoring locations are discussed below and shown in Figure 2:

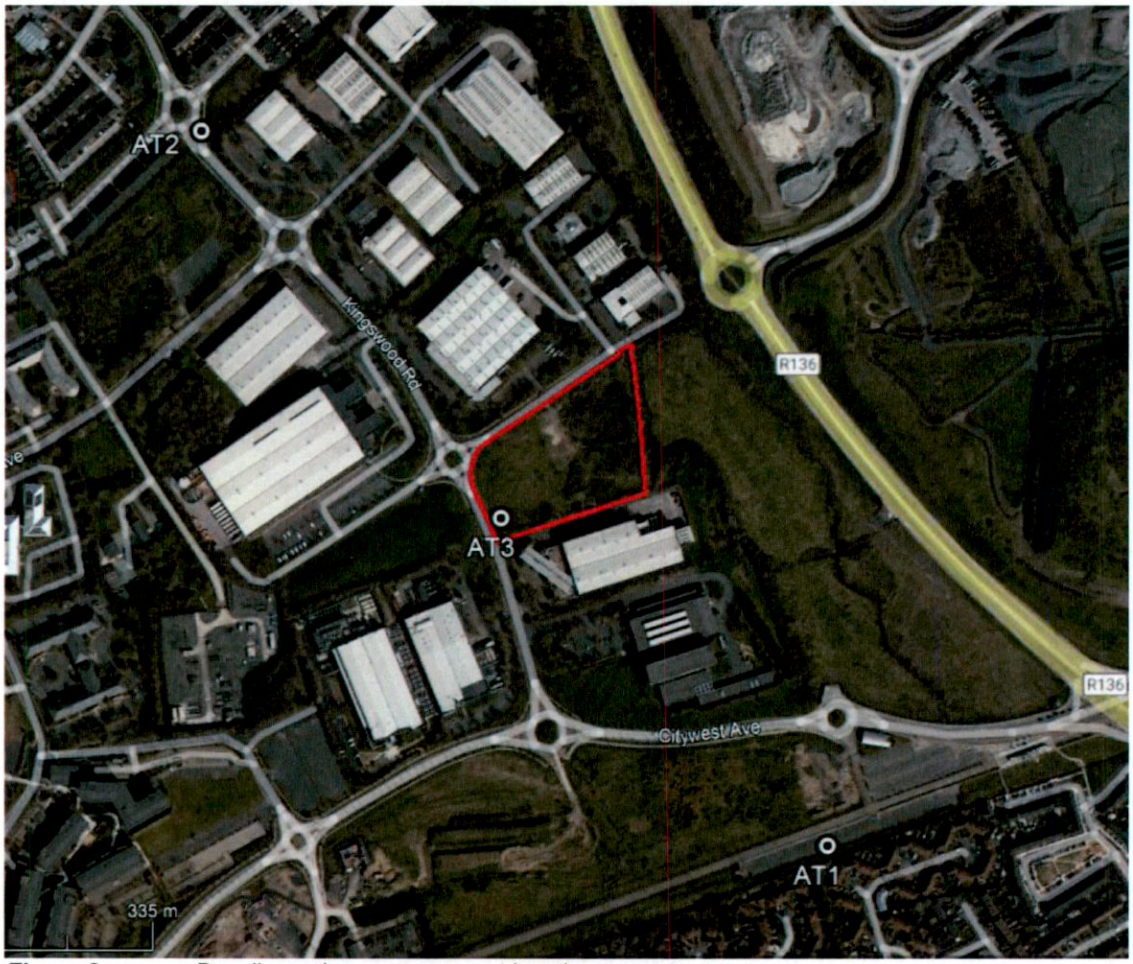

Figure 2 Baseline noise measurement locations

Location AT1 Attended measurement location to capture the noise level at the rear of the NSLs at Brookview Court and Brookview Way..

Location AT2 Attended measurement location to capture the noise level within the industrial estate at nearby commercial locations.

Location AT3 Attended measurement location to capture the noise level at the NSLs at Kinsgwood Avenue.

4.2 Survey Periods

Attended measurements were carried out during the following periods:

- Daytime: 15:25 hrs to 18:40 hrs on 7 June 2022
- Evening time: 21:45 hrs to 22:40 hrs on 7 June 2022
- Night-time: 01:15 hrs to 03:15 on 8 June 2022.

The weather during the survey periods was mainly dry with varying cloud cover. Wind speeds were generally moderate; however they were not considered to have had a detrimental effect on the noise measurements.

4.3 Personnel and Instrumentation

AWN carried out the noise surveys. The following instrumentation was used in conducting the noise and surveys:

Equipment	Type	Serial Number	Calibration Date
Sound Level Meter	Bruel & Kjaer 2250	2818091	Nov 2021

Table 11 Instrumentation Details

4.4 Noise Measurement Parameters

The noise survey results are presented in terms of the following parameters.

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix for the noise parameters denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

4.5 Survey Results

The survey results for the daytime attended monitoring are given in Table 12.

Location	Start Time (hrs)	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)	
		$L_{Aeq,15min}$	L_{A90}
AT1	15:35	59	45
	16:45	58	49
	17:45	57	47
AT2	16:00	61	52
	17:05	54	50
	18:05	54	50
AT3	16:25	56	51
	17:25	52	49
	18:25	52	48

Table 12 Summary of Attended Results - Daytime

At AT1, Noise levels were in the range 57 to 59 dB $L_{Aeq,15min}$ and 45 to 47 dB $L_{A90,15min}$. Traffic and LUAS pass-bys, and a degree of construction noise were audible.

At AT2, Noise levels were in the range 54 to 61 dB $L_{Aeq,15min}$ and 50 to 52 dB $L_{A90,15min}$. Traffic and construction activity were the dominant noise sources.

At AT3, Noise levels were in the range 52 to 56 dB $L_{Aeq,15min}$ and 49 to 51 dB $L_{A90,15min}$. Traffic and construction activity at a location to the east were the dominant noise sources.

The survey results for the evening time attended monitoring are given in Table 13.

Location	Start Time (hrs)	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)	
		$L_{Aeq,15min}$	L_{A90}
AT1	21:45	58	41
AT2	22:05	46	43
AT3	22:25	48	46

Table 13 Summary of Attended Results – Evening Time

During the evening periods, the noise levels at the noise survey locations ranged from 46 to 58 dB L_{Aeq} and 41 to 46 dB L_{A90}. Although reduced, traffic was the dominant noise source, along with Luas movements at location AT1.

The survey results for the night-time attended monitoring are given in Table 14.

Location	Start Time (hrs)	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)	
		$L_{Aeq,15min}$	L_{A90}
AT1	01:15	55	38
	02:20	53	35
AT2	01:40	46	41
	02:40	50	40
AT3	02:00	48	44
	03:00	51	47

Table 14 Summary of Attended Results – Night-time

During the night-time time periods, the noise levels at the noise survey locations ranged from 46 to 55 dB L_{Aeq} and 41 to 47 dB L_{A90}. Distant was the dominant noise source, along a degree of mechanical plant noise from the nearby commercial buildings at location AT3.

4.6 Nearest Noise-Sensitive Locations

In the first instance it is considered appropriate to define a noise sensitive location. In this context, it is considered prudent to give consideration to the definition supplied by the Environmental Protection Agency (EPA) which states the following:

> *"NSL – any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels."*

The nearest noise sensitive locations to the site are highlighted on Figure 2, all of which are residential houses.

Figure 4 highlights the nearest noise sensitive locations where predictions have been carried out to. Locations R01 to R06 represent commercial locations in the immediate surroundings of the proposed site. Locations R07 to R10 represent residential locations at Kinsgwood Avenue at some 410m from the boundary of the proposed. R11 to R21 represent the residential locations at some 400m to the south at Sheehy Skeffington Meadows, Brookview Court, Brookview Way and Ard Mór Court.

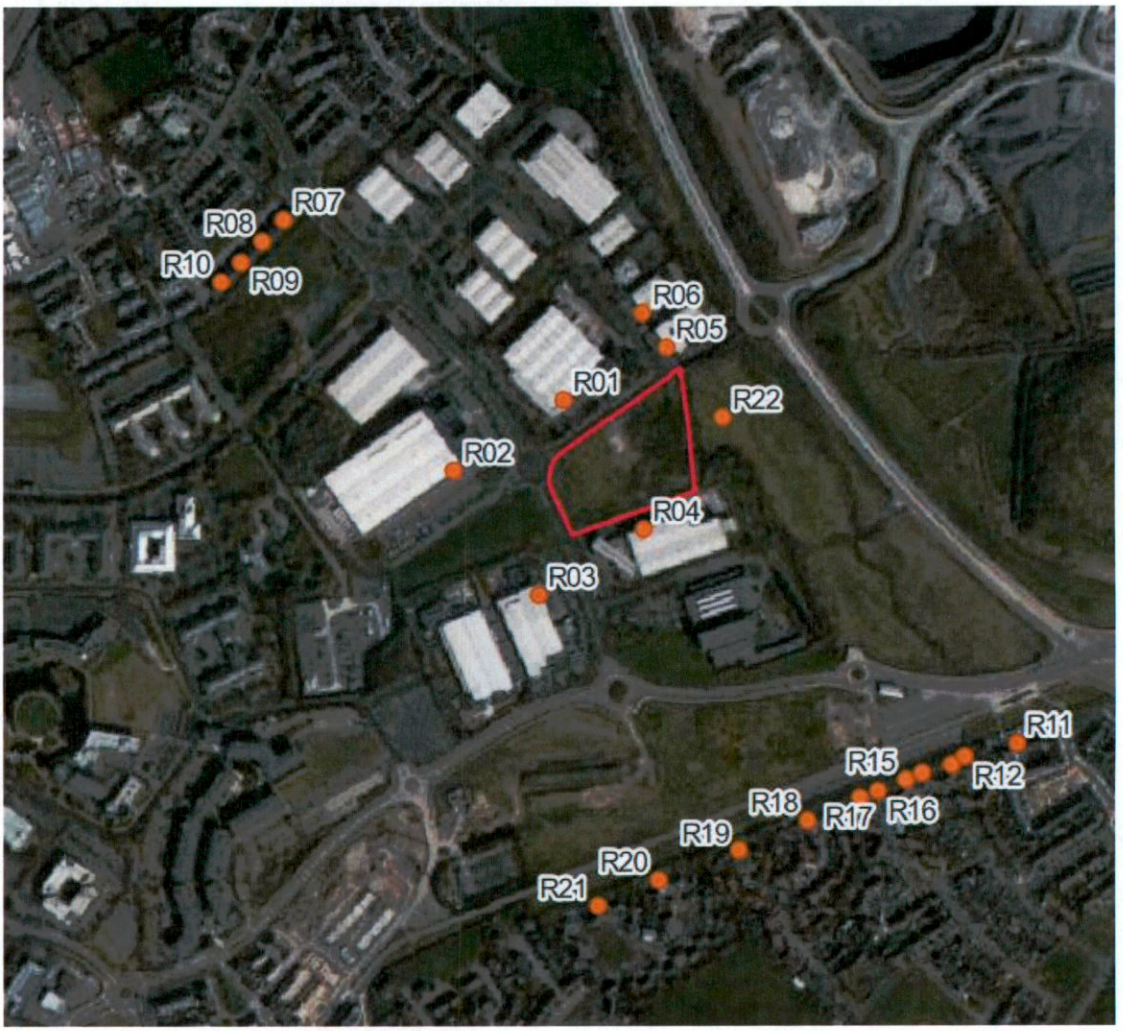

Figure 3 Noise-sensitive locations

5.0 PROPOSED DEVELOPMENT SUMMARY

The proposed development comprises amendments to the development permitted under Reg. Ref.: SD18A/0301. The proposed amendments comprise the following:

- Alterations to the permitted two storey data centre building including internal reconfiguration, alterations to finished floor levels, alterations to the building footprint to provide for the relocation of an internal staircore to the south of the building, and the replacement of the enclosed first floor level with an open screened roof mounted plant space (resulting in a reduction of 4,091 sq.m in the gross floor area (GFA) of the building).
- Associated alterations to the façade of the data centre building, including alterations to fenestration, cladding, step-out in the southern façade to accommodate a staircore, and a reduction in the eastern building parapet height of c. 2 metres.

- The provision of a canopy over the loading docks on the east facade.
- Alterations to the permitted generator compound, generators, and flues, including a reduction in the number of generators (5 no. now proposed), and provision of MV rooms within the generator compound.
- Provision of an ESB substation compound in the northeastern portion of the site, comprising a single storey substation building (with a GFA of c. 125 sq.m), 2 no. transformers, client control building (with a GFA of c. 47 sq.m), and associated access arrangements within a 2.6 metre high security fence. The ESB substation compound will be accessed from Kingswood Drive.
- Omission of the permitted sprinkler tank, pump room and 10kV Substation, reconfiguration of the permitted car parking, and revisions to permitted boundary treatments.
- Associated alterations to landscaping, access and internal road arrangements, services, lighting, and layout, and all associated and ancillary works.

The construction phase will involve excavation, construction of foundations and hardstanding area, general site preparation over the development site and the erection of new buildings over a phased construction period.

Once operational, the outward noise in the operational context are deemed long term and will involve:

- building services noise;
- emergency site operations, and;
- additional vehicular traffic on public roads.

These issues are discussed in detailed in the following sections.

6.0 POTENTIAL IMPACTS OF THE DEVELOPMENT

The potential impacts of the proposed development are discussed for the short-term construction phase and long-term operational phase. These are set out in the following sections.

6.1 Construction Phase

The largest noise and vibration impact of the proposed development will occur during the construction phase due to the operation of various plant machinery and HGV movement to, from and around the site. However, the construction phase can be classed as a short-term phase (approximately 16 months in duration).

The nearest residential NSLs to the site are at distances of approximately 350m to the south and at approximately 400m to the north. Based on the results of the baseline noise surveys undertaken, the ambient daytime noise level at these properties was found to be between 54 and 61 dB $L_{Aeq,T}$.

Thresholds for significant noise from construction can be determined by referring to Table 1 and the baseline ambient noise levels, as outlined in the assessment criteria section. The daytime significance threshold for construction noise at the site is set at 65 dB $L_{Aeq,T}$. A night-time threshold is not included as construction work will not take place at night.

BS 5228-1 contains noise level data for various construction machinery. The noise levels relating to site clearance, ground excavation and loading lorries (dozers, tracked excavators and wheeled loaders) reach a maximum of 81 dB $L_{Aeq,T}$ at a distance of 10 m. For this assessment, a worst-case scenario is assumed of 3 no. such items with a sound pressure level (SPL) of 81 dB at 10 m operating simultaneously along the closest works boundary. This would result in a total noise level of 86 dB at 10 m and an equivalent combined sound power level of 114 dB L_{WA}. This worst-case scenario is the typical assumption made for developments of this size, on the basis that it is unlikely that more than 3 no. items of such plant/equipment would be operating simultaneously in such close proximity to each other.

Guidance on the approximate attenuation achieved by barriers surrounding the site is also provided in BS 5228-1. It states that when the top of the plant is just visible to the receiver over the noise barrier, an approximate attenuation of 5 dB can be assumed, while a 10 dB attenuation can be assumed when the noise screen completely hides the sources from the receiver.

This scenario can be assumed in this case due to the proximity of the NSLs, i.e. a barrier height will be chosen so as to completely hide the source. Table 15 shows the potential noise levels calculated at various distances based on the assumed sound power level and attenuation provided by the barrier of 10 dB.

Description of Noise Source	Sound Power Level (dB Lw(A))	Calculated noise levels at varying distances (dB $L_{Aeq,T}$)				
		50 m	75 m	100 m	125 m	150 m
3 no. items each with SPL of 81 dB at 10 m operating simultaneously.	114	66	61	58	56	54

Table 15 *Potential construction noise levels at varying distances*

The calculated noise levels in Table 15 show that there is potential for the maximum permissible daytime noise level to be exceeded at distances up to 50 m from the works. However, as discussed above, the closest NSL to the works are at distances of the order of 75 m. This indicates that construction noise effects are **negative**, **not significant** and **short-term**.

Construction Vibration

Potential for vibration impacts during the construction phase programme are likely to be limited to excavations and piling works to be used for foundations. For the purposes of this assessment the expected vibration levels during piling assuming augured or bored piles have been determined through reference to published empirical data. The British Standard BS 5228 – Part 2*: Vibration*, publishes the measured magnitude of vibration of rotary bored piling using a 600mm pile diameter for bored piling into soft ground over rock, (Table D.6, Ref. No. 106):

- 0.54mm/s at a distance of 5m, for auguring;
- 0.22mm/s at a distance of 5m, for twisting in casing;
- 0.42mm/s at a distance of 5m, for spinning off, and;
- 0.43mm/s at a distance of 5m, for boring with rock auger.

Considering the low vibration levels at very close distances to the piling rigs, vibration levels at the nearest buildings are not expected to pose any significance in terms of cosmetic or structural damage. In addition the range of vibration levels is typically below a level which would cause any disturbance to occupants of nearby buildings. This indicates that construction vibration effects are **negative**, **not significant** and **short-term**.

Construction Traffic

In terms of the additional construction traffic on local roads that will be generated as a result of the proposed development the following comment is presented: Considering that in order to increase traffic noise levels by 1dB traffic volumes would need to increase by the order of 25% it is considered that additional traffic introduced onto the local road network due to the construction phase associated of the development will not result in a significant noise impact.

6.2 Operational Phase

The primary sources of outward noise in the operational context are deemed medium term and will involve:

- building services noise;
- emergency site operations; and
- additional vehicular traffic on public roads.

These issues are discussed in following sections. See Appendix B for details of the noise modelling undertaken for this assessment and associated assumptions.

6.1.1 Building Services Noise / Emergency Site Operation

Three scenarios have been developed to consider the noise impact of the proposed operations. Scenarios A considers the data centre in normal day-to-day.

Scenario B are representative of emergency situation when a power outage or issue with supply from the national grid has occurred. It should be noted that such an event is an extremely rare occurrence.

Scenario C represents the impact associated with the occasional daytime testing of proposed emergency generators on the site. Typically only one generator unit will be tested at any one time. The assessment presented here assumes the northern most generator in operation, this being the closest to the noise-sensitive location to the north, the commercial building at R01.

See Appendix B for details of the noise model and input sound power levels

Noise contours plots are also presented for the various scenarios in order to demonstrate the noise impact of the proposed development. These are presented in Appendix C.

The results of the iterations of the noise model are presented in Table 16 for Scenarios A, B and C as discussed above. Note all plant will be selected such that no tonal noise emissions are evident at noise sensitive locations.

Location	Predicted dB $L_{Aeq,T}$		
	Scenario A	Scenario B	Scenario C
R01	39	44	41
R02	39	40	39
R03	40	43	40
R04	42	53	43
R05	40	52	49
R06	39	49	46
R07	34	36	35
R08	33	36	34
R09	32	34	33
R10	32	34	33
R11	33	41	36
R12	33	41	36
R13	33	40	36
R14	34	40	36
R15	34	39	35
R16	34	39	35
R17	33	38	35
R18	33	38	35
R19	34	38	35
R20	34	38	35
R21	34	37	34
R22	40	57	52

Table 16 Predicted Plant Noise Levels for Various Scenarios (Scenario A through C)

The above predicted levels are based on a situation where the receiver is downwind of all noise sources. For the purposes of the assessment against the adopted criteria this is a robust worst-case assumption.

Comment on Adopted Noise Criteria Day to Day Operations

The predicted noise levels presented in Table 16 are compared to the relevant noise criteria as adopted for this assessment in Table 17 overleaf.

It should be noted that the emergency generator testing shall take place only between 09.00 and 17.00hrs. The results are summarised as follows:

Scenarios A

All locations are within with the adopted criteria of 55dB $L_{Aeq,T}$ for commercial locations and 35 to 40dB $L_{Aeq,T}$ for residential locations for to day to day operations.

Scenarios B

All locations are within the relevant adopted emergency operation limit of 55dB $L_{Aeq,T}$, in the rare event that a power loss to the site occurs.

Scenarios C

All locations are within the relevant adopted daytime limit of 55dB $L_{Aeq,T}$ during periods when a single generator is undergoing routine testing.

Location	Scenario A			Scenario B			Scenario C		
	Predicted dB $L_{Aeq,T}$	Criterion dB $L_{Aeq,T}$	Complies?	Predicted dB $L_{Aeq,T}$	Criterion dB $L_{Aeq,T}$	Complies?	Predicted dB $L_{Aeq,T}$	Criterion dB $L_{Aeq,T}$	Complies?
R01	39	55	✓	44	55	✓	41	55	✓
R02	39		✓	40		✓	39		✓
R03	40		✓	43		✓	40		✓
R04	42		✓	53		✓	43		✓
R05	40		✓	52		✓	49		✓
R06	39		✓	49		✓	46		✓
R07	34	40	✓	36		✓	35		✓
R08	33		✓	36		✓	34		✓
R09	32		✓	34		✓	33		✓
R10	32		✓	34		✓	33		✓
R11	33	35	✓	41		✓	36		✓
R12	33		✓	41		✓	36		✓
R13	33		✓	40		✓	36		✓
R14	34		✓	40		✓	36		✓
R15	34		✓	39		✓	35		✓
R16	34		✓	39		✓	35		✓
R17	33		✓	38		✓	35		✓
R18	33		✓	38		✓	35		✓
R19	34		✓	38		✓	35		✓
R20	34		✓	38		✓	35		✓
R21	34		✓	37		✓	34		✓
R22	40	55	✓	57		See text	52		✓

Table 17 Comparison of Predicted Noise Levels vs. Adopted Noise Criteria

At R22, which represents a warehousing facility currently under construction, the noise level under Scenario B is 57 dB(A), slightly above the criterion of 55 dB(A) for emergency operations. Given that the ambient noise levels measured at AT3 nearby were in the range 52 to 56 dB L_{Aeq}, and that Scenario B represents a rare situation when a power outage or issue with supply from the national grid has occurred, the environmental noise impact at R22 is not considered significant.

Review of Increases in Noise Level

Table 15 presents the predicted changes in noise level associated with the development at the nearest noise sensitive locations.

Loc.	Scenario A – Typical Operation Night-time				
	Predicted dB $L_{Aeq,T}$	Background Level dB $L_{A90,T}$ NOTE A	Cumulative Noise Level (dB(A))	Change in Noise Level (dB)	EPA Glossary of Impacts
R01	39	44	45	+1	Not Significant
R02	39	44	45	+1	Not Significant
R03	40	44	46	+2	Not Significant
R04	42	44	46	+2	Not Significant
R05	40	44	46	+2	Not Significant
R06	39	44	45	+1	Not Significant
R07	34	40	41	+1	Not Significant
R08	33	40	41	+1	Not Significant
R09	32	40	41	+1	Not Significant
R10	32	40	41	+1	Not Significant
R11	33	35	37	+2	Not Significant
R12	33	35	37	+2	Not Significant
R13	33	35	37	+2	Not Significant
R14	34	35	38	+3	Slight
R15	34	35	38	+3	Slight
R16	34	35	38	+3	Slight
R17	33	35	37	+2	Not Significant
R18	33	35	37	+2	Not Significant
R19	34	35	38	+3	Slight
R20	34	35	38	+3	Slight
R21	34	35	38	+3	Slight
R22	40	44	46	+2	Not Significant

Table 18 Review of Predicted Changes in Existing Noise Levels

Note A: The background noise levels are presented for the quietest night-time hours recorded during the baseline survey to present a worst case assessment.

Review of the predicted increases in noise level at the nearest noise sensitive locations conclude that the associated impact is 'slight' to 'not significant' at all locations for Scenario A – Typical Operation.

Note the assessment table relates to night-time periods, during the day and evening periods the resulting impact is lower than those presented in Table 18 due to the higher prevailing background noise level during these periods (typically between 45 to 50dB L_{A90}).

6.2.1 Additional Vehicular Traffic on Public Roads

In terms of the additional traffic on local roads that will be generated as a result of this development the following comment is presented. Considering that in order to increase traffic noise levels by 1dB traffic volumes would need to increase by the order of 25% it is considered that additional traffic introduced onto the local road network due to this development will not result in a significant noise impact.

6.2.2 Vibration

There are no source of vibration associated with the day to day operation of the development that will give rise to impacts at nearby noise sensitive locations. In terms of these the operational phase of the development the associated effect is stated to be neutral, imperceptible, long term.

7.0 REMEDIAL MEASURES

In order to sufficiently ameliorate the likely noise impact, a schedule of noise control measures has been formulated for both construction and operational phases associated with the proposed development.

7.1 Construction phase

With regard to construction activities, reference will be made to BS5228 Parts 1 and 2, which offer detailed guidance on the control of noise and vibration from demolition and construction activities. Various mitigation measures will be considered and applied during the construction of the proposed development. Specific examples of such measures are:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted (for example, as in paragraph 6(a) of the planning conditions Ref SD18A/0301);
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring levels of noise and/or vibration during critical periods and at sensitive locations; and
- all site access roads will be kept even so as to mitigate the potential for vibration from lorries.

Furthermore, it is envisaged that a variety of practicable noise control measures will be employed. These may include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- erection of barriers as necessary around items such as generators or high duty compressors;
- situate any noisy plant as far away from sensitive properties as permitted by site constraints and the use of vibration isolated support structures where necessary.

We would recommend that vibration from construction activities to off-site residences be limited to the values set out in Section 3.2.2. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely

to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.

7.2 Operational Phase

7.2.1 Building Services Noise / Emergency Site Operation

Noise from building services plant will be minimised by selecting low noise generating equipment and incorporating appropriately specified in line attenuators where necessary. With due consideration as part of the detailed design process, this approach will result in the site operating well within the constraints of the best practice guidance noise limits that have been adopted as part of this detailed assessment.

It is acknowledged that the detail design of the facility may result in alterations to the plant selection and the associated sound output from the operational plant items. It is possible therefore for the operational noise criteria to be achieved by alternative means including selection of AHU's with a lower noise output or with the inclusion of at source attenuation.

Any alterations to the noise source data, building and plant layouts associated with operational phase of the development will be designed such that the operational noise criteria outlined in this report are achieved and associated noise impacts are no greater than those discussed in Section 6.

7.2.2 Additional Vehicular Traffic on Public Roads

The noise impact assessment outlined previously has demonstrated that mitigation measures are not required.

8.0 CONCLUSION

The construction noise assessment has shown that in accordance with the 'significance' thresholds presented in the *British Standard BS 5228 – 1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Noise* impacts during construction will be moderate to major at residential locations and will be controlled to operate within the relevant noise criteria.

The robust operational noise assessment of fixed plant associated with the proposed plant has shown that the predicted change in background noise level due to current application is the order of 2 to 3dB during the quietest night-time periods resulting in a not significant to slight noise impact. Ambient noise levels are and will continue to be dictated by road traffic noise in the area while a low level of plant noise is expected to be audible during lulls in other sources (e.g. distant traffic noise).

The operational noise assessment of vehicle movements associated with the site has shown that in accordance with the scale in the '*Guidelines on the Information to be contained in Environmental Impact Statements*' there will be an imperceptible impact off site noise sensitive locations considering existing traffic volumes on the local road network.

REFERENCES

- EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIA Reports) (2022)
- IEMA Guidelines for Environmental Noise Impact Assessment, 2014.
- *British Standard BS 5228 – 1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Noise.*
- Transport Infrastructure Ireland (TII) publication *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* .2004.
- British Standard BS 7385: 1993: *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.*
- British Standard BS 5228-2: 2009+A1:2014: *Code of practice for noise and vibration control on construction and open sites – Vibration.*
- BS 4142:2014+A1 2019: *Methods for rating and assessing industrial and commercial sound.*
- BS 8233:2014: *Guidance on sound insulation and noise reduction for buildings.*
- Environmental Protection Agencies *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)* (January 2016).
- ISO 1996-2:2017 *Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of environmental noise levels.*
- ISO 9613 (1996): *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.*
- *Calculation of Road Traffic Noise (CRTN)* issued by the Department of Transport in 1988.

APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

ambient noise — The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.

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 ($L_{AF90,T}$).

broadband — Sounds that contain energy distributed across a wide range of frequencies.

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 µPa).

dB L_{pA} — 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 (Hz) — The unit of sound frequency in cycles per second.

$L_{Aeq,T}$ — This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

L_{AFN} — The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.

L_{AFmax} — is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).

$L_{Ar,T}$ — The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and impulsiveness of the sound.

L_{AF90} — Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.

L_{AT}(DW) — equivalent continuous downwind sound pressure level.

L_{fT}(DW) equivalent continuous downwind octave-band sound pressure level.

L_{day} L_{day} is the average noise level during the day time period of 07:00hrs to 19:00hrs

L_{night} L_{night} is the average noise level during the night-time period of 23:00hrs to 07:00hrs.

low frequency noise LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum.

noise sensitive location NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

octave band A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

rating level See $L_{Ar,T}$.

sound power level The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m^2 where:

$$Lw = 10Log\frac{P}{P_0} \text{ dB}$$

Where: p is the rms value of sound power in pascals; and
P_0 is 1 pW.

sound pressure level The sound pressure level at a point is defined as:

$$Lp = 20Log\frac{P}{P_0} \text{ dB}$$

specific noise level A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval ($L_{Aeq,T}$)'.

tonal Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.

$^1/_3$ octave analysis Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one–third of an octave each

APPENDIX B

NOISE MODELLING DETAILS & ASSUMPTIONS

Noise Model

A 3D computer-based prediction model has been prepared in order to quantify the noise level associated with the proposed building. This section discusses the methodology behind the noise modelling process.

DGMR iNoise

Proprietary noise calculation software has been used for the purposes of this modelling exercise. The selected software, DGMR iNoise, calculates noise levels in accordance with ISO 9613: 1996 *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation.*

DGMR iNoise is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

Brief Description of ISO9613-2: 1996

ISO9613-2:1996 calculates the noise level based on each of the factors discussed previously. However, the effect of meteorological conditions is significantly simplified by calculating the average downwind sound pressure level, $L_{AT}(DW)$, for the following conditions:

- wind direction at an angle of ±45° to the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and;
- wind speed between approximately $1ms^{-1}$ and $5ms^{-1}$, measured at a height of 3m to 11m above the ground.

The equations and calculations also hold for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear calm nights.

The basic formula for calculating $L_{AT}(DW)$ from any point source at any receiver location is given by:

$$L_{fT}(DW) = LW + Dc - A \qquad \textbf{Eqn. A}$$

Where:
$L_{fT}(DW)$ is an octave band centre frequency component of $L_{AT}(DW)$ in dB relative to $2x10^{-5}Pa$;
L_W is the octave band sound power of the point source;
D_c is the directivity correction for the point source;

A is the octave band attenuation that occurs during propagation, namely attenuation due to geometric divergence, atmospheric absorption, ground effect, barriers and miscellaneous other effects.

The estimated accuracy associated with this methodology is shown in Table B1 below:

Height, h*	Distance, d†	
	0 < d < 100m	100m < d < 1,000m
0<h<5m	±3dB	±3dB
5m<h<30m	±1dB	±3dB

B1 Estimated Accuracy for Broadband Noise of L_{AT}(DW)

* h is the mean height of the source and receiver. † d is the mean distance between the source and receiver.
N.B. These estimates have been made from situations where there are no effects due to reflections or attenuation due to screening.

Input Data and Assumptions

The noise model has been constructed using data from various source as follows:

Site Layout The general site layout has been obtained from the drawings forwarded by the project architects.

Local Area The location of noise sensitive locations has been obtained from a combination of site drawings provided by the project architects and others obtained from Ordinance Survey Ireland (OSI).

Heights The heights of buildings on site have been obtained from site drawings forwarded by the project architects. Off-site buildings have been assumed to be 6 m high with the exception of industrial buildings where a default height of 10 m has been assumed.

Contours In this instance the ground within the noise model is assumed to be flat.

The final critical aspect of the noise model development is the inclusion of the various plant noise sources. Details are presented in the following section.

Source Sound Power Data

The noise modelling competed indicates the following limits in relation to various items of plant associated with the overall site development. Plant items will be selected in order to achieve the stated noise levels and or appropriate attenuation will be incorporated into the design of the plant/building in order that the plant noise emission levels are achieved on site (including any system regenerated noise).

Each Data centre building has two data hall areas. The following sources have been modelled for each data centre building (i.e. both the north and south building)

- 60 no. 'IDEC' units (indirect air cooling units)
- 8 no. air handling units to external LV Pods
- 2 no. air handling units servicing office areas
- 5 no. backup generators

Table B2 lists the sound power data modelled for each of the items listed above.

Source	L_{wA} - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
IDEC Inlet	51	67	71	74	75	74	72	67	81
IDEC Exhaust	54	69	72	78	81	79	77	72	86
AHU Sides	74	76	74	77	77	74	68	64	83
AHU Ends	68	71	68	72	71	69	62	58	78
AHU Top	72	75	72	76	75	73	66	62	82
LV Pod Intake	60	62	58	54	53	51	41	31	66
LV Pod Exhaust	61	63	58	61	62	58	50	42	69
Generator Inlet	80	85	77	80	80	81	74	79	89
Generator Casing	78	93	84	90	89	89	86	81	97
Generator cooling outlet	62	70	77	80	83	78	76	71	87
Generator Stack	76	74	70	70	70	64	61	66	80

Table B2 L_{wA} levels Utilised in Noise Model

The calculated noise contour plots for each of the modelled scenarios are illustrated in Figures B1 to B6 overleaf. The contours plots are calculated to a height of 1.5m above ground representing the height of the nearest noise sensitive locations to the north and south.

APPENDIX C

NOISE CONTOUR PLOTS

The calculated noise contour plots for each of the modelled scenarios are illustrated in Figures C1 to C3. The contours plots are calculated to a height of 4.0m above ground representing the height of the a typical first-floor window in a residential noise-sensitive location

Figure C1 – Noise contours for Day-to-day operation

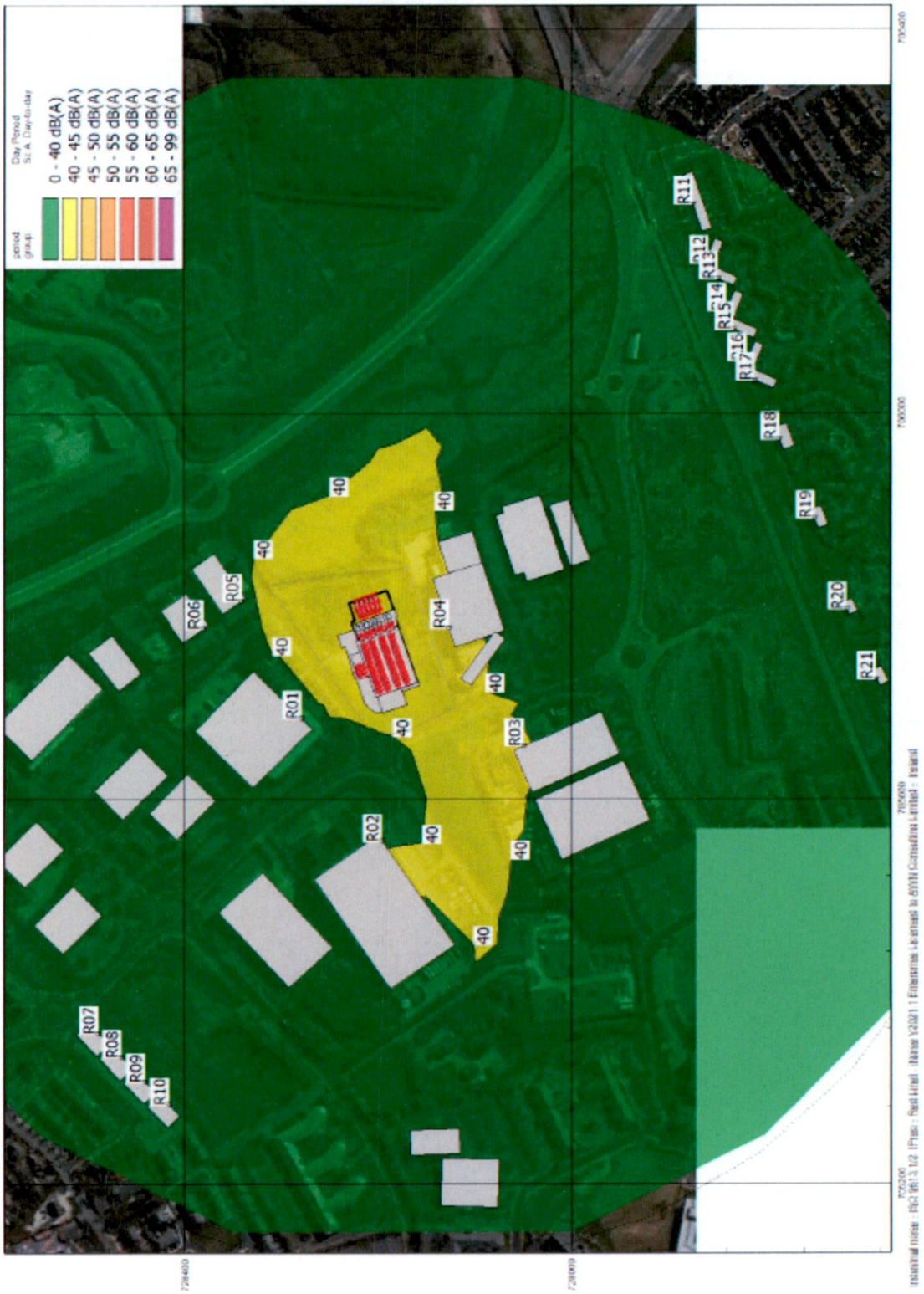

Figure C1 – Noise contours for Day-to-day operation

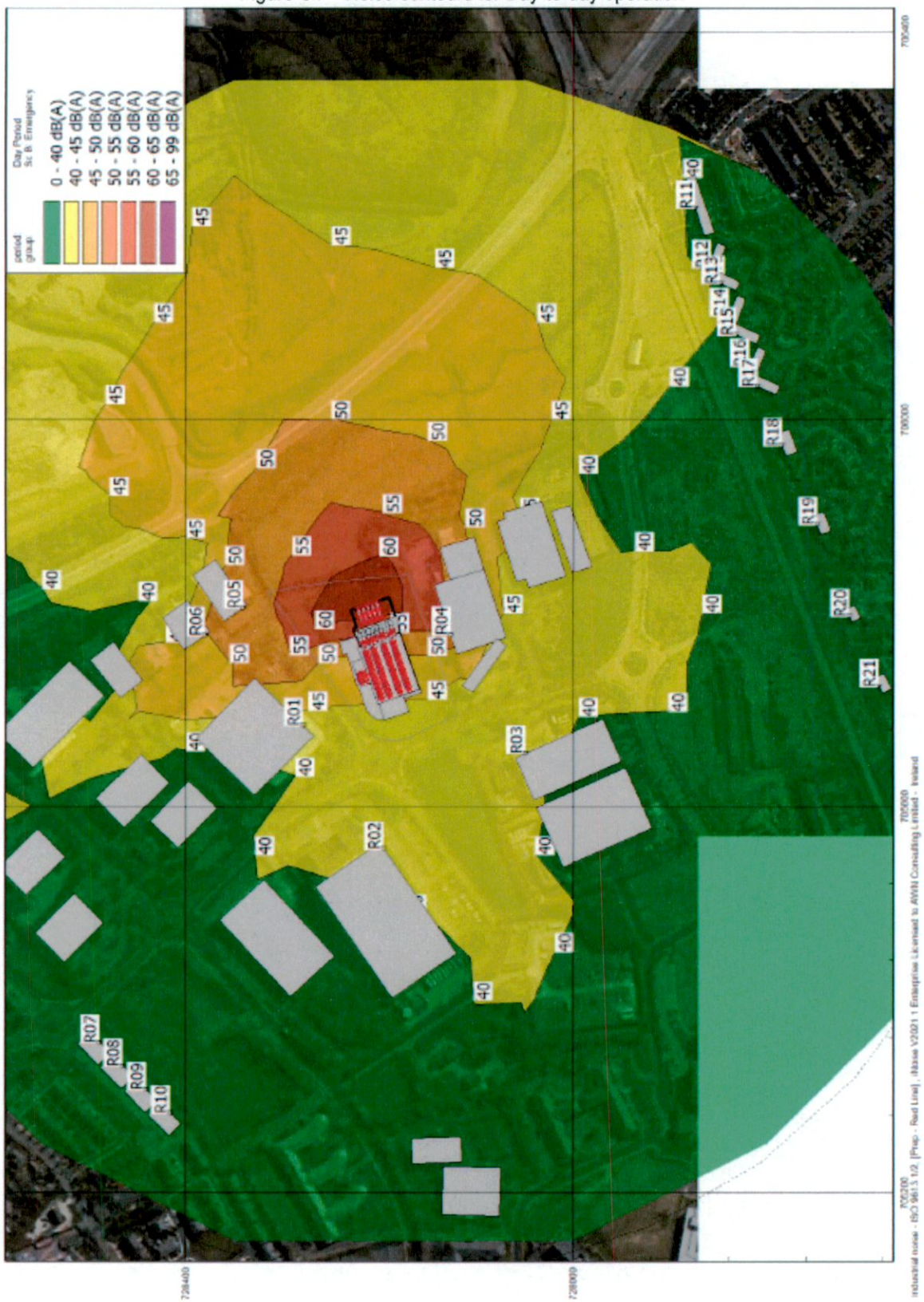

Figure C3 – Noise contours for Generator Testing