Appendix 12

Noise and Vibration

10 Noise and Vibration

10.1 Introduction

This chapter assesses the potential noise and vibration effects on the surrounding environment associated with the construction and operation of the proposed Ringaskiddy Resource Recovery Centre at Ringaskiddy, County Cork.

The main elements of the proposed Ringaskiddy Resource Recovery Centre project are a waste-to-energy facility (waste incinerator).

Other elements will include an upgrade of a section of the L2545 road, a connection to the national electrical grid, an increase in ground levels on part of the site, coastal protection measures above the foreshore on Gobby beach and an amenity walkway to the Ringaskiddy Martello tower

This chapter has been prepared with reference to the most relevant noise and vibration guidance documents applicable to the proposed development.

The specific assessments relating to the potential noise and vibration effects associated with the operational and construction phases are set out in the following sections of this chapter.

10.2 Assessment Methodology

The following methodology has been adopted to assess the potential noise and vibration effects associated with the proposed development:

10.2.1 Standards and Guidelines

The assessment has been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out within the relevant sections of this chapter and included in the references Section 10.9 below. In addition to specific noise guidance documents, the following guidelines were considered and consulted for the purposes of the proposed development:

- Guidelines on the Information to be contained in Environmental Impact Statements, (Draft August 2017), and;
- EPA Advice Notes for Preparing Environmental Impact Statements, (Draft, September 2015).

10.2.1.1 Impact Assessment Methodology

- An environmental noise survey was conducted in the vicinity of the proposed resource recovery facility, in accordance with the EPA's *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4, EPA 2016) and ISO 1996 (2017) *Description Measurement and Assessment of Environmental Noise.* Part 2 *Determination of Environmental Noise Levels*. The purpose of the survey was to determine the prevailing noise environment in the area and to advise the relevant operational noise criteria;

- Noise and vibration effect associated with the construction phase have been calculated in accordance with ISO 9613: *Acoustics: Attenuation of Sound During Propagation Outdoors* (1996) using source data obtained from BS 5228 *Code of Practice for the Control of Noise and Vibration on Construction and Open Sites*. Part 1 – *Noise* and Part 2 – *Vibration* (2009 +A1 2014);
- Noise effects associated with the operational phase have been calculated in accordance with ISO 9613: *Acoustics: Attenuation of Sound during Propagation Outdoors* (1996) and through the use of proprietary acoustic modelling software;
- Road traffic noise effects have been calculated in accordance with the UK's Department of Transport *Calculation of Road Traffic Noise* (CRTN) (1988);
- The results of the predictive assessment have been compared against the relevant criteria adopted for the construction and operational phases, and;
- Mitigation measures, to comply with the adopted criteria have been proposed, where necessary.

10.2.2 Site Visits

Site visits have been undertaken as part of the baseline environmental noise surveys to inform the assessment. Specific details relating to site visits are included in **Section 10.3**.

10.3 Receiving Environment

The study area includes all of the lands within Indaver ownership. The site occupies an area of approximately 13.55 hectares. The L2545, the main road from Ringaskiddy village to Haulbowline Island forms the northern boundary of the site. The eastern boundary of the site extends to the foreshore of Cork harbour along Gobby Beach. The lands to the south and west are in agricultural use. The site encircles the Hammond Lane Metal Recycling Company facility. Hammond Lane expanded its facilities in 2015. There is also an ESB Networks compound (Lough Beg station) located adjacent to the eastern boundary of the Hammond Lane facility. The site is currently covered in scrub with some pockets of trees and open grass areas.

The centre of Ringaskiddy village is located approximately 800m to the west of the site of the proposed development. The Ringaskiddy peninsula is industrial in character, and a number of existing industrial facilities are located in the proximity of the proposed site, located to the south, west and north-west including the Port of Cork and a vehicle distribution centre located to the north east of the development site.

The L2545 is an extension of the N28 that leads from Ringaskiddy past the proposed development site and over the bridge to the crematorium on Rocky Island and Haulbowline Naval base.

The National Maritime College of Ireland (NMCI) and the UCC ERI Beaufort Building is on the northern side of the L2545 road, which forms the northern boundary of the site. Some warehouses are located on the northern side of the L2545 road, to the west of the National Maritime College of Ireland.

The land to the west of the site is in agricultural use. Further to the west there is a single, residential property (Ring House) located approximately 50m from the boundary, set within a field and surrounded by trees.

The eastern section of the M28 Cork to Ringaskiddy Motorway Scheme is proposed to cross the far western part of the Indaver site. This scheme has been granted planning but currently in the planning process. Refer to **Figure 4.7** of **Chapter 4** which shows an indicative location of the proposed M28 Cork to Ringaskiddy Motorway Scheme in the vicinity of the Indaver site.

The section of L2545 road to be upgraded extends along the entire northern boundary of the Indaver site. The section of Gobby Beach where coastal protection works are proposed above the foreshore extends along the eastern boundary of the Indaver site. Refer to **Chapter 4** ***Project Description*** for further details. The lands over which the entire grid connection will be constructed lie within Indaver's ownership (save for a small section comprising associated works on the adjacent Lough Beg substation owned by ESB Networks). These works will be carried out by ESB Networks and do not form part of the planning application however they have been included in this assessment.

10.3.1 Quiet Area Screening of the Development Location

The first step in determining the scope of the baseline survey was to conduct a screening of the development lands for a "Quiet Area", in accordance with **Section 4.4.2** of NG4 (EPA 2016). On review of the relevant screening criteria, the Indaver site does not satisfy the following NG4 requirements for Quiet Areas:

- At least 3km away from any local industry[1].
- At least 15 km from any urban areas with a population >10,000 people;
- At least 10 km from any major industry centre, and;
- At least 5 km from any National Primary Route.

The site encircles the Hammond Lane Metal Recycling Company facility. The Port of Cork and a number of industrial facilities (i.e. DePuy, Hovione and Novartis) are located within 1km of the site boundary. A number of other industrial facilities including GSK, Janssen and Pfizer located within 2 to 3km from the development site boundary.

In addition to the above, a number of population centres with >10,000 inhabitants are located within 15km of the site location and the N28 National road is approximately 750m to the west of the site.

Taking account of the above considerations, the site location would not be classified as a "Quiet Area" in line with EPA Guidelines. In this instance, a baseline survey was undertaken to determine the prevailing noise environment during day, evening and night-time periods in the vicinity of the nearest noise sensitive locations (NSLs) to determine the baseline noise environment and to determine the relevant operational criteria for the proposed facility.

1 Local industry is taken to include all sources of noise that may be considered industrial in nature, for example grain drying facilities, creameries and small factories (Source NG4)

10.3.2 Baseline Noise Survey

10.3.2.1 Selection of Noise Monitoring Locations

Section 6.1 of NG4, which contains guidance on the selection of Survey/Monitoring Locations, states:

> *The measurement positions should include those positions which will be most affected by the facility's emissions. The following process is recommended:*
>
> *An initial site inspection should be carried out with a view to identifying all NSLs in the vicinity of the proposed development*
>
> *NSLs should be marked onto relevant drawings and the proposed development overlaid.*

A total of four measurement locations were selected for noise monitoring, taking into account the site location, and orientation and the proximity of the nearest noise sensitive receptors to the site boundaries. Each location is described below and shown in **Figure 10.1.**

Location N1 This monitoring position was within the bounds of the development site along an existing access track and was set back approximately 75m from the L2545 Road. An unattended 24 hour survey was conducted at this position. This monitoring position is representative of noise levels along the east of the site boundary.

Location N2 This monitoring position was outside residential properties (noise sensitive receptors) within Martello Park, approximately 300m to the west of the site boundary (600m from waste-to-energy facility) and was set back approximately 45m from the L2545 Road. An attended noise survey was conducted at this position. This monitoring position is representative of the closest occupied residential properties to the west of the site.

Location N3 This monitoring position was at the gate entrance to an unoccupied dwelling along the L2545 Road approximately 130m the west of the site boundary (400m from waste-to-energy facility). The monitoring equipment was located inside the gate of the property set back at a distance of approximately 10m from the road edge. An attended noise survey was conducted at this position.

Location N4 This monitoring position was within the car park of the National Maritime College of Ireland approximately 110m to the north of the proposed site boundary and was set back approximately 90m from the L2545 Road. An attended noise survey was conducted at this position.

10.3.2.2 Survey Periods

Noise measurements were conducted over the course of the following survey periods:

Unattended Survey at Location N1

- 10:34hrs on 15 November 2018 to 08:50hrs on 19 November 2018.

Attended Surveys at Locations N2 to N4

- 14:45hrs on 14 November to 18:40hrs on 14 November 2018.
- 21:50hrs on 19 November to 01:55hrs on 19 November 2018.

10.3.2.3 Meteorological Conditions

The weather during the daytime and evening survey periods was dry and calm. Temperatures were of the order of 10 – 13 ˚C and wind speeds were <5m/s. During the night-time survey period, conditions were also dry and calm with temperatures of the order of 7 ˚C and wind speeds of <5m/s.

10.3.2.4 Instrumentation

AWN Consulting conducted the noise level measurements during all survey periods. The measurements were made using the following equipment:

Table 10.1 Noise Monitoring Equipment Details

Manufacturer	Equipment Model	Serial Number	Microphone	Calibration date
Brüel & Kjaer	SLM2250	2818080	½" Type 4189 S/N 2804243	August 2017
	SLM 2238 & UA1404	2684496	½" Type 4189 S/N 2682517	February 2018
	Cal 4321	2460007	n/a	October 2017

10.3.2.5 Procedure

Measurements were conducted on a cyclical basis between the attended monitoring locations. Sample periods were 15 minutes during both the daytime, evening and night-time surveys. During the daytime period, four survey rounds were conducted at the NSLs. One survey round was conducted during the evening period, and three survey rounds were conducted during the night-time periods. At Location N1, the equipment was set to log continuously over 15 minute periods for a 4 days. The results were saved to the instrument memory for later analysis. Survey personnel noted all primary noise sources contributing to noise build-up.

10.3.2.6 Survey Parameters

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

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

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

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

The "A" suffix 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.

10.3.2.7 Results and Discussion

Location N1

The survey results for Location N1 are summarised in **Table 10.2** below. Full Survey Details are presented in **Appendix 10.1**.

Table 10.2 – Summary of Measured Noise Levels at Location N1

Period	Date	Measured Noise Levels (dB re. 2x10-5 Pa)		
		$L_{Aeq,15min}$	L_{Amax}	$L_{A90,15min}$
Daytime (07:00 to 19:00hrs)	15/11/2018	41 – 52	49 – 75	38 – 49
	16/11/2018	46 – 51	55 – 73	44 – 48
	17/11/2018	46 – 51	53 – 70	42 – 48
	18/11/2018	43 – 52	53 – 73	40 – 50
Average		**49**	**61**	**46**
Evening (19:00 to 23:00hrs)	15/11/2018	35 – 46	42 – 64	31 – 39
	16/11/2018	46 – 49	55 – 65	45 – 48
	17/11/2018	46 – 50	53 – 61	44 – 48
	18/11/2018	41 – 46	53 – 60	36 – 42
Average		**46**	**56**	**41**
Night-time (23:00 to 07:00hrs)	16/11/2018	35 – 47	39 – 59	32 – 45
	17/11/2018	45 – 49	50 – 63	43 – 47
	18/11/2018	47 – 50	53 – 62	45 – 49
	19/11/2018	39 – 49	45 – 65	38 – 46
Average		**46**	**53**	**43**

During the set up and collection at this monitoring position, the main sources of noise noted were the operational activities at the adjacent Hammond Lane metal recycling facility, road traffic noise along local and distant roads in addition to background noise from the coastline.

During the daytime period, measured noise levels were in the range of 41 to 55dB $L_{Aeq,15min}$ with an average value of 49dB $L_{Aeq,15min}$ recorded. The background noise levels recorded at the site were in the range of 38 to 50dB $L_{A90,15min}$ with an average value of 46dB $L_{A90,15min}$ recorded. The background noise environment was predominately governed by distant road traffic, wind turbine noise, coastal noise and operational activities in Hammond Lane. Maximum noise levels recorded at this position during the daytime period were noted to be from road traffic noise and operational activities associated at the adjacent Hammond Lane facility.

During the evening period, measured noise levels were in the range of 35 to 50dB $L_{Aeq,15min}$ with an average value of 46dB $L_{Aeq,15min}$ recorded. The background noise levels recorded at the site were in the range of 31 to 48dB $L_{A90,15min}$ with an average value of 41dB $L_{A90,15min}$ recorded. The Hammond Lane facility was closed during the evening period, so ambient and background noise levels were dominated by road traffic sources, wind turbine noise, rustling foliage and coastal sounds.

During the night-time period, measured noise levels were in the range of 35 to 50dB $L_{Aeq,15min}$ with an average value of 46dB $L_{Aeq,15min}$ recorded. The background noise levels recorded at this location were in the range of 32 to 49dB $L_{A90,15min}$ with an average value of 43dB $L_{A90,15min}$ recorded. The Hammond Lane facility was closed during the night-time period, so ambient and background noise levels were dominated by road traffic sources, wind turbine noise, rustling foliage and coastal sounds.

Location N2

The survey results for Location N2 are presented in **Table 10.3** below.

Table 10.3 Summary of Measured Noise Levels at Location N2

Period	Start Time	Measured Noise Levels (dB re. 2x10-5 Pa)		
		$L_{Aeq,15min}$	L_{Amax}	$L_{A90,15min}$
Daytime (07:00 to 19:00hrs)	15:30	55	67	51
	16:28	68	89	49
	17:27	55	68	50
	18:25	54	69	49
Arithmetic Average of L_{A90} (dB):				**50**
Evening (19:00 to 23:00hrs)	22:33	43	62	37
Night-time (23:00 to 07:00hrs)	23:39	45	72	36
	00:40	45	55	40
	01:40	44	54	41
Arithmetic Average of L_{A90} (dB):				**39**

The main noise sources noted during the survey periods at this location were passing road traffic, wind generated noise, and intermittent road works nearby.

During the daytime period at this location, noise levels were measured in the range of 55 to 68dB $L_{Aeq,15min}$, the higher being influenced by dog barking. The average ambient noise level recorded was 55dB $L_{Aeq,15min}$ excluding the higher value influenced by the intermittent event. The background noise levels recorded at the site were in the range of 49 to 51dB $L_{A90,15min}$ with an average value of 50dB $L_{A90,15min}$ recorded.

During the evening period, ambient noise levels were measured as 43dB $L_{Aeq,15min}$ with background noise levels measuring 37dB $L_{A90,15min}$. Occasional passing road traffic, wind turbine and industrial plant noise were noted to be the main contributors to the measured noise levels at this location.

During the night-time period measured noise levels were in the range of 44 to 45dB $L_{Aeq,15min}$. The main contributor to noise levels was occasional passing road traffic, wind turbine and industrial plant noise were noted to be the main contributors to the measured noise levels at this location. The background noise levels recorded were in the range of 36 to 41dB $L_{A90,15min}$ with an average value of 39dB $L_{A90,\mathbf{15min}}$ recorded.

Location N3

The survey results for Location N3 are presented in **Table 10.4**.

Table 10.4 Summary of Measured Noise Levels at Location N3

Period	Start Time	Measured Noise Levels (dB re. 2x10-5 Pa)		
		$L_{Aeq,15min}$	L_{Amax}	$L_{A90,15min}$
Daytime (07:00 to 19:00hrs)	15:03	65	81	49
	16:08	67	84	47
	17:07	65	82	47
	18:07	59	80	46
Arithmetic Average of L_{A90} (dB):				**47**
Evening (19:00 to 23:00hrs)	22:07	48	73	38
Night-time (23:00 to 07:00hrs)	23:20	48	71	36
	00:20	57	85	43
	01:19	41	55	38
Arithmetic Average of L_{A90} (dB):				**39**

The main noise source noted during the survey periods at this location was from passing traffic along the L2545 Road and activities within a vehicle distribution centre along the same road. During traffic lulls in the daytime period, occasional road works and occasional operational activities from Hammond Lane facility was audible at low levels.

During the daytime period, noise levels were measured in the range of 59 to 67dB $L_{Aeq,15min}$ with an average value of 65dB $L_{Aeq,15min}$ recorded. The background noise levels recorded were in the range of 46 to 49dB $L_{A90,15min}$ with an average value of 47dB $L_{A90,15min}$ recorded.

During the evening period, ambient noise levels were measured as 48dB $L_{Aeq,15min}$ with background noise levels measuring 38dB $L_{A90,15min}$. No passing traffic was recorded during this measurement, so noise levels were governed by plant and wind turbine noise from operational industrial facilities in the nearby vicinity.

During the night-time period, measured noise levels were in the range of 41 to 57dB $L_{Aeq,15min}$. The highest recorded value was associated with two passing HGV's along the L2545 Road. The background noise levels were in the range of 38 to 43dB $L_{A90,15min}$ with an average value of 39dB $L_{A90,15min}$ recorded. This was influenced by rustling foliage in addition to plant and wind turbine noise from operational industrial facilities in the nearby vicinity.

Location N4

The survey results for Location N3 are presented in **Table 10.5** below.

Table 10.5 Summary of Measured Noise Levels at Location N4

Period	Start Time	Measured Noise Levels (dB re. 2x10-5 Pa)		
		$L_{Aeq,15min}$	L_{Amax}	$L_{A90,15min}$
Daytime (07:00 to 19:00hrs)	14:45	58	76	50
	15:49	53	67	49
	16:48	53	71	49
	17:48	50	62	46
Arithmetic Average of L_{A90} (dB):				**48**
Evening (19:00 to 23:00hrs)	21:50	59	85	41
Night-time (23:00 to 07:00hrs)	23:01	53	79	38
	00:01	57	86	39
	00:59	43	53	41
Arithmetic Average of L_{A90} (dB):				**39**

The main noise source noted during the daytime survey periods at this location were from operational activities in the Hammond Lane facility and car park activities and passing traffic along the L2545 Road.

During the evening and night-time periods, the car park access was closed, so measurements were taken at a lay-by outside the car park access gates.

During the daytime period, noise levels were measured in the range of 50 to 58dB L_{Aeq} with an average value of 55dB L_{Aeq} recorded. The background noise levels recorded at the site were in the range of 46 to 59dB L_{A90} with an average value of 48dB L_{A90}.

During the evening period, ambient noise levels were measured as 59dB $L_{Aeq,15min}$ with background noise levels measuring 41dB $L_{A90,15min}$. A small number of cars passed along the L2545 Road during this period. Background noise was influenced by plant and wind turbine noise from operational industrial facilities in the nearby vicinity.

During the night-time period measured noise levels were in the range of 43 to 57dB $L_{Aeq,15min}$. The highest recorded value was associated with passing vehicles and a passing motorbike along the L2545 Road. Background noise levels were in the range of 38 to 41dB $L_{A90,15min}$ with an average value of 39dB $L_{A90,15min}$ recorded. Faint noise from an operational wind turbine was the main background noise source during this period. Background noise was influenced by plant and wind turbine noise from operational industrial facilities in the nearby vicinity.

10.4 Characteristics of Proposed Development

The proposed development will involve two distinct stages, the short-term construction phase and the longer term operational phase.

10.4.1 Construction Phase

The construction phase duration is expected to be approximately 31 months. The main element of works will involve site clearance and bulk excavation, foundations and drainage works, construction of the main waste-to-energy building and the ancillary structures, raising ground levels of the western field, upgrade of the small portion of the L2545 Road to the north of the site and placing sacrificial material along the beach front to the east of the site. Construction aspects of the development are identified in **Chapter 5**, ***Construction Activities***.

Due to the nature of the activities undertaken on a large construction site, there is potential for generation of high levels of noise to the surrounding environment. A variety of items of plant will be in use depending on the construction phasing. There will also be vehicular movements to and from the site that will make use of existing roads. Effects of construction traffic are evaluated in **Chapter 7**, ***Roads & Traffic***.

The potential for vibration at neighbouring buildings and residential dwellings will be limited to vibration resulting from excavation works, rock breaking, piling operations and lorry movements on uneven road surfaces. The most potentially significant of these will be the vibration associated with rock breaking and piling operations.

The impacts from each of the main construction phases are assessed in **Section 10.5.2** below.

10.4.2 Operational Phase

Once operational, it is anticipated that the facility will operate 24 hours per day, seven days per week and 365 days per year. However, waste acceptance will be limited to the hours 06.00 to 20.00 on week days and 09.00 to 14.00 on Saturdays.

In terms of process and building services plant, the majority of equipment and processes will be internally housed within the on-site buildings which will significantly reduce the operational noise emissions to the surrounding environment. A full description of the proposed processes and buildings associated with the proposed development is included in **Chapter 4, *Description of the Proposed Development*.**

On review of the details included in **Chapter 4**, the primary potential noise sources associated with the waste-to-energy facility are associated with:

- process and building services plant;
- vehicle movements on site, and;
- additional vehicles on public roads.

There are no expected vibration sources associated with the operational phase.

10.5 Likely Significant Effects

10.5.1 'Do Nothing' Effects

In the event that the proposed development does not proceed, the existing noise environment in the vicinity of the site are expected to remain unchanged assuming no additional development in the area. There are a number of additional developments proposed within the area however, which have the potential to alter the existing environment including the M28 Cork to Ringaskiddy Motorway Scheme and the Port of Cork development. The noise environment resulting from these proposed developments will introduce new sources to the surrounding environment and are likely to lead to increased noise levels at noise sensitive locations in proximity to these developments. The calculations relating to traffic noise along the surrounding road network during the construction and operational phases of the proposed Resource Recovery Centre for the years 2022, 2023 and 2038 take account of the Port of Cork traffic forecast volumes and are therefore accounted for within the future baseline noise 'Do Nothing' scenarios. For the other future developments, these are subject to individual noise and vibration impact assessments and will be required to satisfy all planning conditions relating to noise and vibration control. Further comment relating to potential changes in the noise environment is discussed in **Section 10.7** Cumulative Effects.

10.5.2 Construction Phase

10.5.2.1 Determination of Relevant Criteria

Noise Criteria

There is no statutory guidance relating to permissible noise levels during a project's construction period. Higher noise levels are generally accepted during a short-term construction phase of a project compared to its long-term operational phase, as construction works are temporary and tend to be varied. Over the 31-month construction phase, there will be up to 8 weeks of night time working.

In the absence of statutory guidance or other specific limits prescribed by local authorities, an appropriate best practice measure has been adopted as the standard for this project. Best practice guidelines are taken from the British Standard BS 5228 – 1: 2009 +A1 2014: *Code of practice for noise and vibration control on construction and open sites – Noise*.

BS 5228 sets out an approach for setting appropriate construction noise limits for residential dwellings, but it does not provide guidance for commercial or office buildings. The BS 5228 'ABC method' calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded, indicates a significant noise effect is associated with the construction activities as summarised in **Table.10.6.**

Table 10.6 Example Threshold of Significant Effect at Dwellings

Assessment Category and Threshold Value Period (L_{Aeq})	Threshold Value (dB)		
	Category A [A]	Category B [B]	Category C [C]
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings & Weekends [D]	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

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

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

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

Note D: 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

The site start time will ensure that construction workers arrive in the Ringaskiddy area prior to the morning peak hour for traffic on the local network. No construction vehicles will arrive or depart the proposed development site during the morning and evening peak periods (07:00-09:00 and 16:00-18:00) during the construction phase. Typical working hours during the construction phase will be:

Start	Finish	
0600	2000	Monday – Friday
0700	1300	Saturday

It will be necessary to work overtime (including at weekends) and night shifts at certain critical stages during the project. Consideration of safety, weather or sub-contractor availability is likely to necessitate working outside normal hours. Over the 31-month construction phase there will be up to 8 weeks of night time working. Heavy or noisy construction activities will be avoided outside normal hours and the amount of work outside normal hours will be strictly controlled.

Making reference to the baseline noise environment monitored around the development site, the construction noise criteria relating to 'Category A' are used for the construction phase. These are summarised as follows:

- Weekdays (07:00 – 20:00hrs): **65dB $L_{Aeq,\ 1hour}$**
- Saturday (07:00 to 13:00hrs): **65dB $L_{Aeq,\ 1hour}$**
- Evenings and weekends (outside 'normal hours') **55dB $L_{Aeq,\ 1hour}$**
- Night-time (23:00 to 06:00hrs) **45dB $L_{Aeq,\ 1hour}$**

The proposed weekday construction works will commence at 06:00hrs which falls into the defined 'night-time' period. In this instance, in order to control noise levels to the surrounding environment, the lower night-time noise limit of 45dB $L_{Aeq,\ 1hr}$ will apply during the first hour of construction works, i.e. between 06:00 and 07:00hrs.

Similarly, the last hour of weekday construction works will be during 'evening' periods, i.e. between 19:00 and 20:00hrs. In this instance, the lower evening noise limit will apply during this time period, i.e. 55dB $L_{Aeq,1hr}$.

Further assessment relating to construction effects are included in **Section 10.5.2.2**.

Vibration Criteria

Vibration standards come in two varieties: those dealing with human comfort, and those dealing with cosmetic or structural damage to buildings. For the surface construction works proposed here, vibration is expressed in terms of Peak Particle Velocity (PPV) in mm/s. There are no expected significant vibration sources associated with the development once the facility becomes operational.

Building Response Criteria

Building Damage Building Response British Standard 7385-2 (1993) gives guidance regarding acceptable vibration in order to avoid damage to buildings. British Standard BS 5228-2 (2009) reproduces these guidance values.

These standards differentiate between transient and continuous vibration. Surface construction activities are transient because they occur for a limited period of time at a given location. Risk of cosmetic damage to residential buildings starts at a Peak Particle Velocity (PPV) of 15mm/s at 4Hz. Below 12.5 mm/s PPV, the risk of damage tends to be zero. Important buildings that are difficult to repair might require special consideration on a case by case basis, but buildings of historical importance should not (unless it they are structurally unsound) be assumed to be more sensitive. If a building is in a very unstable state, then it will tend to be more vulnerable to the possibility of damage arising from vibration or any other groundborne disturbance.

The most significant sources of transient vibration during the construction phase of the development are likely to be from the following activities:

- Rock breaking during excavation;
- Breaking of existing road surfaces during road works;
- Vibratory rolling during road works, and.
- Piling foundations, depending on the methodologies chosen.

Table 10.7 summarises the vibration levels below which there is no risk of damage to buildings. These limits apply to vibration frequencies below 15Hz where the most conservative limits are required. For protected or potentially vulnerable buildings, the recommended construction vibration limit is reduced by 50%.

Table 10.7 Transient Vibration Impact Criteria for Buildings (conservative criteria below which there is no risk of cosmetic damage).

Category of Building	Threshold of potential significant effect (Peak Particle Velocity - PPV - at building foundation) for Transient Vibration
Structurally sound and non-protected buildings	12 mm/s
Protected and / or potentially vulnerable buildings	6 mm/s

Human Perception

Humans are sensitive to vibration stimuli, and perception of vibration at high magnitudes may cause concern. Vibration typically becomes perceptible at around 0.15 to 0.3 mm/s and may become disturbing or annoying at higher magnitudes. During surface construction works (piling, rock breaking etc.) the vibration limits set within **Table 10.7** would be perceptible to building occupants and would have the potential to cause subjective effects.

However, higher levels of vibration are typically tolerated for single events or events of short term duration, particularly during construction projects and when the origin of vibration is known. For example, piling can typically be tolerated at vibration levels up to 6 mm/s during the daytime and the evening if those affected are aware of the time-frame and origin of the vibration, and if they have been informed about the limit values relating to the structural integrity of neighbouring properties.

Therefore, regarding the human perception of vibration, the best way to reduce effects on those in the locality is to plan and implement an effective public communications strategy informing neighbours about the time and duration of the vibration, that the vibration is being monitored, and that it is within safe limits.

10.5.2.2 Construction Phase Likely Noise Effects

During the construction phase, the potential noise effects will be associated with site preparation works, rock breaking, piling, foundation construction activities, placing of sacrificial beach material, construction activities and construction vehicle movements. Due to the nature of the activities undertaken on a large construction site, there is potential for generation of high levels of noise.

A variety of items of plant will be in use depending on the construction phasing. There will also be vehicular movements to and from the site that will make use of existing roads.

The construction phase will be undertaken over a number of phases from site preparation through to building construction and internal fit out. In terms of the potential noise and vibration effects, the key phases are considered to be:

- Site clearance and bulk excavations;
- Construction of retaining structures, basement excavations and foundations;
- Construction of main and ancillary buildings;
- Upgrade of L2545 Road, and;
- Placing of sacrificial beach material.

The construction phase will be controlled through the use of construction noise limits which the contractor will be required to work within as set out in this chapter and the relevant section of the CEMP. In this regard, the choice of plant, scheduling of works on site, provision of localised screening and other best practice control measures will be employed in order to ensure noise limits are not exceeded.

Given the construction involves a number of phases which will encompass a range of different activities on a day to day and week to week basis, it is not possible to calculate with a high degree of accuracy the specific levels of noise associated with each phase. It is possible, however, to determine a range of conservative scenarios which represent the key construction phases.

In consultation with the construction design team and on review of the phasing and methodologies set out in **Chapter 5 *Construction Activities*** of this EIAR, an acoustic model was developed for the development site using a proprietary noise calculation package Brüel & Kjær *Predictor*. This is an acoustic modelling package for computing noise levels in the vicinity of different types of noise sources. For the construction model, the calculation standard used in the model is the ISO 9613 (1996) Standard *Acoustics: Attenuation of Sound during Propagation Outdoors*. Part 2: *General Method of Calculation.*

The model takes account of the various factors affecting the propagation of sound in accordance with the standard, including:

- the magnitude of the noise source in terms of sound power;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- attenuation due to atmospheric absorption, and;
- meteorological effects such as wind gradient, temperature gradient and humidity (these have significant effect at distances greater than approximately 400m).

The degree of accuracy associated with this prediction method is shown in **Table 10.8.**

Table 10.8 Estimated accuracy for broadband noise of $L_{AT(DW)}$

Height, h	**Distance, d**	
	0 < d < 100m	**100m < d < 1,000m**
0<h<5m	±3dB	±3dB
5m<h<30m	±1dB	±3dB
Where: h is the mean height of the source and receiver; d is the mean distance between the source and receiver. Note: these estimates have been made from situations where there are no effects due to reflections or attenuation due to screening.		

Source data for operating construction plant items have been obtained from BS 5228: Part 1– *Noise*. This document provides sound power data per octave band which can be used for individual source items. The model takes account of the 'on-time' percentage of equipment on the site as defined by the user. For the purposes of a conservative assessment, the following plant items and their related on-time have been assumed for each of the key construction activities as set out in **Table 10.9.**

Table 10.9 Construction activity assumed for the various activities of the Construction Programme

Construction Programme Phase	Plant Item	No of items	BS 5228 Ref	% On time	Sound Power, L_w dB(A)
Activity 1a L2545 Upgrade and Drainage	Pneumatic breaker	1	C1.6	66%	111
	Wheeled loader	1	C2.26	66%	107
	Dozer	2	C2.10	66%	108
	Dump Truck Tipping fill	2	C2.30	66%	107
	Combined Sound Power, L_w(A)				**116**
Activity 1b L2545 Upgrade – Road Works	Asphalt Paver & Tipping Lorry (C.5.31)	1	C5.31	66%	105
	Vibration rollers (C5.20)	1	C5.20	50%	103
	Road Rollers (C5.19)	1	C5.19	50%	108
	Dozer C.2.10	2	C2.10	66%	108
	Combined Sound Power, L_w(A)				**114**
Activity 2 Site Preparation & Excavation	Hand-held pneumatic breaker	2	C1.6	66%	111
	Tracked excavator (dumping/loading)	2	C1.10	66%	113
	Dozer	2	C2.1	66%	103
	Excavator mounted rock breaker	3	C9.12	50%	113
	Tracked semi-mobile crusher	1	C9.14	66%	118
	Combined Sound Power, L_w(A)				**123**
Activity 3 Raising of levels in western field	Dozer C.2.10	3	C2.10	66%	108
	Dump Truck Tipping fill	3	C2.30	66%	107
	Tracked excavator	2	C2.23	66%	101
	Combined Sound Power, L_w(A)				**115**
Activity 4 Retaining structures and foundations	Crane mounted auger	4	C3.16	50%	107
	Tracked excavator	2	C3.23	66%	96
	Concrete pump	1	C3.25	50%	106
	Tracked mobile crane	2	C3.28	66%	95
	Concrete mixer truck	2	C4.20	66%	108
	Dozer	2	C2.10	66%	108
	Tracked mobile drilling rig	2	C.9.4	20%	115
	Combined Sound Power, L_w(A)				**121**
Activity 5 Building Construction & Fit out	Tracked mobile crane	3	C3.28	40%	106
	Concrete pump	2	C3.25	50%	95
	Concrete mixer truck	3	C4.20	50%	108
	Tower crane	3	C4.48	66%	104

Construction Programme Phase	Plant Item	No of items	BS 5228 Ref	% On time	Sound Power, L_w dB(A)
	Wheeled loader	2	C9.7	50%	116
	Angle Grinder (Grinding Steel)	1	C4.93	30%	108
	Combined Sound Power, L_w(A)				**121**
Activity 6 Placing of sacrificial beach material	Rigid dump truck	2	C9.17	66%	118
	Loading dump truck with pebbles	3	C10.11	66%	113
	Face shovel extracting loader	2	C10.3	66%	111
	Combined Sound Power, L_w(A)				**123**
Activity 7 Night-works	Tracked excavator	2	C3.23	66%	96
	Concrete pump	1	C3.25	66%	106
	Tracked mobile crane	2	C3.28	66%	95
	Concrete mix truck	2	C4.20	66%	108
	Dozer	2	C2.10	66%	108
	Combined Sound Power, L_w(A)				**115**

For each of the activities, the total sound power ranges between 114 to 123dB $L_{w(A)}$ which is equivalent to total sound pressure level of the order of 86 to 95dB(A) on site. This assumes that all of the items of plant listed for each activity are operating simultaneously.

As noted in **Section 10.5.2.1**, between Monday and Friday construction works will commence at 06:00hrs in order to reduce the effect of construction vehicles on the road network during the peak morning period. In addition, it is expected that up to 8 weeks of night-time works (i.e. between 23:00 and 07:00hrs) will be required.

During any night-time periods, impact generating, percussive and high noise generating activities will be avoided. During weekday periods, the first hour will be used for set up and mobilisation. Activities will be scheduled during this period to ensure the night-time noise criterion of 45dB $L_{Aeq,1hr}$ will not be exceeded. During the 8 week period where night-time construction works are required, the main activity likely to take place will involve concrete pours for foundations and retaining walls. In order to assess the potential effect during this phase, a sound power level of 115dB L_w for night-time works is considered to provide a conservative assessment for potential activities taking place during this time period (See **Table 10.9** above.)

During any one activity, the number and items of plant listed in **Table 10.9** are assumed to operate simultaneously. There will be a number of overlaps between the construction activities over the course of the construction phase, the most likely of these being activities 2, 3 and 4. In order, therefore, to assess a further conservative assessment, activities 2, 3 and 4 have been modelled to occur simultaneously.

Receiver locations have been positioned at the closest sensitive locations to the north, south, east and west of the site to assess the potential construction noise effects on the surrounding environment. The receiver locations are shown in **Figure 10.2** and described in **Table 10.10** below.

Table 10.10 Noise Assessment Receiver Locations

Receiver Location Reference	Description of Receiver Locations
R1	Is located to the north east of the proposed site along the coastal area approximately 50m from the proposed development
R2	Located at the Martello Tower to the south-west of the proposed site at a distance of approximately 180m from construction works
R3	Is located outside the National Maritime College of Ireland approximately 100m north of the proposed development site.
R4	At the façade of the nearest private residence (currently unoccupied), Ring House, approximately 150m west of western field and some 400m west of the WTE facility
R5	At the façade of the Rock Cottage to the west of the proposed facility at a distance of approximately 200m from the western field and 500m from the WTE facility
R6	At the residential properties within Martello Park, located at a distance of approximately 320m from the western field and 670m to the west of the WTE facility.
R7	At the residential properties along Shamrock Place, located at a distance of approximately 380m from the western field and 680m to the west of the proposed development.
R8	To the south-west of the proposed development at a distance of approximately 500m from the proposed development.

The calculated results take into account the assumptions set out in **Table 10.9** and include for a standard construction site hoarding of 2.4m around the north, east and western site perimeters.

The calculated construction noise contours during each of the assessed activities are included in **Figures 10.3** to **10.8**. The specific construction noise levels at the assessed noise sensitive locations are summarised in **Table 10.11**.

Table 10.11 Calculated Construction Noise Levels at Nearest Noise Sensitive Locations

Location	Calculated Noise Level, dB $L_{Aeq, 1hr}$					
	Activity 1a	Activity 1b	Activity 2, 3 & 4 combined	Activity 5	Activity 6	Activity 7
R1	53	49	55	57	n/a	46
R2	47	41	50	46	48	36
R3	61	56	59	55	53	47
R4	48	43	53	46	44	40
R5	45	40	49	44	43	36
R6	46	40	48	43	41	35
R7	44	39	48	43	43	35
R8	39	35	43	39	44	30

Note: The beach area will be closed during periods when sacrificial beach material is being deposited, hence this location is not noise sensitive during this activity.

Activity 1a and Activity 1b

During the L2545 Road upgrade and drainage works (approximately 6 – 8 weeks duration), noise levels are calculated to be highest at Location R3 (NMCI) which is the closest noise sensitive location to construction works along this section of road. The calculated noise levels at this location are, however, below the daytime construction noise criterion of 65dB $L_{Aeq,1hr}$.

There is potential for the evening criterion of 55dB $L_{Aeq,1hr}$ to be exceeded at Location R3 depending on the level of construction activity during this period (19:00 to 20:00hrs). Review of the calculated results indicates the use of a ground breaker dominates noise levels during the activity 1a works. Scheduling of works during the evening period will ensure that percussive tools and activities with potential for high noise levels will be restricted during this period to ensure the relevant criteria are not exceeded at the nearest noise sensitive locations. This information will feed into the CEMP.

At all other locations, the assessment has indicated that construction activities associated with the L2545 road upgrade and drainage works can be undertaken within the daytime and evening construction noise criteria.

Activities 2, 3 and 4

Construction activities associated with site preparation and excavation, raising ground levels in the western field and the construction of retaining structures and foundations have all been modelled under one scenario in order to assess a highly conservative assessment. This scenario may also include construction of the grid connection cable between Lough Beg substation and the Indaver site. Given the number of activities assumed during this phase, noise levels associated with this element of works are not expected to generate noise levels over and above those assessed for combined activities 2, 3 and 4.

The calculated noise levels at all receiver locations are below the daytime criterion of 65dB $L_{Aeq, 1hr}$ for this assessed scenario.

The calculated noise levels at all receiver locations are below the evening criterion of 55dB $L_{Aeq, 1hr}$ for this assessed scenario, with the exception of Location R3 which marginally exceeds this value.

Review of the calculated results indicates the use of crushing plant and rock breaking equipment contribute to the highest noise levels at this location for the activities assessed. Scheduling of works during the evening period will ensure that percussive tools and activities with potential to generate high noise levels will be restricted during this period to ensure the relevant criteria are not exceeded at the nearest noise sensitive locations. This information will feed into the CEMP.

It should be noted that the predicted noise levels in **Table 10.11** for this scenario are highly conservative assuming that all items of plant for each activity are occurring at the same time. It is considered that the evening and Saturday construction noise criterion can easily be achieved at this location once works scheduling and on-site mitigation measures are incorporated.

Activity 5

Calculated noise levels associated with the main building construction and fit out works are all well below the daytime construction noise criterion of 65dB $L_{Aeq,1hr}$ at the closest noise sensitive locations to the site.

The calculated noise levels at all receiver locations are below the evening criterion of 55dB $L_{Aeq, 1hr}$ for this assessed scenario, with the exception of Location R1 which is calculated to marginally exceed this criterion. Location R1 represents one location along the adjacent coastline, assessed as an amenity area. Noise levels will therefore vary along the coastline depending on the proximity to the site boundary and the location of construction activities on site. **Figure 10.5** displays the calculated noise contour plot for construction activities associated with this assessed scenario. Similar to the above activities, the scheduling of works will form part of the noise and vibration management of the construction phase to ensure the relevant noise criteria are not exceeded.

Activity 6

During the placing of sacrificial beach material, the calculated noise levels at the nearest noise sensitive building (R3, NMCI), are within the range of construction noise limits set for daytime, evening and weekend periods. During this activity, this section of the beach will be closed off to the public. The expected construction period is of the order of 3 weeks, depending on suitable tidal and weather conditions. The beach amenity area will therefore not be available during these works and hence, is not considered as a noise sensitive location. Therefore, R1 is omitted from Activity 5 in **Table 10.11** above.

Activity 7

The range of construction activities listed for Activity 7 are considered to be a reasonable assumption for typical sound levels during early morning periods between 06:00 and 07:00hrs. As noted in the previous sections, high impact and high noise generating activities and will be avoided during this period.

Full-time night works are likely to take place over a period of 6 to 8 weeks. The likely construction activities during this period will involve concrete pours for foundations, retaining walls etc. The majority of other night-works will involve mechanical and electrical internal fit-outs which will have minimal effect to the surrounding environment. Indicative noise levels calculated at the nearest night-time noise sensitive locations (R4 to R8) assessed for Activity 7 all below 45dB $L_{Aeq,1hr}$ assuming the construction sound power levels in **Table 10.9**.

Notwithstanding the above, any planned night-time works will be designed to operate within this limit value.

Note that the predicted noise levels referred to in this section are indicative only and are intended for comparison with the construction noise criteria. Depending upon the number and type of sources operating, the range of construction noise levels will vary to those presented in **Table 10.11**. The use of best practice noise mitigation measures outlined in **Section 10.6.1** of this chapter will, however, be incorporated into the construction works to ensure the construction noise limits are not exceeded.

10.5.2.3 Construction Traffic

The construction phase will result in increased traffic movements which will make use of the local road network to access and egress the site. **Chapter 7, *Roads and Traffic*** of the EIAR details the traffic assessment along a number of access roads in the vicinity of the site. Construction traffic will be scheduled to avoid the existing peak periods on the local road network, hence construction traffic will access the site will be between 06:00 to 07:00hrs, between 09:00 to 16:00hrs and between 18:00 to 20:00hrs. The peak hour proposed over a typical day will be between 06:00 and 07:00hrs and 18:00 to 19:00hrs.

The construction traffic assessment has indicated that the highest volume of construction traffic will be along the L2545 Haulbowline Road - East of Ferry Port Access Road with the greatest percentage change in traffic flows between the 'with' and 'without' scenarios occurring between the early morning peak between 06:00 and 07:00hrs. The majority of the increased traffic is associated with workforce vehicles entering the site for the early morning shift.

During the evening peak period of 18:00 to 19:00hrs, traffic volumes during the base scenario are much higher and hence the percentage increase in traffic is lower during this time period.

Construction Phase traffic has been assessed for the peak year for construction in 2022. The key difference between existing baseline traffic flows and the future year 2022 will be the operation of the Port of Cork's Phase 1 and Phase 2 development.

The closest noise sensitive locations along the L2545 Haulbowline Road to the east of the ferry port are the residential properties at Martello Park. In order to assess the potential traffic noise level during the peak morning construction period, the specific noise levels associated with passing construction traffic added to the existing baseline and traffic exiting and entering the Port of Cork has been assessed. This can be done by assessing the noise level associated a passing vehicle movement expressed in terms of its Sound Exposure Level (L_{AX}).

The Sound Exposure Level can be used to calculate the contribution of an event or series of events to the overall noise level in a given period.

The appropriate formula is given below.

$$L_{Aeq,T} = L_{AX} + 10\log_{10}(N) - 10\log_{10}(T) + 10\log_{10}(r_1/r_2) \quad dB$$

where:

$L_{Aeq,T}$ is the equivalent continuous sound level over the time period T (in seconds);

L_{AX} is the "A-weighted" Sound Exposure Level of the event considered (dB);

N is the number of events over the course of time period T;

r_1 is the distance at which L_{AX} is expressed;

r_2 is the distance to the assessment location.

The mean value of Sound Exposure Level for a variety of passenger vehicles (i.e. estate, saloon, hatchback, executive) at low to moderate speeds (i.e. 15 to 45kmph) is in the order of 72dB L_{AX} at a distance of 5 metres from the vehicle. The Sound Exposure Level for a HGV at low to moderate speeds (i.e. 15 to 45kmph) is in the order of 82dB L_{AX} at a distance of 10 metres from the vehicle. These figures are based on a series of measurements conducted under controlled conditions.

Using the formula above, traffic noise levels at residential dwellings within Martello Park are calculated using the peak hour morning (two-way flows), taking account of traffic along the N28 and the L2545. Construction traffic includes the HGV traffic volumes assume all construction traffic accessing the site in both directions, the light good vehicles (LGVs) refer to workforce and general site traffic accessing and egressing the site. Please refer to **Chapter 7 *Roads and Traffic*** of this EIAR for the full construction traffic analysis.

In order to assist with interpretation of traffic noise, **Table 10.12** offers guidance as to the likely impact associated with changes in traffic noise level. For construction traffic, due to the short-term period over which this impact occurs, the magnitude of impacts are assessed against the 'short term' period as described in the DMRB[2].

Table 10.12 Likely impact associated with change in traffic noise level during the Short-Term Period

Change in Sound Level (dB L_{A10})	Magnitude of Impact (Short Term)
0	No Change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

[2] Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3. Part 7

Table 10.13 presents the calculated traffic noise levels at properties at Martello Park taking account of the future baseline flows and construction traffic.

Table 10.13 Calculated Construction Traffic Impacts along N28 East of Ferry Port

Location	Traffic Noise Impacts Construction Phase 06:00 - 07:00hrs - $L_{Aeq,1\ hr}$			
	Do Nothing 2022 Note 1	Do Something with Construction Traffic	Increase. dB	Impact Rating
Martello Park (West)	57	61	3.9	Moderate
Martello Park (Middle)	54	59	5.1	Major
Martello Park (East)	54	59	5	Major

Note 1 The 2019 Baseline is calculated taking account of vehicle no's along the N28 & L2545 in addition to Port of Cork Traffic. Calculations take account of varying distances from these sources.

The assessment has determined that during the morning peak hour, noise levels are calculated to increase at residential properties along the L2545 Road east of the ferry port, the magnitude of which depends on the distances from the road. The highest potential impact is calculated at properties furthest east, set back from the N28 to the west of the ferry entrance. A change in noise levels of 4 and 5dB(A) is calculated at these properties, which in accordance with **Table 10.12** is categorised as a moderate to major impact. The cumulative noise levels at these properties is calculated as 59 to 61dB $L_{Aeq,\ 1hr}$.

Whilst the calculated change in noise levels will be perceptible during this early morning peak period, the specific noise levels calculated are not out of line with traffic noise levels at properties adjacent to a busy road. The calculated construction traffic noise level is in line with those experienced during the existing peak hour of 07:30 to 08:30hrs at these properties and those currently experienced along the N28, west of the Ferry Port towards Shannonpark.

10.5.2.4 Construction Phase Likely Vibration Effects

The main potential source of vibration during the construction programme is associated with ground breaking activities, road works and piling, depending on the methodologies proposed.

For the purposes of this assessment the expected vibration levels during piling have been determined through reference to published empirical data. The British Standard BS 5228 – Part 2*: Vibration*, publishes the measured magnitude of vibration of rotary bored piling using a 600mm pile diameter for bored piling into soft ground over rock, (Table D.6, Ref. No. 106):

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

Considering the low vibration levels that are experienced at very close distances to the piling rigs, vibration levels at the nearest buildings are not expected to pose any significance in terms of cosmetic or structural damage.

In addition, the range of vibration levels is typically below a level which would cause any disturbance to occupants of nearby buildings.

During rock breaking activities and the use vibratory rollers during the road upgrade works, there is also potential for vibration to be generated through the ground. Empirical data for these activities is not provided in the BS 5228-2 standard, however, the likely levels of vibration are expected to be orders or magnitude below the relevant criteria used to avoid cosmetic damage to buildings based on experience from other sites and the significant distances between the works and the nearest sensitive buildings. Notwithstanding the above, any construction activities undertaken on the site will be required to operate below the recommended vibration criteria set out in **Table 10.7** during all activities. This will be controlled through the use of monitoring during the construction phase. Further details are set out in **Section 10.6.1.**

10.5.3 Operational Phase

10.5.3.1 Screening for Areas of Low Background Noise

In order to establish whether the noise sensitive locations in the vicinity of the site would be considered 'low background noise' areas, the noise levels measured during the environmental noise survey need to satisfy the following three criteria:

- Average Daytime Background Noise Level ≤40dB L_{AF90}.
- Average Evening Background Noise Level ≤35dB L_{AF90}
- Average Night-time Background Noise Level ≤30dB L_{AF90}

The arithmetic average L_{A90} results at each location are compared against these criteria in **Table 10.14.**

Table 10.14 Comparison of Measurement Results with NG4 Low Background Noise Area Criteria

Location	Period	Average L_{A90} (dB)	NG4 Criterion (dB L_{A90})	Low Background Noise Area?
Location N1	Daytime	46	≤40	No
	Evening	41	≤35	No
	Night-time	43	≤30	No
Location N2	Daytime	50	≤40	No
	Evening	37	≤35	No
	Night-time	39	≤30	No
Location N3	Daytime	47	≤40	No
	Evening	38	≤35	No
	Night-time	39	≤30	No
Location N4	Daytime	48	≤40	No
	Evening	38	≤35	No
	Night-time	41	≤30	No

The assessment results indicate that at Locations N1 to N4 the measured background noise levels during the day, evening and night-time periods are above the threshold values for areas of low background noise.

10.5.3.2 Determination of Appropriate Operational Criteria

Following a review of the measured background noise levels at the survey locations, the standard noise criteria will apply to the noise sensitive properties during day, evening and night-time periods.

Table 10.15 summarises the adopted noise emission limits criteria for the operational phase, in line with NG4 guidance.

Table 10.15 Adopted Operational Criteria at Noise Sensitive Locations

Location	Daytime Noise Criterion, dB $L_{Ar,T}$ (07:00 to 19:00hrs)	Evening Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)	Night-time Noise Criterion, dB $L_{Ar,T}$ (19:00 to 23:00hrs)
N1 – N4	55	50	45
Non-residential dwellings to east (i,e. coastal locations, NMCI)	55	50	n/a

In this instance, the operational noise level at the nearest residential locations to the west of the facility will be limited to noise levels of 55dB $L_{Aeq,T}$ during daytime periods, 50dB $L_{Aeq,T}$ for evening periods and 45dB $L_{Aeq,T}$ during the night-time period. For sensitive locations to the east of the site including the NCMI, the beach area and other amenity areas in the vicinity with similar baseline noise levels, the standard operational criteria of 55dB $L_{Aeq,T}$ and 50dB $L_{Aeq,T}$ during day and evening periods will apply.

The time period in this instance is taken to be 15 minutes for all three periods.

In order to assist with interpretation of traffic noise **Table 10.16** offers guidance as to the likely impact associated with changes in traffic noise level. For operational phase traffic, due to the long-term period over which this impact occurs, the magnitude of impacts are assessed against the 'long term' impact classification periods as described in the DMRB.

Table 10.16 Likely impact associated with change in traffic noise level during the Long-Term Period

Change in Sound Level (dB L_{A10})	Magnitude of Impact (Short Term)
0	No Change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

There are no expected sources of vibration associated with the operational phase.

10.5.3.3 Likely Significant Operational Noise Effects

There is no expected overlap between the construction and operational phase of the project. Once coastal protection works, road works and building construction works are complete, the main sources of noise during the operational phase relate to the main process building. There is potential for coastal protection works to be undertaken at a future stage during the facilities operation, dependent on monitoring studies in this area for coastal protection works. Noise levels associated with this activity are calculated in **Table 10.11** within **Section 10.5.2.2**.

The following section discusses the four key sources associated with ongoing activities associated with the operational phase as follows:

- process and building services plant (fixed installations);
- vehicle movements on site (mobile plant);
- car parking on site, and;
- additional vehicles on public roads.

The following sections address the predicted noise effects relating to these key sources from the operation of the facility.

Fixed Installations and On-Site Vehicle Movements

A noise model of the proposed waste-to-energy facility was developed to assess the noise contribution from all noise generating operating sources and internal traffic movements. The methodology used to develop the model is the same as that described in **Section 10.5.2.1** for construction noise calculations.

In order to develop a model of the proposed facility, the following information was obtained:

- OS mapping and 3D Ground contour mapping supplied by the design team;
- Building layouts of proposed facility provided by the design team;
- Confirmation on the operational noise sources and their location on site by the design team, and;
- Traffic volumes using the facility during peak hours, provided by the traffic consultants.

The majority of the processes and associated plant and equipment for the facility are all internally housed within the main process building, waste bunker, ash hall, firewater pumphouse and turbine building. External items of plant include the turbine cooling plant, grate furnace coolers, and the air-cooled condensers. The location of these items are located within the south-east area of the facility which are significantly screened from the nearest noise sensitive locations by the on-site adjacent buildings and the ground topography.

The source data used as part of this assessment is taken from measured emissions levels from similar items of plant and equipment at Indaver's waste-to-energy facility at Beveren, Flanders, Belgium. This data was reviewed by the design team and was confirmed valid for the current building design. Sound power data for the key items of plant included in the noise model is given in **Table 10.17** below.

Table 10.17 Sound power levels utilised in noise model for process and building services plant

Description	Octave Band Centre Frequency (Hz) – L_W(A)								L_W, dB(A)
	63	125	250	500	1k	2k	4k	8k	
Fan Turbine Building (N façade)	72	78	88	87	82	76	72	64	91
Fan Turbine Building (S façade)	72	78	88	87	82	76	72	64	91
Fan Turbine Building (E façade)	72	78	88	87	82	76	72	64	91
Fan Turbine Building (W façade)	72	78	88	87	82	76	72	64	91
Turbine Cooling No. 1	64	69	72	83	80	77	72	64	86
Turbine Cooling No. 2	64	69	72	83	80	77	72	64	86
Aero Condenser No. 1 Note1	82	87	88	88	93	91	83	80	98
Aero Condenser No. 2 Note1	82	87	88	88	93	91	83	80	98
Aero Condenser No. 3 Note1	82	87	88	88	93	91	83	80	98
Aero Condenser No. 4 Note1	82	87	88	88	93	91	83	80	98
Grid Compressor No. 1	74	73	78	82	76	70	65	64	85
Grid Compressor No. 2	74	73	78	82	76	70	65	64	85
Grid Compressor No. 3	74	73	78	82	76	70	65	64	85
Cooling Grate Furnace No. 1	69	74	77	81	80	76	71	63	86
Cooling Grate Furnace No. 2	69	74	77	81	80	76	71	63	86
Chimney stack	82	89	92	79	75	69	70	70	94
ID Fan	93	93	88	83	78	73	71	68	97
Waste Bunker Façade	61	67	62	64	61	55	47	72	75
Ash hall façade	67	65	71	66	68	65	59	51	75

Note[1] The Aero condensors will be located within an acoustic louvered area to the south east of the site. The required insertion loss (IL) of the louvres has been calculated as in indicated in **Table 10.18 4** No. units are modelled, however the number of condensers are likely to be limited to 3 units.

Table 10.18 IL requirement for ACC louvres

Description	Octave Band Centre Frequency (Hz) - Insertion Loss							
IL for Acoustic Louvers to Aero Condensor area	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
	6	7	10	12	18	18	14	13

In order to incorporate noise emissions relating to on-site traffic into the operational noise model, information relating to the traffic generation to and from the site has been provided by the traffic consultants. Using the calculated worst case HGV traffic movements to and from the site over a typical day, the number of HGV movements entering the site was assessed.

Under a worst-case scenario, a total of 80 HGVs are calculated to access the facility over the operational day, resulting in a total of 160 HGV movements. Of the 160 trips expected, the highest volumes occur during the early morning peak hour (06:00 – 07:00hrs) where 11 HGVs are expected to enter and exit the site, resulting in 22 movements.

For the remaining daytime hours, HGV vehicle trips are typically between 6 to 9 per hour. During the evening period, a total of 2 HGVs per hour are expected between 19:00 and 20:00hrs, beyond 20:00hrs, no HGVs will be permitted on site.

Table 10.19 shows the sound power emission data used for a HGV. This value is highly conservative as it assumes all HGVs entering the site are heavy duty articulated dump trucks.

Table 10.19 Sound Power values used for waste trucks

Description	Octave Band Centre Frequency (Hz) - L_W								L_W dB(A)
	63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Articulated dump truck	94	101	102	109	107	104	97	91	113

In order to assess noise levels arising from the operational phase, the following scenarios have been modelled:

- **Scenario 1**: Daytime operation with ‘peak’ HGV on-site movements (9 HGVs per hour);
- **Scenario 2**: Evening operation with ‘peak’ HGV on-site movements (2 HGVs per hour);
- **Scenario 3**: Night-time operation with ‘peak’ HGV on-site movements (11 HGVs per hour, i.e. between 06:00 and 07:00hrs);
- **Scenario 4:** Night-time operation with no HGV movements (normal operation).

For the purposes of this appraisal, noise levels have been predicted at the nearest noise-sensitive locations and across a noise contour grid, calculated to a height of 4m. The results of the modelled operational scenarios 1 and 2 for daytime and evening periods are included in **Table 10.20** below and presented in **Figures 10.9** and **10.10.**

Table 10.20 Calculated Operational Daytime and Evening Noise Levels

Location	Predicted Noise Levels, dB $L_{Aeq,1hr}$	Relevant Criteria, dB $L_{Aeq,T}$	Predicted Noise Levels, dB $L_{Aeq,1hr}$	Relevant Criteria, dB $L_{Aeq,T}$	Complies?
	Scenario 1 - Daytime		Scenario 2 – Evening		
R1	47	55	45	50	Yes
R2	41	55	41	50	Yes
R3	41	55	38	50	Yes
R4	34	55	32	50	Yes
R5	33	55	32	50	Yes
R6	32	55	31	50	Yes
R7	33	55	32	50	Yes
R8	34	55	34	50	Yes

The results of the evaluation indicate that the operational noise levels during daytime and evening periods are all comfortably below the relevant noise criteria at the nearest noise sensitive locations. Both scenarios include continuous operational plant and the 'peak' on-site vehicle movements. During periods where no traffic access the site or during 'off peak' traffic periods, noise levels will in turn be reduced.

The results of the modelled operational scenarios for night-time periods are included in **Table 10.21** and presented in **Figures 10.11** and **10.12.**

Table 10.21 Calculated Operational Night-time Noise Levels

Location	Predicted Noise Levels, dB $L_{Aeq,1hr}$ Night-time Scenarios		Relevant Criteria, dB $L_{Aeq,T}$	Complies?
	Scenario 3 – peak traffic	Scenario 4 – no traffic		
R4	35	31	45	Yes
R5	34	32		Yes
R6	32	30		Yes
R7	33	32		Yes
R8	34	34		Yes

The results of the assessment indicate that the operational noise levels during night-time periods are all comfortably at or below the night-time noise criterion of 45dB $L_{Aeq,T}$ adopted for the facility at the nearest residential noise sensitive locations.

The Scenario 3 assessment relates specifically to the early morning period between 06:00 and 07:00hr only when HGVs will be permitted to enter the site. During all other 'night-time' hours, HGV traffic will not be permitted on the site.

Additional Vehicles on Public Roads

A detailed appraisal of potential effects arising from the proposed development on roads and traffic has been prepared by Arup contained in **Chapter 7**, ***Roads & Traffic***.

Similar to the Construction Phase, Operational traffic to and from the facility will be scheduled to avoid the existing peak periods on the local road network, hence it is proposed to permit development traffic to access the site between 06:00 to 07:00hrs, between 09:00 to 16:00hrs and between 18:00 to 20:00hrs. The peak hours proposed over a typical day will be between 06:00 and 07:00hrs and 14:00 to 15:00hrs.

The highest volume of operational traffic will be along the N28 between the site and Shannonpark with the greatest percentage change in traffic flows between the 'with' and 'without' scenarios occurring between the early morning peak between 06:00 and 07:00hrs. Due to existing low traffic volumes during the morning peak hour between 06:00 and 07:00hrs, the relative change in traffic numbers between the 'with' and 'without' scenarios are most significant along the L2545 Haulbowline Road and the N28 east of Barnaheely Road during this period. During all other time periods, due to higher baseline traffic volumes, the relative change in traffic volumes is significantly less. This is also true for all other routes accessing the site (Please Refer to **Chapter 7** for detailed traffic analysis during the Operational Phase).

In order to assess the specific effects to the nearest noise sensitive locations along the L2545 Haulbowline Road during the morning peak hour, traffic noise levels have been calculated using the formula outlined in **Section 10.5.2.3** above and using the operational traffic flows to and from the proposed facility between 06:00 and 07:00hrs.

Tables 10.22 and **10.23** present the calculated traffic noise levels at properties at Martello Park taking account of the future baseline flows and operational traffic. The impact magnitudes are based on the DMRB ratings for the 'long term' periods included in **Table 10.16**.

Table 10.22 Calculated Operational Traffic Impacts along N28 East of Ferry Port – AM Peak – Year of Opening 2023

Location	Traffic Noise Impacts Operational Phase 06:00 - 07:00hrs - $L_{Aeq,1\ hr}$			
	Baseline 2023 Note 1	**Cumulative**	**Increase. dB**	**Impact Rating**
Martello Park (West)	57	60	+2.4	Negligible
Martello Park (Middle)	54	57	+3	Minor
Martello Park (East)	54	57	+3	Minor

Table 10.23 Calculated Operational Traffic Impacts along N28 East of Ferry Port – AM Peak – Year of Opening 2038

Location	Traffic Noise Impacts Operational Phase 06:00 - 07:00hrs - $L_{Aeq,1\ hr}$			
	Baseline 2038[Note 1]	Cumulative	Increase. dB	Impact Rating
Martello Park (West)	57	60	+2.2	Negligible
Martello Park (Middle)	54	57	+2.9	Negligible
Martello Park (East)	54	57	+2.9	Negligible

Note 1 The Baseline is calculated taking account of vehicle no's along the L2545, The N28 in addition to Port of Cork Traffic. Calculations take account of varying distances from these sources.

The assessment has determined that during the morning peak hour, noise levels are calculated to increase at residential properties along the L2545 Haulbowline Road, the magnitude of which depends on the distances from the road. The calculated change in noise levels at these properties is 2 to 3dB(A) which in accordance with **Table 10.16** is assigned a 'negligible' impact.

Traffic Vibration

As a vehicle travels along a road, vibration can be generated in the road and potentially propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle.

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Potential effects attributable to road traffic vibration can therefore be largely avoided by maintenance of the road surface.

Ground vibration from additional traffic due to the development under consideration would be expected to be orders of magnitude less than that required to cause cosmetic or structural damage to buildings or lead to disturbance of occupiers.

10.6 Mitigation and Monitoring Measures

In order to sufficiently ameliorate potential noise and vibration effects, a schedule of noise and vibration control measures has been formulated for both construction and operational phases, where required.

10.6.1 Construction Phase

The construction phase appraisal has indicated that, during the various key activities proposed as part of this development, construction activities can be undertaken within the proposed noise criteria at the nearest sensitive buildings. During out–of-hours construction periods, or other construction scenarios with high potential for noise and vibration generating activities best practice noise and vibration control measures will be employed by the contractor in order to avoid significant effects at the nearest sensitive buildings.

The best practice measures set out in BS 5228 (2009 +A1 2014) Parts 1 and 2 will be complied with. This includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet plant;
- noise control at source;
- screening;
- liaison with the public, and;
- monitoring.

Details in relation to these mitigation measures is set out in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise and vibration monitoring.

As discussed in **Section 5.11** of **Chapter 5** ***Construction Activities***, a construction environmental management plan (CEMP) has been prepared prior to construction commencing, refer to **Appendix 5.1**. The Site Environmental Manager (SEM), appointed by the Contractor, will be responsible for the successful development, implementation and maintenance of the CEMP, will carry out environmental inspections.

10.6.1.1 Selection of Quiet Plant

This practice will relate to static plant, such as compressors and generators. Units will be supplied with manufacturers' proprietary acoustic enclosures. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

10.6.1.2 Noise Control at Source

If required, consideration will be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and or maintaining enclosure panels closed during operation can reduce noise levels by up to 10dB. Mobile plant will be switched off when not in use and not left idling.

- For piling plant, noise reduction will be achieved by enclosing the driving system in an acoustic shroud, where necessary. For steady continuous noise, such as that generated by diesel engines, it is possible to reduce the noise emitted by fitting a more effective exhaust silencer system or utilising an acoustic canopy to replace the normal engine cover.

- For percussive tools such as pneumatic concrete breakers, rock drills and tools a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensure any leaks in the air lines are sealed. Further reductions in noise levels will be achieved by erecting localised screens around breakers or drill bits when in operation in close proximity to noise sensitive boundaries.
- For concrete mixers, control measures will be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum.
- For all materials handling, materials will not be dropped from excessive heights. Drops chutes and dump trucks will be lined with resilient materials.
- For compressors, generators and pumps, these will be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation, where required.
- All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

10.6.1.3 Screening

Screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. It has been assumed for the purposes of this assessment that a standard construction site hoarding will be erected around the site boundaries of the main building works of the waste to energy building. The site hoarding will be constructed of a material with a mass per unit of surface area greater than 7 kg/m^2 to provide adequate sound insulation.

In addition, careful planning of the site layout will also be considered. Where feasible, site buildings such as offices and stores will be placed between the source and receiver to provide noise screening.

10.6.1.4 Liaison with the Public

The Site Environmental Manager (SEM) will be the designated officer appointed to site during construction works as described in the CEMP (**Appendix 5.1**). Any noise complaints should be logged and followed up in a prompt fashion by the SEM. In addition, as part of the communication strategy for the project, prior to particularly noisy construction activity or those with potential for perceptible vibration levels, e.g. rock breaking, piling, etc., the SEM will inform the nearest noise sensitive locations of the time and expected duration of the noisy works.

10.6.1.5 Monitoring

Prior to the construction works commencing on site, environmental noise and vibration monitors will be installed at the selected monitoring locations. The SEM will be responsible for this monitoring.

Noise monitoring will be conducted in accordance with the International Standard ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise*. Vibration monitoring will be conducted in accordance with BS 4866 (2010) *Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures*.

10.6.1.6 Project Programme

The construction programme will be arranged so as to control the amount of disturbance in noise and vibration sensitive areas at times that are considered of greatest sensitivity. If piling or rock breaking works are in progress on a site at the same time as other works of construction that themselves may generate significant noise and vibration, the working programme will be phased so as to prevent unacceptable disturbance.

10.6.2 Operational Phase

10.6.2.1 Fixed Installations and On-Site Vehicle Movements

Practicable noise control measures will be employed to ensure that noise from process and building services plant do not exceed the operational noise limits set out in **Table 10.15**. In addition, the inclusion of an acoustic attenuators to the aero condenser structure will be required to meet, as a minimum, the insertion loss values included in **Table 10.18**.

In addition to the measures outlined above, the following forms of noise control techniques will be employed as standard to ensure operational plant noise levels are kept to a minimum:

- plant will be sited as far away from noise-sensitive locations as is practicable;
- duct mounted attenuators will be installed on the atmosphere side of all air moving plant;
- splitter attenuators will be installed providing free ventilation to internal plant areas;
- anti-vibration mounts will be installed on all reciprocating plant.

10.6.2.2 Additional Vehicles on Public Roads

The noise effect assessment outlined above has demonstrated that mitigation measures are not required.

10.6.2.3 Monitoring

The facility will be licenced by the EPA through an IED licence. As part of the IED licence, annual noise monitoring will be required at the nearest noise sensitive locations to compare against the operational Emission Limit Values (ELV's). Monitoring will be undertaken during day, evening and night-time periods in accordance with the monitoring procedures included within EPA's NG4 2016 document.

Monitoring results will be submitted to the EPA for review and will also be included within the facilities Annual Environmental Report (AER) issued to the EPA.

10.7 Cumulative Effects

The cumulative effects of the proposed development in terms of noise and vibration take account of the existing environment coupled with the proposed resource recovery centre.

The existing environment as measured, takes account of existing sources of noise in the surrounding environment (i.e. existing operational industrial, infrastructural, educational, commercial, leisure facilities and road traffic).

Assuming no change to the existing noise environment (i.e. no increase or decrease in the prevailing noise environment occurs as a result of other developments in the area), the following cumulative effects are calculated at the noise sensitive locations measured during the baseline survey.

Table 10.24 Calculated Cumulative Noise Levels at Baseline Survey Locations

Location	**Calculated Operational Noise Level, dB $L_{Aeq,T}$**	**Measured Existing Noise Levels, dB $L_{Aeq,T}$**	**Cumulative Noise Level, dB $L_{Aeq,T}$**	**Increase, dB**
	Scenario 1 – Daytime,	**Daytime**		
NSL1	47	49	51	+2.1
NSL2	32	55	55	0.0
NSL3	34	65	65	0.0
NSL4	41	55	55	+0.2
Location	**Scenario 2 - Evening**	**Evening**		**Increase, dB**
NSL1	45	46	49	+2.5
NSL2	31	43	43	+0.3
NSL3	32	48	48	+0.1
NSL4	38	59	59	0.0
Location	**Scenario 3 -Night-time**	**Night-time**		**Increase, dB**
NSL2	32	44	44	+0.3
NSL3	35	41	42	+1.0
Location	**Scenario 4 -Night-time**	**Night-time**		**Increase, dB**
NSL2	30	44	44	+0.2
NSL3	31	41	41	+0.4

The results of the cumulative assessment indicate the operation of the proposed resource recovery centre is calculated to add 0 to 2.5dB(A) to the prevailing ambient noise environment at the nearest noise sensitive locations in the vicinity of the development site. An increase of this magnitude is minor and is not considered to pose any significant notable noise effect.

The highest calculated cumulative effect is at Location NSL1 (R1) during the day and evening periods where an increase of the order of 2.1 to 2.5dB(A) is calculated assuming peak traffic using the facility. The total noise level at the calculated position, R1, along the coastal area in close proximity to the development for this scenario is 49dB $L_{Aeq,T}$ during the evening period. Whilst an increase in noise levels is calculated, the overall noise level is within the operational criterion for this time period at this location. It is important to note that the calculated noise level at R1 relates to one position along the coastal area to the east of the site. Noise levels at other locations on the shoreline will vary, depending on the distance of the location to the site boundary. Reference to **Figure 10.10** provides a more detailed assessment of noise levels along the closest area of the coastline to the development site which are in the range of 45 to 35dB $L_{Aeq,T}$. At all other locations, the increase in noise levels is 1dB or less which is insignificant.

As noted, the cumulative assessment assumes no change to the baseline noise environment as a result of additional developments in the surrounding area.

In addition to the operation of the proposed resource recovery centre, there are a number of additional projects proposed in the vicinity of Ringaskiddy, namely:

Proposed Projects:

- M28 Cork to Ringaskiddy Motorway Scheme – Under judicial review. Timeline unknown, construction estimated 30-36 months;
- Local projects associated with the Community Gain Fund required by planning condition 18 of the ABP Planning Permission, May 2018; and
- Other planned/permitted projects include the following (note: the construction/operation timelines of these projects are currently unknown):
    - BioMarin - (PA No. 186603) extension to manufacturing building;
    - GE Healthcare Life Science BioPark – (PL04 .248154) – planning granted. To be located in Barnahely;
    - Pfizer Ireland - PA Ref 16/6937: Granted in Jan 2017; and
    - Novartis – Number of permitted projects including the permitted wind turbine (planning for turbine expires November 2022).

Existing Projects

- Hammond Lane Metal Company Ltd. – now operating under a IE licence P0997-01. No further planned expansion;
- Wind turbines –Including the second De Puy 3MW turbine which is now operational since 2018. No information available on construction timeline of the permitted Novartis turbine;
- The National Maritime College of Ireland (NMCI);
- UCC ERI Beaufort Building;

- The Island Crematorium;
- Haulbowline Island Recreational Park – the park is due to be open to the public in 2019;
- Ispat Steelworks Site, Haulbowline Island – Remediation works likely in the future, but timeline known.
- Irish Naval Service base, Haulbowline Island;
- Spike Island – New masterplan is currently being prepared;
- Port of Cork – redevelopment due to be complete in 2020;
- Cork Lower Harbour Drainage Scheme – WwTP complete, other associated upgrade works (pump stations, pipelines) ongoing in the area and due to be complete in 2019;
- Residential Developments - No known planned/permitted projects;
- ESB Aghada Power Station;
- BGE Power Station at Whitegate;
- Amenity developments in Ringaskiddy;
- Ferry and Cruise Ship Business;
- Pharmaceutical and Medical Device Manufacturers.

For the majority of the proposed developments noted above, details of the specific potential noise effects have not yet been assessed. The Spike Island and Haulbowline Island projects are low impact tourism destinations and hence the operational noise levels are expected to be low arising from these developments, particularly given the distance between these and the proposed resource recovery centre (approximately 1km). The cumulative effects from these developments are expected to be neutral.

The operational phase of the sewage treatment project is also expected to be not significant at the nearest noise sensitive locations and hence the cumulative effects from this development are expected to be neutral.

Chapter 14 of the EIS relating to the proposed N28 Cork to Ringaskiddy Road scheme (2017) includes predicted future operational noise levels associated with the proposed motorway scheme at Martello Park residential properties. Calculated noise levels associated with the proposed road development are between 57 to 60dB L_{den} with night time noise levels of 43 to 47dB L_{night}. This will increase the ambient noise environment at these properties.

Review of the Port of Cork EIS notes that predicted noise levels at the noise sensitive properties to the west of the proposed resource recovery centre (R4-R7) are calculated to be typically 46 to 47dB L_{Aeq} during the daytime period and 43 to 44dB L_{Aeq} during the night-time period.

The Novartis wind turbine is yet to be built and will be limited to operational noise level of 45dB L_{Aeq} at the nearest noise sensitive locations to its location, in addition to industrial emissions from the Novartis facility. This noise level is in line with or above the existing noise environment measured at the nearest noise sensitive locations. Planning permission for the wind turbine expires in November 2022.

The predicted noise effects associated with the proposed Resource Recovery Centre are therefore well below those associated with the existing noise environment, those associated with the proposed N28 Link road and the Port of Cork development and other planned projects, hence, once operational, the proposed Resource Recovery Centre is expected to be imperceptible in terms of noise to its surrounding environment.

For other possible or planned projects relating to new and extended industrial facilities as listed above, the distance to the nearest noise sensitive locations assessed for the proposed Resource Recovery Centre is sufficiently large such that cumulative noise levels will be neutral.

Noise levels associated with the operation of the Resource Recovery Centre (RRC) are calculated to be imperceptible at distances beyond 400 to 500m from the development site. The closest area of the Cork Harbour SPA is located some 500m to the south of the development site. This particular area of the SPA is located in close proximity to a number of existing industrial facilities (i.e. GSK, De Puy and Hovione) and hence the operation of the RRC will have no effect to noise levels at this area considering the contribution of these adjacent facilities to the existing noise environment. All other areas of the Cork Harbour SPA are located at distances beyond 1.5km from the proposed site and hence the operation of the RRC is determined to have no measurable or perceptible change to the existing noise environment at any of the designated Cork Harbour SPA's. The overall effect is long-term neutral.

10.8 Residual Effects

The predicted residual effects of the development are set out below taking account of the predicted effects and control measures.

10.8.1 Construction Phase

During the construction phase of the project, there will be a slight to moderate short-term effect on nearby noise sensitive properties due to noise emissions from construction works and site traffic. Due to the distance between the construction works and the nearest sensitive receptors, however, the calculated noise effects are within the relevant criterion set for this phase.

Construction works will take place outside of normal working hours for up to 8 weeks. During these working hours, construction noise will be limited to the criteria set within **Section 10.5.2.1** to avoid any significant effects to the surrounding environment. The implementation of appropriate noise control measures will ensure that noise effect is kept within the recommended criteria.

The application of binding noise limits, monitoring, and controlled working hours, along with implementation of appropriate noise and vibration mitigation measures as set out above, will ensure that noise and vibration effect is sufficiently controlled to within the relevant criteria. The overall noise effect during the construction of the proposed facility at the nearest noise sensitive properties is short term, minor to moderate. Vibration effects during this phase are determined to be temporary and not significant.

Noise levels associated with of the Resource Recovery Centre for the worst-case construction scenarios assessed are calculated to be less than 35dB L_{Aeq} at the closest areas of the Cork Harbour SPA to the south of the development site. This particular area of the SPA is located in close proximity to a number of existing industrial facilities (i.e. GSK, De Puy and Hovione) with operational noise limits of 55dB L_{Aeq} during daytime periods and 45dB L_{Aeq} during night-time periods. Given that predicted construction noise levels at this location are significantly below the permitted operational noise levels from adjacent facilities, the noise effect from construction activities at the closest area of the SPA are short-term, imperceptible.

All other areas of the Cork Harbour SPA are located at distances beyond 1.5km from the proposed site with lower construction noise levels predicted at these distances, (less than 30dB L_{Aeq}) which is well below typical baseline noise levels in the surrounding environment. Taking the above into consideration, the construction phase of the Resource Recovery Centre is determined to have no significant effect to the existing noise environment at any parts of the designated Cork Harbour SPA. The overall effect is neutral, short-term, imperceptible.

10.8.2 Operational Phase

The proposed waste-to-energy facility has been assessed against the relevant operational noise emission limit values (ELV's) prescribed within the EPA's noise guidance document *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities* (NG4, EPA 2016) at the closest noise sensitive locations The assessment has concluded that due to the distance between the proposed development and the nearest sensitive buildings, the proposed site layout and the recommended noise mitigation measures, the facility can operate within the adopted day, evening and night-time noise limit values.

The overall noise and vibration effect from the operation of the proposed facility is expected to be long term, not significant taking account of the existing noise environment and the predicted effect of the proposal.

10.9 References

British Standard BS 7385 (1993): *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.*

British Standard BS 5228 (2008 +A1 2014): *Code of Practice for Noise and Vibration Control on Construction and Open Sites. Part 1: Noise and Part 2 Vibration.*

British Standard BS4142: (2014): *Method for Rating and assessing industrial and commercial sound.*

British Standard BS4866 (2010*) Mechanical vibration and shock. Vibration of fixed structures. Guidelines for the measurement of vibrations and evaluation of their effects on structures.*

Department of Transport Welsh Office, HMSO, (1988) *Calculation of Road Traffic Noise,*

Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3. Part 7 Noise and Vibration (2011)

Environmental Protection Agency (2002) *Guidelines on the information to be contained in Environmental Impact Statements*

Environmental Protection Agency (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities*

Environmental Protection Agency (Draft August 2017) Guidelines on the Information to be contained in Environmental Impact Statements

Environmental Protection Agency (Draft, September 2015) Advice Notes for Preparing Environmental Impact Statements.

IEMA & IOA (2010*) Guidelines for Noise Impact Assessment*

ISO9613: *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996*

M28 Cork to Ringaskiddy Project EIS (2017)

National Road Authority (NRA 2004) *Guidelines for the Treatment of Noise in National Road Schemes*

National Road Authority (NRA 2014) *Good Practice Guide for the Treatment of Noise during the Planning of National Road Schemes.*

Ringaskiddy Port Development EIS (2014) *Chapter 9: Noise and Vibration.*

Appendix 10.1

Noise and Vibration Results

APPENDIX 10.1

10.1 Baseline Noise Monitoring Location Images

Plate 1 Unattended Noise Meter at Location N1



Plate 2 Attended Noise Survey at Location N2



Plate 3 Attended Noise Survey at Location N3



Plate 4 Attended Noise Survey at Location N4



10.2 Unattended Monitoring Results from Location N1

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
15/11/2018	10:34:49	60	84	58	48
15/11/2018	10:49:49	51	64	54	47
15/11/2018	11:04:49	52	63	55	49
15/11/2018	11:19:49	51	64	53	48
15/11/2018	11:34:49	51	63	53	48
15/11/2018	11:49:49	51	66	54	48
15/11/2018	12:04:49	52	75	54	48
15/11/2018	12:19:49	51	66	54	47
15/11/2018	12:34:49	50	62	52	46
15/11/2018	12:49:49	47	62	50	44
15/11/2018	13:04:49	45	59	48	42
15/11/2018	13:19:49	46	61	49	40
15/11/2018	13:34:49	47	60	49	42
15/11/2018	13:49:49	48	61	51	43
15/11/2018	14:04:49	49	66	52	45
15/11/2018	14:19:49	49	63	51	44
15/11/2018	14:34:49	49	65	52	45
15/11/2018	14:49:49	49	66	52	45
15/11/2018	15:04:49	48	63	51	44
15/11/2018	15:19:49	49	67	51	43
15/11/2018	15:34:49	50	70	53	46
15/11/2018	15:49:49	48	61	51	45
15/11/2018	16:04:49	49	73	49	44
15/11/2018	16:19:49	47	59	49	43
15/11/2018	16:34:49	47	65	49	42
15/11/2018	16:49:49	45	61	48	43
15/11/2018	17:04:49	45	59	47	43
15/11/2018	17:19:49	45	54	47	43
15/11/2018	17:34:49	46	63	48	42
15/11/2018	17:49:49	45	54	47	42
15/11/2018	18:04:49	43	55	45	40
15/11/2018	18:19:49	41	49	44	38
15/11/2018	18:34:49	42	51	44	40
15/11/2018	18:49:49	42	55	45	38
15/11/2018	19:04:49	43	62	46	39
15/11/2018	19:19:49	46	64	47	39
15/11/2018	19:34:49	42	50	45	38
15/11/2018	19:49:49	44	56	48	38
15/11/2018	20:04:49	43	57	46	37
15/11/2018	20:19:49	42	56	45	37

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
15/11/2018	20:34:49	40	53	44	35
15/11/2018	20:49:49	42	56	45	36
15/11/2018	21:04:49	40	56	41	36
15/11/2018	21:19:49	39	50	41	33
15/11/2018	21:34:49	36	49	36	32
15/11/2018	21:49:49	37	54	39	31
15/11/2018	22:04:49	40	54	43	32
15/11/2018	22:19:49	36	49	37	33
15/11/2018	22:34:49	35	42	36	33
15/11/2018	22:49:49	36	47	37	34
15/11/2018	23:04:49	37	47	38	35
15/11/2018	23:19:49	37	47	39	32
15/11/2018	23:34:49	36	47	37	33
15/11/2018	23:49:49	36	40	37	34
16/11/2018	00:04:49	35	41	37	33
16/11/2018	00:19:49	35	44	36	33
16/11/2018	00:34:49	36	49	36	33
16/11/2018	00:49:49	36	41	37	35
16/11/2018	01:04:49	38	56	37	35
16/11/2018	01:19:49	37	47	38	36
16/11/2018	01:34:49	36	39	37	35
16/11/2018	01:49:49	36	47	37	35
16/11/2018	02:04:49	36	47	37	35
16/11/2018	02:19:49	38	46	39	36
16/11/2018	02:34:49	37	48	38	35
16/11/2018	02:49:49	36	41	37	34
16/11/2018	03:04:49	37	50	37	34
16/11/2018	03:19:49	36	46	36	34
16/11/2018	03:34:49	36	40	37	35
16/11/2018	03:49:49	38	47	40	36
16/11/2018	04:04:49	41	46	42	39
16/11/2018	04:19:49	42	46	43	41
16/11/2018	04:34:49	44	48	45	43
16/11/2018	04:49:49	44	53	45	43
16/11/2018	05:04:49	44	52	45	42
16/11/2018	05:19:49	45	53	46	43
16/11/2018	05:34:49	43	49	45	42
16/11/2018	05:49:49	42	48	44	40
16/11/2018	06:04:49	45	57	46	43
16/11/2018	06:19:49	45	53	46	44
16/11/2018	06:34:49	46	53	47	44
16/11/2018	06:49:49	47	59	48	45
16/11/2018	07:04:49	47	57	48	45

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
16/11/2018	07:19:49	48	63	50	45
16/11/2018	07:34:49	49	62	50	45
16/11/2018	07:49:49	46	55	48	44
16/11/2018	08:04:49	48	58	49	45
16/11/2018	08:19:49	51	67	53	48
16/11/2018	08:34:49	50	67	53	47
16/11/2018	08:49:49	50	65	52	47
16/11/2018	09:04:49	50	64	52	47
16/11/2018	09:19:49	50	69	52	47
16/11/2018	09:34:49	49	65	51	46
16/11/2018	09:49:49	47	67	48	45
16/11/2018	10:04:49	46	61	47	45
16/11/2018	10:19:49	47	58	49	45
16/11/2018	10:34:49	50	62	53	46
16/11/2018	10:49:49	49	61	51	47
16/11/2018	11:04:49	51	61	53	48
16/11/2018	11:19:49	50	64	53	47
16/11/2018	11:34:49	50	61	52	47
16/11/2018	11:49:49	51	62	53	48
16/11/2018	12:04:49	50	73	52	47
16/11/2018	12:19:49	50	62	52	47
16/11/2018	12:34:49	50	60	52	47
16/11/2018	12:49:49	48	63	50	47
16/11/2018	13:04:49	48	61	50	46
16/11/2018	13:19:49	49	61	51	47
16/11/2018	13:34:49	51	61	53	48
16/11/2018	13:49:49	50	63	51	47
16/11/2018	14:04:49	49	64	51	46
16/11/2018	14:19:49	50	60	52	47
16/11/2018	14:34:49	50	63	52	46
16/11/2018	14:49:49	48	58	50	46
16/11/2018	15:04:49	48	60	50	46
16/11/2018	15:19:49	48	60	50	47
16/11/2018	15:34:49	48	59	50	46
16/11/2018	15:49:49	48	58	50	47
16/11/2018	16:04:49	49	59	50	47
16/11/2018	16:19:49	49	60	51	46
16/11/2018	16:34:49	49	58	50	47
16/11/2018	16:49:49	50	60	51	48
16/11/2018	17:04:49	49	59	50	47
16/11/2018	17:19:49	49	59	51	48
16/11/2018	17:34:49	50	73	51	48
16/11/2018	17:49:49	48	61	50	47

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
16/11/2018	18:04:49	49	58	50	47
16/11/2018	18:19:49	49	56	50	47
16/11/2018	18:34:49	49	56	50	47
16/11/2018	18:49:49	49	60	50	47
16/11/2018	19:04:49	48	58	49	46
16/11/2018	19:19:49	49	59	50	47
16/11/2018	19:34:49	49	60	50	48
16/11/2018	19:49:49	49	61	51	48
16/11/2018	20:04:49	48	60	49	46
16/11/2018	20:19:49	48	59	49	46
16/11/2018	20:34:49	46	55	48	45
16/11/2018	20:49:49	49	65	49	46
16/11/2018	21:04:49	48	59	50	47
16/11/2018	21:19:49	48	58	49	46
16/11/2018	21:34:49	48	55	49	46
16/11/2018	21:49:49	46	56	47	45
16/11/2018	22:04:49	46	55	48	45
16/11/2018	22:19:49	46	58	47	45
16/11/2018	22:34:49	48	63	49	47
16/11/2018	22:49:49	49	60	50	47
16/11/2018	23:04:49	48	56	49	47
16/11/2018	23:19:49	49	60	50	47
16/11/2018	23:34:49	48	59	50	47
16/11/2018	23:49:49	48	60	50	46
17/11/2018	00:04:49	48	56	49	46
17/11/2018	00:19:49	48	63	50	46
17/11/2018	00:34:49	47	60	48	46
17/11/2018	00:49:49	46	56	48	45
17/11/2018	01:04:49	46	57	47	45
17/11/2018	01:19:49	47	52	48	45
17/11/2018	01:34:49	47	57	48	45
17/11/2018	01:49:49	46	53	47	44
17/11/2018	02:04:49	46	51	47	44
17/11/2018	02:19:49	45	50	47	43
17/11/2018	02:34:49	46	51	48	45
17/11/2018	02:49:49	46	53	48	45
17/11/2018	03:04:49	47	53	48	46
17/11/2018	03:19:49	47	53	48	46
17/11/2018	03:34:49	46	52	47	44
17/11/2018	03:49:49	46	51	47	44
17/11/2018	04:04:49	46	52	48	44
17/11/2018	04:19:49	46	54	48	44
17/11/2018	04:34:49	46	53	47	44

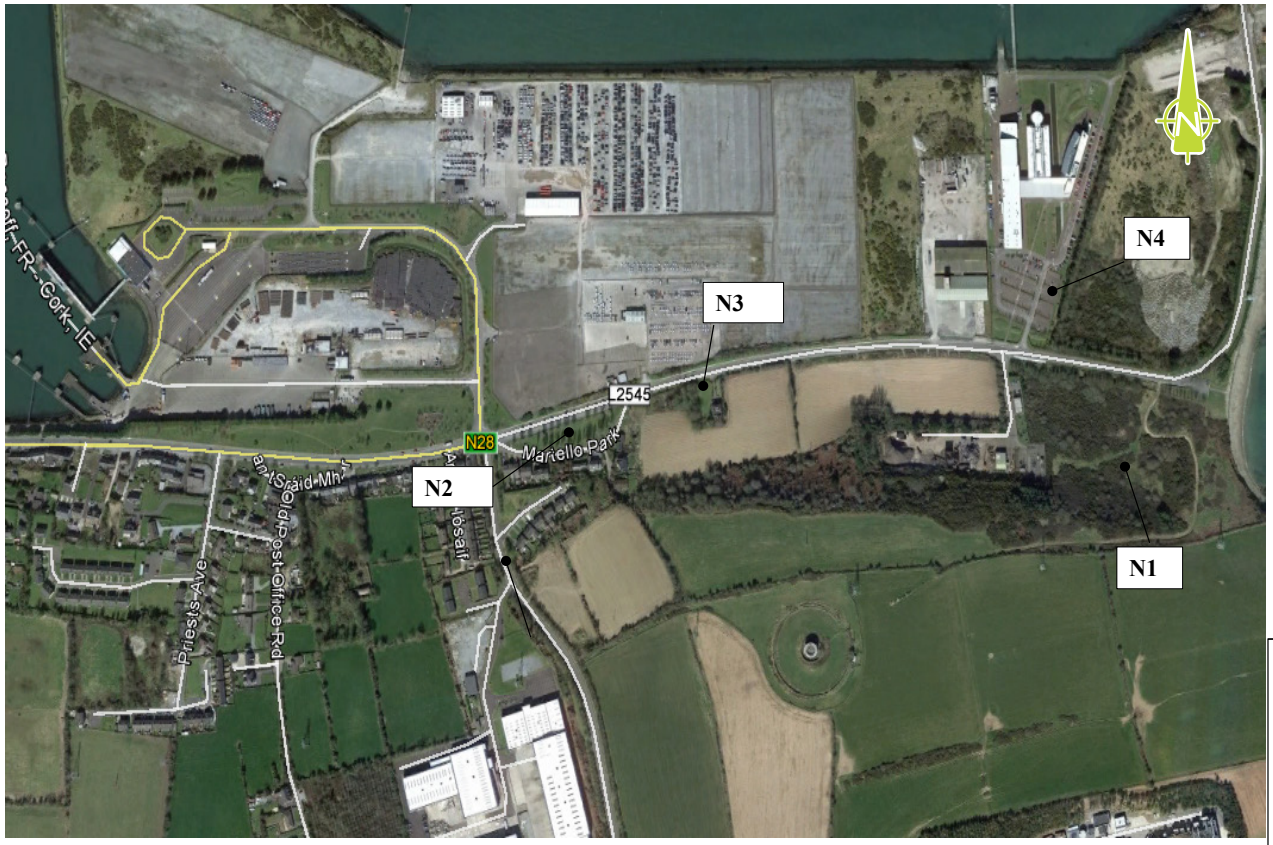
Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
17/11/2018	04:49:49	46	55	47	44
17/11/2018	05:04:49	47	54	48	45
17/11/2018	05:19:49	48	57	49	46
17/11/2018	05:34:49	47	56	49	46
17/11/2018	05:49:49	47	61	48	45
17/11/2018	06:04:49	45	58	47	44
17/11/2018	06:19:49	47	56	48	45
17/11/2018	06:34:49	48	57	49	47
17/11/2018	06:49:49	47	55	49	46
17/11/2018	07:04:49	49	60	50	47
17/11/2018	07:19:49	48	67	49	46
17/11/2018	07:34:49	48	61	49	46
17/11/2018	07:49:49	48	59	50	47
17/11/2018	08:04:49	48	57	49	46
17/11/2018	08:19:49	49	66	50	47
17/11/2018	08:34:49	49	70	51	47
17/11/2018	08:49:49	49	61	50	47
17/11/2018	09:04:49	48	53	49	46
17/11/2018	09:19:49	49	61	50	47
17/11/2018	09:34:49	49	58	51	48
17/11/2018	09:49:49	48	57	49	47
17/11/2018	10:04:49	48	61	49	46
17/11/2018	10:19:49	49	64	49	46
17/11/2018	10:34:49	49	61	50	47
17/11/2018	10:49:49	49	57	50	47
17/11/2018	11:04:49	49	57	51	47
17/11/2018	11:19:49	47	57	48	45
17/11/2018	11:34:49	48	59	50	46
17/11/2018	11:49:49	49	61	50	48
17/11/2018	12:04:49	48	63	50	46
17/11/2018	12:19:49	47	59	49	44
17/11/2018	12:34:49	48	56	50	46
17/11/2018	12:49:49	50	56	51	48
17/11/2018	13:04:49	49	56	51	47
17/11/2018	13:19:49	50	60	52	48
17/11/2018	13:34:49	49	57	51	47
17/11/2018	13:49:49	48	65	49	46
17/11/2018	14:04:49	51	70	51	45
17/11/2018	14:19:49	47	57	49	45
17/11/2018	14:34:49	50	66	51	47
17/11/2018	14:49:49	49	58	50	47
17/11/2018	15:04:49	48	56	50	47
17/11/2018	15:19:49	48	55	49	47

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
17/11/2018	15:34:49	47	57	49	46
17/11/2018	15:49:49	47	56	48	45
17/11/2018	16:04:49	48	57	49	46
17/11/2018	16:19:49	48	57	50	47
17/11/2018	16:34:49	48	62	49	46
17/11/2018	16:49:49	48	58	49	46
17/11/2018	17:04:49	47	56	48	44
17/11/2018	17:19:49	48	57	49	46
17/11/2018	17:34:49	46	60	48	42
17/11/2018	17:49:49	46	57	48	44
17/11/2018	18:04:49	46	58	48	42
17/11/2018	18:19:49	47	60	49	43
17/11/2018	18:34:49	47	57	48	45
17/11/2018	18:49:49	47	55	49	46
17/11/2018	19:04:49	47	55	49	45
17/11/2018	19:19:49	48	56	49	47
17/11/2018	19:34:49	46	58	48	44
17/11/2018	19:49:49	48	58	49	46
17/11/2018	20:04:49	47	56	49	45
17/11/2018	20:19:49	47	61	49	44
17/11/2018	20:34:49	47	60	49	45
17/11/2018	20:49:49	47	55	49	45
17/11/2018	21:04:49	47	53	49	45
17/11/2018	21:19:49	48	59	50	46
17/11/2018	21:34:49	49	60	50	47
17/11/2018	21:49:49	49	56	50	47
17/11/2018	22:04:49	48	53	49	46
17/11/2018	22:19:49	48	56	49	46
17/11/2018	22:34:49	48	53	49	46
17/11/2018	22:49:49	50	58	51	48
17/11/2018	23:04:49	50	58	51	48
17/11/2018	23:19:49	50	56	51	48
17/11/2018	23:34:49	49	59	50	47
17/11/2018	23:49:49	50	57	51	49
18/11/2018	00:04:49	50	58	51	48
18/11/2018	00:19:49	49	56	50	47
18/11/2018	00:34:49	49	60	51	48
18/11/2018	00:49:49	49	58	51	47
18/11/2018	01:04:49	49	60	51	48
18/11/2018	01:19:49	49	57	50	47
18/11/2018	01:34:49	48	55	50	47
18/11/2018	01:49:49	49	57	50	47
18/11/2018	02:04:49	48	57	50	47

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
18/11/2018	02:19:49	49	53	50	47
18/11/2018	02:34:49	48	58	49	46
18/11/2018	02:49:49	48	54	49	46
18/11/2018	03:04:49	48	53	49	46
18/11/2018	03:19:49	47	53	49	45
18/11/2018	03:34:49	49	55	50	47
18/11/2018	03:49:49	49	57	51	48
18/11/2018	04:04:49	49	59	50	47
18/11/2018	04:19:49	49	53	50	47
18/11/2018	04:34:49	49	57	51	48
18/11/2018	04:49:49	48	56	50	47
18/11/2018	05:04:49	49	59	51	48
18/11/2018	05:19:49	49	62	51	46
18/11/2018	05:34:49	47	55	49	45
18/11/2018	05:49:49	49	58	50	47
18/11/2018	06:04:49	48	55	50	47
18/11/2018	06:19:49	49	60	50	47
18/11/2018	06:34:49	49	57	50	48
18/11/2018	06:49:49	50	60	52	49
18/11/2018	07:04:49	50	57	52	49
18/11/2018	07:19:49	51	67	52	48
18/11/2018	07:34:49	52	64	53	50
18/11/2018	07:49:49	50	62	52	49
18/11/2018	08:04:49	51	73	52	48
18/11/2018	08:19:49	52	67	53	50
18/11/2018	08:34:49	50	64	52	48
18/11/2018	08:49:49	50	63	51	48
18/11/2018	09:04:49	51	62	53	49
18/11/2018	09:19:49	49	56	50	47
18/11/2018	09:34:49	48	57	50	47
18/11/2018	09:49:49	49	61	51	48
18/11/2018	10:04:49	51	60	52	49
18/11/2018	10:19:49	50	59	51	48
18/11/2018	10:34:49	49	60	51	48
18/11/2018	10:49:49	50	57	51	48
18/11/2018	11:04:49	50	61	52	49
18/11/2018	11:19:49	51	61	53	49
18/11/2018	11:34:49	51	59	52	49
18/11/2018	11:49:49	50	59	52	49
18/11/2018	12:04:49	51	59	52	49
18/11/2018	12:19:49	51	59	52	48
18/11/2018	12:34:49	50	59	52	48
18/11/2018	12:49:49	49	59	51	47

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
18/11/2018	13:04:49	49	60	50	46
18/11/2018	13:19:49	49	58	50	47
18/11/2018	13:34:49	48	60	49	46
18/11/2018	13:49:49	48	59	50	47
18/11/2018	14:04:49	49	63	50	47
18/11/2018	14:19:49	50	60	51	48
18/11/2018	14:34:49	50	62	52	49
18/11/2018	14:49:49	50	64	51	48
18/11/2018	15:04:49	49	57	50	47
18/11/2018	15:19:49	48	55	49	47
18/11/2018	15:34:49	48	61	49	46
18/11/2018	15:49:49	49	73	49	46
18/11/2018	16:04:49	49	67	49	46
18/11/2018	16:19:49	48	57	50	46
18/11/2018	16:34:49	47	57	49	44
18/11/2018	16:49:49	47	62	49	43
18/11/2018	17:04:49	46	62	48	44
18/11/2018	17:19:49	47	56	48	45
18/11/2018	17:34:49	48	59	50	46
18/11/2018	17:49:49	47	56	49	46
18/11/2018	18:04:49	45	59	47	42
18/11/2018	18:19:49	43	58	45	40
18/11/2018	18:34:49	45	53	46	43
18/11/2018	18:49:49	43	54	45	41
18/11/2018	19:04:49	44	55	46	40
18/11/2018	19:19:49	42	56	44	39
18/11/2018	19:34:49	43	57	44	38
18/11/2018	19:49:49	42	55	45	36
18/11/2018	20:04:49	44	60	46	41
18/11/2018	20:19:49	46	60	48	41
18/11/2018	20:34:49	44	57	47	39
18/11/2018	20:49:49	44	57	46	40
18/11/2018	21:04:49	43	55	45	41
18/11/2018	21:19:49	43	54	45	42
18/11/2018	21:34:49	41	53	43	39
18/11/2018	21:49:49	41	55	43	39
18/11/2018	22:04:49	43	56	46	39
18/11/2018	22:19:49	43	57	45	40
18/11/2018	22:34:49	43	56	44	41
18/11/2018	22:49:49	41	55	43	38
18/11/2018	23:04:49	42	53	44	38
18/11/2018	23:19:49	44	57	45	42
18/11/2018	23:34:49	44	56	46	40

Start date	Start time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)			
		L_{Aeq}	L_{AFmax}	L_{AF10}	L_{AF90}
18/11/2018	23:49:49	42	51	45	39
19/11/2018	00:04:49	42	54	43	38
19/11/2018	00:19:49	40	54	42	38
19/11/2018	00:34:49	42	51	45	39
19/11/2018	00:49:49	45	55	46	43
19/11/2018	01:04:49	44	65	44	39
19/11/2018	01:19:49	39	45	41	38
19/11/2018	01:34:49	41	46	43	40
19/11/2018	01:49:49	43	55	44	41
19/11/2018	02:04:49	42	48	43	40
19/11/2018	02:19:49	40	53	42	39
19/11/2018	02:34:49	41	48	43	40
19/11/2018	02:49:49	40	46	42	38
19/11/2018	03:04:49	40	45	41	38
19/11/2018	03:19:49	43	49	46	39
19/11/2018	03:34:49	47	54	48	46
19/11/2018	03:49:49	48	56	50	46
19/11/2018	04:04:49	47	53	48	45
19/11/2018	04:19:49	45	52	47	44
19/11/2018	04:34:49	47	58	48	45
19/11/2018	04:49:49	46	52	48	44
19/11/2018	05:04:49	47	58	48	44
19/11/2018	05:19:49	47	55	49	46
19/11/2018	05:34:49	48	61	49	46
19/11/2018	05:49:49	48	59	50	46
19/11/2018	06:04:49	47	55	49	44
19/11/2018	06:19:49	45	58	46	43
19/11/2018	06:34:49	49	62	51	45
19/11/2018	06:49:49	48	58	50	46
19/11/2018	07:04:49	49	65	51	46
19/11/2018	07:19:49	49	62	52	46
19/11/2018	07:34:49	50	68	52	46
19/11/2018	07:49:49	49	62	52	45
19/11/2018	08:04:49	51	68	54	45
19/11/2018	08:19:49	52	61	54	48
19/11/2018	08:34:49	51	61	54	47
19/11/2018	08:49:49	56	77	56	47



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Figure 10.1

Baseline Noise Monitoring Locations

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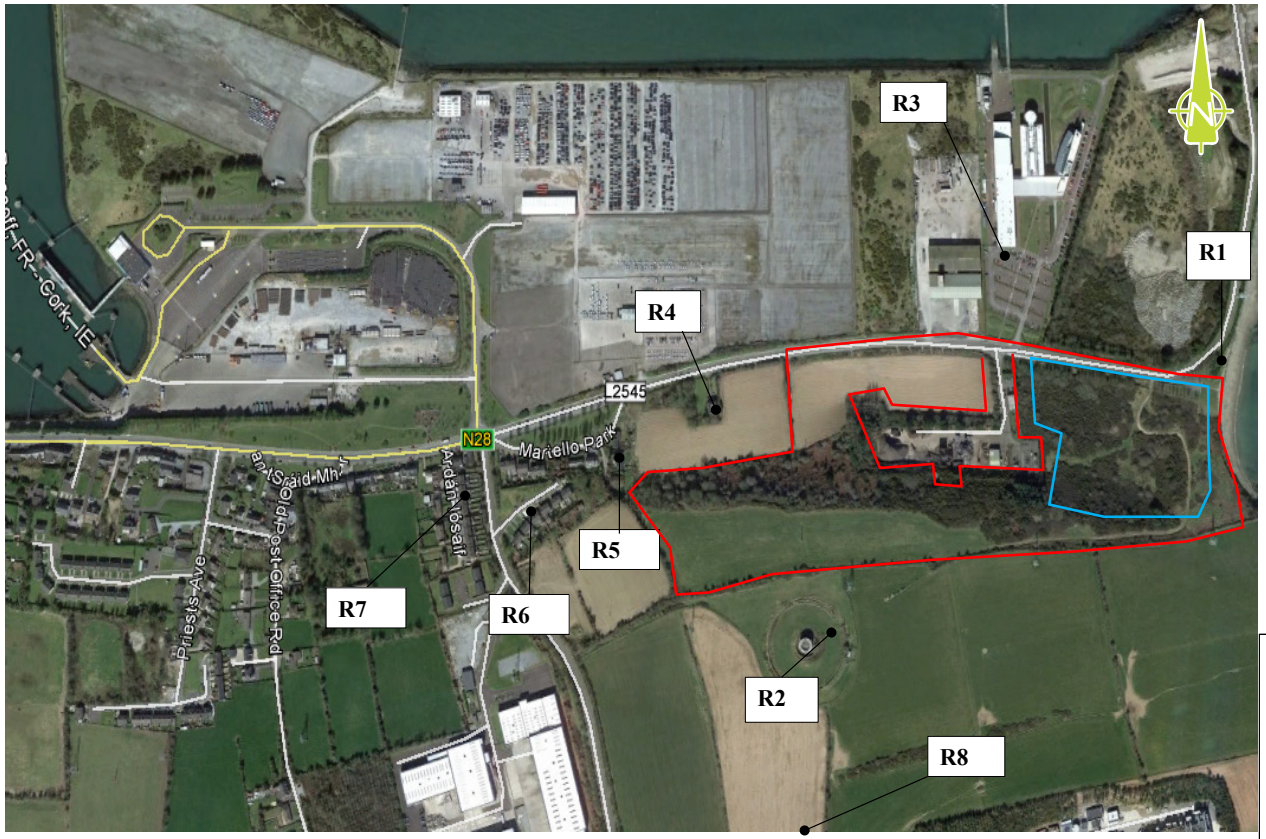
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Baseline Noise Monitoring Locations

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Red line Boundary

Extent of WTE facility

R1

Noise Receiver Assessment Location

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Figure 10.2

Noise Assessment Locations

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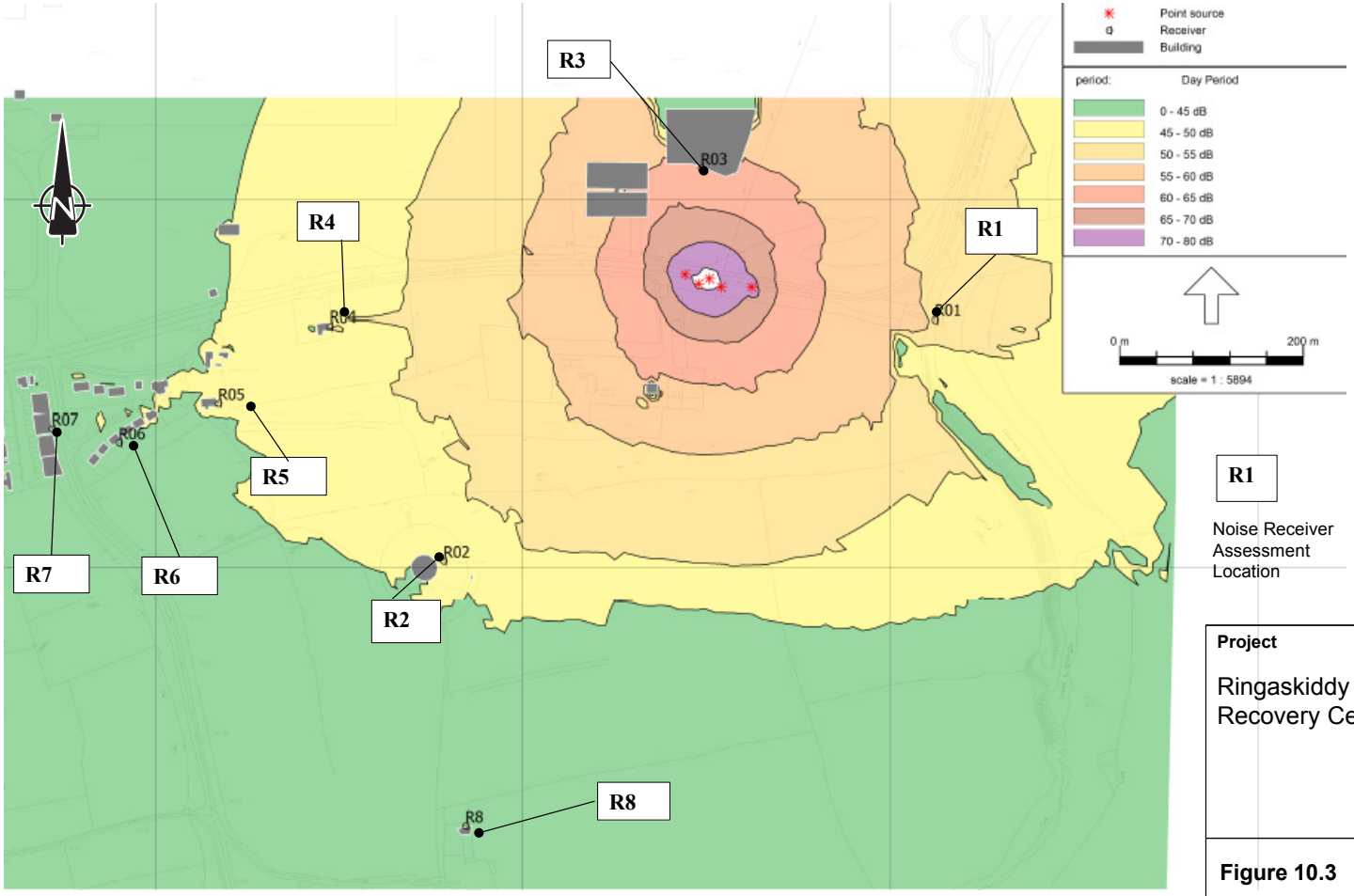
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Noise Assessment Locations

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Noise Receiver Assessment Location

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Figure 10.3

Construction Activity 1a Calculated Noise Contours

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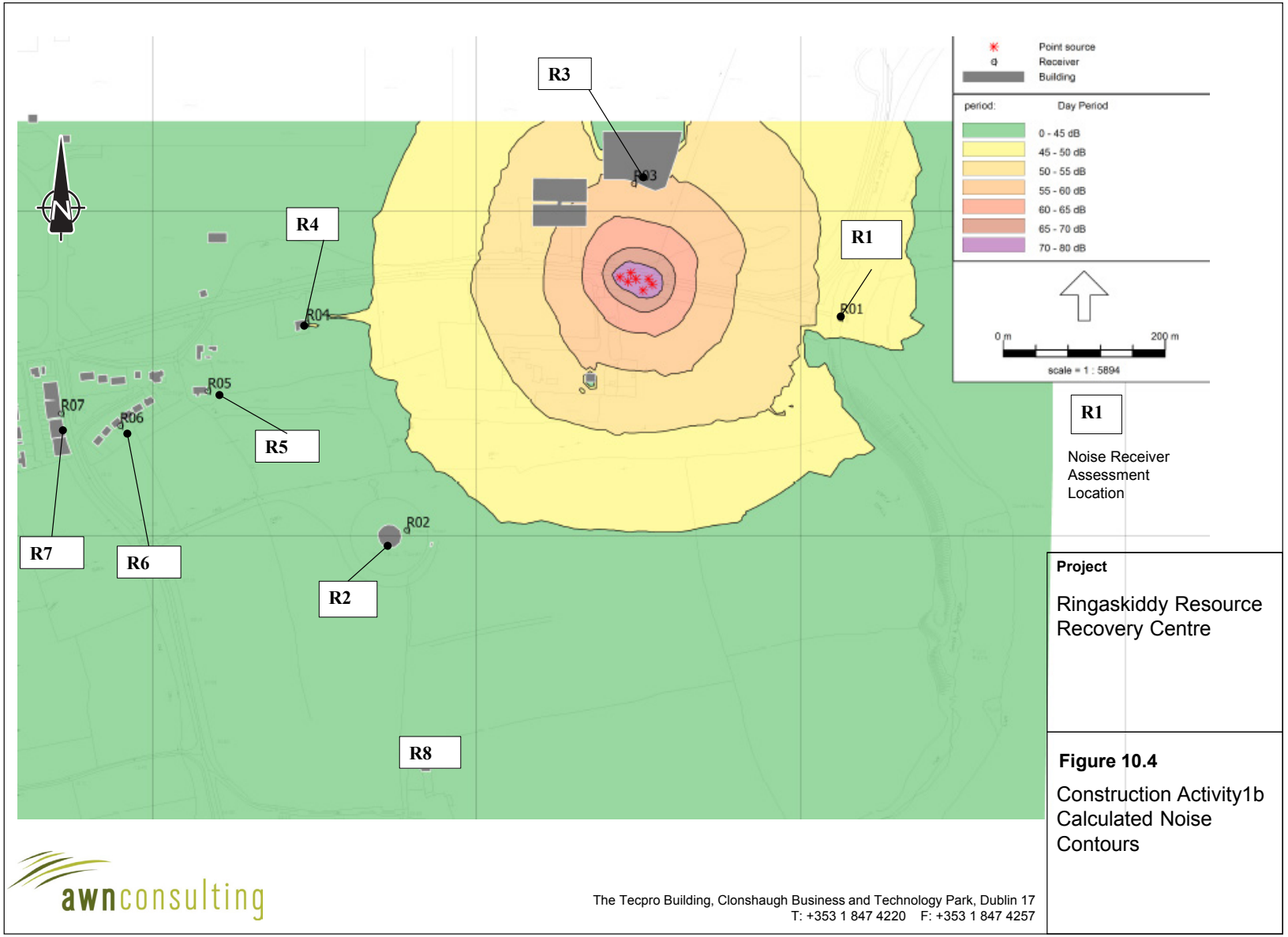
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Construction Phase 1a Calculated Noise Contours

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Figure 10.4

Construction Activity1b Calculated Noise Contours

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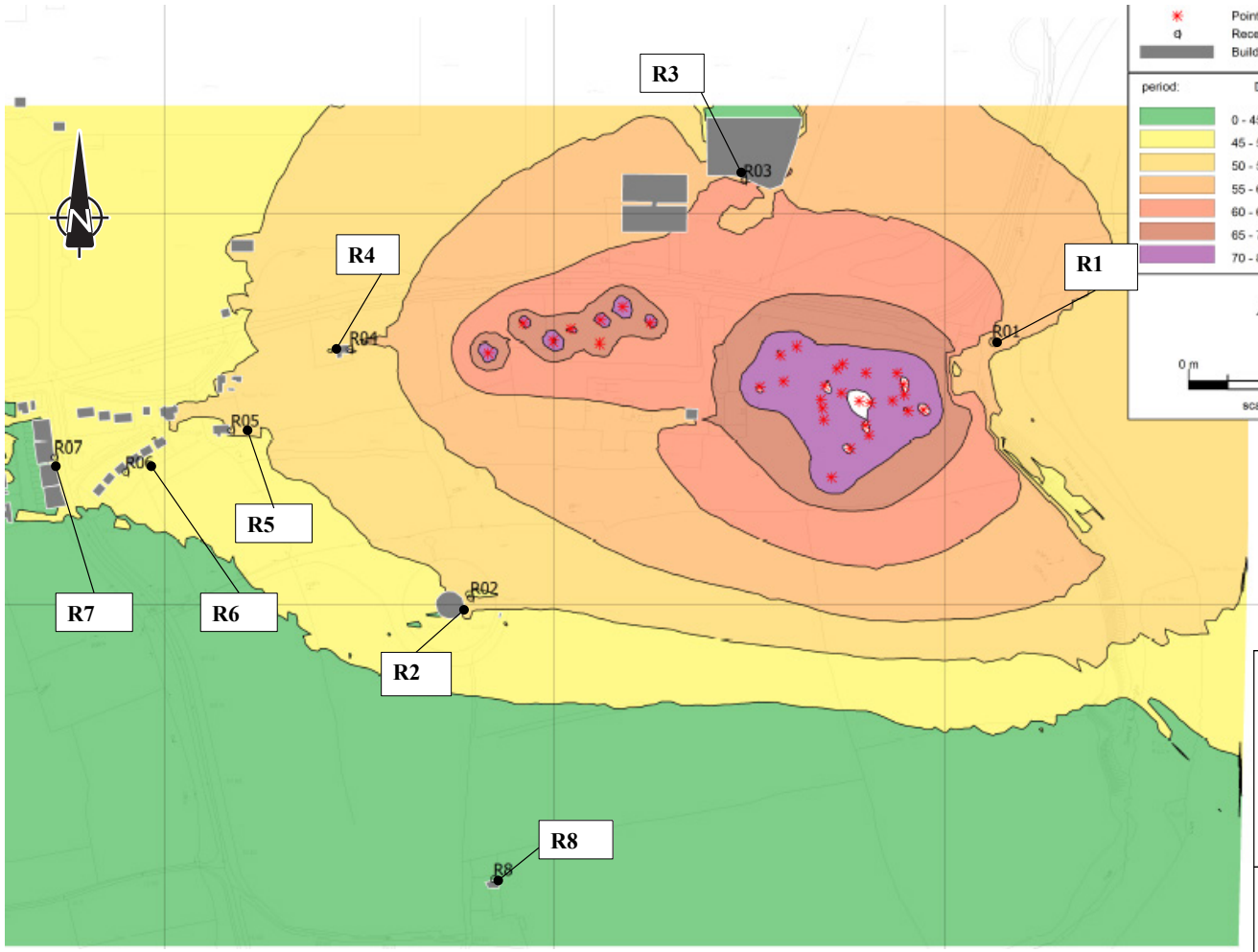
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Construction Phase 1b Calculated Noise Contours

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Figure 10.5

Construction Activities 2, 3 & 4 Calculated Noise Contours

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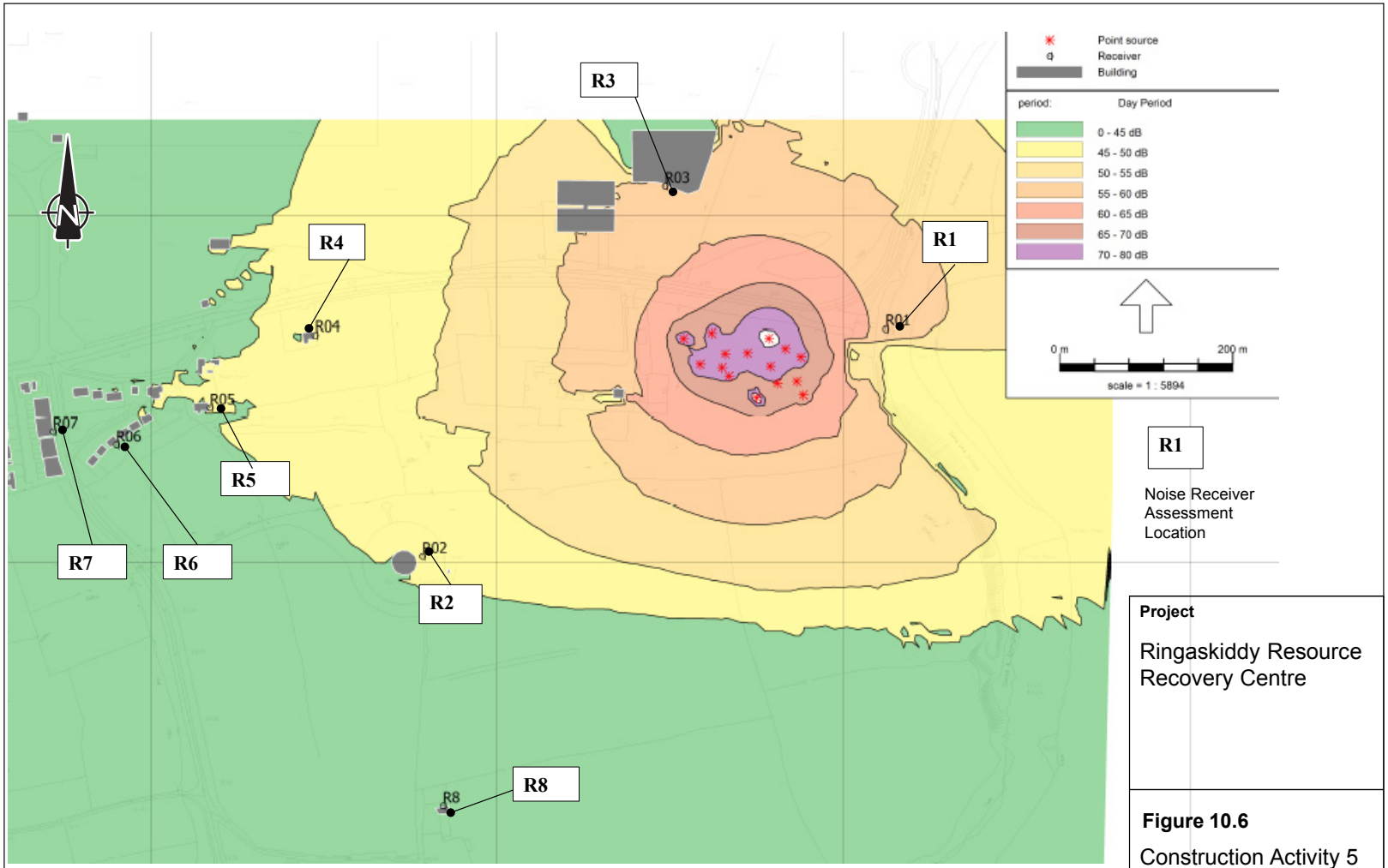
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Construction Phase 2, 3 & 4 Calculated Noise Contours

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Figure 10.6

Construction Activity 5 Calculated Noise Contours

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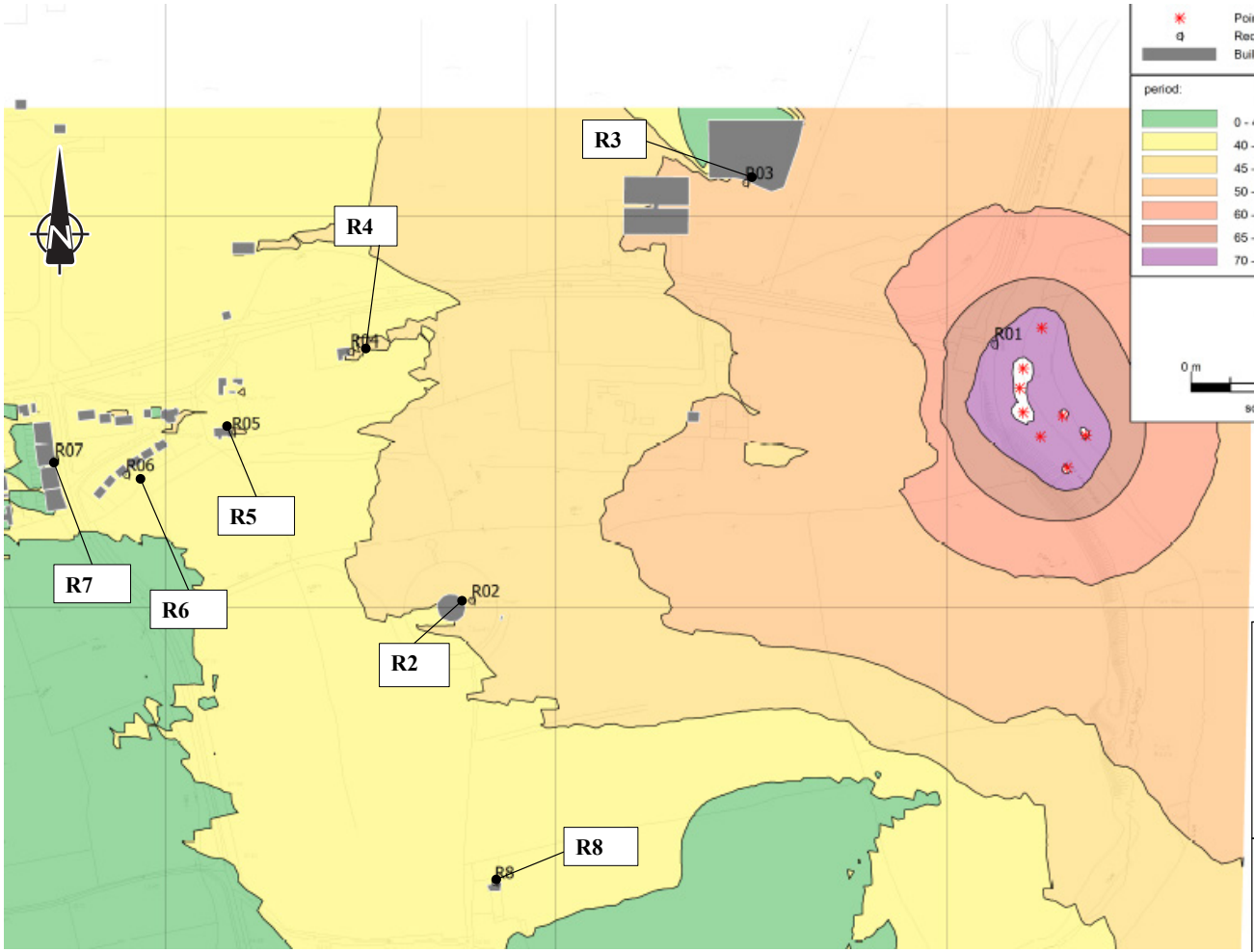
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Construction Activity 5 Calculated Noise Contours

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Noise Receiver Assessment Location

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Figure 10.7

Construction Activity 6 Calculated Noise Contours

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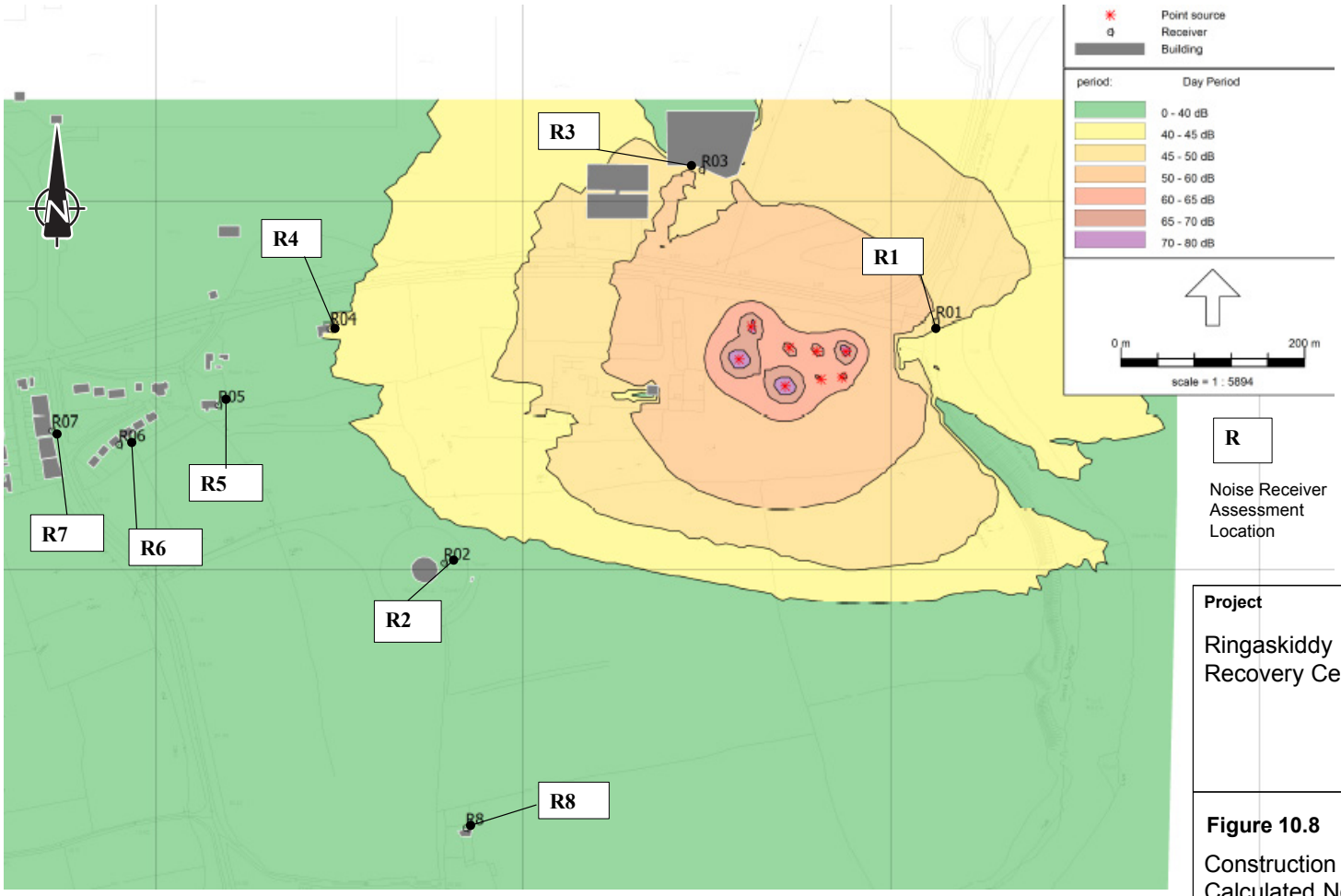
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Construction Phase 6 Calculated Noise Contours

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Figure 10.8

Construction Activity 7 Calculated Noise Contours

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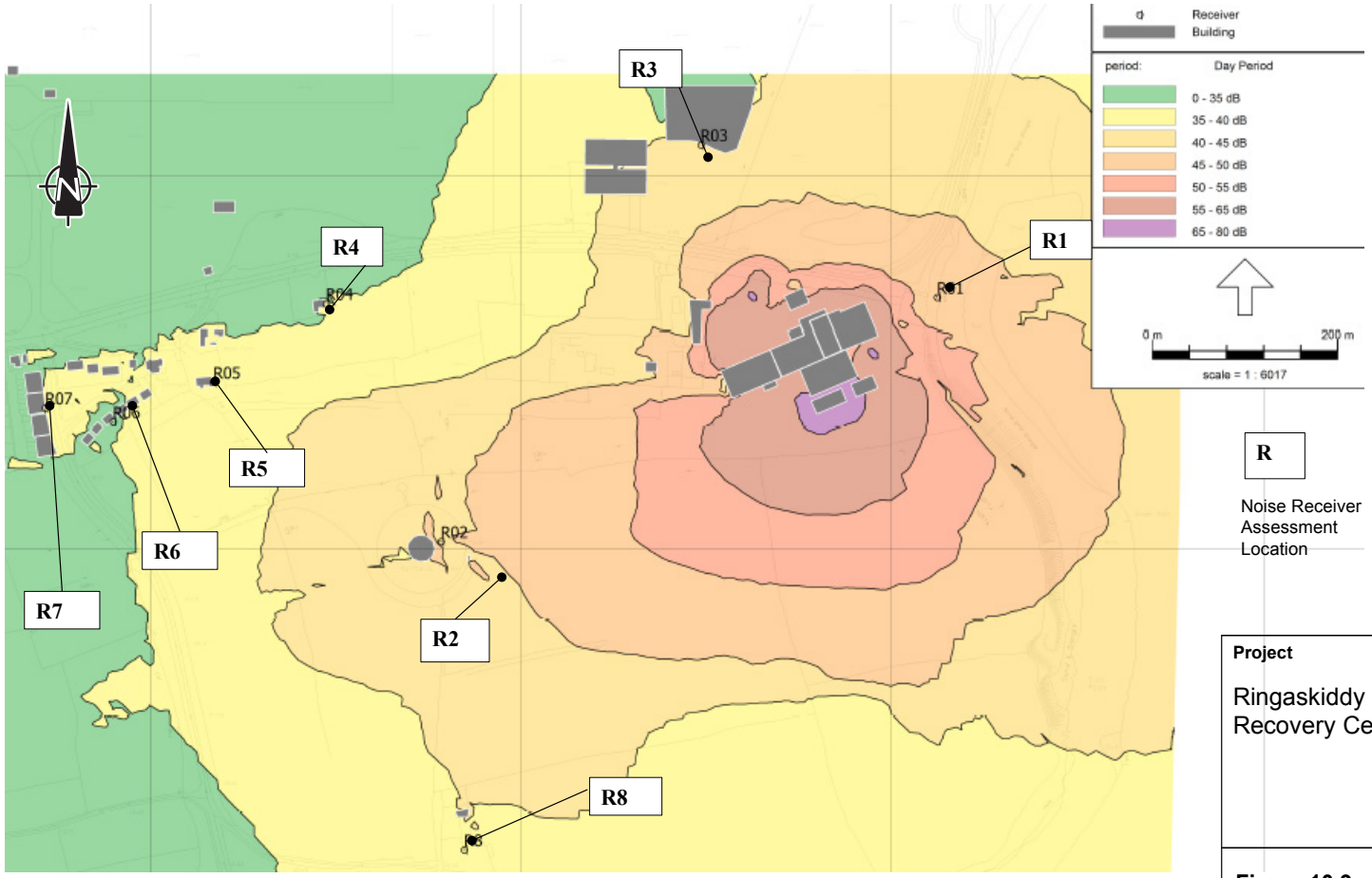
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Construction Phase 7 Calculated Noise Contours

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Figure 10.9

Operational Modelled Scenario 1

Calculated Noise Contours

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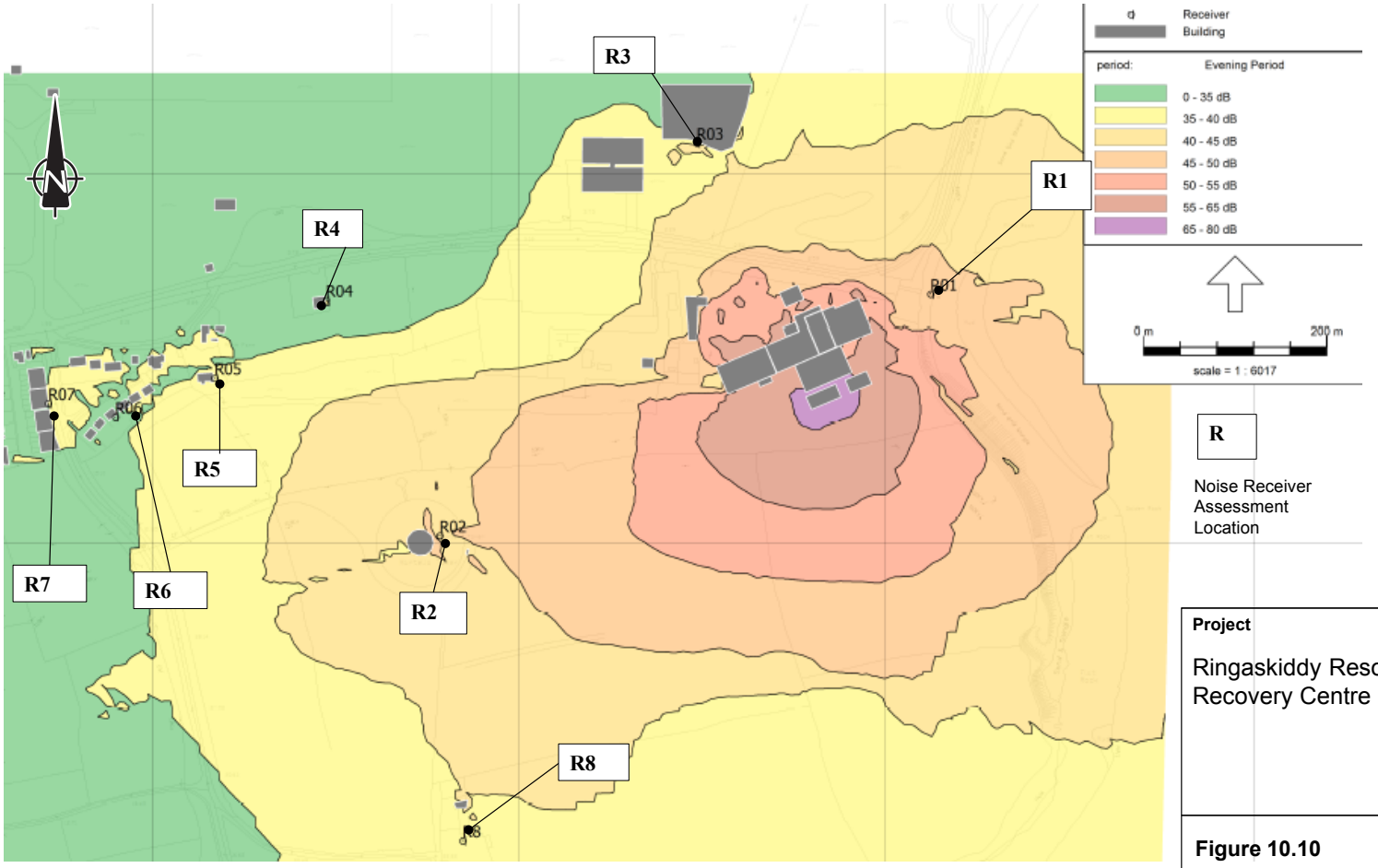
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Operational Modelled Scenario 1 Calculated Noise Contours

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Figure 10.10

Operational Modelled Scenario 2

Calculated Noise Contours

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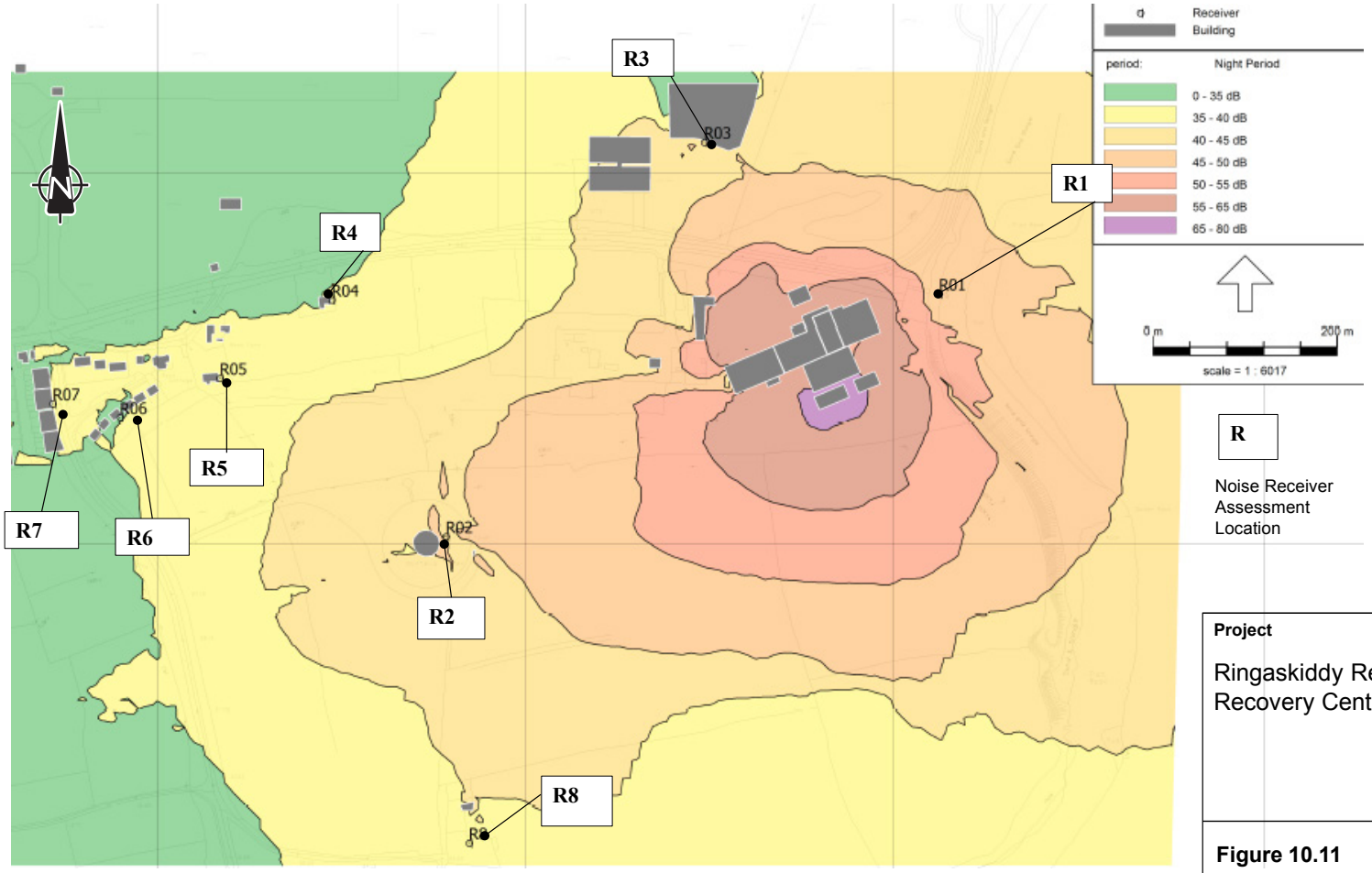
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Operational Modelled Scenario 2 Calculated Noise Contours

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Figure 10.11

Operational Modelled Scenario 3

Calculated Noise Contours

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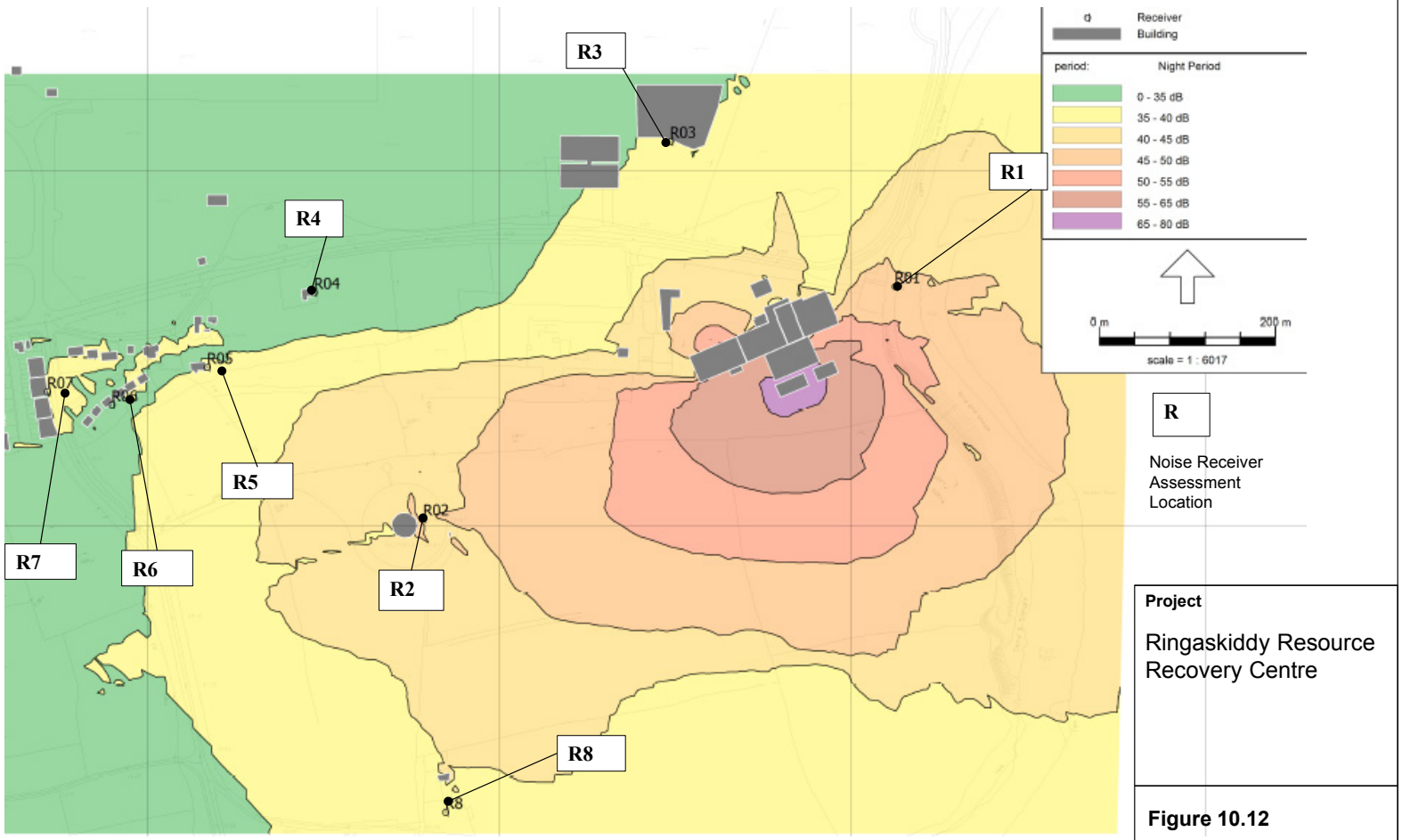
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Operational Modelled Scenario 3 Calculated Noise Contours

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Figure 10.12

Operational Modelled Scenario 4

Calculated Noise Contours

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Operational Modelled Scenario 4 Calculated Noise Contours

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