N4 Collooney to Castlebaldwin, *Proposed Road Development*

APPENDIX NO. 8.3

Spoil Repository/Borrow Pits (Type 2) No 3 @ Cloonymeenaghan Td.: Noise & Vibration Assessments

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Document Control

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1.1 Relevant Standards

In developing the noise and vibration assessment for this project, consideration will be given to the following guidance documents where appropriate:

- *Environmental Management in the Extractive Industry*, EPA 2004; *Quarries and Ancillary Activities – Guidelines for Planning Authorities* – DoEHLG, April 2004;
- ISO 1996: 2003 – *Acoustics Description, assessment and measurement of environmental noise*;
- BS 5228: 2009 – *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*;
- BS 5228: 2009 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*;
- BS 6472: 2008 – *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting,* and;
- Minerals Policy Statement 2: *Controlling and Mitigating the Environmental Effects of Mineral Extraction in England – Annex 2: Noise*.

1.2 Methodology

The impact of the use of these sites will be determined by comparing the predicted noise levels associated with the operation of the quarrying operations of the Spoil Repository/Borrow Pit sites to the recommended noise and vibration criteria. These criteria will be determined through reference to Irish and international guidance and will be carefully chosen making appropriate reference to the results of the baseline survey.

1.3 Existing Noise Environment

The nearest noise sensitive location is located approximately 240m to the south east of the site.

An environmental noise survey was conducted in order to quantify the existing background noise environment. The survey was conducted in general accordance with ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise*. Specific details are set out below.

1.3.1 Dates & Times of Survey

For the purpose of this document, daytime is taken to be between 08:00hrs and 22:00hrs, whilst night-time is between 22:00hrs and 08:00hrs. It is understood that the borrow pits including its quarrying operations, when in operation, will operate during daytime hours only and as such a night-time survey is not required.

The survey was conducted on Wednesday 7 August 2013 between 11:30hrs and 13:50hrs.

The daytime measurements cover a period that was selected in order to provide a typical snapshot of the background noise climate during hours when the quarry would have been in operation.

1.3.2 Personnel and Instrumentation

Louis Smith (AWN) conducted the noise level measurements.

The noise measurements were performed using a Brüel & Kjær Type 2260 Sound Level Analyzer. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

1.3.3 Measurement Locations

Two measurement locations were selected; each is described in turn and also shown on Figure 1-1.

Location 1 is located beyond the south eastern boundary of the proposed quarry[1].

Location 2 is located in the vicinity of the nearest residential dwellings to the west of the proposed sited.

Figure 1-1: Noise survey locations (Source: Google Earth)

1.3.4 Survey Methodology

Sample periods for the noise measurements were 15 minutes, with 3 no. baseline measurements being conducted at each location. The results were noted onto a Survey Record Sheet immediately following each sample, and were also saved to the instrument memory for later analysis if required. Survey personnel noted the primary noise sources contributing to noise build-up.

1.3.5 Weather

The weather during both the survey period was dry and bright with winds of less than 1m/s and temperatures in the range of 15 to 18°C.

1.3.6 Measurement Parameters

The noise survey results are presented in terms of the following five 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. It is typically used as a descriptor for ambient noise.

L_{Amax} is the instantaneous maximum sound level measured during the sample period.

[1] Measurement location was removed from nearest residential dwelling due to barking dog significantly influencing measured noise levels.

L_{Amin} is the instantaneous minimum sound level measured during the sample period.

L_{A10} is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise.

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 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.

1.3.7 Survey Results and Discussion

1.3.7.1 Location 1

The survey results for Location 1 are given in Table 1-1 below.

Table 1-1 Summary of noise measurements from Location 1.

Time (hrs)		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	11:39 - 11:54	38	69	24	39	27
	12:07 - 12:22	38	62	26	38	30
	12:59 - 13:14	39	54	29	42	31

During the baseline measurements, the main noise sources observed were distant road traffic movements from the N4 and a degree of birdsong. Noise levels were in the range of 38 to 39dB L_{Aeq} and 27 to 31dB L_{A90}.

No significant sources of vibration were observed.

1.3.7.2 Location 2

The survey results for Location 2 are given in Table 1-2 below.

Table 1-2 Summary of noise measurements from Location 2.

Time (hrs)		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)				
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}
Daytime	12:01 - 12:16	66	84	24	71	38
	12:30 - 12:45	65	82	25	70	30
	13:32 - 13:47	65	83	28	70	34

During the baseline measurements, the measured noise levels were dominated by passing road traffic along the N4 mainline. Noise levels were in the range of 65 to 66dB L_{Aeq} and 30 to 34dB L_{A90}.

No significant sources of vibration were observed.

1.4 Noise & Vibration Standard Conditions

1.4.1 Noise Criterion

The EPA guidance document *Environmental Management in the Extractive Industry*; *Quarries and Ancillary Activities – Guidelines for Planning Authorities* (EPA 2004) sets out a standard noise condition for quarrying operations in relation to noise:

- Noise from the installation shall not give rise to sound pressure levels ($L_{Aeq,T}$) measured at the nearest noise sensitive location[2] (NSL), which exceed the limit value(s).

  Daytime (08:00hrs to 22:00hrs): 55dB $L_{Aeq,T}$[3]

  Night-time (22:00hrs to 08:00hrs): 45dB $L_{Aeq,T}$

- There shall be no clearly audible tonal component or impulsive component in the noise emission from the activity at any noise sensitive boundary.

It is understood that the quarry operations in the borrow pits will not operate during night-time hours.

1.4.2 **Vibration Criterion**

1.4.2.1 Peak Particle Velocity (PPV)

BS 7385, 1993 states that there should typically be no cosmetic damage if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228-2, 2009 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above. Below these values minor damage is unlikely. Where continuous vibration is such as to give rise to dynamic magnification due to resonance, the guide values may need to be reduced by up to 50%. *BS 5288-2, 2009* also comments that important buildings which are difficult to repair might require special consideration on a case by case basis.

Table 1-3 indicates the maximum PPV values, below which transient vibration should not cause cosmetic damage buildings.

Table 1-3 Peak particle velocities (PPV in mm/s) below which transient vibration should not cause cosmetic building damage (BS 7385, 1993 & BS 5228-2, 2009)

Type of structure	**Frequency of vibration**	
	4 Hz to 15 Hz	**15 Hz and above**
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

Error! Reference source not found. indicates the maximum PPV values as recommended by the EPA 2004 uidance document.

Table 1-4 Operational peak particle velocities (PPV in mm/s) limit for quarry activities (EPA 2004)

Type of structure	**Frequency of vibration**
	Less than 40 Hz
Noise sensitive receptor	12 mm/s, measured in any of the three mutually orthogonal directions at the receiving location

[2] 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.

[3] 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), 1 hour in this instance.

1.4.2.2 Air Overpressure

Air overpressure[4] from blasting operations is a special case and can under some circumstances give rise to concern or even alarm to persons unaccustomed to it.

These pressure waves will consist of energy over a wide range of frequencies, some of which are audible and known as sound waves or noise, but most of the energy is inaudible at frequencies of less than 20Hz.

The intensity and character of air overpressure can vary at different phases of work, at different times and under differing conditions of, for example, topography, geology, climate and methods of operation. Meteorological conditions, over which an operator has no control, such as temperature, cloud cover, humidity, wind speed, turbulence and direction, all affect the intensity of air overpressure at any location and cannot be reliably predicted. These conditions vary in time and position.

The US Bureau of Mines has undertaken considerable research which has led to statements on levels which are liable to cause damage and also recommended maximum levels[5]. The weakest parts of most structures that are exposed to air overpressure are windows. Poorly mounted, and hence pre-stressed, windows might crack at around 150dB (Lin) with most cracking at 170dB (Lin). Structural damage can be expected at 180dB (Lin).

Maximum recommended levels in residential properties vary according to instrument response. These levels are detailed in Table 1-5 below.

Table 1-5 Recommended maximum levels in terms of instrument response

Instrument Response	Maximum Level dB(Lin)
0.1Hz High Pass	134
2.0Hz High Pass	133
5.0 or 6.0Hz High Pass	129
C – slow	105

Routine open – pit blasting operations in the UK regularly generate air overpressures up to a magnitude of 120dB (Lin) (measured with a 2.0Hz High Pass system), with levels in excess of 125dB (Lin) being relatively rare[6]. Damage levels are rarely approached let alone exceeded. EPA Guidance[7] indicates acceptable limits for air overpressure should not exceed 125dB (Lin) Peak Value.

In addition the EPA recommends blasting is only carried out during 09:00 – 18:00hrs Monday to Friday. Blasting outside these hours should be restricted for emergency or safety reasons only.

Residents should also be notified in advance of blasting.

1.5 Characteristics of the Site

The site is located to the east of the existing N4 in the townland of Cloonymeenaghan, Co Sligo. The nearest noise sensitive location is the residential dwelling located approximately 240m beyond the south eastern boundary (represented by noise measurement Location 1).

4 Air overpressure can be quantified either as a pressure or as a level in linear (unweighted) decibels (dB)

5 US Bureau of Mines RI 8485, "*Structural Response and Damage Produced by Air Blast from Surface Mining*".

6 Wilton, T.J., Institute of Quarrying Transactions, "*Air Overpressure from Blasting*".

7 EPA Environmental Management Guidelines November 2003. Section 3.5

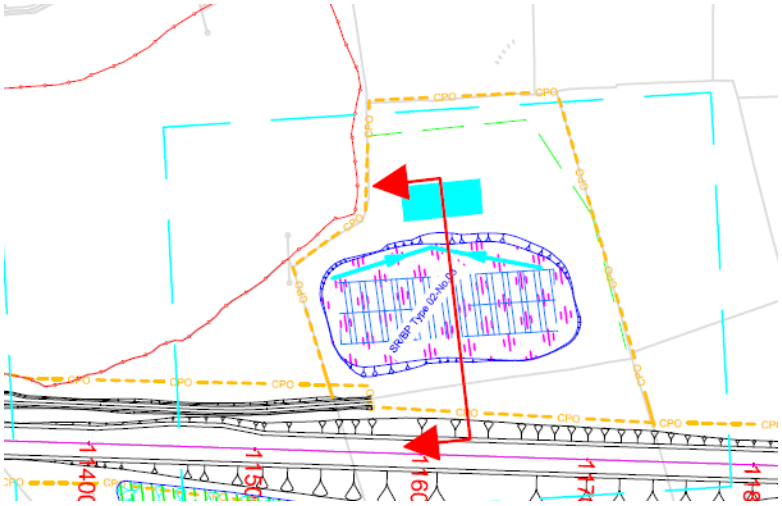

Figure 1-2: Borrow Pit site outlined in dashed blue (Source: Sligo Co. Co.)

It is understood that the quarry will only operate during daytime hours.

1.6 Potential Impacts of the Development

The expected processes with significant noise emissions at the site are as follows;

- Removal of overburden material and construction of screening berms around the perimeter of the site as required.
- Drilling blast holes down into limestone rock in accordance with extraction plan and blast design, where blasting is required.
- Loading of the blast holes with industrial explosives and detonation in accordance with blasting procedure where required.
- Breaking of rock in accordance with rock-breaking procedure.
- Loading of rock into a crusher to reduce fragment sizes. Crushed stone is then transferred into a screening unit for grading and stockpiling.
- Material is removed from site via HGV.

The exact extraction method is not known at time of writing.

The main plant expected to be used on site includes:

- excavators and dumper trucks to remove overburden and construct berms if required;
- track mounted drill rig to drill blast holes;
- track mounted rock-breaker;
- excavator used to load crusher;
- mobile crusher and screening units used to process blasted rock, and;
- wheel loader used to stockpile products and load customer road trucks.

1.6.1 **Noise Impact**

The following operations are noise generating sources or activities at the borrow pit:

- site activity, including;
  - extraction of material;
  - excavator movements on site;
  - transfer of material to screener, and;
  - screening of material.
- movement of HGV's along paved public roads;

- movement of HGV's along unpaved haul roads, and;
- blasting and/or rock-breaking noise.

Noise emissions have been derived from BS 5228-1 and are presented in Table 1-6 below.

Table 1-6 Noise data used from prediction (BS 5228-1)

BS 5228-1 Ref	Description	A-weighted Sound Pressure Level L_{Aeq} dB at 10m
C.9.2	Tracked mobile drilling rig	92
C.9.6	Tracked hydraulic excavator	91
C.9.15	Tracked semi mobile crusher	96
C.9.16	Rigid dump truck on haul road	91
C.9.23	Rigid dump truck discharging into hopper	85

1.6.1.1 Site Activity

Predictions of the noise impact with each of the sources outlined in Table 1-6 have been performed. A number of assumptions have been made:

- All plant items are located on the south eastern boundary of the quarry, i.e. as close as possible to the assessment location.
- Plant items will operate for 66% of a working day.
- The south eastern boundary of the site will incorporate screening (hoarding or earthen berm) of at least 2m height.

The results of these predictions are summarised below.

Table 1-7 Predicted noise levels

BS 5228-1 Ref	Description	Predicted Level at Noise Sensitive Location $L_{Aeq,12hrs}$ dB
C.9.2	Tracked mobile drilling rig	47
C.9.6	Tracked hydraulic excavator	46
C.9.15	Tracked semi mobile crusher	51
C.9.16	Rigid dump truck on haul road	46
C.9.23	Rigid dump truck discharging into hopper	40

The predicted levels during the operational noise measurements are all within the 55 L_{Aeq} criteria for daytime operations.

Note that the predicted noise levels referred to in this section are indicative only and are intended for comparison with the relevant noise criteria. Depending upon the number and type of sources operating, the noise levels may be higher or lower than those stated.

It should also be noted that the predicted "worst case" levels are expected to occur for only short periods of time whilst quarrying activity is occurring along the south eastern boundary of the site. For the majority of the time activities are expected to occur at greater distances from the nearest sensitive location thus reducing the

impact. Therefore it is expected that noise levels will be lower than these levels for the majority of the time at the assessment location.

1.6.1.2 HGV Movements along Public Roads

In terms of the additional traffic on local roads generated as a result of HGV movements to and from the quarry, the following comment is presented. Given the proximity of the borrow pits site to the proposed alignment the operation of the quarry is expected to generate relatively few HGV movements and a very small number of staff movements along the local road network over a typical working day. Considering that in order to increase traffic noise levels by 1dB traffic volumes would need to increase by the order of 25% it is concluded that these additional traffic movements introduced onto the local road network during peak operation of the quarry would not result in a significant noise impact.

1.6.1.3 Blasting Noise

Considering the infrequent nature of blasting events, it is considered very unlikely that such events would have the potential to exceed the recommended daytime criterion of 55dB L_{Aeq}.

Furthermore the operator will required to select a blasting method such that the criteria set out in Section 1.4 will not be exceeded.

1.6.1.4 Overall Cumulative Impact

Whilst there is the potential for the cumulative noise impact to exceed the recommended 55dB L_{Aeq} criterion, it is expected that such occurrences will be limited to periods when multiple items or plant are operating simultaneously along the south eastern boundary of the site.

The likely cumulative noise associated with the operation of the quarry for the majority of the time is expected to be below the commonly adopted criterion.

1.6.2 **Vibration Impact Assessment**

The extraction method for material has not been finalised at time of writing.

Due to the number of variables involved, it is not possible to undertake meaningful predictions of the likely ground-borne vibration associated with either blasting or rock-breaking activities nor the air overpressure impacts associated with blasting.

1.6.3 **REMEDIAL AND MITIGATION MEASURES**

1.6.3.1 Noise

Whilst no specific requirements for remedial measures have been identified a number of generic mitigation measures are recommended for reducing the potential noise, vibration and blasting nuisances.

These mitigation measures include:

- perimeter screening berms along boundaries shared with noise sensitive locations;
- monitoring of blasts to ensure compliance with criteria;
- notifying residents in advance of blasting
- following best practice in relation to blasting;
- face profiling before every blast;
- limiting the drop heights (where possible) of falling materials, and;
- limiting the speed vehicles travel at the site.

The site layout itself provides a significant degree of natural acoustic screening to the nearest residential dwelling.

1.6.3.2 Vibration

It is recommended that continuous vibration monitoring is undertaken at the nearest sensitive location during the extraction period from the quarry.

The method of extraction will be chosen to ensure that the measured PPV levels during the operational vibration measurements are all within the 12mm/s criteria recommended by the EPA 2004 guidance document. Levels of vibration of these magnitudes would not be expected to cause any structural damage at the assessment locations.

Monitoring should be undertaken during a trial blast event to show that the measured air overpressure levels during the operational vibration measurements can comply with the 125dB (Lin) peak value criterion recommended by the EPA 2004 guidance document.

1.7 References

1. *Environmental Management in the Extractive Industry*, EPA 2004; *Quarries and Ancillary Activities – Guidelines for Planning Authorities* – DoEHLG, April 2004;
2. ISO 1996: 2003 – *Acoustics Description, assessment and measurement of environmental noise*;
3. BS 5228: 2009 – *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*;
4. BS 5228: 2009 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*;
5. BS 6472: 2008 – *Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting,* and;
6. Minerals Policy Statement 2: *Controlling and Mitigating the Environmental Effects of Mineral Extraction in England – Annex 2: Noise*.
7. US Bureau of Mines: RI 8892: *Airblast and Ground Vibration Generation and Propagation from Contour Mine Blasting*.