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Project

EIS noise & vibration assessment: Proposed extension at McHale Engineering Ltd., Ballinrobe, Co. Mayo

Client

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Contents

Summary

Prepared separately

1 Introduction

1.1 Potential noise and vibration impacts associated with the proposed McHale Engineering Ltd. (referenced MEL in this report) development are assessed below. The assessment was undertaken by DixonBrosnan noise consultants. As an application to the Environmental Protection Agency (EPA) for an Industrial Emissions Directive (IED) licence will be required, much of the noise information is compiled and presented in a format suitable for same. A glossary of noise and vibration terms is provided at the end of the report.

2 Standards & guidance

2.1 There are no national mandatory noise limits in force in Ireland with respect to industrial or commercial noise emissions. Such emissions are usually controlled through noise conditions attached to site specific planning permissions or licences.

2.2 All facilities constructed or modified since 1963 require planning permission from their local authority. Any permission granted will usually include several conditions, one or more of which may relate to noise emissions. The existing MEL facility was constructed following the 1998 grant of planning permission by Mayo County Council (planning reference number 98555). Any noise conditions attached to this permission may be considered out of date at this stage. Any such conditions will also become redundant following granting of any site IED licence.

2.3 The second vehicle through which site specific noise limits are usually imposed on an industrial facility is through any IED licence granted by the EPA. No such licence has been issued in respect of the MEL facility in the past. The proposed extension to the facility will bring the MEL operation under the remit of the EPA, and will require submission of an IED licence application.

2.4 In assessing an IED licence application, the EPA will have regard to their document *NG4 Guidance note for noise: Licence applications, surveys and assessments in relation to scheduled activities* (2012). Noise limits suggested by NG4 are presented in **table 1**. For the first time, the NG4 document introduces a specific evening period and corresponding limit.

Table 1: NG4 noise limits.

Period	Time	Limit	Parameter
Daytime	0700-1900	55 dB	$L_{AR\,T}$
Evening	1900-2300	50 dB	$L_{AR\,T}$
Night-time	2300-0700	45 dB	$L_{Aeq\,T}$

2.5 The $L_{AR\,T}$ parameter specified with respect to daytime and evening hours allows the presence of clearly audible tonal and/or impulsive emissions from the site to be penalised by the addition of a penalty. The document notes that rigorous efforts should be made to avoid such emissions. In contrast, clearly audible tonal and impulsive emissions are to be entirely avoided during night-time hours, hence reference to the $L_{Aeq\,T}$ parameter during the period 2300-0700.

2.6 NG4 also introduces the concept of quieter areas, described as either 'quiet areas' or 'areas of low background noise', depending on certain criteria. The document notes that such areas may benefit from stricter limits than those presented in **table 1**. On the basis of geographical and noise criteria discussed in **paragraph 3.14** below, it is concluded that the MEL premises is not located in a quiet area or area of low background noise, and limits presented in **table 1** therefore remain applicable.

2.7 From the foregoing, limits presented in **table 1** are considered appropriate to this assessment. The limits are free field values (see **appendix 3**). In line with the EPA's guidance, which notes that limits at standalone facilities such as the MEL premises are typically applied at offsite receptors rather than at boundaries, it is expected that any limits imposed by the agency will apply to offsite noise sensitive locations (NSLs). The guidance note defines an NSL as:

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

2.8 It should be noted that the limits presented in **table 1** are relevant only to the commissioned development, and are not suitable for the construction phase. Greater tolerance is typically shown by residents to construction phase emissions due to their temporary nature. Historically, most regulatory authorities have not specified noise limits with respect to such emissions, preferring instead to refer to control measures outlined in *British Standard BS 5228*. However, the latest edition of this standard (*British Standard BS 5228:2009 Code of practice for noise and vibration control on construction and open sites Part 1: Noise*) introduces noise limits considered suitable for the construction phase of projects. The standard outlines two methods which may be used to derive suitable construction phase limits; both methods generate a daytime noise limit of 65 dB at the study site, applicable to NSLs, and this limit is considered appropriate here.

3 Receiving environment

3.1 National secondary route N84 runs northwest from Ballinrobe town to Castlebar. The MEL site fronts onto the N84 1.5 km northwest of Ballinrobe. Thus the northeast boundary of the site adjoins the N84. The northwest boundary adjoins undeveloped scrubland. The southeast boundary adjoins a residential estate consisting of approximately 60 detached and semi-detached units. The southwest boundary adjoins grazing land. As is evident in **figure 1** over, approximately one third of the MEL plot is comprised of the current activity area in the northwest

quadrant, with the balance occupied by a meadow. The meadow allows a separation distance of 100 m between the activity area and the residential estate boundary to the southeast.

3.2 The MEL site lies on the periphery of Ballinrobe, and local land use reflects the transition from urban to rural. At this distance from the town, the built environment generally consists of residential and commercial development scattered along the N84 as it leaves the town. Such development includes the residential estate described above, a smaller estate on the opposite side of the N84, one-off dwellings, a service station, and a cluster of commercial units opposite the MEL premises. The built environment quickly intensifies as one approaches the town.

3.3 Beyond the urban area the landscape becomes rural, and land use is dominated by agricultural activities, chiefly sheep and cattle grazing. Ballinrobe horse racing course is located further northwest, with the course boundary lying within 300 m of the MEL premises at its closest. A number of small stone pits are evident beside the N84 in this area, although it is unclear if these are in use. The local landscape is relatively flat, and long distance views towards the MEL site are not provided.

Figure 1 ⇨
MEL site, showing boundary in white and current activity area in red.
N

3.4 There are no NSLs within proximity of the facility to its west, northwest or southwest. The nearest receptors in these directions consist of a cluster of dwellings located over 700 m southwest of the site, and therefore well outside audible range. The horse racing course to the northwest is not considered to be an NSL, as defined in **paragraph 2.7** above. It is noted that, when in use, noise emissions arising at the course are likely to far exceed any other sources in the local environment.

3.5 The nearest NSL to the MEL facility consists of a detached dwelling situated opposite the site entrance, with the dwelling itself lying 100 m from the closest built MEL façade. This dwelling is bounded to its northwest by a small commercial zone which includes several noise generating facilities. Noise sources noted here during site inspections include a sawdust collection system at a furniture manufacturing facility, cooler units at a cold storage facility, and mobile plant and trucks at both. It was noted that certain emissions at the cold storage facility arise throughout the night. In addition to these sources, the dwelling is particularly exposed to traffic noise on the N84.

3.6 Between Ballinrobe town and the dwelling described above, a number of houses have been constructed along the N84, both in residential estates and as standalone ribbon development. A small development of seven detached and semi-detached units is situated 80 m southeast of the MEL site entrance, and 150 m from the nearest MEL façade. Across the road from this development lies the 60 unit residential estate described in **paragraph 3.1**. The nearest dwellings here are positioned 130 m from MEL activity areas. The estate extends southwards away from the N84, and a number of dwellings along the western boundary of the estate are within audible range of the external storage area at the rear of the MEL premises.

3.7 There are no other NSLs within audible range of the site, apart from a cluster of holiday homes approximately 400 m to the south-southeast. This cluster is partially screened from the facility by small rise in the intervening terrain.

3.8 The chief noise source in the local area is road traffic noise arising from the N84. Despite the urban speed restriction which applies on the outskirts of Ballinrobe, it was noted during site inspections that traffic speed on the N84 in this area is relatively high due to the wide and straight road alignment. Overtaking was also prevalent during inspections. The alignment and terrain allows traffic noise over a long corridor, estimated at almost 2 km in length, to remain audible within the study area. During lulls in N84 traffic, it was noted that distant traffic was audible on other roads which converge on Ballinrobe, including the N84 to Galway, and regional routes R331 and R334. In this regard, it is noted that the flat open terrain and straight road alignment which allows N84 traffic to remain audible over a long corridor also applies to the other roads described.

3.9 During the infrequent lulls in N84 traffic passing the study site, several other noise sources become audible:

- Distant traffic as identified above, audible throughout the day, evening and night.
- Intermittent traffic movements arising throughout local residential estate roadways.
- Emissions from the MEL facility itself, arising chiefly from plant and truck movements on the external yard. Limited external activity arises outside daytime hours.

- Emissions from several units immediately north of the MEL premises, as described in **paragraph 3.5**. Several sources here continue through the night.
- Noise from Ballinrobe horse racing course further northwest, which holds up to eight meetings per year. Noise impacts here are associated chiefly with an onsite public address system and with elevated traffic volumes during meeting events.
- Emissions from agricultural machinery audible in surrounding areas and in the distance.
- Extraneous emissions such as passing aircraft, bird song/calls, barking dogs, and children playing in residential areas. During night-time hours, water flowing in a river 500 m south of the site becomes faintly audible.
- During site inspections, there was no activity at any of the stone pits scattered along the N84 in this area. However, the possibility of noise emissions arising in the future cannot be discounted.

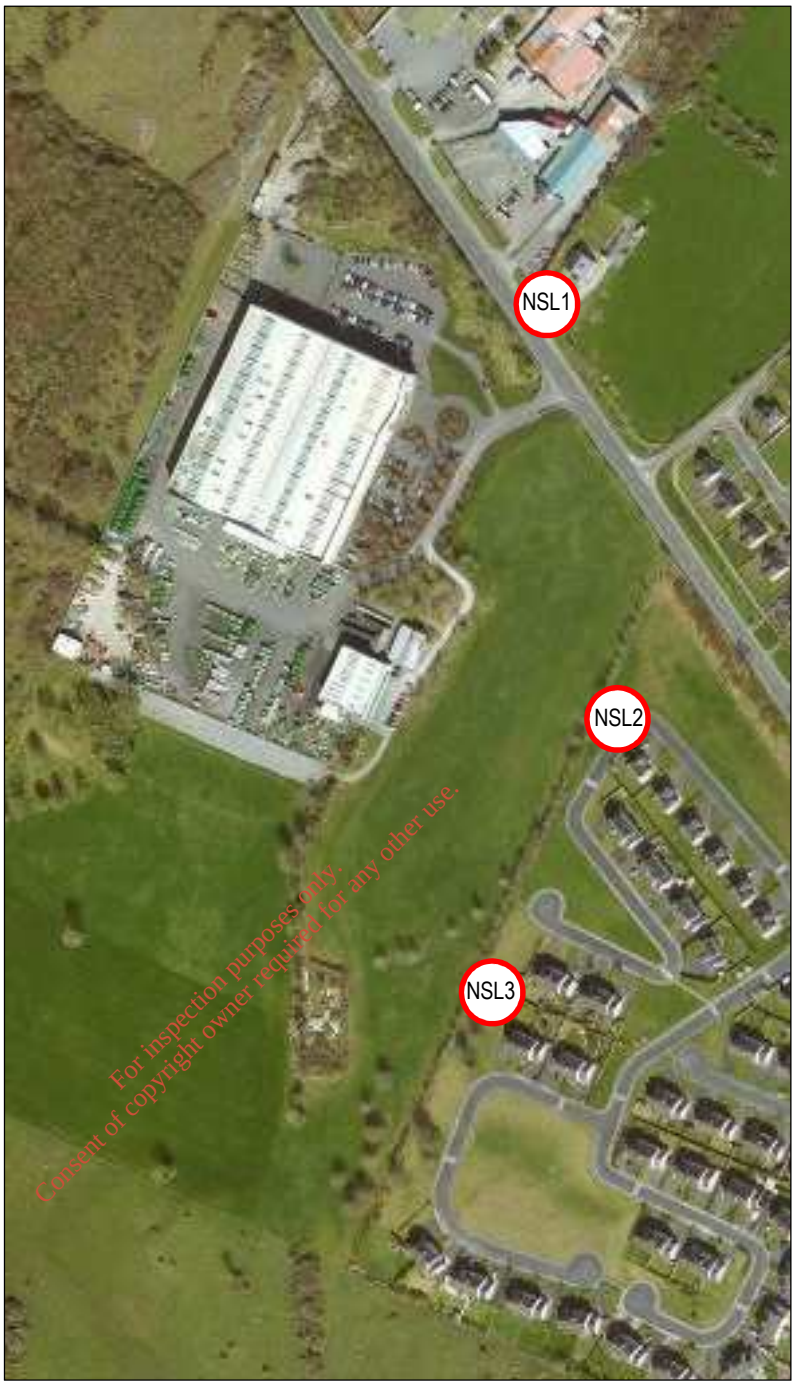
3.10 In order to quantify the receiving noise environment, ambient noise levels were measured on Tuesday 25.06.13 and Wednesday 26.06.13. Survey details, equipment specifications and weather conditions are listed in **appendix 1**. Noise levels were recorded at three offsite locations, designated NSL1, NSL2 and NSL3, selected to represent the receptors described above. The receptors are listed in **table 2**, and shown in **figure 2** over. These receptors will most likely be proposed as routine noise monitoring stations in a future IED licence application submitted to the EPA. Intervals of 15 minutes were used as suggested by *NG4 Guidance note for noise: Licence applications, surveys and assessments in relation to scheduled activities* (2012).

Table 2: Offsite noise monitoring locations.

Station	ITM NGR	Location	Propagation route terrain
NSL1	518184 765701	Entrance to dwelling opposite entrance, 18 m from MEL boundary, selected to represent this dwelling; also representative of 7 unit residential development to SE	N84 road, MEL boundary stone wall; terrain level
NSL2	518216 765485	Grassed area at residential estate southeast of MEL facility, selected to represent dwellings in N half of estate, nearest dwelling 20 m from MEL boundary and 130 m from MEL activity area	Lawn and pasture; terrain level
NSL3	518150 765333	Grassed area at residential estate southeast of MEL facility, selected to represent dwellings in S half of estate, nearest dwelling 20 m from MEL boundary and 150 m from MEL activity area; also representative of holiday home cluster to S	Lawn and pasture, intervening hedgerow; slight rise in terrain

3.11 Offsite noise data are presented in **appendix 2**. Levels are summarised in **table 3**. Daytime, evening and night-time periods are as defined by the EPA (respectively 0700-1900, 1900-2300 and 2300-0700). Although MEL emissions continued throughout the survey to 0000 hours, in most cases emissions were not sufficiently loud to affect measured data, and data are therefore considered residual. Residual $L_{AF90\ 15\ min}$ levels describe background noise levels.

Figure 2 ⇨
Offsite noise measurement stations.
N



3.12 Residual $L_{Aeq\ 15\ min}$ levels were relatively high across all three stations due to the intrusion of N84 road traffic noise which dominated the local noise environment throughout the day, evening and into the night. With increasing setback distance from the road, $L_{Aeq\ 15\ min}$ levels decreased, being highest at NSL1 and lowest at NSL3 across all periods. Traffic noise was sufficiently frequent to also influence $L_{AF90\ 15\ min}$ levels. A decrease was again seen from NSL1 to NSL3, although the decrease was less pronounced due to the impact of distant rather than local N84 traffic on the $L_{AF90\ 15\ min}$ parameter.

Table 3: Offsite residual noise data summary.

Station	Period	Residual $L_{Aeq\ 15\ min}$ (dB)	Residual $L_{AF90\ 15\ min}$ (dB)
NSL1	Daytime	72-73	52-55
	Evening	71-73	46-52
	Night-time	64-68	32-36
NSL2	Daytime	56-58	47-53
	Evening	54-58	40-51
	Night-time	49-54	27-31
NSL3	Daytime	45-48	40-43
	Evening	42-47	33-40
	Night-time	33-39	24-30

3.13 *British Standard BS 4142:1997 Method for rating industrial noise affecting mixed residential and industrial areas* (1997) notes that residual $L_{AF90\ 15\ min}$ levels may be used to describe background noise levels. It follows that daytime background noise levels ranged from 40 to 55 dB, depending on proximity to the N84. Evening and night-time ranges of 33-52 dB and 24-36 dB were measured respectively. These ranges are considered reasonably representative of current long term levels.

3.14 The EPA document *NG4 Guidance note for noise: Licence applications, surveys and assessments in relation to scheduled activities* (2012) sets out a procedure whereby noise limits to be applied at an EPA licensed facility may be derived using geographical position and background noise levels. The MEL facility is not located in a 'quiet area' as defined by NG4, chiefly due to its location within 3 km of an agglomeration with a population exceeding 1000. In this regard, it is noted that the population of Ballinrobe was listed at 2700 in 2011 (*Draft Mayo County development plan*, Mayo County Council, 2013). With respect to background noise criteria, **table 4** presents screening undertaken in accordance with NG4, based on data presented in **appendix 2**. Low background criteria are to be met during all three periods in order to qualify as an area of low background noise. The table indicates that the site does not lie in an 'area of low background noise', and noise limits identified in **table 1** previously are therefore considered relevant to the MEL facility.

Table 4: Area of low background noise screening.

Station	Period	$L_{AF90\ 15\ min}$ levels (dB)	Arithmetic average (dB)	LBA criterion (dB)	Low background
NSL1	Daytime	52 52 52 55	53	<40	No
	Evening	52 46 51 47	49	<35	
	Night-time	32	32	<30	
NSL2	Daytime	47 47 52 53	50	<40	No
	Evening	51 50 42 40	46	<35	
	Night-time	27	27	<30	
NSL3	Daytime	40 40 43 43	42	<40	No
	Evening	40 40 33 37	38	<35	
	Night-time	24	24	<30	

3.15 Any noise impact assessment is required to include a brief comment on the likely progression of background noise levels in the absence of the proposed development, in this case the proposed expansion of the MEL facility. Based on site inspections, the following pressures on the local noise environment are noted:

- N84 road traffic volume, the main determinant of local noise levels, is likely to remain relatively consistent into the future. The volume (ie. number of vehicles) is unlikely to change sufficiently to alter noise levels; in this regard it is noted that a doubling of traffic volume generates only a 3 dB increase. It is possible, however, that road traffic noise may increase or decrease as surfaces are repaired and as other roads are constructed. Possible future changes include a reduction in traffic noise due to extension of the urban speed zone further northwest past the MEL site, or construction of a town relief road.
- It is possible that infill development along the N84 between the MEL site and Ballinrobe town centre, and possibly beyond the site, will lead to the introduction of new noise sources and increased traffic. It is noted that Mayo County Council has previously received an application for commercial development near the MEL site.
- It is possible that several small stone pits along the N84 in this area will be worked in the future.

4 Existing facility emissions

4.1 The layout of the MEL facility is described elsewhere in this EIS. The facility produces agricultural machinery, chiefly associated with silage baling and wrapping. Manufacture involves steel and component import and storage, steel cutting and profiling, sub-assembly welding, washing, painting, component installation (three lines), packing, storage and loading.

4.2 All of the foregoing operations, excluding product storage, are carried out internally within the main building complex. Repair, and research and development, are undertaken in a smaller building southeast of the main building. Noise emissions from within both buildings are inaudible externally, except where propagated through open roller shutter doors. A number of noise sources are located externally, and noise emissions from these, in addition to various external activities, may be audible at the site boundaries and beyond. Inspections of the facility indicate that externally audible noise emissions currently arise from the following existing onsite sources:

- Noise emissions from internal operations (cutting, welding, assembly, painting, etc.) may be audible externally through a number of roller shutter doors on the northeast, northwest and southwest facades of the main building. Several of these are typically open throughout the working day and into the evening to allow forklift truck access. The emissions are generally broadband, continuous and steady in nature, arising from continuously operating plant systems and compressors. Additional emissions may arise intermittently from internal plant movement and power tool use. These emissions are variously inaudible or slightly audible at site boundaries, depending on boundary proximity and N84 traffic flow.
- A stationary power washer (**photograph 1**) located externally, midway along the northwest façade, operates continuously throughout the day. The washer is used for painting preparation. Washer emissions are continuous,

with an audible hum evident. The emissions represent one of the most significant external noise sources onsite. However, they are audible only at the northwest boundary as other boundaries are screened by the building.

- Several compressors located internally within the main building draw their air intermittently from two intakes positioned on the northwest façade near the northwest corner. Noise emissions from the intakes are continuous when present, broadband, and relatively low. The emissions are audible only at the nearest point of the northwest boundary.
- A number of vents across the main building roof are opened as required during warm days, allowing emission of internal noise. Site inspections indicate that this source is negligible, partly due to roof parapet screening.
- Four roof vents (**photograph 2**) associated with the internal painting booth give rise to continuous and steady emissions. The emissions include increased energy in the region of 1000 Hz, barely discernible during site surveys at offsite locations to the southeast. The emissions were discernible by character rather than volume, and only with difficulty were traced to the four roof vents. The vent noise emissions are not of audible significance, and are not objectively tonal.
- Noise emissions arise from several mobile plant used around the yard, including a number of diesel forklift trucks, a telescopic loader, and a small front end loader with yard sweeping attachment. During site inspections, it was noted that typically up to two of these may be in use externally during daytime hours, with limited external activity after 1900 hours. Their operation is chiefly confined to the storage yard to the south of the main building.
- Trucks, tractors, cars and vans access the MEL facility intermittently throughout the day. Cars and vans access carparking areas near the northeast corner of the main building, and a small carpark to its east. Trucks and tractors access the storage area behind the main building. Car movements coincide with shift patterns, while truck and tractor movements chiefly arise during daytime hours.
- Noise emissions arise at specified times during the day from a siren used to announce break times starts and finishes. The siren is clearly audible across external areas of the site, although is insignificant at offsite receptors.

Photograph 1 ⇨
Power washer unit on NW façade.

Photograph 2 ⇨
Four spray painting booth vents on roof.

4.3 Noise emissions from stationary sources identified above currently arise throughout the working day (0600-0000 hours). Car movements peak with shift starts/stops (0600, 1500, 0000), although continue to arise intermittently throughout daytime hours. Truck and tractor movements, and operation of mobile plant on external yards, chiefly occurs during daytime hours (0700-1900), but may arise sporadically during the periods 0600-0700 and 1900-0000.

4.4 Noise levels at offsite NSLs attributable to current MEL operations were determined during the survey described in **paragraph 3.10** above. Site specific levels are summarised in **table 5**, estimated from ambient data presented in **appendix 2**. Residual $L_{Aeq\ 15\ min}$ and $L_{AF90\ 15\ min}$ levels are also presented for comparison purposes.

Table 5: MEL emissions at NSLs.

Station	Period	Residual $L_{Aeq\ 15\ min}$ (dB)	Residual $L_{AF90\ 15\ min}$ (dB)	Specific $L_{Aeq\ 15\ min}$ (dB)	MEL noise audible
NSL1	Daytime	72-73	52-55	<45	No MEL emissions audible apart from occasional vehicle movements through entrance.
	Evening	71-73	46-52	<40	No MEL emissions audible apart from sporadic vehicle movements through entrance. Inbuilding emissions sporadically slightly audible on one occasion.
	Night-time	64-68	32-36	30-31	MEL roof vent emissions faintly audible during N84 lulls.
NSL2	Daytime	56-58	47-53	<40	MEL roof vent emissions faintly audible during N84 lulls. Yard emissions slightly audible for several seconds.
	Evening	54-58	40-51	<40	MEL vent emissions faintly audible during N84 lulls.
	Night-time	49-54	27-31	25-26	When present, MEL vent emissions faintly audible during N84 lulls.
NSL3	Daytime	45-48	40-43	<35	MEL vent emissions faintly audible during N84 lulls. Yard emissions slightly audible for several seconds.
	Evening	42-47	33-40	<35	MEL vent emissions faintly audible during N84 lulls.
	Night-time	33-39	24-30	28-29	When present, MEL vent emissions faintly audible during N84 lulls.

4.5 From the table, it can be seen that four MEL noise sources were audible offsite:

- Occasional vehicle movements through the site entrance, audible at NSL1.
- Inbuilding activity, slightly audible at NSL1 during an evening interval.
- Sporadic activity on the external yard, lasting several seconds at a time, slightly audible at NSL2 and NSL3.
- Continuous emissions faintly audible at all three stations during traffic lulls, attributable to roof vents. These emissions were broadband in character, although slightly increased energy was evident in the 1000 Hz third octave band at NSL2 and NSL3.

4.6 Existing site emissions are quite satisfactory, and comply with the daytime, evening and night-time criteria indicated in **table 1** previously. It is apparent that existing emissions are lower than background levels (ie. residual $L_{AF90\ 15\ min}$ levels) during daytime, evening and night-time periods. Site specific levels are also markedly lower than residual $L_{Aeq\ 15\ min}$ levels.

4.7 It was noted during the survey that site emissions were neither tonal nor impulsive. While emissions from the painting booth roof vents contained increased energy around 1000 Hz, this was not of audible significance and barely registered in recorded third octave band frequency spectra. Acoustic energy was also detected in the 25 Hz band during several intervals, most likely arising from the power washer. Again, this signal was not of audible significance, and not tonal when assessed using Annex D of *International Standard ISO 1996-2 Acoustics – Description, measurement and assessment of environmental noise, Part 2: Determination of environmental noise levels* (2007). A typical $L_{ZF90\ 15\ min}$ spectrum is shown in **figure 3**, recorded 2039-2054 hours at NSL2 on 26.06.13. Frequency spectra and time history profiles for all 31 offsite measurements are available on request.

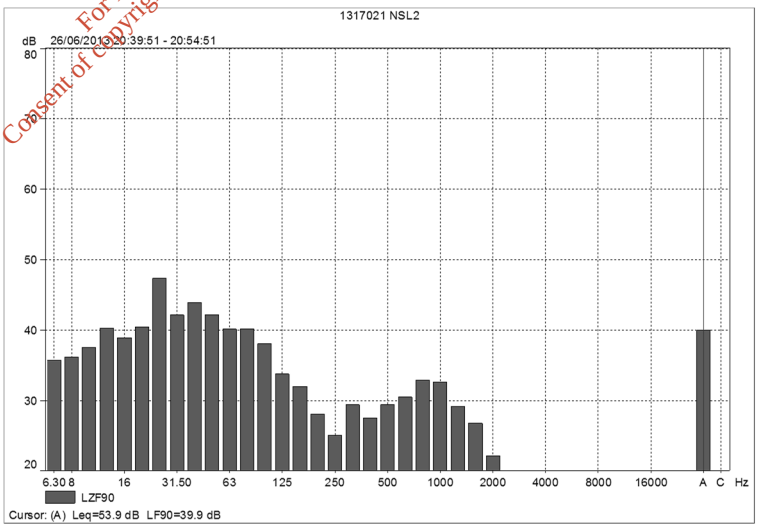


Figure 3 ⇨
Typical $L_{ZF90\ 15\ min}$ spectrum, recorded 26.06.13 2039-2054 at NSL2. Acoustic energy at 25 Hz and 1000 Hz is evident, although neither was audibly or objectively tonal.

4.8 During the survey of 26.06.13, noise levels were also measured at four MEL boundary locations shown in **figure 4** below. Boundary levels are not of direct relevance to this noise impact assessment, particularly in light of the EPA's preference (as stated in NG4) to assign noise limits to offsite NSLs with respect to standalone facilities such as the MEL premises. However, boundary noise data are in any case required by the IED licence application

form, and their inclusion here provides further indication of the satisfactory nature of existing MEL emissions. Boundary noise data are included in **appendix 2**, and summarised in **table 6**.

Figure 4 ⇨
Boundary noise monitoring stations.
N

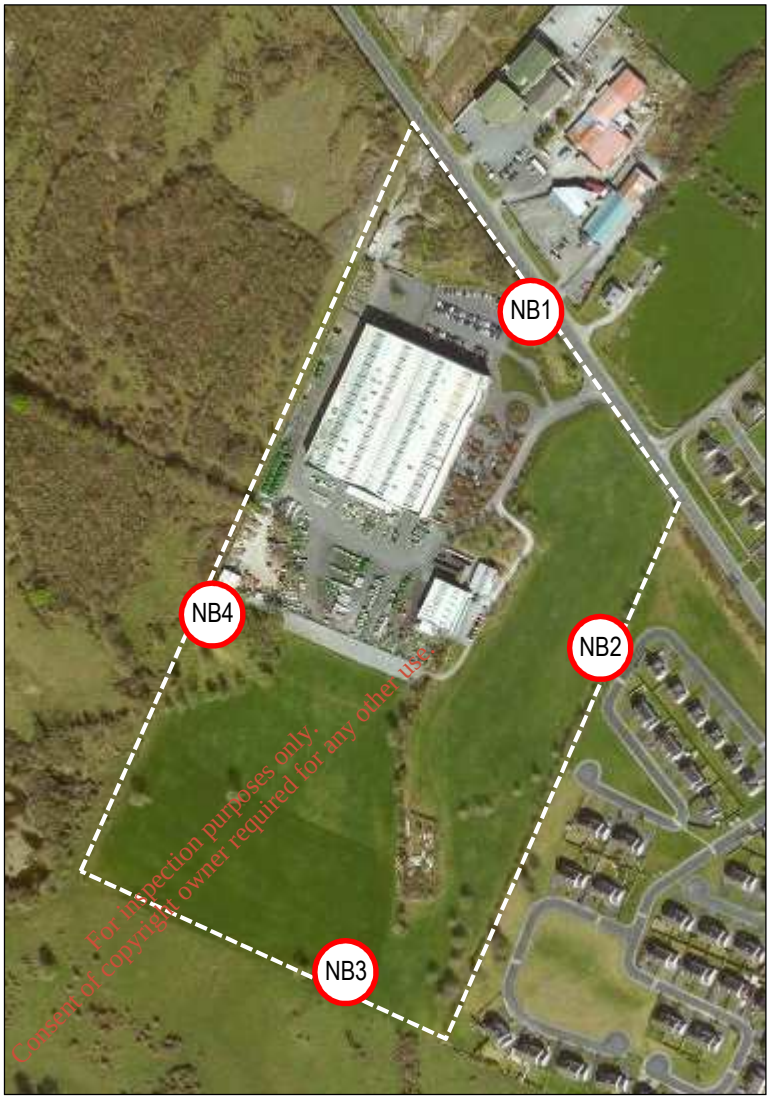


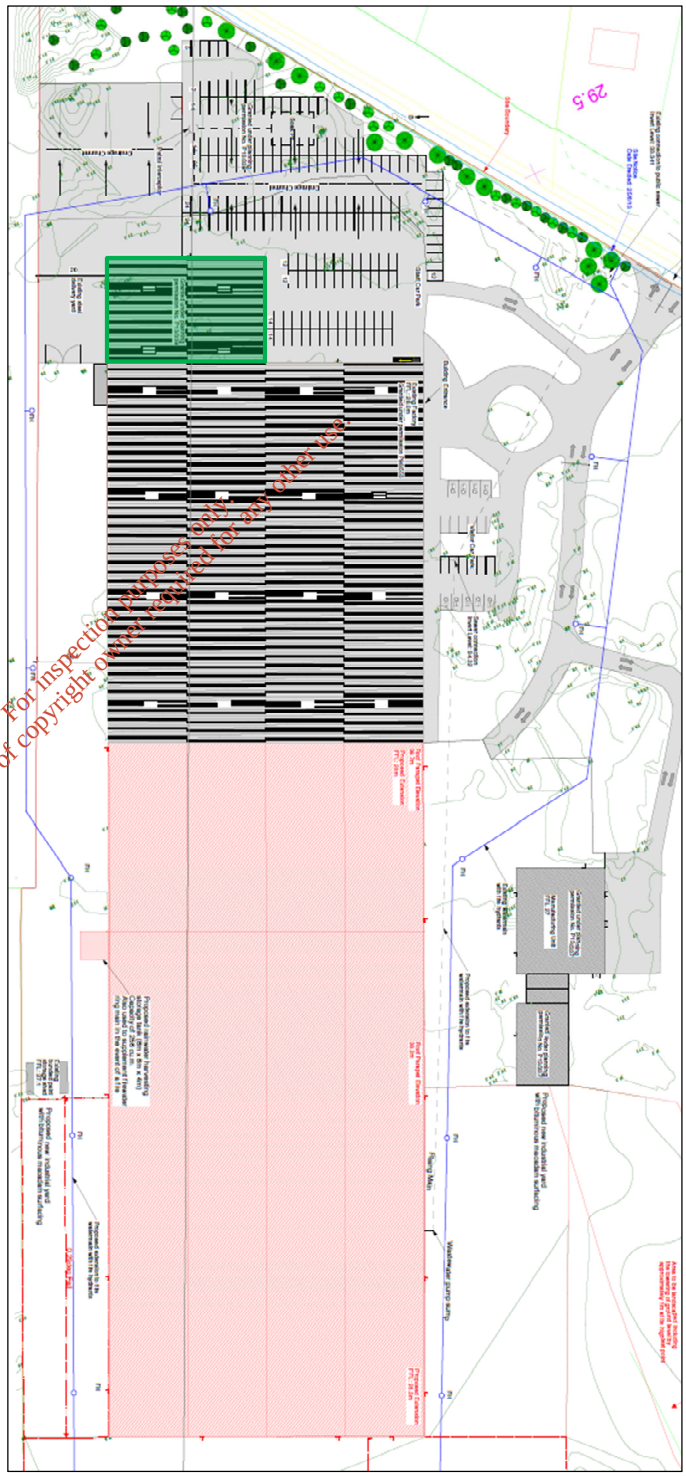
Table 6: Boundary noise data summary.

Station	Period	Specific $L_{Aeq\ 15\ min}$ (dB)	MEL noise audible
NB1	Daytime	<46	Inbuilding operations audible at low level through open doors during N84 lulls, until closure of doors in late evening. Carpark movements. After shut down, continuous broadband emissions within building slightly audible through facade, from equipment still operating.
	Evening	42-46	
	Night-time	<29	
NB2	Daytime	<37	Roof vent emissions faintly discernible, not significant and no tones detected. Emissions from plant in rear yard slightly audible occasionally when present.
	Evening	<37	
	Night-time	<35	
NB3	Daytime	<35	Roof vent emissions faintly discernible, not significant and no tones detected. Emissions from plant in rear yard slightly audible occasionally when present.
	Evening	<33	
	Night-time	<29	
NB4	Daytime	36-44	Roof vent emissions faintly discernible, not significant and no tones detected. Plant movements around rear yard clearly audible when present. When absent, ops in building slightly audible through open doors.
	Evening	<35	
	Night-time	<33	

5 Proposed development

5.1 Most existing onsite operations, including cutting, welding, assembly and painting, are undertaken in the main onsite building located near the northern corner of the site. It is proposed to increase the floor area of this building from 10,000 to 28,000 m^2 by extending the rear façade 200 m southwest. The existing external storage yard will be relocated to the rear of the extension. The proposed layout is shown in **figure 5**.

Figure 5 ⇨
Proposed site layout, showing existing building (hatched), proposed extension (pink), and permitted but unbuilt extension (green).
⇖N



5.2 It should be noted that a small extension on the northeast façade has received planning permission from Mayo County Council, and will be constructed in 2013-2014. The extension will not alter the noise environment at any of the offsite NSLs. In particular, it is noted that the extension will not affect the nearest receptor NSL1 for several reasons:

- The extension will not house any new sources of noise other than a fourth laser cutting rig, noise emissions from which will not be significant.
- As the existing northern façade will be retained as an internal wall between the existing building and the extension, the extension is expected to reduce external propagation of noise emissions arising internally across the building floor, and is therefore expected to reduce noise emissions at NSL1.
- The noise environment at NSL1 is affected to such a degree by N84 traffic noise that MEL noise emissions are, in any case, generally inaudible here.

5.3 The proposed southwest extension which is the subject of this EIS will not result in the introduction of any new processes, other than replacement of the existing spray painting process with an electrophoretic coating method with respect to approximately 90 % of components. A new extraction system will be installed over the proposed electrophoretic coating area, venting to the roof through ten vents. Of the four existing spray booth vents, two will be retained at their existing position, and two will be relocated to the proposed extension. The use of the existing spray booth will decrease significantly in the long term, as will the requirement to power wash components prior to painting. Both spray booth and power washer will be retained for a small proportion of components not suitable for electrophoretic coating.

5.4 The proposed electrophoretic coating system will involve dipping production parts in tanks of coating paint. The process will not generate any noise emissions, other than those associated with overhead rails used to move parts along the line, lowering and raising when required. The overhead rail system will be identical to that used in the existing building, and will merely consist of an extension to that system. Site inspections indicate that emissions from the existing rail system are not of external audible significance.

5.5 The proposed extension will allow the number of assembly lines to increase, with a resulting increase in the number of welding and assembly stations. The number of welding rigs and power tools will increase, although all such units will be operated internally. A small rise in the number of diesel powered forklift trucks may marginally increase the number of units operating simultaneously on external yards.

5.6 From the foregoing, the proposed extension will not involve any significant changes in onsite processes, other than an increase in the number of assembly lines and the introduction of electrophoretic coating. Hours of operation will remain as before. The number of employees will increase by approximately 60 %, with a concomitant increase in staff vehicle movements. Truck movements associated with materials import and product export will approximately double.

6 Operational noise impacts

6.1 The assessment of potential noise impacts arising from the proposed development may be facilitated by dividing expected changes in noise emissions into five categories:

- External propagation of inbuilding noise emissions: The proposed development will see an increase in the number of internal assembly lines, rigs, welding zones and power tools. However, the increased noise emissions will spread into a considerably larger building, and reverberant noise levels are not expected to change significantly. It should be noted that the applicant will be required to comply with the *Safety, Health and Welfare at Work (General Application) Regulations 2007* (SI 299 of 2007), which give Irish effect to *EU Directive 2003/10/EC on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (noise)* (2003). The regulations specify upper and lower exposure action values of 85 and 80 dB respectively. A review of an occupational noise survey undertaken 24.01.13 by Environmental Efficiency Ltd. on behalf of the applicant indicates that $L_{EX\ 8\ h}$ levels are currently below 85 dB. More relevant to this assessment, the report notes that L_{Aeq} levels at internal work stations are lower than 85 dB, apart from one station at 86 dB. The proposed development is highly unlikely to see an increase in internal reverberant noise levels, and external propagation of internal emissions is therefore expected to remain satisfactory. In this regard, it is noted that any noise breakout from the proposed extension will most likely occur through roller shutter doors on the southwest façade through which most trucks and mobile plant will access the building. These doors will replace those on the existing southwest façade, effectively relocating the main access doors 200 m southwest. This relocation will benefit NSLs located at the residential estate to the east and southeast, based on the assumption that doors on the eastern façade of the proposed extension will remain closed during normal operations. The separation distance to a holiday home development further southeast, and dwellings to the southwest, will remain large enough such that negative noise impacts will not arise. The proposed extension will not affect NSL1 to the north.
- External mobile plant: Mobile plant currently used around external yard areas consist of forklift trucks, a telescopic loader, and a front end loader with yard sweeping attachment. The proposed development will result in a marginal increase in the number of external forklift truck movements. At present, 1-2 forklift trucks may operate simultaneously on yard areas. This is expected to increase to 1-3 movements at any time. As at present, movements will be generally confined to the external storage area at the rear of the building, which will be relocated 200 m southwest. This relocation will marginally benefit NSLs in the northern half of the nearby residential estate. Dwellings in the southern half may see a marginal increase in noise emissions. However, noise surveys indicate that mobile plant emissions are currently insignificant offsite, and impacts arising from same following construction of the proposed extension will continue to be negligible. Impacts will also be negligible at the holiday home development to the southeast. Dwellings to the southwest will not be affected. NSL1 to the north will also not be affected. No changes are expected to arise in the number of loader movements. Little or no storage or mobile plant activity will take place along the eastern flank of the proposed extension, thus benefitting the residential estate.
- Vehicle movements: The number of truck movements associated with materials import and product export will approximately double. Staff vehicle movements are expected to increase by approximately 60 %. These

increases represent a 2-3 dB rise over existing vehicle noise levels (as say $L_{Aeq\ 15\ min}$ or $L_{Aeq\ 30\ min}$ levels). This increase is marginal. Noise levels arising from each individual vehicle movement will remain as before. It is noted that existing car, van and truck noise emissions are entirely negligible at offsite receptors. While the proposed extension will result in an increased onsite road traverse of 200 m to the new storage area, noise impacts associated with trucks will be entirely minimised by preventing high engine revolutions along the lengthened onsite roadway. This may be readily achieved through a combination of an onsite speed restriction and a driver code of practice. Absence of potential impulsive emissions from truck body and trailer rattling may be guaranteed by maintaining onsite roadway surfaces in satisfactory condition.

- Power washer: Despite its relatively small size, it was noted during site inspections that the existing power washer constitutes a significant external noise source due to its continuous operation and the character of its emissions. However, the emissions do not affect any offsite receptors due to screening provided by the existing building. Replacement of the current painting process with the proposed electrophoretic coating system will remove the need to prewash components using the power washer. No change will arise at offsite receptors as existing emissions are inaudible offsite.
- Painting booth vent emissions: Noise emissions from the existing booth vents will cease. Emissions will continue to arise from two vents associated with an existing extraction system, and from ten new vents linked to an extraction system in the proposed electrophoretic coating area. Noise emissions from the current vents are faintly audible at the nearby residential estate during lulls in N84 traffic. Emissions from the proposed vents are likely to be similarly audible. As the extraction system fan model has not yet been selected, accurate modelling of vent emissions is not possible. The most practical solution here is to ensure that the vent emissions will not result in an increase over existing vent emissions, and this may be readily achieved by selection and design of an appropriate system through consultation with the system supplier. Guaranteed absence of potentially tonal emissions will be an important consideration here.

6.2 Impacts are summarised in **table 7** over. Receptors listed are those identified in **section 3** previously. Impacts are quantified using guidance provided by EPA documents *Guidelines on the information to be contained in environmental impact statements* (2002) and *Advice notes on current practice in the preparation of environmental impact statements* (2003). Impact assessment assumes that mitigation will be provided where required.

6.3 Noise emissions associated with the proposed development will generally be similar to existing emissions, and mathematical modelling is not required. Minor increases in yard and truck activity will give rise to marginal increases in noise levels. Emissions from these activities are currently satisfactory, and significant headroom for expansion exists. Noise emissions will remain compliant with the 55 dB daytime, 50 dB evening and 45 dB night-time criteria specified by the EPA at offsite receptors.

6.4 Noise impacts will be neutral at most offsite receptors. Impacts will be potentially slight negative at the westernmost dwellings in the southern half of the adjacent residential estate due to a shortening of the separation distance to the external storage yard. Noise emissions from the yard may increase over existing levels due to an increase in forklift truck movements. However, any increase will be marginal and occasional. In this regard it is noted that existing yard emissions are satisfactory at the nearest receptors in the northern half of the residential estate, and yard contributions to the southern half are likely to be similar.

6.5 The proposed extension and associated increase in activity will not result in any alteration in the character of noise emissions, other than the elimination of increased acoustic energy in the 25 Hz and 1000 Hz third octave bands due respectively to the elimination of routine power washing and painting booth use. Expansion of the site extraction system will require design to ensure that tonal fan emissions are not introduced. As at present, no impulsive emissions will arise.

Table 7: Noise impacts summary.

Receptor	Impacts description	Impact
Dwelling opposite entrance	No site impacts. Increased vehicle activity through gate will give rise to marginal increase in noise, entirely negligible in context of N84 traffic. Increase in number of roof vents will require emissions control.	Neutral
Dwelling cluster NE of entrance	None. Increase in number of roof vents will require emissions control.	Neutral
Residential estate: N half	Reduction in yard noise. Potential marginal increase in truck noise emissions unless controlled. Increase in number of roof vents will require emissions control.	Neutral
Residential estate: S half	Increase in building breakout noise unless doors on proposed eastern façade remain closed. Yard activity will become more audible, but will remain satisfactory. Potential marginal increase in truck noise emissions unless controlled. Increase in number of roof vents will require emissions control.	Neutral to slight negative
Holiday home cluster 400 m SSE	None, due to separation distance.	Neutral
Dwelling cluster 700 m SW	None, due to separation distance.	Neutral

7 Construction noise impacts

7.1 Construction of the proposed extension and associated paved areas is expected to take approximately 6-10 months. Plant required onsite during this period will vary, depending on project stage. Most sources will be small and localised eg. generators, lifting platforms, power floats, etc. The limited ground works involved will require use of one or more excavators, and possibly rock breaking for a short period. Erection of the proposed building extension may require hammering on occasion. Materials including concrete, particularly concrete required for yard and floor pours, will require 2-3 periods of intensive deliveries to the site.

7.2 It is not considered practical to predict the level of construction noise arising onsite for several reasons:

- The timing, duration and amplitude of construction phase emissions will vary considerably.
- Construction details, plant requirements, etc. may be modified on a daily basis as circumstances change.
- Little or no construction noise will arise during long periods eg. during installation of electrical fixtures.
- Each individual source may be relocated frequently eg. excavators.

- The overall construction period will be relatively short. The duration of individual stages will be limited, lasting days or weeks at most, eg. steelwork erection.

7.3 Due to the foregoing, it is not possible to accurately calculate the noise output which will arise onsite throughout the construction phase. An alternative approach here is to calculate the maximum onsite noise level permissible in order to comply with the construction phase noise limit suggested in **paragraph 2.8**. This limit is 65 dB, applicable at offsite receptors. The nearest NSL to the works area will be at 140 m. Management of construction phase emissions to ensure compliance with the suggested 65 dB limit at this NSL will guarantee compliance at more distant receptors.

7.4 *International Standard ISO 9613 Acoustics: Attenuation of sound during propagation outdoors Part 2 General method of calculation (1996)* and *British Standard BS 5228:2009 Code of practice for noise and vibration control on construction and open sites Part 1: Noise* both provide a methodology for calculation of noise levels propagated from a source. Central to both methodologies is the factor 20log[*d*] which describes the attenuation due to distance *d*. Applying the method in reverse allows the maximum onsite noise level permissible in order to meet a construction phase limit of 65 dB at distance *d*. At a distance of 140 m to the nearest NSL, the maximum plant emissions level is calculated at 88 dB at 10 m, ie. any onsite works that generate noise emissions which do not exceed 88 dB at 10 m will not give rise to noise levels higher than 65 dB at offsite NSLs. No corrections are included for ground attenuation, topographical screening or atmospheric attenuation. It should be noted that the 20log[*d*] factor assumes hard ground, and the 88 dB criterion therefore incorporates a large safety margin.

7.5 A review of typical sound output data presented in *BS 5228:2009* indicates that onsite plant and likely combinations of plant are highly unlikely to generate noise levels over 88 dB at 10 m, with a single exception: rock breaking. Excluding this exception, onsite construction phase noise emissions are unlikely to exceed 65 dB at any NSL, and noise emissions arising during this period will be satisfactory.

7.6 Breaking out of rock may be required for a short period during the site clearing stage, estimated to last approximately 1-3 weeks. Rock breaking will be carried out using a hydraulic breaker mounted on a tracked excavator. *British Standard BS 5228:2009* lists sound pressure levels from such plant at 85-95 dB at 10 m, depending on plant size and power rating. Using a worst case scenario of 95 dB at 10 m, noise impacts from breaking at the nearest NSLs are determined in **table 8**, calculated using *British Standard BS 5228:2009* soft ground modelling methodology, and assuming that the breaking face does not provide screening.

Table 8: Rock breaking noise impacts.

Receptor	Distance from breaking zone to nearest NSL	Predicted level
Dwelling opposite entrance	320 m	59 dB
Dwelling cluster NE of entrance	270 m	61 dB
Residential estate: N half	140 m	68 dB
Residential estate: S half	150 m	68 dB
Holiday home cluster 400 m SSE	440 m	56 dB
Dwelling cluster 700 m SW	750 m	50 dB

7.7 From **table 8**, it is apparent that noise emissions arising from rock breaking will exceed the 65 dB criterion by 3 dB at the nearest NSLs located in the residential estate to the southeast of the site. These emissions may arise for 1-3 weeks early during the construction period. The emissions may be significantly reduced below 65 dB by breaking from the west, thus allowing the intervening hillock to act as an acoustic barrier. *British Standard BS 5228:2009* notes that a reduction of 5-10 dB is likely to be gained by using the hillock in this manner, thereby reducing emissions at NSLs to the southeast to 58-63 dB. It is noted that rock breaking emissions are likely to be audibly impulsive at the nearest NSLs in the residential estate, and mitigation will be required here.

8 Vibration

8.1 No noise emissions are discharged by the existing MEL facility into media other than the atmosphere. Onsite operations do not give rise to ground-borne vibration. There is no equipment onsite of such mass, of such mounting arrangement, or of such mode of operation, that ground born vibration may arise offsite. The separation distance to offsite receptors additionally eliminates any possibility of offsite vibration nuisance, or of cosmetic or structural damage to buildings. Once commissioned, the proposed development will not alter the foregoing.

8.2 Outside of rock breaking, the construction phase is unlikely to give rise to ground borne vibration. Blasting or piling will not be required, and air overpressure emissions will not arise. Rock breaking may be required for a period of 1-3 weeks early in the construction phase. Breaking will require use of a hydraulic rock breaker unit fitted to a tracked excavator. Although this activity may give rise to relatively high levels of ground vibration in proximity to the breaking area, rock breaking typically contains relatively little energy in the lower frequencies at which buildings and occupants are most vulnerable. In addition, the higher frequencies associated with rock breaking attenuate more rapidly than low frequencies, thus minimising the impact zone. For this reason, most vibration guidance documents such as *British Standard BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* ignore rock breaking vibration. **Table 9** lists various peak particle velocity (PPV) levels reported in literature at sites where hydraulic rock breaking has been undertaken. The range in levels noted reflects variations in equipment power and rock type.

Table 9: Reported rock breaking vibration levels.

Distance	5 m	10 m	20 m	50 m
PPV	0.2-4.5 mm/s	0.06-3.0 mm/s	0.02-1.5 mm/s	0.1-0.3 mm/s

8.3 In order to assess the potential impact on structures and humans arising from rock breaking vibration levels discussed above, a brief comment on typically applied standards is required. Limits included in such standards vary, and are usually based on empirical evidence rather than predictive assessment. Limits recommended by the two most respected international authorities are presented in **table 10**. The limits are those below which cosmetic damage (hairline cracking, etc.) to buildings is unlikely to occur. Limits relating to structural damage are significantly higher.

Table 10: Recommended vibration limits.

Source	Structure	Lower frequencies	Higher frequencies
1	Modern dwellings	<40 Hz: 19 mm/s	>40 Hz: 51 mm/s
	Older dwellings	<40 Hz: 12.7 mm/s	>40 Hz: 51 mm/s
2 & 3	Industrial & heavy commercial	4-15 Hz: 50 mm/s	>15 Hz: 50 mm/s
	Residential & light commercial	4-15 Hz: 15-20 mm/s	>15 Hz: 20-50 mm/s

Sources:

[1]*US Bureau Of Mines report RI 8507: Structural response and damage produced by ground vibration from surface mines blasting (1980).*

[2]*British Standard BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.*

[3]*British Standard BS 7385-02: 1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration.*

8.4 The strictest limit included in **table 10** is 12.7 mm/s reported by the US Bureau Of Mines with respect to older dwellings (typically plaster on wood lath in the US). Limits reported for newer buildings by both US and British authorities are 15 mm/s or higher. A comparison with **table 9** indicates that typical rock breaking levels are significantly lower than these limits, and no vibration impacts on buildings are expected.

8.5 With respect to occupants of buildings, ground borne vibration generally becomes noticeable around 1 mm/s PPV. At 140 m, which is the distance to the nearest residential receptor, ground borne vibration from rock breaking operations will be negligible.

9 Mitigation

9.1 The assessment of operational noise impacts presented above assumes that certain control measures will be applied onsite, and these are listed below as mitigation measures which have been reviewed and approved by the applicant:

- All roller shutter doors proposed on the eastern façade of the extension remain closed during normal operations, and particularly outside of the period 0700-1900 hours.
- Activities which require local visits by mobile plant such as forklift trucks will be avoided along the eastern flank of the proposed extension.
- All car, van, truck and tractor movements onsite, particularly along the proposed eastern access roadway, will be subject to a speed restriction which will entirely eliminate high engine revolutions. Speed control measures will not include traffic ramps.
- A code of good driving practice will be prepared by site management, and drivers off all trucks, tractors and mobile plant will be obliged to follow this code. The code will include measures such as avoidance of aggressive driving, prohibition of horn use, and avoidance of impulsive emissions from items such as forklift truck fork rattle.
- All yard and roadway areas will be maintained in satisfactory condition. In particular, potholes will be repaired immediately, as is current practice.

- Emissions from the expanded extraction system vents will not result in any increase over existing vent noise emissions. The expanded system will be designed so as to avoid any potential tonal emissions. It is noted that existing emissions are significantly attenuated by a roof parapet which will be continued around the proposed extension.
- Plant used externally onsite such as loaders and forklift trucks will be maintained in satisfactory condition. In particular, exhaust silencers will be maintained in a state of good repair at all times.

9.2 Noise emissions arising throughout the construction phase will be satisfactory, with levels remaining below 65 dB at the nearest receptors. This conclusion assumes that the rock breaking operator will work from the west, thus using the intervening hillock as an acoustic screen with respect to NSLs to the southeast. The only mitigation measures recommended with respect to these emissions are the following:

- As noted above, rock breaking will be undertaken from the west.
- Although using the hillock as an acoustic barrier is expected to maintain rock breaking noise emissions below 65 dB at the nearest NSLs in the residential estate to the southeast of the site, emissions may nonetheless be audibly impulsive. Impacts associated with same will be minimised by confining rock breaking to daytime hours, and by notifying residents prior to the commencement of breaking.
- During concentrated events such as concrete pours, trucks will not queue or park up at the site entrance.
- Should concrete pours require night-time power floating, a noise management plan will be prepared in advance.
- Tender specifications will include that all contractors maintain plant and exhaust silencers in satisfactory condition at all times.
- Where potentially noisy plant or processes which have not been assessed in this report are introduced to the site during the construction phase, noise impacts associated with same will be evaluated in advance.

10 Residual impacts & conclusions

10.1 Impacts assessed in **sections 6 and 7** above assume that mitigation measures outlined in **section 9** will be applied. These measures have been agreed with the applicant. It follows that residual impacts will be as summarised in **table 7** above ie. neutral at most offsite receptors, and neutral to slight negative in the southern half of the adjacent residential estate (slight negative due to potentially increased audibility, although noise levels will nonetheless remain low).

10.2 As at present, emissions will not exceed daytime, evening and night-time criteria specified by the EPA. No tones or impulses will arise. In summary, noise emissions will remain similar to existing emissions. Site surveys indicate that such emissions are satisfactory throughout daytime, evening and night-time hours.

Appendix 1: Survey details

File	Project ref.	1317
	Client	O'Callaghan Moran & Associates
	Location	McHale Engneering Ballinrobe Co Mayo
	Stations	Offsite
	Purpose	Noise impact assessment
	Comment	Facility operating to 0000 h
Event	Period	Daytime Evening Night-time
	Date	25.06.13
	Day	Tuesday
	Time	1400-0100
	Operator	Damian Brosnan BSc MIOA MIEI
Conditions	Cloud cover	100 %
	Precipitation	0 mm apart from passing band of mist 1400-1445
	Temperature	17 falling to 13 ^{0}C
Wind	Direction	NW
	Speed	0-2 m/s, decreasing to 0 m/s after 1900
	Measurement	Anemo anemometer 2 m above ground level
Sound level meter	Instrument	Bruel & Kjaer Type 2250-L
	Instrument serial no.	2566801
	Microphone serial no.	2571655
	Application	BZ7130 Version 2.0
	Bandwidth	Broadband & 1/3 octaves
	Max input level	142.66 dB
	Broadband weightings	Time: Fast Frequency: AC
	Spectrum weightings	Time: Fast Frequency: Z
	Windscreen correction	UA1404 outdoor kit
	Sound field correction	Free-field
	UKAS calibration	22.01.13
	Calibrating laboratory	Bruel & Kjaer Denmark
	Calibration certificate	Available on request
Onsite calibration	Time	25/06/2013 14:03:38
	Calibration type	External
	Sensitivity	43.35 mV/Pa
	Post measurement check	93.9 dB
Onsite calibrator	Instrument	Bruel & Kjaer Type 4231
	Instrument serial no.	2342544
	UKAS calibration	22.01.13
	Calibrating laboratory	Bruel & Kjaer Denmark
	Calibration certificate	Available on request
Methodology	Standards	ISO 1996 Part 1 (2003) & Part 2 (2007) EPA NG4 (2012)
	Exceptions	-
	Intervals	15 min

File	Project ref.	1317
	Client	O'Callaghan Moran & Associates
	Location	McHale Engneering Ballinrobe Co Mayo
	Stations	Onsite emissions Onsite boundary Offsite
	Purpose	Noise impact assessment
	Comment	Facility operating to 0000 h
Event	Period	Daytime Evening Night-time
	Date	26.06.13
	Day	Wednesday
	Time	1230-0100
	Operator	Damian Brosnan BSc MIOA MIEI
Conditions	Cloud cover	30-50 % hazy afternoon & evening
	Precipitation	0 mm
	Temperature	Initially 20, rising to 21, falling to 10 ^{0}C
Wind	Direction	NW
	Speed	0-1 m/s, decreasing to 0 m/s after 1800
	Measurement	Anemo anemometer 2 m above ground level
Sound level meter	Instrument	Bruel & Kjaer Type 2250
	Instrument serial no.	2506594
	Microphone serial no.	2529531
	Application	BZ7224 Version 2.5
	Bandwidth	Broadband & 1/3 octaves
	Max input level	141.16 dB
	Broadband weightings	Time: Fast Frequency: AC
	Spectrum weightings	Time: Fast Frequency: Z
	Windscreen correction	UA-1650
	Sound field correction	Free-field
	UKAS calibration	17.01.12
	Calibrating laboratory	Bruel & Kjaer Denmark
	Calibration certificate	Available on request
Onsite calibration	Time	26/06/2013 12:31:36
	Calibration type	External
	Sensitivity	47.46 mV/Pa
	Post measurement check	93.9 dB
Onsite calibrator	Instrument	Bruel & Kjaer Type 4231
	Instrument serial no.	2342544
	UKAS calibration	22.01.13
	Calibrating laboratory	Bruel & Kjaer Denmark
	Calibration certificate	Available on request
Methodology	Standards	ISO 1996 Part 1 (2003) & Part 2 (2007) EPA NG4 (2012)
	Exceptions	-
	Intervals	15 min Various for onsite emissions measurements

Appendix 2: Noise data

NSL1 data

Time	$L_{Aeq\ 15\ min}$ dB	$L_{AF10\ 15\ min}$ dB	$L_{AF90\ 15\ min}$ dB	Noise audible
1405-1420 25.06.13	72	77	52	N84 traffic continuously audible on approaches, and intrusive when passing NSL. No emissions audible from facility, apart from occasional vehicle movements through entrance. No other noise audible apart from local birdsong. During rare N84 lulls, continuous emissions slightly audible from plant at wood working facility immediately NW of dwelling.
1420-1435 25.06.13	72	77	52	
1554-1609 25.06.13	72	76	52	As before. Data considered residual, as no emissions from facility other than occasional movements through entrance, inconsequential in context of N84 traffic.
1609-1624 25.06.13	73	77	55	
1901-1916 25.06.13	73	78	52	No facility emissions audible. N84 traffic almost continuously dominant, both when local and on approaches. During rare lulls, no other noise audible apart from bird calls/song, and sporadic PA announcements at race meet (incl continuous race PA 1915-1919). Latter no effect on data, and thus data residual. Wood working facility closed.
1916-1931 25.06.13	71	76	46	
2056-2111 25.06.13	73	77	51	As previous. Road traffic still intrusive. Traffic levels elevated due to departing race traffic. Birdsong decreasing. PA at race faintly audible 2100-2105. Data considered atypical due to race traffic, and invalid. Survey halted until 2200.
2200-2215 25.06.13	71	77	51	Resumption of survey now that race traffic disbanded and N84 returned to normal. N84 traffic dominant on approaches. No other noise audible. No emissions from site other than sporadic vehicle movements through entrance.
2301-2316 25.06.13	68	72	36	N84 traffic volume decreasing enough to allow site emissions audible from 3 sources during lulls: faint whine, faint broadband emissions, and occasional reversing alarms. Last 2 audible through open doors on facade facing road. Reversing alarms on forklift truck(s) also audible at cold storage facility to NW. No other noise audible.
0001-0016 26.06.13	64	62	32	No facility emissions. N84 traffic now absent from local straight 1/2 of the time, although almost continuously audible in distance due to long approaches and high speeds. Traffic noise also slightly audible to W. Continuous fan emissions slightly audible from cold storage facility, with occasional internal reversing alarm emissions audible at low level.
2021-2036 26.06.13	72	78	47	N84 traffic continuously dominant, intrusive when local and continuously audible on approaches. During infrequent lulls, McHale whine faintly discernible. Inbuilding emissions sporadically slightly audible when coinciding with traffic lulls. Birdsong.

NSL2 data

Time	$L_{Aeq\ 15\ min}$ dB	$L_{AF10\ 15\ min}$ dB	$L_{AF90\ 15\ min}$ dB	Noise audible
1442-1457 25.06.13	57	60	47	Faint whine evident from McHale fans. No tone detected, and emissions not of audible significance. N84 traffic entirely dominant, and fan emissions only evident during periods when no N84 traffic on local 500 m stretch. Forklift truck emissions on site yard slightly audible on one occasion. No other emissions audible apart from local birdsong, and sporadic vehicle movements on nearest residential estate roadway. As fan noise not contributing to L_{Aeq} due to N84 noise, emissions considered residual. Fan emissions at least 3 dB below L_{AF90}.
1457-1512 25.06.13	56	59	47	
1630-1645 25.06.13	57	60	52	As before, although nearby trees rustling slightly. Also, agricultural machinery audible at low level several hundred metres to W from 1650. Again L_{Aeq} residual.
1645-1700 25.06.13	58	61	53	
1935-1950 25.06.13	58	61	51	Whine from facility faintly audible as before, but again no tone. No other emissions audible from site, apart from minor yard emissions audible on 3 occasions for several seconds, data unaffected. N84 traffic continuously dominant. Sporadic residential estate traffic, and birdsong. Vegetation rustling ceased. Race PA 1950-1955 faintly audible, data unaffected.
1950-2005 25.06.13	58	61	50	
2218-2233 25.06.13	56	60	42	McHale whine slightly audible, more discernible than earlier due to decreasing volume of traffic, but still not of audible significance, and no tone detected.N84 traffic still continuously dominant locally, on approaches and in distance. No other noise audible apart from sporadic residential estate traffic.
2320-2335 25.06.13	54	58	31	Decreased N84 traffic now allowing continuous cold storage broadband fan emissions to become slightly audible, along with McHale whine, not significant. Forklift truck alarms faintly audible at cold storage site. N84 traffic only other source audible.
0022-0037 26.06.13	49	54	27	Road traffic noise faintly audible in distance most of the time, but infrequent locally. Continuous fan emissions audible at low level from cold storage facility. Occasional reversing alarms here also audible at low level.
2039-2054 26.06.13	54	59	40	McHale whine faintly discernible. No other site emissions audible. N84 traffic continuously dominant locally and in distance. Sporadic car movements in residential estate. Local birdsong.

NSL3 data

Time	$L_{Aeq\ 15\ min}$ dB	$L_{AF10\ 15\ min}$ dB	$L_{AF90\ 15\ min}$ dB	Noise audible
1519-1534 25.06.13	46	50	40	Faint McHale whine evident occasionally on breeze, although again not of audible significance, and no tone detected. No other site emissions audible, apart from short 20 s forklift truck event slightly audible. N84 traffic continuously dominant, less so locally and more in distance. Birdsong. Rustling trees audible nearby. Sporadic car movements on nearby residential estate roadway. Emissions from facility not affecting L_{Aeq}. Fan at least 3 dB below L_{AF90}. Thus data considered residual.
1534-1549 25.06.13	45	48	40	
1704-1719 25.06.13	48	49	43	As before, except agricultural machinery now clearly audible several hundred metres to W. PA voice at race meet audible 3-4 times at low level during interval, not loud enough to affect data.
1719-1734 25.06.13	47	50	43	
2011-2026 25.06.13	47	50	40	Faint McHale whine audible as before. No other site emissions. N84 traffic continuously dominant on approaches. PA announcements at race meet from 2020, becoming sufficiently loud and continuous to affect data 2025-2030. Voices from children audible playing across residential estate, and sporadic vehicle movements. Birdsong. Data considered residual outside 2025-2030.
2026-2041 25.06.13	45	48	40	
2237-2253 25.06.13	42	46	33	Faint McHale whine continuously audible, less masked by N84 traffic. No other site emissions. Continuous broadband emissions from cold storage site also becoming faintly discernible. Distant traffic remaining continuously audible and dominant. Sporadic residential estate traffic.
2340-2355 25.06.13	39	43	30	As above, with continuous broadband emissions slightly clearer here, unclear if from McHale or cold storage, still only slightly audible. McHale whine slightly audible. No reversing alarms. N84 traffic. Local car x1 in residential estate.
0043-0058 26.06.13	33	36	24	Distant traffic almost continuously audible. Continuous cold storage emissions slightly audible during local lulls. Distant dog barking.
2058-2113 26.06.13	45	48	37	McHale whine faintly audible. Broadband component also slightly audible. No other site noise. N84 traffic continuously audible at low level. Children audible playing within 100 m continuously. Birdsong.

NB1 & NB2 data

Station	Time	$L_{Aeq\ 15\ min}$ dB	$L_{AF10\ 15\ min}$ dB	$L_{AF90\ 15\ min}$ dB	Noise audible
NB1	1409-1424 26.06.13	61	66	46	N84 traffic outside boundary continuously dominant. During infrequent lulls, McHale emissions audible at low level from internal operations audible through open doors. Continuous emissions also audible during lulls from wood working facility across road. Local birdsong.
	1551-1606 26.06.13	62	67	50	As previous. Rock breaker operating 100 m NW, near McHale boundary, clearly audible continuously during traffic lulls.
	1900-1915 26.06.13	61	66	46	Emissions from within McHale building audible at a low level during lulls in N84 traffic, including continuous and fluctuating emissions. N84 traffic continuously audible in distance, and frequently local. Wood working emissions ceased. Birdsong.
	2127-2142 26.06.13	59	63	42	As above, although N84 traffic volume decreasing, allowing inbuilding emissions to be more clearly audible. McHale emissions close to L_{AF90}. Birdsong decreasing.
	2341-2356* 26.06.13	54	53	29	No whine or manufacturing emissions as staff departed. However, continuous broadband emissions within building slightly audible through facade, from equipment still operating. N84 traffic continuously slightly audible, and dominant when local. Continuous fan emissions and reversing alarms audible at low level from cold storage facility, also occasional impulsive emissions from loading/unloading bangs.
	0111-0126 27.06.13	45	41	29	Emissions from air management system or similar running continuously in MEL building faintly audible continuously, through closed facade doors, broadband, not contributing to data. Continuous emissions from distant road traffic in several directions slightly audible, and also continuous emissions from cold storage facility. Occasional passing N84 traffic dominant when present.
NB2	1436-1451 26.06.13	44	46	37	Whine from roof plant faintly discernible, not significant and no tones detected. Emissions from plant in rear yard slightly audible occasionally. N84 traffic continuously audible over long section. Local birdsong. Playing children in residential estate frequently clearly audible, including locally 1450-1452.
	1612-1627 26.06.13	46	49	40	As previous, minus children.
	1919-1934 26.06.13	50	53	42	Continuous MEL whine faintly discernible. No other site noise audible, apart from one car movement at nearest building, and break-siren audible at low level at 1930. N84 traffic continuously dominant. Birdsong. Lawnmower continuously audible at low level at approx. 100 m in residential estate.
	2146-2201 26.06.13	46	50	35	Continuous whine faintly discernible. No other site noise audible. N84 traffic continuously dominant, although volume decreasing. Birdsong also decreasing. Mower audible at approx. 200 m in residential estate. Voices also slightly audible in estate.
	2330-2335* 26.06.13	48	51	36	No site emissions audible, as shutting down. N84 traffic continuously dominant. Reversing alarm and continuous emissions from cold storage facility slightly audible.
	0051-0106 27.06.13	44	47	24	No site emissions. Sporadic local N84 traffic dominant when present. Otherwise, continuous distant traffic in several directions, and continuous cold storage fan emissions, both slightly audible.

*Shortened measurements used to allow full circuit prior to site lock up. Data are nonetheless considered representative of 15 min intervals.

NB3 & NB4 data

Station	Time	$L_{Aeq\ 15\ min}$ dB	$L_{AF10\ 15\ min}$ dB	$L_{AF90\ 15\ min}$ dB	Noise audible
NB3	1506-1521 26.06.13	43	42	35	Whine from facility faintly discernible continuously. Occasional forklift truck movement on yard audible at low level. N84 traffic audible at low level continuously. Local birdsong and sheep bleating in adjacent field. Also, sporadic vehicle movements audible on private road 200 m SW. Agricultural machinery slightly audible almost continuously in distance.
	1636-1651 26.06.13	40	42	36	As previous, minus distant agri machinery.
	1937-1954 26.06.13	40	43	35	Whine faintly discernible continuously. Sporadic forklift truck movements on external yard also slightly audible. N84 traffic continuously audible at low level. Dog barking audible repeatedly at several hundred metres in residential estate. Birdsong. Sporadic traffic audible on road to SW.
	2227-2242 26.06.13	39	42	33	Faint whine continuously audible. No other site emissions. N84 traffic continuously audible at low level. Sporadic traffic audible on road to SW.
	2316-2326* 26.06.13	37	40	29	No noise audible apart from distant traffic almost continuously audible at low level to NE and also to NW. One high altitude aircraft pass significant.
	0028-0043 27.06.13	33	35	28	No site emissions. Distant traffic slightly audible in several directions, and also river flow to SW.
NB4	1527-1542 26.06.13	40	41	36	MEL whine faintly audible. Regular forklift truck and telescopic loader movements around rear yard clearly audible. When these absent, ops in building slightly audible through open doors. N84 traffic continuously audible at low level. Birdsong.
	1707-1719 26.06.13	44	45	38	As previous. Small loader onsite with yard sweeping attachment clearly audible moving around nearest yards.
	2000-2015 26.06.13	40	43	35	Whine faintly discernible. Broadband emissions also slightly audible, unclear if from roof vents or power washer. No yard activity. N84 traffic continuously audible at low level. Birdsong significant. Sporadic traffic slightly audible to S.
	2245-2300 26.06.13	37	38	33	Whine ceasing during interval. Continuous N84 traffic noise. No other sources of significance audible. Doors on this facade closed, so no inbuilding emissions audible.
	2301-2311* 26.06.13	37	39	33	As previous. Traffic volume (amplitude) decreased enough to allow reversing alarm at cold storage facility to NE become audible.
	0007-0022 27.06.13	30	33	25	No site emissions. No noise audible other than slightly audible distant traffic in several directions, and faintly audible continuous emissions from cold storage facility.

*Shortened measurements used to allow full circuit prior to site lock up. Data are nonetheless considered representative of 15 min intervals.

Appendix 3: Glossary

Air overpressure	Intensity of air pressure wave caused by blasting. Expressed as decibels without any A-weighting ie. linear or Z-weighting.
Ambient	Total noise environment at a location, including all sounds present.
A-weighting	Weighting or adjustment applied to sound level to approximate non-linear frequency response of human ear. Denoted by suffix A in parameters such as $L_{Aeq\,T}$, $L_{AF10\,T}$, etc.
Background level	$L_{AF90\,T}$. A-weighted sound pressure level of residual noise exceeded for 90 % of time interval T.
Broadband	Noise which contains roughly equal energy across frequency spectrum. Does not contain tones, and is generally less annoying than tonal noise.
Decibel	Shortened to dB. Unit of noise measurement scale. Based on logarithmic scale so cannot be simply added or subtracted. 3 dB difference is smallest change perceptible to human ear. 10 dB difference is perceived as doubling or halving of sound level. **Throughout this report noise levels are presented as decibels relative to 20 µPa**. Examples of decibel levels are as follows: 20 dB: very quiet room; 30-35 dB: night-time rural environment; 55-65 dB: conversation; 80 dB: busy pub; 100 dB: nightclub.
Fast response	0.125 seconds response time of sound level meter to changing noise levels. Denoted by suffix F in parameters such as $L_{AF10\,T}$, $L_{AF90\,T}$, etc.
Free field	Noise environment away from all surfaces other than ground ie. outside near field.
Frequency	Number of cycles per second of a sound or vibration wave. Low frequency noise may be perceived as hum, while whine represents higher frequency. Range of human hearing approaches 20-20,000 Hertz.
Hertz	Shortened to Hz. Unit of frequency measurement.
Impulse	Noise which is of short duration, typically less than one second, sound pressure level of which is significantly higher than background.
Interval	Time period T over which noise monitoring is conducted. Denoted by T in $L_{Aeq\,T}$, $L_{AF90\,T}$, etc.
$L_{Aeq\,T}$	Equivalent continuous sound level during interval T, effectively representing average A-weighted noise level.
L_{AF}	Sound pressure level averaged over one second, and changing each second in fluctuating noise environment.
$L_{AF10\,T}$	Sound pressure level exceeded for 10% of interval T, usually used to quantify traffic noise.
$L_{AF90\,T}$	Sound pressure level exceeded for 90% of interval T, usually used to quantify background noise. May also be used to describe noise level from continuous steady or almost-steady source, particularly where local noise environment fluctuates.
$L_{EX\,8h}$	Daily noise exposure level. Time weighted average of noise exposure levels for nominal 8 hour working day.
$L_{Req\,T}$	Rating noise level, derived from $L_{Aeq\,T}$ plus specified adjustments for tonal and impulsive characteristics. Equivalent to $L_{Ar\,T}$ used by EPA.
Masking	The rendering inaudible of one noise source by another noise source(s) which may be louder, or may contain significant acoustic energy in the same part of the frequency spectrum. In the latter case, any tone(s) in the original source emissions may become inaudible.
Noise sensitive location	Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or area of high amenity which for its proper enjoyment requires absence of noise at nuisance levels.
1/3 octave band	Frequency spectrum may be divided into octave bands. Upper limit of each octave is twice lower limit. Each octave may be subdivided into thirds, allowing greater analysis of tones.

Peak particle velocity	Shortened to PPV. Rate of change of displacement of particles in solid medium due to vibration, measured as mm/s. Usually used to assess vibration in relation to activities such as blasting as correlates well with human perception of vibration and property damage.
Residual level	Noise level remaining when specific source is absent or does not contribute to ambient.
Reverberant level	Sound pressure level in room where emitted acoustic energy is balanced by room surface absorption, resulting in steady noise level.
Specific level	Sound pressure level contribution arising from specific noise source, measured directly or by estimation or calculation.
Tone	Character of noise caused by dominance of one or more frequencies which may result in increased noise nuisance.
Z-weighting	Standard weighting applied by sound level meters to represent linear scale. Denoted by suffix Z in parameters such as $L_{Zeq\ T}$, $L_{ZF90\ T}$, etc. used to describe 1/3 octave band levels in frequency spectra.

In this report units are generally presented using US National Institute Of Standards & Technology guidelines.