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13 Noise & Vibration

13.1 Introduction

This Chapter of the Environmental Impact Assessment Report (EIAR) assesses the noise and vibration impact of the Ballyhale Flood Relief Scheme, Ballyhale, Co. Kilkenny during the Construction and Operational Phases.

This Noise Impact Assessment has been prepared by Mervyn Keegan of AONA Environmental Consulting Ltd. Mervyn Keegan is a Director of the environmental consultancy, AONA Environmental Consulting Ltd. Mervyn Keegan's areas of professional expertise are in Noise Control & Acoustics and Air Quality & Odour consultancy, including impact assessment and mitigation design. Mervyn Keegan has 23 years of environmental consultancy experience. Mervyn is a member of the Institute of Acoustics, a member of the Institute of Environmental Sciences and a member of the Institute of Air Quality Management with a Bachelor of Science Degree (Applied Sciences), a Master of Science Degree (Environmental Science) and a Diploma in Acoustics in Noise Control. AONA Environmental Consulting Ltd. is an independent consultancy specialising in Environmental Impact Assessment and Licensing. Mervyn Keegan has prepared in excess of fifty Noise & Vibration and Air Quality & Climate impact assessments annually for infrastructure and quarry developments in the Republic of Ireland, Northern Ireland and the UK in the last 20 years and is an expert in the awareness and understanding of the relevant legislation and guidance that pertains to best practise in such assessments. Mervyn Keegan has appeared as an Expert Witness at oral hearings, public inquiries and legal hearings. Mervyn Keegan has produced Noise, Air Quality & Odour Impact Assessment reports to assess the impacts of a range of development types including roads, residential developments, industrial developments, quarries and mines and wind energy developments among others.

13.2 Assessment Methodology

13.2.1 ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures

ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures defines the basic quantities to be used for the description of noise in community environments and describes assessment procedures. It also specifies methods to assess environmental noise and gives guidance on predicting the potential annoyance response of a community to long-term exposure from

various types of environmental noises. Application of the method to predict annoyance response is limited to areas where people reside and to related long-term land uses. ISO 1996: 2016 describes adjustments for sounds that have different characteristics. The term rating level is used to describe physical sound predictions or measurements to which one or more adjustments have been added. Based on these rating levels, the long-term community response can be estimated. The potential noise is assessed either singly or in combination, allowing for consideration, when deemed necessary by responsible authorities, of the special characteristics of their impulsiveness, tonality and low-frequency content, and for the different characteristics of road traffic noise, other forms of transportation noise (such as aircraft noise) and industrial noise.

13.2.2 BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise

BS5228 gives recommendations for methods of noise control relating to construction sites, including sites where demolition, remediation, ground treatment or related civil engineering works are being carried out, and open sites, where work activities/operations generate significant noise levels, including industry-specific guidance. The legislative background to noise control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. This part of BS5228 provides guidance concerning methods of predicting and measuring noise and assessing its impact on those exposed to it.

Annex E of BS5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*, provides guidance on assessing the potential significance of noise effects from construction activities. In relation to construction noise limits, BS 5228-1:2009+A1: 2014 *Noise and Vibration Control on Construction and Open Sites Part 1: Noise* details the ‘ABC method’, which recommends a construction noise limit based on the existing ambient noise level. General and short-term construction noise impacts that are deemed typical of any construction site noise sources, including activities such as ground preparation, site clearance, foundation earthworks, erection of new buildings, etc. are assessed in accordance with the ‘ABC method’ defined in BS 5228.

For the proposed flood relief scheme, the ambient noise levels have been determined through the baseline noise survey and then rounded to the nearest 5dB to determine the appropriate category (A, B or C) and subsequent threshold value. A potential significant effect is indicated if the construction noise level exceeds the appropriate category threshold value. If the existing ambient level exceeds the threshold category values, then a potential significant impact is indicated if the total noise level, including both the ambient noise and the various contributions

of construction noise, is greater than the ambient noise level by more than 3dB. **Table 13-1**, reproduced from BS5228, demonstrates the criteria for selection of a noise limit for a specific receiver location.

Table 13-1: Construction noise threshold levels based on the BS 5228 ‘ABC’ method

Assessment Category and Threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A ^(A)	Category B ^(B)	Category C ^(C)
Night time (23.00 to 07.00)	45	50	55
Evening and weekends ^(D)	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 - 13.00)	65	70	75

Notes:

Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.

Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.

Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

13.2.3 TII Construction Noise Guidelines

There are no national construction noise limit guidelines. Instead, there are indicative levels of acceptability for construction noise, as contained in the National Roads Authority (now Transport Infrastructure Ireland or TII) “Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes” (March 2014) and outlined in **Table 13-2**.

Table 13-2: Maximum permissible noise levels at the façade of dwellings during construction

Days & Times	L_{Aeq} (1hr) dB	L_{AMax} dB
Monday to Friday - 07.00 to 19.00	70	80*
Monday to Friday - 19.00 to 22.00	60*	65*
Saturday - 08.00 to 16.30	65	75

* Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant local authority. (Ref. TII Guidelines)

13.2.4 Construction Vibration Guidelines

The relevant guidelines for vibration limits are the following:

- British Standards Institution. *British Standard 7385: Evaluation and measurement for vibration in buildings. Part 1: Guide for measurement of vibration and evaluation of their effects on buildings*. 1990.
- British Standards Institution. *British Standard 7385: Evaluation and measurement for vibration in buildings. Part 2: Guide for damage levels from ground borne vibration*. 1993.
- British Standards Institution. *British Standard 6472: Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting*. 2008.
- National Roads Authority (now TII), *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*, March 2014.

Relevant vibration limits and guidelines can be divided into two categories, those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. Higher levels of vibration are typically tolerated for single events or events of short duration such as during construction projects compared to permanent vibration from operational industrial sources. For example, blasting (an instantaneous activity) and piling (a repetitive/continuous activity), two of the primary sources of vibration during construction projects, are typically tolerated at vibration levels up to 12mm/s and 2.5mm/s, respectively.

The TII Guidelines (March 2014) identify limits for protection against cosmetic damage as a function of vibration frequency, and are:

- 8 mm/s (vibration frequency <10Hz)
- 12.5 mm/s (vibration frequency 10 to 50Hz)
- 20 mm/s (vibration frequency >50 Hz).

Guidance relevant to acceptable vibration at the foundation of buildings is contained within BS 7385 (1993): *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration*. This guidance states that there should typically be no cosmetic damage to buildings 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 refer to relatively modern buildings.

13.3 Baseline Environment

13.3.1 Baseline Noise Survey

A daytime baseline noise monitoring survey was undertaken in proximity to the residential properties close to the alignment of the existing Ballyhale River on 7th September 2021. The noise survey was undertaken in accordance with the methodologies outlined in ISO 1996 Description, measurement and assessment of environmental noise and BS 4142. A Norsonic Nor140 Sound Level Meter (Serial No. 1402988 – Calibration Date – 26/03/2021) was used during the noise monitoring survey. A wind shield was used on the microphone throughout the survey and the sound level meter was calibrated before and after the survey period. The sound level meter was placed at a height of approximately 1.25m at the selected monitoring locations. The noise monitoring survey durations in proximity to the nearest noise sensitive receiver locations were undertaken over consecutive 15-minute periods. The meteorological conditions during the noise survey periods were noted as ideal with no periods of rainfall or higher wind speeds. The weather conditions during the noise survey were noted to be calm with little to no breeze, a temperature of approximately 18°C and no rainfall.

The measurement parameters recorded and reported during the baseline noise survey are defined as follows:

- A-weighted Decibel (dBA): Decibels measured on a sound level meter incorporating a frequency weighting (A Weighting) which differentiates between sound of different frequency (pitch) in a similar way to the human ear. This takes account of the fact that the human ear has different sensitivities to sound at different frequencies.
- L_{Aeq} is the A-weighted equivalent continuous steady sound level during the sample period.
- L_{A10} is the A-weighted sound level that is exceeded for 10% of the sample period and is generally used to quantify traffic noise.
- L_{A90} is the A-weighted sound level that is exceeded for 90% of the sample period and is generally used to quantify background noise.
- L_{Amin} is the minimum A-weighted sound level measured during the sample period.
- L_{Amax} is the maximum A-weighted sound level measured during the sample period.

Baseline noise measurements were undertaken in proximity to the representative residential receivers in accordance with ISO 1996: 2016 as shown in **Figure 13-1**. All noise measurement data was downloaded at the company office, exported from the manufacturer's software and stored as Microsoft Excel spreadsheet files.



Figure 13-1: Noise Monitoring Locations (NML)

Table 13-3: Baseline Noise Levels

Location	Time	L _{Aeq}	L _{AMax}	L _{AMin}	L _{A10}	L _{A90}	Sources
NML 1	09:48	42.1	66.4	35.9	44.1	38.2	Quiet area. Infrequent car passing. Traffic on R448. Ballyhale River. Leaf rustle.
	10:47	42.7	72.9	35.5	46.7	37.6	
NML 2	10:08	60.2	75.1	38.3	64.5	40.5	Passing traffic dominant.
	11:07	58.5	74.8	37.5	47.2	39.1	
NML 3	10:27	55.5	79.5	37.8	57.9	40.9	Passing traffic dominant.
	11:25	52.5	73.9	33.2	47.6	37.9	Occasional noise from car repair yard.

The baseline noise measurement data indicates that Ballyhale is a quiet village with passing traffic on the R448 the dominant noise source. Passing traffic is not continuous through the village during daytime.

13.4 Characteristics of the Proposed Development

A full description of all of the proposed works can be found in the **Chapter 5, The Proposed Development**. The main areas and works which are predicted to give rise to noise and vibration during construction of the Ballyhale Flood Relief Scheme are described in **Table 13-5**. The nature of proposed construction works in each area and distance to nearest noise sensitive receivers are also summarised in **Table 13-5**.

There will be no significant vibration impact during the construction of the proposed Ballyhale Flood Relief Scheme as there is no proposal for piling to occur during construction.

As stated above, there will be no operational noise and/or vibration impact from the operation of the proposed Ballyhale Flood Relief Scheme.

Section 13.6 describes the construction mitigation measures that are required relevant to the nature of the proposed works and proximity to noise sensitive receivers.

13.5 Predicted Impacts of the Proposed Development

13.5.1 Construction Stage

Noise impact as a result of the construction phase of the proposed flood relief scheme will be perceptible at nearby properties but this will be intermittent and temporary. Construction activities will not take place during night-time hours. The following construction practices have the potential to produce intermittent and temporary noise impacts:

- Site Clearance & Excavation - dozers, tracked excavators & dump trucks;
- Infilling / Levelling / Piling - Excavators, wheeled loaders, and rollers;
- Wall removal & construction - Concrete mixer trucks & delivery vehicles;
- General Construction - Masonry construction, *etc.*

The proposed development will generate HGV movements throughout the duration of the construction period. It is expected that there will ~1,800m³ of imported material and ~2,100m³ of exported material. Assuming a lorry carries 20-25m³ of material, this will equate to 156-195 lorry movements during the course of the construction works. It is not expected that HGV vehicle movements will exceed 4 vehicles per hour during the busiest period of construction works.

Construction noise can be assessed in terms of the equivalent continuous sound level and/or in terms of the maximum level. The level of sound in the neighbourhood that arises from a construction site depends on a number of factors and the estimation procedures need to take into account the following significant factors;

- the sound power outputs of processes and plant;
- the periods of operation of processes and plant;
- the distances from sources to receiver;
- the presence of screening by barriers;
- the reflection of sound;
- ground attenuation;
- meteorological conditions (particularly wind speed and direction), and
- atmospheric absorption.

Typical noise levels from construction works likely to take place during construction phase of proposed flood relief scheme are outlined in **Table 13-4**.

Table 13-4: Typical Noise Levels from Construction Works likely to take place during the construction of proposed development

Ref No.	Equipment	A-weighted sound pressure level, L_{Aeq} , dB @ 10m
Table C.2 Sound level data on site preparation		
Clearing Site & Ground excavation/earthworks		
1	Dozer ж (142 kW, 20T)	75 ж
3	Tracked excavator (102 kW, 22T)	78
12	Dozer (142 kW, 20T)	80
14	Tracked excavator (226 kW, 40T)	79
Loading lorries		
27	Wheeled loader (493 kW)	80
Distribution of material		
30	Dump truck (tipping fill) (306 kW, 29T)	79
31	Dump truck (empty) (306 kW, 29T)	87
Rolling and compaction		
37	Roller (rolling fill) ж	79 ж
Table C.4 Sound level data on general site activities		
Distribution of materials		

Ref No.	Equipment	A-weighted sound pressure level, L_{Aeq} , dB @ 10m
1	Articulated dump truck ж	81 ж
Mixing & Pumping concrete		
20	Concrete mixer truck	80
Trenching		
63	Tracked excavator	77
Power for site cabins		
84	Diesel generator	74
Pumping water		
88	Water pump (diesel) (10 kW, 100Kg)	68
Sweeping and dust suppression		
90	Road sweeper (70 kW)	76
91	Dust suppression unit trailer	78
Table C.5 Sound level data on road construction works		
Breaking road surface & concrete		
1	Backhoe mounted hydraulic breaker	88
6	Hand-held pneumatic breaker	95

ж Drive-by maximum sound pressure level in L_{Amax} (overall level)

(Ref: BS 5228 Noise on Construction and Open sites)

It is most likely that the above outlined construction activities will occur separately throughout periods of construction at each works location. The proposed construction works will not be continuous over the construction period at any one location. By its nature, construction phases of such a proposed development are transient in terms of locations of precise activities on site from time to time. Therefore, the predicted worst-case $L_{Aeq,1 \text{ hour}}$ noise levels at specific locations have been outlined to present a worst-case range of noise levels that have the potential to occur at various stages throughout the construction period.

The predicted worst-case construction noise levels at specific locations in proximity to potential future construction works are summarised in **Table 13-5**.

Table 13-5: Predicted worst-case construction noise levels at specific locations in proximity to potential future construction works.

Reference	Description	Complementary Works	Typ Height required above existing ground	Approx. Length	Likely Equipment / Plant expected to be required	Proximity to nearest receiver	Predicted Noise Level <small>L_{Aeq}/1 hour</small>
E-001	Flood Embankment: Raise ground levels along existing agricultural tracks to prevent overland flow path	Carry out minor clearance/maintenance works to channel	0.3m-0.7m	94	1 No. Excavator, 1 No. Dozer, 1 No. Dump Truck	~95m (NSR1)	59 dB(A)
E-002	Flood Embankment: Embankment / berm at rear of properties to prevent overland flow path		1m	91	1 No. Excavator, 1 No. Dozer, 1 No. Dump Truck	~15m (NSR2)	79 dB(A)
E-003	Flood Embankment: Remove existing church walkway to recombine stream discharges and form new pedestrian connection to the church		1.5m	17	1 No. Excavator, 1 No. Dump Truck	~15m (NSR2)	75 dB(A)
E-004	Flood Embankment: Form flood embankment / berm at rear of properties		0.3m-1.8m	75	1 No. Excavator, 1 No. Dozer, 1 No. Dump Truck	~20m (NSR3)	75 dB(A)
E-005	Flood Embankment: Form flood embankment / wall at rear of Garda Station building		0.8m-1.2m	19	1 No. Excavator, 1 No. Dump Truck	~20m (to Garda Station)	73 dB(A)
D-001	New Channel: Form new channel form outlet in Ballyhale Church Channel to remove flow split and combine both branches to single main channel				1 No. Excavator, 1 No. Dump Truck, 1. No. Concrete Truck, 1 No. Pump	~15m (NSR2)	75 dB(A)
D-002	Channel Works: Regrade existing Channel to form constant gradient				1 No. Excavator, 1 No. Dump Truck	~20m (NSR4)	72 dB(A)
L-001	Flood Wall: Form flood wall to rear of Arrigle View		0.6m-0.8m	28	1 No. Excavator, 1 No. Pump, 1. No. Concrete Truck	~5m (NSR2)	70 dB(A)
L-002	Flood Wall: Form flood wall to rear of Pub / Garage		0.7m-1m	24	1 No. Excavator, 1 No. Pump, 1. No. Concrete Truck	~50m (NSR3)	45 dB(A)
L-003	Flood Wall: Form flood wall to infill existing gap in roadside boundary wall		0.3m	33	1 No. Excavator, 1 No. Pump, 1.	~25m (NSR5)	52 dB(A)

Reference	Description	Complementary Works	Typ Height required above existing ground	Approx. Length	Likely Equipment / Plant expected to be required	Proximity to nearest receiver	Predicted Noise Level <small>L_{Aeq}/1 hour</small>
					No. Concrete Truck		
X-001	Item Removal: Remove existing access bridge	Minor works to adjacent bridge to maintain access across bridge above flood defence level.		4	1 No. Excavator, 1 No. Dump Truck	~50m (NSR3)	62 dB(A)
X-002	Item Removal: Remove existing wall spanning channel			5	1 No. Excavator, 1 No. Dump Truck	~50m (NSR3)	62 dB(A)
X-003	Item Removal: Remove existing weir and replace with culvert with clear span access			8	1 No. Excavator, 1 No. Dump Truck, 1 No. Pump, 1. No. Concrete Truck	~20m (NSR4)	72 dB(A)
G-001	Channel Works: Clear channel and create low flow channel to aid maintenance and reflect reduced flow conditions				1 No. Excavator, 1 No. Dump Truck	~10m (NSR3)	80 dB(A)
G-002	Channel Works: Realign channel at roadway bridge to remove siltation and improve inlet condition	Provide riprap bank lining upstream of culvert where erosion evident.			1 No. Excavator, 1 No. Dump Truck	~20m (NSR6)	73 dB(A)
G-003	Channel Works: Install Rock Ramp				1 No. Excavator, 1 No. Dump Truck	~5m (NSR2)	70 dB(A)
G-004	Channel Works: Install Pool and Boulder Pass				1 No. Excavator, 1 No. Dump Truck	~40m (NSR6)	70 dB(A)
P-001	Pipe Works: Provide overflow pipe to discharge at reduced flood height area downstream of business park culvert.			155	1 No. Excavator, 1 No. Dump Truck, 1 No. Roller, 1. No. Concrete Truck	~10m (NSR4)	80 dB(A)
P-002	Pipe Works: Provide additional conveyance capacity to the main Street Bridge. The additional conveyance will be provided by an additional bridge opening (box culvert) set at a high level to provide capacity for extreme flood events				1 No. Excavator, 1 No. Dump Truck, 1. No. Concrete Truck , 1 No. Pump	~25m (NSR6)	72 dB(A)

<u>Reference</u>	<u>Description</u>	<u>Complementary Works</u>	<u>Typ Height required above existing ground</u>	<u>Approx. Length</u>	<u>Likely Equipment / Plant expected to be required</u>	<u>Proximity to nearest receiver</u>	<u>Predicted Noise Level</u> <u>L_{Aeq}/1 hour</u>
LW-001	Form public realm walkway within lands acquired for flood works				1 No. Excavator, 1 No. Dump Truck	~20m (NSR3)	73 dB(A)

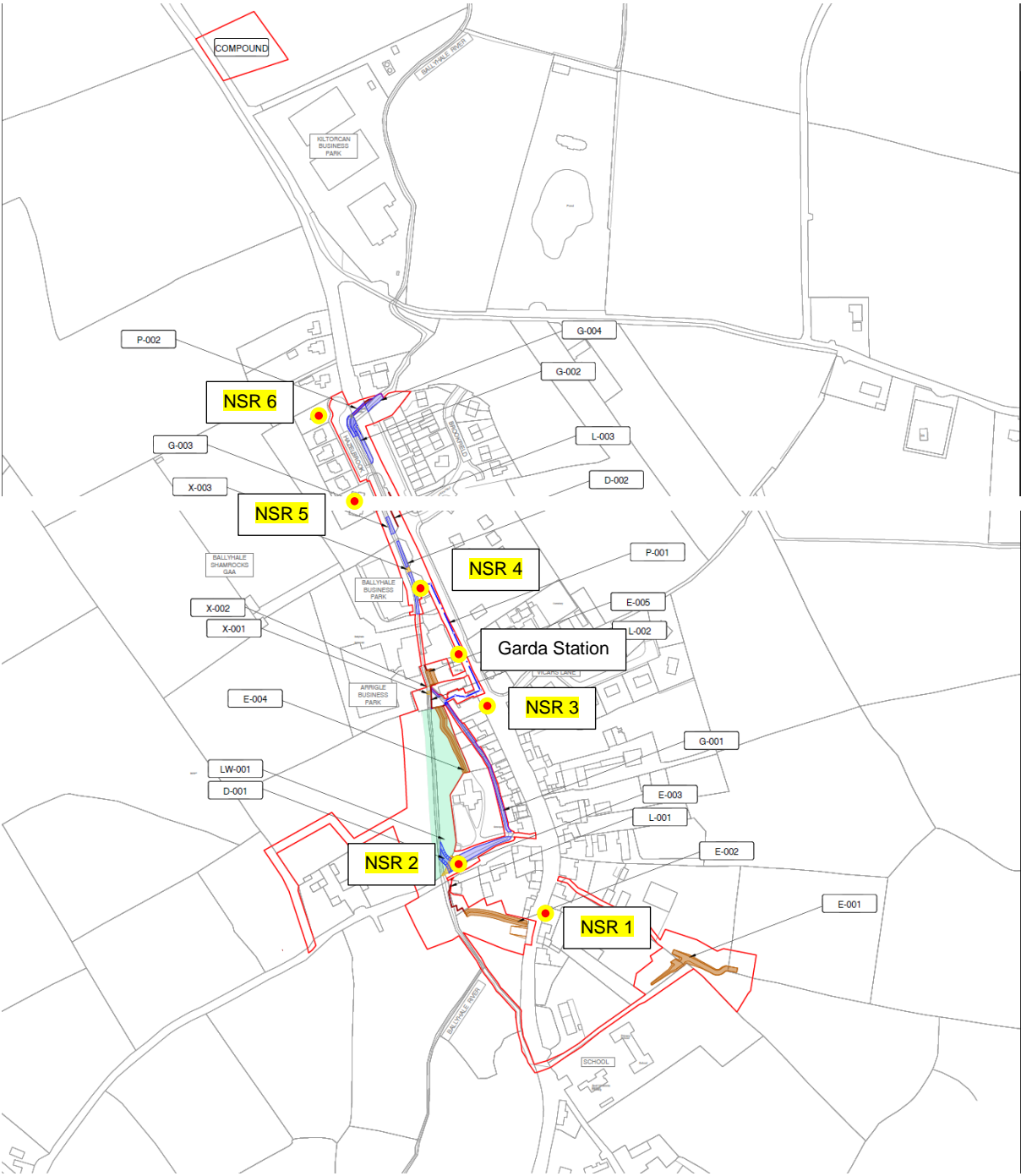


Figure 13.2: Selected representative Noise Sensitive Receiver Locations (NSR)

13.5.2 Construction Noise Impact Significance

In accordance with the BS 5228-1:2009+A1: 2014 Noise and Vibration Control on Construction and Open Sites Part 1: Noise 'ABC method', the ambient noise levels (rounded to the nearest 5 dB) in the area of the proposed construction works range from 45 - 60 dB $L_{Aeq,T}$ during daytime. As a result, the noise sensitive receivers fall into Category A of the 'ABC' assessment methodology.

It is important to note that construction noise impacts will occur during daytime hours only and will be short-term at each area of construction along the proposed flood relief scheme. Not all construction noise sources will operate at once and construction noise levels are likely to vary throughout the typical working day.

A pragmatic approach needs to be taken when assessing the significance of noise effects of any construction project. The significance of the construction noise from the project has been determined by considering the change in the ambient noise level with the construction noise on-going. BS5228 states that noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq, Period}$, from construction noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact. BS5228 also states that for public open space, impact might be deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise ($L_{Aeq, Period}$) by 5 dB or more for a period of one month or more.

Based on the BS5228 'ABC' assessment methodology, the contractor should aim to limit daytime construction noise to 65 dB $L_{Aeq,12\text{ Hour}}$ at all works areas with the application of appropriate mitigation measures.

Based on the expected short-term duration of works at each location there will be a short-term noise impact at the nearest sensitive receivers to the proposed works. In some of the works areas, the predicted worst-case 1-hour construction noise levels may briefly be in excess of the recommended maximum noise level of 70 dB L_{Aeq} / 80 dB L_{AMax} at 1m from the façade of the nearest residential properties as outlined by the TII Guidelines (March 2014). Noise from construction works will fluctuate throughout the course of a typical working day as well as over the course of the construction works being undertaken in any one location. Therefore, the daytime construction noise limit

of 65 dB $L_{Aeq,12\text{ Hour}}$ should be achieved at the nearest residential properties. The construction noise impacts will be short-term and will not be significant.

Appropriate construction mitigation measures outlined below will be implemented as part of the Construction Environmental Management Plan (CEMP).

13.5.3 Construction Vibration at Sensitive Receivers

Construction vibration impacts have the potential to occur if piling works are undertaken in very close proximity to sensitive receivers. Piling works are not proposed in the proposed flood relief scheme.

13.5.4 Operational Stage

There are no mechanical elements such as removable flood defences proposed in the proposed flood relief scheme. Therefore, there will be no operational noise impact.

13.6 Mitigation Measures

13.6.1 Construction Mitigation

Appropriate mitigation measures have been identified to ensure the Construction Phase target noise limits are not exceeded. The contractor will be required to implement the control measures recommended in BS 5228 and apply the appropriate measures where applicable. Other measures will include:

- Working hours during site construction operations will be restricted to daytime hours from 07:30 hours to 16:30 hours (Monday to Friday) and, as may be required, from 08.00 hours to 13.00 hours (Saturdays). Evening and night-time work is not expected to take place although it is possible that limited 24 hours working may be required to take place on occasion. This will only take place with the prior agreement of Kilkenny County Council.
- An on-site speed limit will be enforced for all traffic. Drivers of vehicles will be advised of the speed limits through the erection of signs *i.e.* a typically recommended on site speed limit is 10 km/hr.
- Where practicable, the use of quiet working methods and the most suitable plant will be selected for each activity having due regard to the need for noise control.
- Best practicable means will be employed to minimise noise emissions and will comply with the general recommendations of BS 5228. To this end operators will use “*noise reduced*” plant and/or will modify their construction methods so that noisy plant is unnecessary.

- By positioning potentially noisy plant as far as possible from noise sensitive receivers the transmission of sound can be minimised. Earth mounds and/or stockpiles of material or perimeter hoarding on site can be used as a physical barrier between the source and the receiver.
- Mechanical plant used on site will be fitted with effective exhaust silencers. Vehicle reverse alarms will be silenced appropriately in order to minimise noise breakout from the site while still maintaining their effectiveness.
- All plant will be maintained in good working order. Where practicable, machines will be operated at low speeds and will be shut down when not in use.
- Compressors will be of the “noise reduced” variety and fitted with properly lined and sealed acoustic covers.
- In all cases engine and/or machinery covers will be closed whenever the machines or engines are in use.
- All pneumatic percussive tools will be fitted with mufflers or silencers as recommended by the equipment manufactures. Where practicable, all mechanical static plant will be enclosed by acoustic sheds or screens.
- Employees working on the site will be informed about the requirement to minimise noise and will undergo training on the following aspects:
 - The proper use and maintenance of tools and equipment.
 - The positioning of machinery on-site to reduce the emission of noise to the noise sensitive receivers.
 - Avoidance of unnecessary noise when carrying out manual operations and when operating plant and equipment.
 - The use and maintenance of sound reduction equipment fitted to power pressure tools and machines.
- Cognisance will also be taken of the *Environmental good practice site guide* 2005 compiled by CIRIA and the UK Environment Agency. This guide provides useful and practical information regarding the control of noise at construction sites.
- Where excessive noise levels are recorded, further mitigation measures will be employed which may include temporary wooden hoarding / acoustic screening

to be installed to a height of no less than 2m around areas of construction where loud noise levels occur.

- The contractor will ensure that the TII Guidelines which identify limits for protection against cosmetic damage as a function of vibration frequency are not exceeded through the use of the selected low vibration piling method.
- Responsible Person –The Contractor will appoint a responsible and trained person who will be present on site and who will be willing to answer and act upon complaints and queries from the local public.
- Night-time Working - If there are items of plant (e.g. dewatering pumps and similar) in use during night-time hours they will be chosen, sited and enclosed such that levels at the nearest properties do not exceed the measured background noise levels.

13.6.2 Monitoring

- Where deemed necessary due to excessive impact or complaints received, noise monitoring will be undertaken during construction works to determine noise levels at noise sensitive receivers. On the basis of the findings of such noise monitoring, appropriate noise mitigation measures will be implemented to reduce noise impacts.
- The contractor will conduct continuous monitoring of vibration levels during any piling that may have the potential to result in a vibration impact at nearby properties.

13.6.3 Operational Mitigation

The proposed flood relief scheme will not result in an operational noise impact. Therefore, no operational mitigation measures are deemed necessary.

13.7 Residual Impacts

The assessment of construction noise impacts from the proposed flood relief scheme has indicated that construction noise limit criteria may be exceeded at the nearest residential properties for short periods during daytime. This may occur on occasions when heavy construction activity occurs in close proximity to noise sensitive receivers. Noise from construction works will fluctuate throughout the course of a typical working day as well as over the course of the construction works being undertaken in any one location. Therefore, the daytime construction noise limit of 65 dB $L_{Aeq,12\text{ Hour}}$ should be achieved at the nearest residential properties. The construction noise impacts will be

short-term and will not be significant. Also, while the overall construction activities for the proposed flood relief scheme will occur over several months, the nature of the proposed works and its duration will mean that noise sensitive receivers will not be exposed to continuous construction noise impact during the construction period.

Once the above mitigation measures have been implemented, the residual impacts from the development will not be significant.

13.8 In-Combination Effects

The removal of soils, overburden and rocks along with the increased traffic during the construction phase has the potential to give rise to noise impacts, potentially giving rise to impacts on Biodiversity and Population and Human Health. Potential interactive negative impacts have been identified in Chapter 16, a full suite of appropriate mitigation measures have been included in the relevant sections of the EIAR and are listed in a schedule of mitigation included in Chapter 17.

13.9 Cumulative Effects

In relation to the in combination construction and/or operational impact of the proposed Ballyhale Flood Relief Scheme, with other proposed schemes planned in the area, the list of schemes noted from the planning chapter have been reviewed. None of these schemes will result in any significant additional construction and/or operational Noise and Vibration Impact.

13.10 Difficulties Encountered in Assessment

No significant difficulties were encountered when preparing the Noise and Vibration impact assessment.