

9.0 NOISE AND VIBRATION

9.1 Introduction

This Chapter of the EIS considers the potential and likely significant effects of the proposed alterations to the permitted development on noise and vibration. The purpose of this Chapter is to identify and describe any likely significant noise and vibration effects as a result of the proposed alterations in the context of the permitted development. Full details of the proposed alterations are included in Chapter 3 Project Description.

Ringaskiddy Port is located in an area that contains a significant number of settlements. The nearest residential properties to the proposed alterations, as with the permitted Ringaskiddy Port Redevelopment works, are the properties to the south of the existing N28 Main Street, properties to the west of the Port at Shanbally, properties to the northwest of the port at Monkstown and properties to the north and northeast at Cobh, Whitepoint and Blackpoint. In addition to the residential properties, there are other potentially noise sensitive receptors in the study area, including the National Maritime College of Ireland (NMCI), the Naval Base on Haulbowline Island and numerous schools, churches, clinics and leisure clubs.

The proposed alterations will be contained on the site of the existing Ringaskiddy Port, where there is an existing Deepwater Berth (DWB) and ferry service which operates during day and night-time periods. On account of this, there is a long history of noise from Port related activities in the vicinity of the proposed alterations. In addition to this, there are numerous existing industrial facilities located in the general study area. Road traffic noise is the dominant noise source in the vicinity of the majority of the nearest noise sensitive properties to the existing Port at Ringaskiddy.

During the construction phase of the proposed alterations as with the permitted development, there is potential for noise impacts at the nearest noise sensitive properties from the use of plant and equipment and vibration impacts from the use a certain construction phase activities (e.g. piling). The assessment of operational phase noise includes an assessment of the noise impact from new plant/equipment at the Port as a result of the proposed alterations and the assessment of road traffic changes in the vicinity of the Port as a result of the proposed alterations in the context of the permitted development.

There are no statutory noise limits that can be applied to the assessment of noise and vibration impacts from planned developments in Ireland. The assessment of noise and vibration impacts has been completed on the basis of recognised Irish and international guideline documents in the areas of noise and vibration assessment.

A key component of the assessment process has been to determine the likely noise and vibration impacts of the proposed alterations in the context of the permitted development and existing noise and vibration environment at the nearest sensitive properties to the proposed alterations.

This Chapter should be read in conjunction with Figure 9.1 - 9.3.

9.2 Methodology

9.2.1 Noise Guidance Documents

This section includes a summary of Irish and International guidance documents that have been used as reference material for the purposes of completing the Noise and Vibration Assessment.

Environmental Protection Agency (EPA) Office of Environmental Enforcement (OEE) - Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

This document relates primarily to noise surveys and assessments for EPA licensed facilities but in the absence of any other directly applicable guidance documents, it provides useful reference material for the purposes of completing the noise assessment for the proposed alterations to the permitted Ringaskiddy Port Redevelopment project.

The EPA published two earlier documents in relation to the survey, assessment and management of noise emissions from licensed facilities, namely the *Environmental Noise Survey Guidance Document* (commonly referred to as NG1) and *Guidance Note for Noise in Relation to Scheduled Activities - 2nd Edition* (commonly referred to as NG2). These two documents have been withdrawn with the publication of NG4.

NG4 provides detailed consideration of a range of noise related issues including basic background to noise issues, various noise assessment criteria and procedures, noise reduction measures, Best Available Techniques (BAT) and the detailed requirements for noise surveys. NG4 provides typical limit values for noise from licensed sites, namely:

- Daytime (07:00 - 19:00) - 55dB $L_{Ar,T}$;
- Evening (19:00 - 23:00) - 50dB $L_{Ar,T}$;
- Night-time (23:00 - 07:00) - 45dB $L_{Aeq,T}$.

In the description of the limits above, the $L_{Aeq,T}$ is the equivalent continuous sound level over the measurement period and $L_{Ar,T}$ is equal to the L_{Aeq} but includes an additional penalty of 5dB(A) to account for any tonal or impulsive characteristics to the noise source.

While consideration is given to these threshold limits in the general context of the noise assessment for the proposed alterations, the alterations are located in the context of an urban/suburban environment where existing noise levels regularly exceed the typical noise limits set out in NG4 for EPA licensed sites.

Other EPA guidelines such as *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]* have been considered also in the preparation of this Noise and Vibration Chapter.

National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004)

This guidance document is primarily concerned with setting out the design criteria with regard to noise from new road schemes in Ireland; however it also provides useful reference material in terms of discussing suitable noise and vibration threshold limits for construction phase activities associated with road schemes in Ireland.

The NRA Guidelines list maximum permissible noise levels typically deemed to be acceptable for the construction phase of road schemes (See Table 9.1). These values are indicative only and more stringent limits may be applied where pre-existing noise levels are low.

Table 9.1: Maximum Permissible Noise Levels at the Façade of Dwellings During Construction

Days & Times	L_{Aeq} (1 hr) dB	$L_{pA(max)slow}$ dB
Monday to Friday 07:00 – 19:00hrs	70	80
Monday to Friday 19:00 – 22:00hrs	60*	65*
Saturday 08:00 – 16:30hrs	65	75
Sunday Bank Holidays 08:00 – 16:30hrs	60*	65*

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

British Standard BS5228:2009+A1:2014 Noise and Vibration Control on Construction and open Sites

This British standard consists of two parts and covers the need for protection against noise and vibration of persons living and working in the vicinity of construction and open sites. The standard recommends procedures for noise and vibration control in respect of construction operations and aims

to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners.

Part 1 of the standard provides a method of calculating noise from construction plant, including:

- Tables of source noise levels;
- Methods for summing up contributions from intermittently operating plant;
- A procedure for calculating noise propagation;
- A method for calculating noise screening effects; and
- A way of predicting noise from mobile plant, such as haul roads.

The standard also provides guidance on legislative background, community relations, training, nuisance, project supervision and control of noise and vibration.

The ABC method outlined in Section E3.2 has been used for the purposes of determining whether the predicted noise levels from the construction activities will result in any significant noise impact at the nearest noise sensitive properties.

Table 9.2 below outlines the applicable noise threshold limits that apply at the nearest noise sensitive receptors. The determination of what category to apply is dependent on the existing baseline ambient (L_{Aeq}) noise level (rounded to the nearest 5dB) at the nearest noise sensitive property. For daytime, if the ambient noise level is less than the Category A threshold limit, the Category A threshold limit (i.e. 65dB) applies. If the ambient noise level is the same as the Category A threshold limit, the Category B threshold limit (i.e. 70dB) applies. If the ambient noise level is more than the Category A threshold limit, the Category C threshold limit (i.e. 75dB) applies. The applicable limits that apply at each of the sensitive receptors included in the construction phase noise model are presented and discussed in section 9.4 of this Chapter.

Table 9.2: Noise Threshold Limits at Nearest Sensitive Receptors for Drilling Rig Activities

	Threshold Limits [dB(A)]		
	Category A	Category B	Category C
Night-time (23:00 - 07:00)	45	50	55
Evening and Weekends (19:00 - 23:00 Weekdays, 13:00-23:00 Saturdays, 07:00-23:00 Sundays)	55	60	65
Weekday daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

World Health Organisation (WHO) - Guidelines for Community Noise

In the World Health Organisation (WHO) *Guidelines for Community Noise* (1999), a L_{Aeq} threshold daytime noise limit of 55 dB is suggested for outdoor living areas in order to protect the majority of people from being seriously annoyed. A second daytime limit of 50 dB is also given as a threshold limit for moderate annoyance.

The guidelines suggest that an internal L_{Aeq} not greater than 30 dB for continuous noise is needed to prevent negative effects on sleep. This is equivalent to a façade level of 45 dB L_{Aeq} , assuming open windows or a free-field level of about 42 dB L_{Aeq} . If the noise is not continuous, then the internal level required to prevent negative effects on sleep is a $L_{Amax,fast}$ of 45 dB. Therefore, for sleep disturbance, the continuous level as well as the number of noisy events should be considered.

World Health Organisation (WHO) - Night Noise Guidelines for Europe

The *Night Noise Guidelines for Europe* was published in 2009 on the back of extensive research completed by a WHO working group. Considering the scientific evidence on the threshold of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive (2002/49/EC), an $L_{night,outside}$ of 40dB should be the target of the night noise guideline (NNG) to protect public, including the most vulnerable groups such as children, the chronically ill and the elderly. An interim target of 55dB is recommended where the NNG cannot be achieved. These guidelines are applicable to Member States of the European Region and may be considered as an extension to the previous WHO Guidelines for Community Noise (1999). The guidelines do not expand on the noise limits applicable to non-continuous noise and hence the guidance included in the 1999 guidelines is still applicable in relation to this.

In the context of the existing environment in the vicinity of the proposed alterations, noise levels in the study area regularly exceed the 40dB night noise limit included in this document.

World Health Organisation (WHO) - Methodological Guidance for Estimating the Burden of Disease from Environmental Noise

In 2012, the WHO published the *Methodological Guidance for Estimating the Burden of Disease from Environmental Noise*. This document outlines the principles of quantitative assessment of the burden of disease from environmental noise, describes the status in terms of the implementation of the European Noise Directive and reviews evidence on exposure-response relationships between noise and cardiovascular diseases.

UK Department of Transport (Welsh Office) - Calculation of Road Traffic Noise [CRTN]

This Calculation of Road Traffic Noise (CRTN) guidance document outlines the procedures to be applied for calculating noise from road traffic. These procedures are necessary to enable entitlement under the Noise Insulation Regulations (NI) 1995 to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.

The document consists of three different sections, covering a general method for predicting noise levels at a distance from a highway, additional procedures for more specific situations and a measurement method for situations where the prediction method is not suitable. The prediction method constitutes the preferred calculation technique but in a small number of cases, traffic conditions may fall outside the scope of the prediction method and it will then be necessary to resort to measurement. The prediction method has been used in this instance to determine the likely traffic noise increases as a result of the proposed alterations. There is no difference in predicted traffic flows between the permitted development and the proposed alterations and hence there is no change in the traffic noise impacts.

Environmental Noise Directive (END) 2002/49/EC

END 2002/49/EC was transposed into Irish legislation in the form of the Environmental Noise Regulations, 2006. The legislation sets out the manner by which Strategic Noise Maps must be

prepared in Ireland for large agglomerations, major roads, major railways and major airports. Strategic Noise Maps were prepared for the Cork Agglomeration in 2012 and a draft Noise Action Plan (NAP) was published for consultation.

The proposed alterations, as with the permitted development, will alter the noise environment in the vicinity of Ringaskiddy Port and hence will alter the Strategic Noise Maps in this area. Under the requirements set out under END, the Strategic Noise Maps are required to be updated every five years. The changes brought about by the permitted development and the proposed alterations will be incorporated into the updated Strategic Noise Maps for the Cork Agglomeration as part of this ongoing update process. This is done separately from the planning process and is not discussed further in this chapter.

9.2.2 Vibration

The NRA *Guidelines for the Treatment of Noise & Vibration in National Road Schemes* is one of the few Irish guidance documents that give recommendations relating to vibration from construction phase activities in Ireland. The guidelines recommend that vibration is limited to the values set out in Table 9.3 in order to ensure that there is little or no risk of even cosmetic damage to buildings. These values and the values indicated in Table 9.4 should be used as guidance for monitoring vibration levels from the construction phase of the proposed alterations in the context of the permitted development.

Table 9.3: Recommended Vibration Level Thresholds for NRA Schemes

Allowable Vibration Velocity (Peak Particle Velocity) at the Closest Part of Any Sensitive Property to the Source of Vibration, at a Frequency of:		
Less than 10Hz	10 to 50 Hz	50 to 100 Hz (and above)
8mm/s	12.5mm/s	20mm/s

Limits of transient vibration, above which cosmetic damage could occur, are also given numerically in Table 9.4 (Ref: BS5228-2:2009). Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 9.4, and major damage to a building structure can occur at values greater than four times the tabulated values (definitions of the damage categories are presented in BS7385-1:1990, 9.9).

Table 9.4: Transient Vibration Guide Values for Cosmetic Damage (Ref BS5228-2:2009)

Type of Building	Peak Particle Velocity (PPV) (mm/s) in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

British Standard BS 7385 (1993) *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration* indicates that cosmetic damage should not occur to property if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz. These guidelines refer to relatively modern buildings and therefore, these values should be reduced to 50% or less for more sensitive buildings.

9.2.3 Methodology for Noise Monitoring

A baseline noise survey was completed involving attended noise measurements to record the existing noise environment at the nearest noise sensitive receptors to the proposed alterations and the permitted development. The baseline noise monitoring locations selected generally represent “worst-case” receptors in terms of sensitivity and proximity to the site of the proposed alterations and the permitted development.

The noise monitoring was carried out using Bruel & Kjaer Model 2250 and 2260, Type 1 Integrating Digital Sound Level Meters (SLMs), capable of measuring within +/- 0.1dB(A) in L_{eq} and sound pressure levels (SPL) in ‘A’ scale. The instruments record the L_{Aeq} , L_{A10} , L_{A90} , L_{AMax} and L_{AMin} percentiles simultaneously. The instruments were calibrated in accordance with *ISO 1996 Acoustics - Description, Measurement and Assessment of Environmental Noise* and *BS4142 Method for Rating industrial noise affecting mixed Residential and Industrial areas* prior to commencing the surveys using the recommended standard calibration procedure and a known pure tone noise source. The units were again calibrated on completion of the surveys to record drift. The units had not drifted during the surveys. Drift is normally associated with battery fade and/or temperature.

Measurements were made at a height of 1.2 – 1.5m above ground level and under free field conditions. The weather conditions were in accordance with the requirements of *BS7445: Description and Measurement of Environmental Noise* and *ISO 1996: Acoustics - Description, Measurement and Assessment of Environmental Noise*.

The following parameters were recorded during each monitoring period:

- L_{Aeq} The continuous equivalent A-weighted sound pressure level. This is an “average” of the sound pressure level.
- L_{Amax} This is the maximum A-weighted sound level measured during the sample period.
- L_{Amin} This is the minimum A-weighted sound level measured during the sample period.
- L_{A10} This is the A-weighted sound level that is exceeded for noise for 10% of the sample period.
- L_{A90} This is the A-weighted sound level that is exceeded for 90% of the sample period.

9.2.4 Noise Model

The proposed alterations in the context of the permitted development were modelled using CadnaA noise modelling software. The CadnaA noise modelling software package uses the ISO9613 prediction methodology along with a range of topographical and ordnance data collected on the surrounding area to build up a picture of the noise environment in the vicinity of sensitive receptors in the study area. The software was used to build a 3-dimensional model of all features which may affect

the generation and propagation of noise in the vicinity of the existing environment and the permitted development

The CadnaA noise model was used for predicting cumulative noise levels at various stage of the construction phase and for predicting the cumulative noise levels from proposed scenarios for the operational phase of the proposed alterations. The noise model was validated using noise measurement data recorded within the existing port during operational hours.

9.3 Existing Environment

9.3.1 Noise Survey at Nearest Sensitive Receptors

Noise monitoring was undertaken at 5 locations to determine the existing noise environment at the nearest noise sensitive properties. Noise monitoring at each location was conducted in the format of one hour measurements on different days during day and night-time periods at the same 5 locations. The noise monitoring locations are illustrated in Figure 9.1. Subjective observations were recorded during each of the short-term measurements.

In general, the baseline noise monitoring survey illustrated that road traffic noise is the most dominant noise source at the majority of locations. This is supplemented to a greater or lesser extent by a number of different noise sources including various industrial activities, the Port activities, various human activities and birdsong.

In Ringaskiddy, road traffic noise from the existing N28 road and the various local roads around the village was the dominant noise source. The influence of road traffic noise reduces as one travels from Ringaskiddy village out towards the NMCI and on to Haulbowline Island as various other noise sources contribute more to the overall ambient noise levels. A similar scenario prevails at Monkstown with road traffic noise from the R610 being the dominant source. Road traffic noise is dominant in Cobh also, however the further one travels from the main road links towards Whitepoint and Blackpoint, the influence of road traffic noise diminishes and the overall ambient noise is derived from multiple and varied sources.

The noise survey data for each location is presented Tables 9.6 - 9.7 below.

Table 9.6: Summary of Daytime Attended Noise Monitoring

Monitoring Time	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
Location 1					
15/11/16 14:27 – 15:27	48	83	35	49	40
17/11/16 10:17 – 11:17	52	78	42	51	46
18/11/16 09:36 – 10:36	55	81	44	57	47
Combined	53	83	35	52	44
Location 2					
15/11/16 15:31 – 16:31	66	83	41	70	50
17/11/16 11:23 – 12:23	63	80	47	68	51
18/11/16 14:46 – 15:46	67	79	46	71	54
Combined	66	83	41	70	52
Location 3					

Monitoring Time	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
16/11/16 10:22 – 11:22	59	81	40	62	44
17/11/16 12:29 – 13:29	60	75	44	64	48
19/11/16 09:25 – 10:25	53	74	40	53	42
Combined	58	81	40	60	45
Location 4					
16/11/16 10:33 – 11:33	69	87	40	73	47
17/11/16 14:09 – 15:09	72	87	45	76	52
19/11/16 10:35 – 11:35	71	84	40	75	44
Combined	71	87	40	75	48
Location 5					
16/11/16 12:28 – 13:28	49	75	38	50	42
19/11/16 11:41 – 12:41	50	76	35	48	38
19/11/16 12:41 – 13:41	47	72	34	47	36
Combined	49	76	34	48	39

Table 9.7: Summary of Night-time Attended Noise Monitoring

Monitoring Time	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
Location 1					
14/11/16 23.12 - 23.42	43	80	30	37	33
15/11/16 02.11 - 02.41	45	81	32	40	36
15/11/16 23.01 - 23.31	45	83	33	41	36
16/11/16 01.28 - 01.58	44	80	36	40	38
Combined	44	83	30	40	36
Location 2					
14/11/16 23.55 - 00.25	55	78	33	49	36
15/11/16 02.47 - 03.17	51	84	32	45	34
15/11/16 23.36 - 00.06	54	82	32	48	35
16/11/16 02.03 - 02.33	49	85	35	43	39
Combined	53	85	32	46	36
Location 3					
15/11/16 00.30 - 01.00	46	84	29	36	32
15/11/16 02.21 - 02.51	48	82	29	40	30
16/11/16 00.10 - 00.40	49	80	35	46	33
16/11/16 02.37 - 03.07	50	81	32	41	35
Combined	48	84	29	41	33
Location 4					
15/11/16 01.31 - 02.01	53	87	33	40	34
15/11/16 04.31 - 05.01	55	84	33	41	35
16/11/16 00.49 - 01.19	55	84	33	40	35
16/11/16 03.17 - 03.47	46	83	33	40	36
Combined	53	87	33	40	35
Location 5					
19/11/16 23.15 - 00.15	43	74	34	40	36
20/11/16 00.15 - 01.15	39	62	32	38	34
20/11/16 01.15 - 02.15	38	68	31	37	34
Combined	41	74	31	38	35

The noise survey information included in Table 9.7 illustrates that existing ambient noise levels in all locations currently exceed the WHO night noise guideline limit of 40dB(A) (see page 9-4) and in the majority of cases also exceed the EPA NG4 night-time guideline limit of 45dB(A) (see page 9-2).

9.4 Construction Phase Impacts

9.4.1 Construction Noise - General

A detailed noise model was created of the Port and surrounding noise sensitive receptors in order to predict the cumulative noise level associated with construction phase activities of the proposed alterations in the context of the permitted development at the nearest noise sensitive properties. In order to create the noise model, it was necessary to define the various plant and equipment used as part of the construction phase activities associated with the proposed alterations. Table 9.8 includes a list of the most significant plant/equipment to be used during the construction phase for the proposed alterations.

Table 9.8: Plant and Equipment to be Used During Construction Phase of the proposed alterations in the context of the permitted development (Ref: BS5228:2009+A1:2014)

Activity / Plant (Reference from Annex C & D, BS5228:2009)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Sound Power Level (dB)
Rolling and Compaction: Vibratory roller (C5 - Ref 27)	20	3t	95
Haulage: Road Lorry - Full (C6 - Ref 21)	270	39t	108
Lifting: Wheeled Mobile Telescopic Crane (C4 - Ref 38)	610	400t	106
Clearing Site: Tracked excavator (C2 - Ref 3)	102	22t	106
Clearing Site: Wheeled backhoe loader (C2 - Ref 8)	62	8t	96
Ground Excavation: Dozer (C2 - Ref 12)	142	20t	109
Ground Excavation: Tracked excavator (C2 - Ref 14)	226	40t	107
Ground Excavation: Wheeled loader (C2 - Ref 27)	193	-	108
Poker Vibrator (C4 - Ref 33)	-	-	106
Power: Diesel Generator (C4 - Ref 83)	3	210kg	93
Distribution of Material: Tipper Lorry (C8 - Ref 20)	-	-	107
Piling: Tubular Steel Piling - hydraulic hammer - (C3 - Ref 3)	-	240mm diameter	116
Piling: Sheet Steel Piling - hydraulic jacking - power pack (C3 - Ref 10)	147	6t	96
Pumping Water: Water pump (C2 - Ref 45)	20	6 in	93
Dredging: Ship Chain Bucket (D12 - Ref 1)*	-	35m long	124

* BS5228:2009+A1:2014 has no reference for the specific drill and blast technique and therefore the noisiest dredging technique from BS5229:2009+A1:2014 has been used as reference.

A worst-case construction scenario was modelled with proposed alterations including the following activities: piling, anchor wall works, capping beam works, bunds/armouring, bulk fill, crane foundations, deck slab piling, deck slab works to the CB / MPB quay walls, removal of dolphins and proposed maintenance building works. The plant and equipment requirements for this construction scenario are detailed below on the basis of the activities stated above. The noise model for this scenario assumes that all of the items of plant/equipment for the scenario are active simultaneously.

Permitted Development Construction Scenario

Mobile crane x 5 (piling, anchor wall, capping beam, crane foundations, deck slab works), tubular steel and steel sheet piling rigs x 3 (quay wall, anchor wall and deck slab works), excavator x 3 (quay wall piling, anchor wall and bulk filling), tipper lorry x 2 (capping beam and bulk filling), compressor x 3 (capping beam works, crane foundation and deck slab works), poker x 2 (capping beam works and deck slab works) and dozer (bulk filling).

Proposed Alterations Construction Scenario

In addition to the items listed above, additional items have been included in the construction scenario to reflect the changes to the construction phase of the scheme from that assessed in the published EIS (2014). These changes include:

- removal of two existing dolphins and construction of three new mooring dolphins;
- extension of the dredge pocket further south to accommodate an alteration to Berth 1;
- the construction of a new maintenance building to the south of the terminal area.

Dredging and piling inputs in the noise model have been moved to reflect the more southerly location included in the revised construction plans for bullet points 1 & 2 above and demolition activity has been included to reflect the demolition of the existing dolphins (Ref: BS5228:2009+A1:2014, Table C1, ref C6). The additional plant/equipment included in the noise model to cover the noisiest part of the construction of the new maintenance building are detailed below. The references in brackets relate to details included in Annex C of BS5228:2009+A1:2014.

- Breaking up concrete: Breaker mounted on wheeled backhoe (C1 - Ref 2) - $L_w = 120\text{dB}$
- Lifting: Wheeled Mobile Telescopic Crane (C4 - Ref 38) - $L_w = 106\text{dB}$
- Clearing Site: Tracked excavator (C2 - Ref 3) - $L_w = 106\text{dB}$
- Clearing Site: Wheeled backhoe loader (C2 - Ref 8) - 96dB
- Ground Excavation: Dozer (C2 - Ref 12) - $L_w = 109\text{dB}$
- Ground Excavation: Tracked excavator (C2 - Ref 14) - $L_w = 107\text{dB}$
- Ground Excavation: Wheeled loader (C2 - Ref 27) - $L_w = 108\text{dB}$
- Haulage: Road Lorry - Full (C6 - Ref 21) - $L_w = 108\text{dB}$
- Pre-cast concrete piling - hydraulic hammer (C3 - Ref 1) - $L_w = 117\text{dB}$

The model has also been updated to include the new 4m noise barrier that has been built adjacent to the entrance to the site as part of the advanced works completed in 2016 as part of the permitted development.

9.4.2 Predicted Impact of Construction Noise from Proposed alterations

Where construction activity takes place for a development in the vicinity of residential properties, it is standard practice that the activities would operate between the hours of 08:00 and 18:00 on Monday to Fridays, between 08:00 and 13:00 on Saturdays and there will be no activity on Sundays or Bank Holidays.

The construction scenario detailed in section 9.4.1 is a worst-case scenario of the construction phase where the greatest number of items of plant/equipment will operate at the closest distance to the nearest noise sensitive properties. This scenario is very much a worst-case scenario and it represents an over-estimation of the likely construction phase noise impacts associated with the proposed alterations at any one time.

There are hundreds of receptors in the vicinity of the proposed redevelopment and rather than include all of these, a select number of receptors have been selected and included in the noise model. The selected receptors are representative of those properties that are nearest to the proposed works. These properties are also representative of the properties adjacent to them but not included in the noise model. Some representative properties that are a little further away from the proposed alterations are also included in the model to illustrate the decreasing noise impact with distance from the proposed alterations. Table 9.9 includes the worst-case predicted noise levels for Construction Scenarios described in Section 9.4.1. The locations of the receptors included in the table below are illustrated in Figures 9.1 - 9.3 that accompany this chapter.

Table 9.9: Worst-Case Predicted Construction Noise Levels at Nearest Noise Sensitive Properties

Property Reference	Property Address (See Figures 9.1-9.3)	Predicted Worst-Case Construction Noise (dBA)
1	1 Martello Park	54.9
2	9 Martello Park	52.5
3	2A Main St	55.7
4	13 Main St	55.6
5	Reamur, Old Post Office Road	46.4
6	Island View, Main St	53.9
7	Roughy House, Main St	53.2
8	Allenvale, Main St	54.2
9	Leeview, Main St	54.2
10	Lackendarra, Main St	54.2
11	Drouch Na Mara, Warren's Court	50.4
12	5 Belle Vue Place	41.8
13	Detached dwelling, The Demense	38.6
14	Summerland, Strand Road	41.4
15	Thorncliffe, Alta Terrace	41.1
16	Cooleen House, Rinacoltig	45.3
17	Detached dwelling, Rinacoltig	44.2
18	1 Whitepoint Estate	43.0

Table 9.9 illustrates the worst-case predicted cumulative construction noise levels at the nearest noise sensitive receptors. These worst-case predicted noise levels have been calculated on the basis that all items of plant/equipment are at the nearest point of their usage to the respective noise sensitive property. The worst-case predicted noise levels are based on all plant being active simultaneously and hence represent an overestimation of likely construction noise levels at any one time. They have also been completed on the basis of the predicted noise level at the first floor bedroom window (i.e. 4m) at the nearest noise sensitive property.

In order to determine the noise impact associated with the worst-case predicted construction noise levels included in Table 9.9, the predicted noise levels have been compared to the permissible construction noise levels included in the NRA Guidelines (see Table 9.1) and the derived threshold noise limits using the ABC Method from BS5228:2009+A1:2014 (see Table 9.2). Tables 9.10 illustrates whether the worst-case predicted construction noise levels are within the respective noise threshold limits outlined in the NRA Guidelines and BS5228:2009+A1:2014.

Table 9.10: Comparison of Worst-Case Predicted Construction Noise Levels with Noise Threshold Limits in NRA Guidelines (2004) and BS5229:2009+A1:2014

Property Reference	Property Address (See Figures 9.1-9.3)	Predicted Worst-Case Construction Noise (dBA)	Noise Threshold Limit (L _{Aeq}) (dBA)	
			NRA Guidelines	BS5228:2009 ABC Method
1	1 Martello Park	54.9	70	65
2	9 Martello Park	52.5	70	65
3	2A Main St	55.7	70	65
4	13 Main St	55.6	70	65
5	Reamur, Old Post Office Road	46.4	70	65
6	Island View, Main St	53.9	70	65
7	Roughly House, Main St	53.2	70	65
8	Allenvale, Main St	54.2	70	65
9	Leeview, Main St	54.2	70	65
10	Lackendarra, Main St	54.2	70	65
11	Drouch Na Mara, Warren's Court	50.4	70	65
12	5 Belle Vue Place	41.8	70	65
13	Detached dwelling, The Demense	38.6	70	65
14	Summerland, Strand Road	41.4	70	65
15	Thornccliffe, Alta Terrace	41.1	70	65
16	Cooleen House, Rinacoltig	45.3	70	65
17	Detached dwelling, Rinacoltig	44.2	70	65
18	1 Whitepoint Estate	43.0	70	65

Table 9.10 illustrates that the worst-case predicted construction noise levels are well below the maximum permissible noise threshold limits include in the NRA Guidelines for construction phase activities and within the applicable daytime limit outlined in the BS5228:2009+A1:2014 ABC Method.

While the worst-case construction noise levels are well below the noise threshold limits outlined in the NRA Guidelines and BS5228:2009+A1:2014, all measures should be employed during the construction phase activities in these areas to reduce construction noise levels to the lowest possible levels. Mitigation measures aimed at reducing construction phase noise levels are outlined in section 9.5 of the chapter. These measures already form part of the An Bord Pleanála approval of the permitted development of the Ringaskiddy Port Redevelopment and therefore do not require any changes and remain entirely appropriate.

9.4.3 Construction Phase Traffic Impacts

Construction phase traffic noise impacts are the same as those assessed in the permitted development.

9.4.4 Construction Phase Vibration Impacts

Construction phase vibration noise impacts are the same as those assessed in the permitted development.

9.5 Operational Phase Impacts

9.5.1 Noise Impact from Deepwater Berth (DWB) extension

There are no proposed alterations at the Deepwater Berth. No noise impacts are predicted.

9.5.2 Noise Impact from the Container Berth/Multi-purpose Berth (CB/MPB) Alterations

This section includes an assessment of the potential noise impact associated with the addition of new plant/equipment to the proposed site as a result of the proposed alterations to the CB / MPB at Ringaskiddy East. The assessment is similar to that completed as part of the previous assessment

associated with the permitted development but has been updated to reflect the proposed alterations, including the following elements:

- the change in the type of container handling system and stacking arrangements from the use of rubber tyre gantries (RTG) to straddle carriers and a rail mounted gantry (RMG) to the south of the site (reach stackers and terminal transporters were required for the RTG operation but are not required for the straddle carrier/RMG operation and have been omitted from the model);
- changes to the layout of the operational area as compared with that previously assessed in the EIS, with operations moving marginally more southward than previously assessed in the EIS;
- the addition of a new maintenance building for the straddle carriers;
- alterations to berth 1.

In terms of noise emitting plant/equipment, the majority of the plant/equipment operating at the proposed CB / MPB will be new plant/equipment to the Port. It is proposed that straddle carriers will be brought from the existing Tivoli operations (noise levels from these have been measured and included in Table 9.11), but these will be the newer models which are the least noisy straddle carriers currently in operation in Tivoli.

Table 9.11 includes reference data for the various plant and equipment that will operate on the proposed CB / MPB. The data for each item of plant/equipment has been taken from a number of different sources including the SourcedB database (EU Imagine Project), the Dublin Port EFFORTS Study and detailed plant specification sheets. This data list has been updated from that included in the previous assessment associated with the permitted development to reflect the omission of the RTGs from the proposed alterations operation and the inclusion of the straddle carriers and rail mounted gantry (RMG). Reach stackers and terminal transporters which were also included in the noise model for the RTG operation have been omitted as they are not required for a straddle carrier / RMG operation.

For the straddle carrier noise reference in Table 9.11, a noise survey was conducted at Port of Cork's Tivoli operation to measure noise levels from the straddle carriers that will be used at permitted Ringaskiddy Port Redevelopment as part of the proposed alterations. Reference noise measurements were made of straddle carriers at 10m distance when undertaking the noisiest activities during normal operations (i.e. hoisting & dropping containers). In all, 14 reference measurements were used which generated an average measurement of 73dB(A) L_{Aeq} at 10m distance, which equate to a sound power level (L_w) of 101dB(A). Only straddle carriers that comply with this reference noise level output will be used at the proposed Ringaskiddy Port Redevelopment.

Table 9.11: Source Noise Data Used in Noise Model for the permitted CB / MPB with the proposed alterations

Item of Plant/Equipment	Sound Power Level (L_w) dB(A)	Proportional On-Time (%)
Ship	101.5	100
Ship to Shore Gantry (SSG) Crane	97.0	80
Rail Mounted Gantry (RMG) Crane	97.0	80
Straddle Carrier	101.0	80
Reefer container	90.6	100
HGV	103.8	50
Mobile Crane (LHM 550)	106.4	80
SSG/RTG/Mobile Crane Alarm/Beacon	100.0*	25
Container Handling Activity	112.0**	1

* All alarm/beacon associated with plant will be of the broadband variety and will be set to a maximum output of 100dB L_w .

** Tonal penalty of 5dB added

In Table 9.11, an entry has been included for general container handling noise, which has been included in the noise model in addition to the plant noise from the various items of plant that will be handling the containers. This noise level was taken from direct measurements completed as part of the Dublin Port EFFORTS Study and has been included here in order to incorporate the various banging noises associated with container handling. The noise level for the container handling noise has been increased by 5dB(A) as a penalty to account of the impulsive nature of this noise (i.e. 107dB + 5dB = 112dB).

Also, in addition to the plant noise for the various crane sources used in the noise model, an alarm/beacon noise source has also been included in the model as conditioned by the permitted development (alarm noise to be limited to 100dB L_w and will be broadband in nature as opposed to the tonal beeping alarms). This also reflects the more recent changes to port operations whereby the Port of Cork have been installing broadband alarms on plant throughout its existing operations.

For the proposed operational phase, two different scenarios were modelled for day and night-time periods and these are detailed in the bullet points included below:

- Scenario 1 - Daytime: proposed CB / MPB operating at 100% capacity with 3 ships, 2 SSG cranes, 1 mobile crane, 15 straddle carriers, 2 RMGs and reefer noise active simultaneously. This option includes container handling events and alarm noise for all lifting plant in the proportions listed in Table 9.11;
- Scenario 2 - Night-time: proposed CB / MPB operating with 1 ship, 1 SSG crane, 6 straddle carriers, 1 RMG and reefer noise active simultaneously. This option includes container handling events and alarm noise for all lifting plant in the proportions listed in Table 9.11;

Table 9.12 contains the predicted noise levels for Scenarios 1-2 as described above. The nearest noise sensitive properties listed in the table are the same as those used for the construction phase noise assessment and are illustrated in Figures 9.1 - 9.3. All predicted noise levels are at a height of 4m to reflect the height of a first floor window.

Table 9.12: Noise Model Predictions of Proposed Operational Phase Noise from Activities at CB / MPB

Property Reference	Property Address (See Figures 9.1-9.3)	Predicted Operational Phase Noise from Proposed CB / MPB (dBA)	
		Scenario 1 (Day)	Scenario 2 (Night)
1	1 Martello Park	44.8	41.7
2	9 Martello Park	43.6	40.2
3	2A Main St	45.5	42.2

4	13 Main St	46.1	42.8
5	Reamur, Old Post Office Road	41.8	39.3
6	Island View, Main St	47.0	43.8
7	Roughy House, Main St	46.3	43.3
8	Allenvale, Main St	47.8	44.6
9	Leeview, Main St	46.7	43.6
10	Lackendarra, Main St	47.9	44.9
11	Drouch Na Mara, Warren's Court	44.6	41.5
12	5 Belle Vue Place	36.5	33.6
13	Detached dwelling, The Demense	34.5	31.6
14	Summerland, Strand Road	36.3	33.4
15	Thorncliffe, Alta Terrace	36.1	33.2
16	Cooleen House, Rinacoltig	41.0	38.2
17	Detached dwelling, Rinacoltig	40.1	37.2
18	1 Whitepoint Estate	39.5	36.5

Scenario 1 is based on a maximum daytime operation at the proposed redeveloped port with all plant in operation at one time. These worst-case predicted operational phase noise levels are significantly below the daytime noise threshold limit of 55dB $L_{A,T}$ as outlined in the EPA guideline document NG4 (see Section 9.2.1). They are also below the evening threshold limit of 50dB $L_{A,T}$.

It may be required at various stages and for various reasons that limited night-time operations may be required to service particular functions within the port. A night-time scenario was modelled as described in Scenario 2 above and the prediction noise levels from this operation was found to be within the night-time 45dB limit at all prediction locations, albeit only marginally so at the nearest noise sensitive properties.

In the context of the night-time predictions included in Table 9.12, the noise survey information included in Table 9.7 illustrates that in the majority of cases, existing night-time ambient noise levels (i.e. L_{Aeq}) exceed the EPA NG4 night-time guideline limit of 45dB(A) (see page 9-2) at the nearest noise sensitive receptors.

The baseline noise monitoring survey (Tables 9.6 & 9.7) illustrate that road traffic noise is the dominant noise source in the study area. This is supplemented by other noise sources such as port activities, other industrial activities, various human activities and a range of miscellaneous noise sources. The proposed alterations will not change the existing noise environment in the vicinity of the proposed redevelopment.

9.5.3 Noise Impact from Traffic Movements In and Out of Port from Proposed Alterations

There is no change to the traffic flows entering or leaving the permitted development as a result of the proposed alterations. The assessment of traffic noise impacts concludes that there will be no significant traffic noise impact on sensitive receptors in the study area as a result of the proposed alterations.

9.5.4 Operational Phase Vibration Impacts

As for the permitted development the proposed alterations will not result in any vibration generating activities being placed in close proximity to any of the nearest vibration sensitive receptors in the study area. There will be no vibration impact associated with the operational phase of the proposed alterations.

9.5.5 Cumulative Noise Impacts

There a range of projects in the study area that are in different stages of planning and have the potential to influence the noise environment in the vicinity of the proposed alterations. These have all been considered in the context of the proposed alterations to the permitted development and the potential for cumulative noise impacts at the nearest noise sensitive receptors.

Current or future projects that have the potential to alter the noise environment in the study area include the East Tip Remediation Project at Haulbowline Island, the construction of 5 wind turbines by the Cork Lower Harbour Energy Group, the upgrade of facilities at the Hammond Lane Metal Company, the IMERC Masterplan, the Spike Island Masterplan and the proposed Monkstown Marina.

As for the permitted development the proposed alterations has been assessed against a quieter background noise environment not including any potential noise from the above sources (i.e. worst-case assessment). The above mentioned projects have the potential to increase noise levels at sensitive locations in the immediate vicinity to them. Any noise in the context of the proposed alterations to the permitted development will as a result be less prominent at those receptors.. The cumulative noise impacts associated with the proposed alterations are the same as for the permitted development.

9.6 Mitigation Measures

9.6.1 Construction Phase

There is no change to the proposed mitigation measures from those already included in the permitted development. Construction Phase mitigation measures already form part of the An Bord Pleanála approval of the permitted development of the Ringaskiddy Port Redevelopment and remain entirely appropriate.

9.6.2 Operational Phase

Section 9.5 includes an assessment of the operational phase noise and vibration impacts associated with the proposed alterations as part of the permitted development. The noise modelling predictions indicate that full daytime operational noise levels will be well below the daytime noise threshold limit of 55dB as presented in the EPA guidelines NG4 and will also be below the evening threshold limit of 50dB. A night-time scenario was also modelled and was found to be inside the night-time threshold limit of 45dB, albeit only marginally so.

In the context of the night-time predictions included in Table 9.12, the noise survey information included in Table 9.7 illustrates that in the majority of cases, existing night-time ambient noise levels (i.e. L_{Aeq}) exceed the EPA NG4 night-time guideline limit of 45dB(A) (see page 9-2) at the nearest noise sensitive receptors.

In relation to potential night-time operations, it must be noted that this assessment compares worst-case predicted noise levels from the proposed alterations as part of the permitted development during the night at the nearest noise sensitive receptors. In setting the context for this assessment, it must be considered that worst-case noise levels will only occur for a relatively small proportion of the time and that noise levels will generally be below worst-case noise levels and in many instances, well below worst-case noise levels.

In addition to this, the port will not be active every night. The extent of night-time working at the Port will be generally quite similar to what is occurring at present, with the plan being to deal with much of the existing scheduled visits (e.g. the weekly Maersk visit) at the proposed CB / MPB rather than at the DWB where it is currently processed.

Port of Cork will only operate plant with broadband alarms during night-time hours, which is a change that Port of Cork has already been making to its fleet of plant in Ringaskiddy. The difference between broadband alarms and the traditional beeping alarms is significant and it is the tonal quality of the beeping alarms that has been a significant aspect of complaints received in relation to port activities in the past.

A series of 4m barriers are already conditioned to the permitted development and these barriers will be in place for the amended scheme. These will provide significant attenuation in relation to port noise in the direction of Ringaskiddy in particular.

These measures already form part of the An Bord Pleanála approval of the permitted development of the Ringaskiddy Port Redevelopment and therefore do not require any changes and remain entirely appropriate.

9.6.3 Vibration

As outlined in section 9.4.4, the construction phase of the permitted development is not likely to result in any significant vibration impacts at the nearest sensitive receptors. Section 9.5.4 clarified how there will be no operational phase activities likely to give rise to vibration impacts at any of the nearest sensitive receptors. The proposed alterations will not change this prediction.

As per the extant conditions for the permitted development *BS5228:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and open Sites - Part 2: Vibration* includes a range of measures for the reduction of vibration associated with piling activities and for general surface based activities. The contractor will adhere to the mitigation measures included in BS5228:2009+A1:2014 where practicable to reduce vibration levels from general and piling activities to the lowest possible levels.

These measures already form part of the An Bord Pleanála approval of the permitted development of the Ringaskiddy Port Redevelopment and therefore do not require any changes and remain entirely appropriate.

9.7 Residual Impact

The residual impact from the proposed development will be the same as that detailed in the assessment for the permitted development of Ringaskiddy Port Redevelopment.