10 Noise and Vibration

10.1 Introduction

This chapter describes the likely significant noise and vibration effects resulting from the construction and operation of the proposed development. Where necessary, mitigation measures are identified to reduce effects and the likely residual construction and operational effects are described.

Chapter 4 provides a description of the proposed development and **Chapter 5** describes the Construction Strategy. The following aspects are particularly relevant to the noise and vibration assessment:

- Construction:
  - Noise and vibration associated with construction activities at the WwTP site;
  - Noise associated with the revetment construction;
  - Noise associated with the sea outfall construction;
  - Noise and vibration associated with construction activities at the interceptor sewer locations; and
  - Noise associated with construction traffic.
- Operation:
  - New sources of noise associated with the operation of the WwTP; and
  - Noise associated with operational traffic.

10.2 Assessment Methodology

10.2.1 General

This assessment considers the potential for generating significant noise and vibration impacts during the construction and operation of the proposed development and the likely significant effects of noise and vibration on sensitive receptors. Vibration has been considered during the construction phase only as there is not considered to be the potential for significant sources of vibration during the operation of the proposed development.

10.2.2 Guidance and Legislation

The noise and vibration assessment has been undertaken in accordance with the overarching EIA guidance identified in **Section 1.4.3 of Chapter 1** and in accordance with the following:

- EPA (2016) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)*[1];
- Transport Infrastructure Ireland (TII, formerly NRA) (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes*[2];
- TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*[3]; and
- British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. *Code of practice for noise and vibration control on construction and open sites. Noise and Vibration*[4].

These guidance documents, have set out noise and vibration limits during construction which are generally applied by planning authorities to all construction projects in Ireland.

10.2.3 Categorisation of the Baseline Environment

10.2.3.1 Overview of the Surveys

The baseline noise environment was determined by conducting surveys on 12 and 13 April 2018 at sensitive receptors (residential properties) in the vicinity of the proposed development. The surveys were undertaken in accordance with ISO 1996-1:2016[5].

10.2.3.2 Survey Locations

Attended noise measurements were conducted in Arklow town at three locations in the vicinity of the WwTP site and at five locations in the vicinity of the proposed interceptor sewers. These eight locations are representative of the types of receptors encountered across the proposed development.

[1] EPA (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4). Available from: http://www.epa.ie/pubs/advice/noise/guidancenotefornoiseng4.html [Accessed 24 April 2018]
[2] TII (2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes.* Available from: http://www.tii.ie/technical-services/environment/planning/Good_Practice_Guidance_for_the_Treatment_of_Noise_during_the_Planning_of_National_Road_Schemes.pdf [Accessed 24 April 2018]
[3] TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*.
[4] British Standards Institution (BSI) (2014) 5228-1 and 2:2009+A1:2014. Code of practice for noise and vibration control on construction and open sites. Noise and Vibration.
[5] ISO (2016) Acoustics – Description, measurement and assessment of environmental noise (Part 1 & Part 2).

The coordinates and descriptions of each of the survey locations are presented in **Table 10.1** and illustrated in **Figure 10.1 in Volume 3.**

Table 10.1: Description of baseline noise survey locations

Survey Location	Description	Coordinates	
		Easting	Northing
S01	Three storey residential apartment complex located on the North Quay, c. 150m west of the proposed WwTP site boundary.	325119	173280
S02	Three storey residential apartment complex located on the North Quay, c. 130m west of the proposed WwTP site boundary.	325116	173212
S03	Two storey residential dwelling located on the South Quay, c. 180m southwest of the proposed WwTP site boundary.	325114	172999
S04	Two storey residential dwelling located on the South Quay, c. 40m southwest of the nearby proposed interceptor sewer.	324922	173212
S05	Three storey residential dwelling located on the South Quay, c. 10m southwest of the proposed interceptor sewer.	324702	173445
S06	Two storey residential dwelling located adjacent to the roundabout to the northeast of Arklow bridge, c. 30m northeast of the proposed interceptor sewer.	324800	173628
S07	Three storey residential dwelling located on the South Quay, c. 25m south of the proposed interceptor sewer.	324560	173554
S08	Three storey residential dwelling located on the South Quay, c. 30m south of the nearby proposed interceptor sewer.	324293	173538

10.2.3.3 Instrumentation

A Brüel & Kjær 2250 Light Class 1 Sound Level Meter was used to carry out the baseline noise surveys. This meter complies with applicable industry standards[6]. The noise meter was calibrated before and after each measurement at each survey location using a Brüel & Kjær 4231 Acoustic Calibrator. A windshield was used to provide the microphone with effective wind protection to ensure that local meteorological conditions did not impact on the monitoring.

10.2.3.4 Meteorological Conditions

Meteorological conditions over the monitoring periods are set out in Table 10.2. Meteorological data has been taken from Johnstown Castle, Co. Wexford weather station data (the nearest weather station) for each day the surveys occurred.

Table 10.2: Meteorological conditions for survey periods

Date	Rainfall (mm)	Max Temp (°C)	Min Temp (°C)	Mean Wind Speed (m/s)
12 April 2018	0	9.9	7	3.0
13 April 2018	0	11.3	5.8	2.7

10.2.3.5 Measurement Parameters

The following parameters were recorded and reported as part of the baseline surveys:

- L_{Aeq} – this is the continuous steady sound level during the sample period and effectively represents an average value;
- L_{A10} – this is the sound level that is exceeded for 10% of the sample period. It is typically used as a descriptor for traffic noise; and
- L_{A90} – this 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 are "A-weighted" in order to account for the non-linear nature of human hearing.

10.2.3.6 Survey Periods

Measurements were conducted at the survey locations during the following survey periods:

- Between 7am and 7pm on 12 April 2018 for daytime;
- Between 7pm and 11pm on 12 April 2018 for evening time; and
- Between 11pm on 12 April 2018 and 7am on 13 April 2018 for night-time.

[6] International Electro-Technical Commission (IEC) (2002) *Specification for Sound Level Meters*.

All surveys were carried out on a week day and during time periods that were selected in order to provide a typical snapshot of the existing baseline noise environment in the vicinity of the sensitive receptors.

The results were initially noted onto a survey record sheet immediately following each sample and were also saved to the instrument memory for later analysis where appropriate. Survey personnel also noted all primary noise sources contributing to the baseline noise environment.

10.2.4 Impact Assessment Methodology

10.2.4.1 Traffic Volumes (Construction and Operation)

The TII guidance[2] states that routes should be considered for assessment where the flow of traffic volumes is likely to increase or decrease by 25% or more during construction and/or operation.

As outlined in **Section 7.4 of Chapter 7**, the operation of the proposed development will not result in offsite traffic increases of greater than 25%, therefore a detailed assessment of noise and vibration associated with traffic is not required.

During construction, there will be increases in traffic volumes due to the presence of construction vehicles and traffic diversions. These diversions will be in place for periods of between two weeks to nine months. **Chapter 4** and **Chapter 7** outlines the full details of the traffic diversions during the construction of the proposed development. Table 10.3 outlines the classification of magnitude of noise impacts in the short term for traffic noise, as stated in DMRB guidance[7].

Table 10.3: Classification of magnitude of noise impacts in the short term

Noise change, $L_{A10,18h}$	**Magnitude of Impact**
0	No change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

[7] Design Manual for Roads and Bridges, Vol 11 Section 3 Part 7 HD 213/11 Noise and Vibration. Highways Agency.

For traffic noise predictions, the Calculation of Road Traffic Noise (CoRTN)[8] was used to calculate road traffic noise as receptors are located in close proximity to the road. The noise levels are calculated based on the following inputs;

- Traffic volumes;
- Vehicle speeds and road gradient;
- Angle of view of road (degrees);
- Location of receptors;
- Road surface; and
- Any obstacles, such as screens or barriers.

10.2.4.2 Construction Noise – Limits and Significance Criteria

Airborne Construction Noise

BS 5228[4] outlines guidance on construction noise criteria with reference to the existing noise environment, as well as prediction methodologies to estimate impacts. This guidance is considered the most appropriate to apply in this instance as they consider the existing baseline noise environment and include night-time limits. BS 5228[4] states that:

"*a potential significant effect is indicated if the $L_{Aeq,\ T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.*"

Table 10.4 sets out the ABC method for establishing the impact criteria of construction noise as presented in BS5228.

Table 10.4: BS5228 (Part 1) ABC assessment categories and thresholds at dwellings [4]

Assessment Category and Threshold Value Period $L_{Aeq,\ 1\ hour}$	Threshold Value in Decibels (dB)		
	A[A)]	B[B)]	C[C)]
Night (23:00-07:00hrs)	45	50	55
Evening and weekends [D)]	55	60	65
Day (07:00-19:00hrs) and Saturdays (08:00-14:00)	65	70	75

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

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

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

D) 19:00 – 23:00hrs weekdays, 14:00-23:00hrs Saturdays and 07:00-23:00hrs Sundays.

[8] Department of Transport UK, (1988) The Calculation of Road Traffic Noise (CoRTN)

The construction noise criteria outlined in Table 10.5 has been applied at the nearest sensitive receptor to the construction works based on the BS5228[4] criteria. Sensitive receptors are defined in BS5228[4] as any occupied premises outside a site used as a dwelling, place of worship, educational establishment, hospital or similar institution or any other property likely to be adversely affected by an increase in noise level.

Table 10.5: Noise limits to be applied based on BS5228 criteria

Assessment Category and Threshold Value Period L_{Aeq}	**Standard noise limits at sensitive receptors $L_{Aeq, 1\ hour}$**	**Noise limit at S05 $L_{Aeq, 1\ hour}$**
Night (23:00-07:00hrs) (L_{Aeq}, dB)	(Cat B)50	(Cat B)50
Evening (19:00-23:00hrs) (L_{Aeq}, dB)	(Cat A) 55	(Cat A) 55
Day (07:00-19:00hrs) ($_{LAeq}$, dB)	(Cat A) 65	(Cat A) 70[9]

Where an exceedance of the construction noise criteria, as outlined in Table 10.5, is predicted, the impact associated with the noise increase is rated in accordance with Table 10.6.

Table 10.6: Likely impact associated with exceedance of construction noise criteria

Extent of Noise Impact (Exceedance of Assessment Criteria)	**Noise Impact Magnitude**	**Magnitude Rating**
Less than 3dB	No significant change/Imperceptible	Neutral to Slight Impact
Increase of 3-5dB	Slight increase	Slight to Moderate Impact
Increase of 6-10dB	Moderate Increase	Moderate to Major Impact
Increase of more than 10dB	Substantial Increase	Significant Impact

Table 10.7 outlines the duration and frequency of effect based on EPA guidance[10].

Table 10.7: Duration and frequency of effects

Effect Type	**Duration**
Momentary Effects	Effects lasting from seconds to minutes
Brief Effects	Effects lasting less than a day
Temporary Effects	Effects lasting less than a year
Short-term Effects	Effects lasting one to seven years.
Medium-term Effects	Effects lasting seven to fifteen years.
Long-term Effects	Effects lasting fifteen to sixty years.
Permanent Effects	Effects lasting over sixty years

[9] Based on Table 10.4, a daytime noise limit of 70 dBL_{Aeq} can be applied at S05 as baseline noise levels at that location (when rounded to the nearest 5 dB), are the same as Category A values.
[10] EPA (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports.

Groundborne Construction Noise

Groundborne noise is generated as a result of propagation of vibration at various frequencies. Underground tunnelling has the potential to generate such frequencies and therefore an assessment for ground borne noise has been undertaken. BS 5228[4] provides the empirical formula to estimate groundborne noise for tunnelling works. $L_p = 127 - 54log_{10}r$

where;

$L_p$is the room sound pressure level, in decibels (dB) and r is the slope distance from the pile toe or tunnel crown, in metres (m).

This formula has been adapted to the formula below based on average ground conditions that are expected to be encountered across the proposed development[11].

$$L_p = 117 - 54log_{10}r$$

There are no relevant national or international standards setting criteria for groundborne noise. The impact criteria set out in Table 10.8 and Table 10.9 have been drawn from projects in the UK and Ireland that have required tunnelling works e.g. Crossrail, the Jubilee Line extension, DART Underground and High-Speed 2.

Absolute criteria, rather than noise change criteria, apply for groundborne noise as there is rarely any appreciable ambient groundborne noise at a receptor and the character and nature of groundborne noise differs from other ambient noise heard inside buildings.

Table 10.8: Groundborne noise impact criteria for residential receptors

Impact Classification	**Groundborne Noise Level (dB L_{Amax}) measured indoors, near the centre of any dwelling room on the ground floor[12]**	
Negligible	< 35	Not Significant
Low	35-39	
Medium	40-44	Significant Impact
High	45-49	
Very High	>49	

[11] The information for vibration prediction in BS5228-2 is based on the empirical data within Transport Research Laboratory paper 429 (Groundborne vibration caused by mechanised construction works), which contains vibration data for construction processes in a number of soil types. The updated formula is based on data for tunnelling through clay.
[12] The centre of any dwelling room on the ground floor has been assumed to be 2m from the façade of any building.

Table 10.9: Groundborne noise impact criteria for non-residential receptors

Building	Significant Impact Threshold (dB L_{Amax})
Theatres / Large Auditoria & Concert Halls	25
Sound Recording / Broadcast Studios	30
Places of meeting for Religious Worship / Courts / Lecture Theatres / Museums / Small Auditoria or Halls	35
Offices / Schools / Colleges / Hospitals / Hotels / Libraries	40
Factories / Warehouses	50

10.2.4.3 Construction Vibration – Limits and Significance Criteria

Sheet Piling

Sheet piling is proposed during two construction phases of the proposed development to enable the construction of the interceptor sewer via trench works (that require piling) and at the WwTP during the installation of the below ground structures and the cofferdam for the SWO. The piling works at the WwTP will not give rise to any significant vibration impacts at the nearest sensitive receptor as these receptors are located at over 100m from the works. In contrast, due to the close proximity of sensitive receptors during the interceptor sewer piling works, this construction activity has therefore been assessed as a reasonable worst case.

Sheet piling will be carried out along the southern banks of the Avoca River; from in the vicinity of Arklow Bridge to approximately the South Green – South Quay intersection. BS 5228-2[4] provides an empirical formula to estimate groundborne vibration for vibratory sheet piling, $v_{res} = k_v/x^{\delta;}$ where;

- v_{res} is the resultant PPV (peak particle velocity) in mm/s;
- k_v is a scaling factor (60 – 266 depending on probability of predicted values being exceeded. A value of 126 has been applied for screening);
- δ is an operations factor (assumed as 1.3, the average factor over both steady state and start up/rundown operations); and
- x is the distance measured along the ground surface in metres.

Tunnelling

Tunnelling will be carried out along the entire interceptor sewer route along North Quay and for approximately 350m of the interceptor sewer route on South Quay. BS 5228-2[4] provides an empirical formula to estimate groundborne vibration for tunnelling works, $v_{res} <= 180/x^{1.3}$ where;

v_{res} is the resultant PPV in mm/s and x is the distance measured along the ground surface in metres.

This formula has been adapted to the formula below based on average ground conditions that are expected to be encountered across the proposed development[13].

$$v_{res} <= 18/x^{1.3}$$

The main source of vibration during construction will be due to tunnelling and sheet piling. The TII guidance[2] recommends that in order to ensure that there is no potential for vibration damage during construction, vibration from construction activities should be limited to 8mm/s at frequencies of less than 10Hz, to 12.5mm/s for frequencies of 10 to 50Hz and to 20mm/s at frequencies of 50Hz and above.

Separately, Table 1 in BS 7385-2[14] and Table B.2 in BS5228-2[4] outline vibration limit values for transient vibration for cosmetic damage[15]. Both standards state that:

"where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 1 may need to be reduced by up to 50%."

As the BS 7385-2 limits are directly applicable to vibration in buildings, for continuous and transient vibration, and are also more onerous at lower frequencies compared to the TII limits, they have been carried through for assessment purposes.

Table 10.10 outlines the limits for transient vibration, applied in this assessment and recommend for the construction phase of the proposed development.

Table 10.10: Vibration limits at the nearest sensitive receptor

Type of building	**Peak component particle velocity in frequency range of predominant pulse**			
	Transient		***Continuous***	
	4 Hz to 15 Hz	**15 Hz and above**	**4 Hz to 15 Hz**	**15 Hz and above**
Reinforced or framed structures (Industrial and heavy commercial buildings)	50 mm/s		25 mm/s	
Unreinforced or light framed structures (Residential or light commercial type buildings)	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25mm/s at 40 Hz and above

[13] Transport Research Laboratory paper 429: Groundborne vibration caused by mechanised construction works.
[14] BS 7385-2 (1993) Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from groundborne vibration
[15] 'Cosmetic' damage is defined in BS ISO 4866:2010 as *The formation of hairline cracks on drywall surfaces or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*

BS 5228-2[4] outlines guidance on the effects of vibration levels for humans. Vibration levels above 0.3mm/s PPV are likely to be perceptible but significantly higher values can be tolerated which will not cause annoyance. Table 10.11 outlines the likely human response to vibration levels.

Table 10.11: Human perception to vibration levels

Vibration level	Significance Level
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level

10.2.4.4 Operation – Limits and Significance Criteria

The effects of the proposed development during operation are assessed through the application of significance criteria based on predicted changes in noise level due to the proposed development. This was achieved by calculating the change in L_{Aeq} and applying a significance level as defined in Table 10.12.

Table 10.12: Significance criteria for changes in noise levels during operation [1,16,17]

Change in Sound Level (dB)	Subjective Reaction	Significance Level
None	No change	No change
<3	Inaudible	Imperceptible
4-5	Perceptible	Slight
6-10	Up to doubling of loudness	Moderate
11-15	Over a doubling of loudness	Significant
>16		Profound

[16] BSI (2014) 4142:2014. *Methods for rating and assessing industrial and commercial sound*.

[17] Department of Communications and Local Government (1994) *Planning Policy Guidance 24 (PPG24): Planning and Noise*.

The EPA guidance[1] sets out permissible levels for industrial facilities. Typical limit values (free field) for noise from industrial sites at sensitive receptors are:

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

$L_{Ar,T}$ is the rated noise level, equal to the L_{Aeq} during a specified time interval (T), plus specified adjustments for tonal character and/or impulsiveness of the sound.

$L_{Aeq,T}$ is the equivalent continuous sound level. It is an average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).

The proposed development will operate on a 24-hour basis. The limits above are applied to assess the effect of operational noise sources at the site boundary.

In addition, the lands adjacent to the WwTP are zoned for Waterfront (WZ), which includes for a mix of residential, commercial, employment, leisure and tourism uses (Refer to **Section 2.6.7 of Chapter 2** for further detail). These lands have therefore been included as future sensitive receptors for the operational assessment. The site boundary of the WwTP site is therefore considered the most suitable location to apply the operational noise limits.

10.3 Baseline Conditions

Table 10.13 presents the results of the baseline noise survey at each location. The results of the survey have indicated that baseline noise levels at all locations that have been assessed are dominated by passing traffic on the local road network. No sources of vibration were noted during the surveys.

Table 10.13: Baseline noise survey results

Survey Date and Time		Survey Location	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A10} (dB)	L_{A90} (dB)	Qualitative Description
Day – 12 April 2018	18:19 – 18:49	S01	55	82	52	40	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians, noise from a nearby playing pitch and birdsong.
	17:48 – 18:18	S02	51	80	52	44	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	16:56 – 17:12	S03	56	76	57	49	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	17:28 – 17:43	S04	55	72	58	45	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included distant industrial noise from Arklow marina, noise from pedestrians and birdsong.
	16:11 – 16:26	S05	63	81	65	60	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included water flow under Arklow bridge, noise from pedestrians and birdsong.
	16:29 – 16:44	S06	61	83	63	56	The dominant noise source at this location was local traffic on the adjacent roundabout. Other sources of noise included water flow under Arklow bridge and noise from pedestrians.
	15:53 – 16:08	S07	51	65	53	48	The dominant noise source at this location was local traffic. Other sources of noise included distant traffic, noise from pedestrians and birdsong.
	15:28 – 15:43	S08	44	68	45	40	The dominant noise source at this location was birdsong. Other sources of noise included distant traffic and noise from pedestrians.
Evening – 12 April 2018	19:00 – 19:30	S01	52	86	48	39	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from a nearby playing pitch and birdsong.

Survey Date and Time		Survey Location	L_{Aeq} (dB)	L_{Amax} (dB)	L_{A10} (dB)	L_{A90} (dB)	Qualitative Description
	19:32 – 20:02	S02	48	66	50	43	The dominant noise source at this location was local traffic on North Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
	20:21 – 20:51	S03	53	72	54	44	The dominant noise source at this location was local traffic on South Quay. Other sources of noise included industrial noise from Arklow marina, noise from pedestrians and birdsong.
Night – 12 /13 April 2018	23:47 – 00:02	S01	45	65	46	43	Noise sources included occasional local traffic on North Quay, distant traffic noise and the movement of water in the Avoca River.
	23:30 – 23:45	S02	45	64	47	42	Noise sources included occasional local traffic on North Quay, distant traffic noise and the movement of water in the Avoca River.
	23:01 – 23:16	S03	47	68	47	44	Noise sources included occasional local traffic on South Quay, distant traffic noise and the movement of water in the Avoca River.
	23:19 – 23:24	S04	47	69	48	42	Noise sources included occasional local traffic on South Quay, distant traffic noise and the movement of water in the Avoca River.

10.4 Likely Significant Effects

10.4.1 Do-Nothing Scenario

In the scenario where the proposed development does not proceed as planned, none of the effects as set out in this chapter would occur. Under the 'do nothing' scenario, the noise and vibration baseline as presented in **Section 10.3** would persist and no significant effects would arise.

10.4.2 Assessment of Effects During Construction

10.4.2.1 Construction Phasing and Plant

The construction of the proposed development will involve construction activities within each of the working areas including WwTP site works, interceptor sewer trench construction works and tunnelling and construction of a sea outfall.

It is not possible at this stage to predict the exact equipment that will be chosen by the contractor(s) and predicted calculations are indicative only and used for the purposes of comparison with the adopted criteria. Based on the indicative construction programme (Refer to **Appendix 5.2**), a reasonable worst-case assessment has been undertaken. For the purposes of this assessment, the following construction phases are considered for the construction of the WwTP and the interceptor sewers:

- WwTP
  - Site preparation;
  - General site activities;
  - Building construction;
  - Revetment construction; and
  - Sea outfall construction.
- Interceptor Sewer
  - Open trench works (soil stripping, excavation, piling, rock breaking, pipe laying, backfilling, reinstatement);
  - Shaft construction;
  - Tunnelling; and
  - Sheet Piling.

The calculations assume that plant and equipment are operating simultaneously, as outlined in the following sections. Mitigation, in the form of a 2.4m hoarding, has been applied to each of the modelling scenarios. In practice, a reduction up to 10dB(A) can be achieved for hoarding of this height.

For the construction of the WwTP, open trench works and construction of the tunnelling shafts, a 10dB(A) reduction has been assumed on the basis that the noise sources are completely screened from sensitive receptors[4]. For the outfall and revetment upgrade works a 5dB(A) reduction has been assumed on the basis that the noise sources are partially screened from sensitive receptors[4].

The calculations also assume that all plant and equipment associated with the individual phases are operating simultaneously and at the distance specified in Table 10.14, Table 10.16, Table 10.18, Table 10.21, Table 10.22 and Table 10.23

Typically, construction will be from 7am to 7pm, Monday to Friday and 8am to 2pm on Saturday. However, during the construction of tunnel section of the interceptor sewer, the Tunnel Boring Machine (TBM) equipment (including generator) will operate continuously. Tunnelling will occur 24-hours a day, seven days per week and has been conservatively estimated to take 20-25 days per 100m section (including setup and removal), although this is dependent on the rate of progress of tunnelling. It is envisaged that a tunnelling rate of up to 10m per day can be achieved but for assessment purposes the conservative rate of progress has been assumed herein.

It is anticipated that the tunnelling works will take approximately one year and the construction of the subsurface and above ground structures, as well as the outfalls and the revetment for the WwTP will take approximately 22 months.

No additional works other than tunnelling are anticipated on Sundays and Bank Holidays. Notwithstanding the 24-hour use of the tunnelling equipment, it is anticipated that there may be times due to exceptional circumstances that construction activities may be necessary outside of the standard hours. This will be agreed in advance with Wicklow County Council and communicated to local residents with an estimation of the timing and duration.

10.4.2.2 WwTP

Table 10.14 outlines the number and type of plant and equipment assumed to be required during construction of the WwTP, along with the percentage time in operation, during the site preparation, general activities and building construction.

Table 10.14: Specification and number of equipment for each construction phase of the WwTP

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Site Preparation				
Tracked Excavator	C.1.12	3	110	66
Dump Truck	C.2.30	2	107	66
Crusher	C.1.14	1	110	66
Tower Crane	C.4.48	1	104	66
Breaker Mounted on Excavator	C.1.9	1	118	66
General Activities				
Piling	C.3.14	1	111	66
Tracked Excavator	C.1.12	2	110	66
Dump Truck	C.2.30	2	107	66
Angle Grinder	C.4.93	1	108	66
Tower Crane	C.4.48	1	104	66
Generator	C.4.84	2	102	66
Building Construction				
Cement Mixer Truck	C.4.18	2	103	66
Poker Vibrator	C.4.33	2	106	66
Tower Crane	C.4.48	1	104	66
Generator	C.4.84	1	102	66
Tracked Excavator	C.1.12	2	110	66
Circular Saw	C.4.72	1	107	66
Water Pump	C.2.46	2	93	66

Table 10.15 outlines the results for the site preparation, general site activities and construction phases at the three nearest sensitive receptors to the WwTP site (Refer to **Figure 10.2 in Volume 3**).

Table 10.15: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP during daytime

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level daytime (dBA)	Predicted Noise Level ($L_{Aeq, 1\ hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Site Preparation	R52	55	59	60	Moderate
	R51	51	57	58	Moderate
	R36	56	56	59	Slight
General Activates	R52	55	55	58	Slight
	R51	51	54	56	Slight
	R36	56	52	57	Imperceptible
Building Construction	R52	55	54	58	Slight
	R51	51	53	55	Slight
	R36	56	51	57	Imperceptible

The results of the assessment indicate that for the site preparation, general activities and construction of the WwTP, the daytime noise limit of 65 dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term imperceptible negative impact to short term moderate negative impact.

The above calculations are indicative and are used for the purposes of comparison only with the adopted criteria.

10.4.2.3 Revetment

Table 10.16 outlines the number and type of plant and equipment assumed to required during construction of the revetment upgrade, along with the percentage time in operation, during the revetment upgrade works adjacent to the WwTP.

Table 10.16: Specification and number of equipment for revetment construction works

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Tracked Excavator	C.1.12	3	110	66
Dump Truck	C.2.30	2	107	66
Crusher	C.1.14	2	110	66
Tower Crane	C.4.48	2	104	66
Breaker Mounted on Excavator	C.1.9	1	118	66
Generator	C.4.84	2	102	66
Water Pump	C.2.46	2	93	66

Table 10.17 outlines the results for the revetment upgrade works at the three nearest sensitive receptors to the WwTP site (refer to **Figure 10.2 in Volume 3**).

Table 10.17: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for revetment works

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level (dBA)	Predicted Noise Level ($L_{Aeq, 1\ hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Revetment Construction	R52	55	60	61	Slight
	R51	51	60	61	Significant
	R36	56	58	60	Slight
	R55	55	61	62	Moderate

The results of the assessment indicate that for the revetment upgrade works, the daytime noise limit of 65 dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term slight negative impact to short term significant negative impacts.

The above calculations are indicative and are used for the purposes of comparison only with the adopted criteria.

10.4.2.4 Outfall

Construction of the long sea outfall will include works from both the land and sea. It is expected that several vessels may be required during the construction of the outfall and that diving support is likely to be required at times.

Section 5.6.5.1 of Chapter 5 outlines in detail the potential methods for the construction of the marine outfall. Based on current practice and site constraints/characteristics there are considered to be three potential construction methodologies:

- Horizontal directional drilling method;
- Flood and float method; and
- Bottom-pull method.

As the flood and float method and bottom pull method are deemed to generate more noise that the directional drilling option, these works have been assessed as a worst case.

Table 10.18 outlines the number and type of equipment assumed to be required for construction of the outfall, along with the percentage time in operation, during the sea outfall construction works adjacent to the WwTP site in the Irish Sea. Specification for the equipment and operational times have been taken from BS 5228-1[4]

Table 10.18: Specification and number of equipment for construction of the outfall

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Dredging	D.12.1	1	124	100
Loading dredged aggregates	D.12.4	1	112	100
Grab – hopper dredging ship	C.7.2	1	110	100

Table 10.19 outlines the results for the outfall construction works at the three nearest sensitive receptors to the WwTP site (refer to **Figure 10.2 in Volume 3**).

Table 10.19: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for construction of the outfall

Phase	Receptor ID (see Figure 10.2)	Baseline Noise Level (dBA)	Predicted Noise Level ($L_{Aeq, 1\ hr}$) dB(A)	Total predicted noise level dB(A)	Impact Rating (refer to Table 10.6)
Outfall Construction	R52	55	62	59	Moderate
	R51	51	63	58	Significant
	R36	56	63	60	Moderate

The results of the assessment indicate that for the outfall construction works, the daytime noise limit of 65 dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term moderate negative impact to short term significant negative effects.

The construction of the outfall has the potential for impacting marine mammals. Without mitigation, these impacts may have a short term significant impact on mammals, however, with the mitigation measures outlined in **Section 10.5.1.2**, the effects will not be significant.

10.4.2.5 Impact of WwTP, Sea Outfall and Revetment Construction

Table 10.20 outlines the results of the cumulative assessment for works ongoing at the WwTP, outfall and revetment simultaneously.

Table 10.20: Predicted sound pressure levels at the nearest sensitive receptors to the WwTP for works ongoing at the WwTP, outfall and revetment simultaneously

Phase	**Receptor ID (see Figure 10.2)**	**Baseline Noise Level daytime (dBA)**	**Predicted Noise Level ($L_{Aeq, 1 hr}$) dB(A)**	**Total predicted noise level dB(A)**	**Impact Rating (refer to Table 10.6)**
WwTP Site Preparation with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	65	65	Moderate
WwTP General Activities with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	64	64	Moderate
WwTP Building Construction with Revetment and sea outfall construction	R52	55	65	65	Significant
	R51	51	65	65	Significant
	R36	56	64	65	Moderate

The results of the assessment indicate that for the simultaneous WwTP works, the revetment works and outfall construction, the daytime noise limit of 65dB L_{Aeq} can be complied with at the nearest sensitive receptors to the WwTP site. The impact ratings associated with these works range from short term moderate negative impact to short term significant negative effects.

10.4.2.6 Interceptor Sewer Works (Airborne Noise)

Table 10.21 to Table 10.23 outlines the number and type of equipment assumed to be in operation, along with the percentage time in operation, during open trench works, construction of shafts and the operation of the tunnelling equipment.

Table 10.21: Specification and number of equipment in use for open trench works

Plant included in site preparation assessment	**BS 5228 [4] reference**	**Number**	**Sound Power Level (L_w) dB**	**Percentage time in operation (%)**
Open trench works (soil stripping)				
Tracked Excavator	C.2.18	1	103	50
Dozer	C.5.12	1	105	50
Open trench works (excavation)				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Open trench works (sheet piling)				
Mobile Crane	C.3.29	1	98	50
Sheet Piling	C.3.6	1	96	50
Open trench works (rock breaking)				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Hydraulic Rock Breaker	C.1.8	1	102	50
Open trench works (pipe laying)				
Mobile Crane	C.3.29	1	98	50
Lorry	C.2.34	1	108	30 Note 1
Open trench works (backfilling)				
Tracked Excavator	C.2.18	1	103	50
Articulated Dump Truck	C.5.16	1	104	50
Open trench works (reinstatement)				
Tracked Excavator	C.2.18	2	103	50
Dozer	C.5.12	1	105	50

Note 1 – limited operational time required during pipe laying

Table 10.22: Specification and number of equipment in use for shaft construction

Plant and equipment included in assessment	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
Shaft construction				
Piling Rig	C.3.17	1	104	50
Hydraulic Rock Breaker	C.1.8	1	102	50
Excavator	C.2.18	1	103	50
Dozer	C.5.12	1	105	50
Articulated Dump Truck	C.5.16	1	104	50
Water Pump	C.5.40	1	96	50
Mobile Crane	C.3.29	1	98	50

Table 10.23: Specification and number of equipment in use for tunnelling[18]

Plant and equipment included in assessment	Number	Sound Power Level (L_w) dB	Percentage daytime in operation (%)	Percentage evening time and night time in operation (%)
TBM				
Base Tanks and Pump	1	99	25	25
Screens	2	90	100	100
Desilter	1	92	100	100
Centrifuge	1	91	100	100
Cascade	1	92	100	100
Setting tanks and pumps	2	94	100	100
Compressor	1	100	100	100
Generator	1	87	100	100
Dump Truck	1	102	100	0
Excavator	1	99	25	0
Water Pump	1	93	100	100
Mobile Crane	2	95	20	5

Table 10.24 to Table 10.27 outline the results for the open trench works, launch and retrieval shaft construction and tunnelling construction phases at various distances from the proposed interceptor sewer locations.

[18] Dublin City Council (2012) Ringsend Wastewater Treatment Works Extension Environmental Impact Statement.

Banded distances have been selected to reflect the moving nature of the works with the closest sensitive receptor along the scheme approximately 10m from open trench works and 15m from shaft construction and tunnelling.

Table 10.24: Predicted sound pressure levels at banded distances for open trench works

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	10m	**20m**	**30m**	**40m**
Open Trench Works – Soil Stripping	66	60	57	54
Open Trench Works – Excavation	66	60	56	53
Open Trench Works – Piling	59	53	50	47
Open Trench Works – Rock Breaking	67	61	57	55
Open Trench Works – Pipe Laying	65	59	56	53
Open Trench Works – Backfilling	66	60	56	53
Open Trench Works – Reinstatement	66	60	57	54

The predicted results for the open trench works for the interceptor sewer, show slight exceedances of 1 to 2 dB for the daytime noise limit of 65 dB L_{Aeq} at 10m distance from the works.

Table 10.25: Predicted sound pressure levels at banded distances for open shaft construction

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	15m	**30m**	**45m**	**60m**
Shaft construction	67	61	57	54

The predicted results for shaft construction works for the interceptor sewer, show slight exceedances of 2dB for the daytime noise limit of 65 dB L_{Aeq} at 15m from the works.

As stated in **Section 10.5.1.1**, it is not possible at this stage to select the exact plant and equipment that will be chosen by the contractor(s) and so the above calculations are indicative and are used for the purposes of comparison only with the adopted criteria, using conservative estimates for plant, equipment and expected attenuation due to mitigation measures. It will be the responsibility of the contractor to minimise significant negative effects at nearby receptors for the duration of the construction works.

Table 10.26: Predicted sound pressure levels at banded distances for tunnelling – daytime

Phase	**Predicted Noise Level ($L_{Aeq, 1 hr}$) at various distances**			
	15m	**30m**	**45m**	**60m**
TBM tunnelling	65	59	55	53

Table 10.27: Predicted sound pressure levels at banded distances for tunnelling evening time and night-time

Phase	Predicted Noise Level ($L_{Aeq, 1\ hr}$) at various distances			
	15m	30m	45m	60m
TBM tunnelling	63	57	54	51

The predicted results in Table 10.26 for airborne noise for tunnelling works during daytime for the interceptor sewer, show compliance with the daytime noise limit of 65 dB L_{Aeq}. Furthermore, as the tunnelling works progress away from the launch shaft noise levels will reduce further due to ground attenuation i.e. sound being contained and absorbed by the soil surrounding the TBM. Noise levels will likely reduce by up to 10dB during tunnelling works at distance from the launch shafts. The time predicted is based on a conservative tunnelling progress rate of 4m/day (25 days for 100m, as referred to in **Section 10.4.2.1**). It is envisaged that a tunnelling rate of up to 10m per day can be achieved.

The predicted results in Table 10.27 for airborne noise for tunnelling works during evening time and night-time for the interceptor sewer, show exceedances with the evening time and night-time noise limit of 55 dB L_{Aeq} and 50 dB L_{Aeq}, respectively. These exceedances are predicted to be short term significant negative impacts. Again, noise levels will likely reduce by up to 10dB during tunnelling works at distance from the launch shafts.

10.4.2.7 Impact Assessment for Residential receptors – Trench Works

Table 10.28 outlines the predicted sound pressure levels and impact ratings at each of the monitoring locations during trench works. Green shaded results indicate compliance.

The results of the assessment outlined in Table 10.28 indicate that at two of the three receptors assessed (S07 and S08), the predicted daytime noise at both receptors can comply with the daytime noise limit of 65 dB $L_{Aeq.}$ Table 10.28 also indicates that at S05, predicted noise levels are compliant with the daytime noise limit of 70 dB L_{Aeq}.

The impact rating for these works show that two of the three receptors modelled (S07 and S08) may experience significant short term negative impacts.

Table 10.28: Predicted sound pressure levels and impact ratings at monitoring locations during trench works.

Receptor Number	**Measured Daytime Noise Level (dBA_{LAeq})**	**Soil Stripping**	**Excavation**	**Piling**	**Rock Breaking**	**Pipe Laying**	**Backfilling**	**Reinstatement**
Predicted noise level from works (dB(A))								
S05		68	67	61	69	67	67	68
S07		63	62	56	63	62	62	63
S08		60	60	53	61	59	60	60
Total noise level (dB(A))								
S05	63	69	68	65	70	68	68	69
S07	51	63	62	57	63	62	62	63
S08	44	60	60	54	61	59	60	60
Predicted increase in noise levels (dBA)								
S05	63	6	5	2	7	5	5	6
S07	51	12	11	6	12	11	11	12
S08	44	16	16	10	17	15	16	16
Impact rating (refer to **Table 10.6**)								
S05	63	Moderate	Moderate	Imperceptible	Moderate	Slight	Slight	Moderate
S07	51	Significant	Significant	Moderate	Significant	Significant	Significant	Significant
S08	44	Significant	Significant	Moderate	Significant	Significant	Significant	Significant

10.4.2.8 Impact Assessment for Residential Receptors – Shaft Construction and Tunnelling

Table 10.29 outlines the predicted sound pressure levels and impact ratings at each of the monitoring locations during shaft construction and tunnelling. Green shaded results indicate compliance while red shaded results indicate exceedances.

The results of the assessment outlined in Table 10.29 indicate that at each of the five receptors assessed, for shaft construction and tunnelling, the daytime noise limit of 65 dB L_{Aeq} can be complied with at three of the five receptors (S01, S02 and S03). Two receptors (S02 and S04) may potentially experience significant short term negative impacts during shaft construction.

During evening time works for tunnelling, one of the three receptors modelled (S02) may exceed the evening time noise limit of 55 dB L_{Aeq}. S02 may potentially experience significant short term negative impacts during tunnelling. Table 10.29 also indicates that at S03, predicted noise levels are compliant with the evening time noise limit of 55 dB L_{Aeq}.

During night time works for tunnelling, all four of the receptors modelled may exceed the night time noise limit of 50 dB L_{Aeq}. All four receptors will also experience a significant short term negative impacts during tunnelling.

Table 10.29: Predicted sound pressure levels and impact ratings at monitoring locations during shaft construction and TBM operation.

Time	Receptor Number	Baseline Noise Level (dBA)	Predicted Construction Noise Level (dBA)		Predicted Total Noise Level (dBA)		Predicted Increases in Noise Levels (dBA)		Impact Rating (refer to Table 10.6)	
			Shaft construction	TBM	Shaft construction	TBM	Shaft construction	TBM	Shaft construction	TBM
Day time	S01	55	60	57	61	59	6	4	Moderate	Slight
	S02	51	63	60	63	61	12	10	Significant	Moderate
	S03	56	58	55	60	59	4	3	Slight	Slight
	S04	55	67	64	67	65	12	10	Significant	Moderate
	S06	61	64	61	66	64	5	3	Slight	Slight
Evening Time	S01	52	No shaft construction during evening or night time	55		57		5		Slight
	S02	48		59		59		11		Significant
	S03	53		54		57		4		Slight
Night Time	S01	45		55		55		10		Significant
	S02	45		59		59		14		Significant
	S03	47		54		55		8		Significant
	S04	47		62		62		15		Significant

10.4.2.9 Interceptor Sewer (Groundborne Noise)

Table 10.30 presents the predicted results for the groundborne noise assessment at sensitive receptors and are compared to the values in Table 10.8 and Table 10.9.

Table 10.30: Predicted groundborne sound pressure levels for tunnelling

Nearest sensitive receptor to tunnelling works	Receptor type	Approximate slope distance to TBM (m)	Predicted Noise Level dBL_{Amax}	Impact Classification (refer to Table 10.6)
R01	Residential	40	30	Negligible
R02	Residential	56	22	Negligible
R03	Residential	25	42	Medium
R04	Residential	44	28	Negligible
R05	Residential	15	54	Very High
R06	Residential	19	48	High
R07	Residential	23	45	High
R08	Residential	25	42	Medium
R09	Residential	26	41	Medium
R10	Residential	59	21	Negligible
R11	Residential	27	40	Medium
R12	Residential	27	40	Medium
R13	Residential	57	22	Negligible
R14	Residential	26	41	Medium
R15	Residential	25	42	Medium
R16	Residential	21	46	High
R17	Residential	57	22	Negligible
R18	Residential	17	51	Very High
R19	Residential	31	36	Low
R20	Residential	18	50	Very High
R21	Residential	16	52	Very High
R22	Residential	17	51	Very High
R23	Residential	46	27	Negligible
R24	Residential	37	32	Negligible
R25	Residential	18	50	Very High
R26	Residential	16	52	Very High
R27	Residential	12	59	Very High
R28	Residential	42	29	Negligible
R29	Residential	39	31	Negligible
R30	Residential	36	33	Negligible

Nearest sensitive receptor to tunnelling works	Receptor type	Approximate slope distance to TBM (m)	Predicted Noise Level dBL_{Amax}	Impact Classification (refer to Table 10.6)
R31	Residential	34	35	Low
R32	Residential	30	38	Low
R33	Residential	26	41	Medium
R34	Commercial	12	58	Very High[19]
R35	Commercial	23	43	Negligible[19]
R36	Residential	42	29	Negligible
R37	Residential	47	27	Negligible
R38	Residential	40	30	Negligible
R39	Residential	33	35	Low
R40	Residential	28	39	Medium
R41	Church	55	23	Negligible[20]
R42	Residential	45	28	Negligible
R43	Doctor Surgery	18	50	High[21]
R44	Residential	51	25	Negligible
R45	Residential	20	47	High
R46	Commercial	25	42	Negligible[19]
R47	Sailing club	29	38	Negligible[19]
R48	Commercial	14	55	Medium[19]
R49	Residential	36	33	Low
R50	Residential	24	43	Medium
R51	Residential	14	54	Very High
R52	Residential	15	53	Very High
R53	Residential	34	34	Low
R54	Commercial	12	59	High[19]

The results in Table 10.30 have been summarised in Table 10.31 for assessment purposes.

[19] Using a significance threshold of 50dBL_{Amax} as outlined in Table 10.9, a factored rating is applied to this receptor.

[20] Using a significance threshold of 35dBL_{Amax} as outlined in Table 10.9, a factored rating is applied to this receptor.

[21] Using a significance threshold of 40dBL_{Amax} as outlined in Table 10.9, a factored rating is applied to this receptor.

Table 10.31: Summary of impact classifications for groundborne noise

Impact Classification (see Table 10.8)		**Number of receptors**	**List of receptors**
Not significant	Negligible	20	R1,2,4,10,13,17, 23,24,28,29,30,35,36,37,38,41 ,42,44,46,47.
	Low	6	R19,31,32,39,49,53
Significant	Medium	11	R3,8,9,11,12,14,15,33,40,48,5 0.
	High	6	R6, 7,16,43,45,54.
	Very High	11	R5,18,20,21,22,25,26,27,34,51 ,52.

The results presented in Table 10.31 show that of the 54 receptors assessed, the impact at 26 of these are considered not significant, 11 are considered of medium significance, 6 of high significance and 11 of very high significance. All impacts are considered short term negative, see Table 10.7.

Based on the results in Table 10.31, Table 10.32 predicts the length of time before the impact associated with groundborne noise at each receptor (identified in Table 10.31) is rated as not significant due to the movement of the TBM away from each the receptor. The time predicted is based on a conservative tunnelling progress rate of 4m/day (25 days for 100m, as referred to in **Section 10.4.2.1**). It is envisaged that a tunnelling rate of up to 10m per day can be achieved.

Table 10.32: Time required (in days) to reduce groundborne noise impact to not significant

Receptor	**Receptor type**	**Approximate slope distance to TBM (m)**	**Approximate slope distance required before compliant with appropriate limit (m)**	**Time required for TBM to reach required slope distance from a receptor (days)**
R05	Residential	14	23	<5
R06	Residential	18		<3
R07	Residential	21		<1
R16	Residential	20		<2
R18	Residential	16		<4
R20	Residential	17		<3
R22	Residential	16		<4
R25	Residential	17		<3
R26	Residential	15		<4
R27	Residential	11		<6
R34	Residential	12		<6

Receptor	Receptor type	Approximate slope distance to TBM (m)	Approximate slope distance required before compliant with appropriate limit (m)	Time required for TBM to reach required slope distance from a receptor (days)
R45	Residential	19		<2
R51	Residential	12		<5
R52	Residential	13		<4
R27	Residential	12		<6
R54	Commercial	12	18	<3
R43	Doctors	18	23	<3

In such circumstances, projects have considered using noise insulation or temporary re-housing as mitigation measures to prevent unacceptable levels of noise affecting receptors. In the case of groundborne noise, noise insulation will not mitigate against this type of noise, as the path of transmission is not through the windows, and so only temporary re-housing is an option in this case.

BS5228-1[4] provides an example of noise insulation and temporary rehousing policy, based on those adopted by several large infrastructure schemes in the UK. In addition to defining the threshold value of eligibility, this recommends a minimum number of days before a resident may be eligible. Where minimum durations of *a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any 6 consecutive months,* are predicted, BS 5228-1[4] recommends re-housing as an appropriate mitigation measure.

It is important to note that the predicted groundborne levels are an estimate based on the BS 5228[4] empirical formula, while in practice it is possible that the impact may be lower. The finalised construction details, plant and equipment for the proposed development are not known at present. The appointed contractor(s) will outline the specific construction methodologies and agree a schedule that minimises the impact on the effected receptors.

Any requirement for temporary re-housing will be confirmed by the contractor(s) in consultation with Irish Water and the affected stakeholder. The determination for such mitigation will be made after detailed construction methodologies, phasing and detailed equipment are known. This information will be presented in the Noise and Vibration Management Plan (NVMP), a template for which is included an appendix to the Outline CEMP (Refer to Appendix 5.1).

As outlined in **Section 10.6.2.1**, continuous noise monitoring will be undertaken at the three nearest receptors during the construction phase of the proposed development to measure compliance with the limit values presented in Table 10.5.

10.4.2.10 Interceptor Sewer (Vibration)

Table 10.33 presents the calculated groundborne vibration levels that may be experienced at the nearest sensitive receptor and compares these to the values in Table 10.10.

Table 10.33: Predicted vibration levels for tunnelling

Nearest sensitive receptor to tunnelling works	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
R01	Residential	38	0.16
R02	Residential	54	0.10
R03	Residential	22	0.32
R04	Residential	42	0.14
R05	Residential	12	0.71
R06	Residential	16	0.49
R07	Residential	19	0.39
R08	Residential	22	0.32
R09	Residential	23	0.31
R10	Residential	57	0.09
R11	Residential	24	0.29
R12	Residential	24	0.29
R13	Residential	55	0.10
R14	Residential	23	0.31
R15	Residential	22	0.32
R16	Residential	18	0.42
R17	Residential	55	0.10
R18	Residential	14	0.58
R19	Residential	29	0.23
R20	Residential	15	0.53
R21	Residential	13	0.64
R22	Residential	14	0.58
R23	Residential	44	0.13
R24	Residential	35	0.18
R25	Residential	15	0.53
R26	Residential	13	0.64
R27	Residential	8	1.03
R28	Residential	40	0.15
R29	Residential	37	0.16
R30	Residential	33	0.19
R31	Residential	31	0.21

Nearest sensitive receptor to tunnelling works	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
R32	Residential	27	0.25
R33	Residential	23	0.31
R34	Residential	10	0.90
R35	Residential	21	0.34
R36	Residential	40	0.15
R37	Residential	45	0.13
R38	Residential	38	0.16
R39	Residential	30	0.22
R40	Residential	25	0.27
R41	Church	53	0.10
R42	Residential	43	0.14
R43	Doctor Surgery	15	0.53
R44	Residential	49	0.11
R45	Residential & commercial	17	0.45
R46	Commercial	22	0.32
R47	Sailing club	26	0.26
R48	Commercial	11	0.80
R49	Residential	33	0.19
R50	Residential	21	0.34
R51	Residential	10	0.90
R52	Residential	11	0.80
R53	Residential	31	0.21
R54	Commercial	7	1.43

The result of the assessment show that at all receptors the predicted vibration levels will be in good compliance with the vibration limits as presented in Table 10.10. The potential impact is assessed as negligible in terms of potential for building damage. All impacts are considered short term, see Table 10.7.

Table 10.33 shows that the tunnelling works may exceed the level of 1mm/s at two receptors (R27 and R54). In general, it is recommended that prior notice be given to local residents before tunnelling commences. The proposed development will involve open trench works underneath Arklow Bridge. Based on the results for tunnelling, the impact of the trench works is not considered significant.

It should be noted that the predicted groundborne levels are an estimate based on the BS 5228 empirical formula, while in practice it is possible that the impact may be lower.

As stated in **Section 10.5.1.1**, it is not possible at this stage to select the exact plant and equipment that will be chosen by the contractor(s) and so the above calculations are indicative and used for the purposes of comparison only with the adopted criteria. It will be the responsibility of the contractor to minimise impacts at nearby receptors for the duration of construction.

10.4.2.11 Sheet Piling (Vibration)

Table 10.34 presents the calculated groundborne vibration levels that may be experienced at the nearest sensitive receptor and compares these to the values in **Table 10.10**.

Table 10.34: Predicted vibration levels for sheet wall piling

Nearest sensitive receptor to tunnelling works (see Figure 10.3)	Receptor type	Distance measured along the ground surface (m)	PPV (mm/s)
V01	Residential	11	5.9
V02	Commercial	12	5.0
V03	Commercial	13	4.7
V04	Residential	14	4.0
V05	Residential	12	5.3
V06	Residential	10	6.2
V07	Residential	14	4.2
V08	Residential	16	3.5
V09	Residential	16	3.5
V10	Residential	18	2.9
V11	Residential	23	2.2
V12	Residential	17	3.2
V13	Residential	17	3.2

The result of the assessment shows that at all residential and commercial receptors the predicted vibration levels are in compliance with the vibration limits as presented in Table 10.10 for transient vibration. All impacts are considered short term, see Table 10.7

Table 10.34 shows that the tunnelling works may exceed the level of 1mm/s at all receptors which may cause residential complaints. As outlined in Table 10.10, vibration above 10mm/s is likely to be intolerable for any more than a very brief exposure to this level. In general, it is recommended that prior notice be given to local residents before tunnelling commences.

It should be noted that the predicted groundborne levels are an estimate based on the BS 5228 empirical formula, while in practice it is possible that the impact may be lower.

10.4.2.12 Arklow Bridge Works

The proposed interceptor sewer will pass under the most southern arch of Arklow Bridge. At this point, the sewer will be approximately 3m-3.5m below ground level and approximately 1m below the existing river bed. **Chapter 5** outlines in details the various methodologies which may be used for the underpinning works including:

- Grouting and traditional underpinning;
- Mini piling; and
- Load bearing pile.

The underpinning and lowering of the floor of the bridge is likely to entail the following activities:

- Grouting each of the piers and the abutments of Arklow Bridge and the river bed to a depth of up to 2m below the piers and abutments, including drilling of holes to accommodate the grouting from the bridge deck, in order to stabilise the bridge and its formation during the underpinning works (Refer to **Figure 5.6 in Chapter 5**);
- Construction of a temporary causeway from the river bank to provide access to each of the piers and abutments;
- Creation of a bund around each pier or group of piers to allow works to be carried out in a dry environment;
- Removal of existing formation in a phased manner from the underside of each pier and abutment to a depth of approximately 1.6m below existing bed level and replacement with concrete (Refer to **Figure 5.7 in Chapter 5**); OR
- Construction of mini-piles around each pier to support the pier foundation (Refer to **Figure 5.8 in Chapter 5**); OR
- Construction of piles through the piers and abutments from the bridge deck to support the bridge during the underpinning works (Refer to **Figure 5.9 in Chapter 5**);
- Demolition of the existing concrete scour protection slabs and lowering of the floor of the bridge by approximately 1m on average (It should be noted that the floor of the second arch will be lowered by approximately 1.2m); and
- Construction of a new concrete scour protection slab between approximately 10m upstream to approximately 15m downstream of the bridge and beneath the arches of the bridge and the placement of riprap along the upstream and downstream edges of the concrete slab.

The proposed works have the potential to give rise to structural damage to Arklow Bridge. In terms of risks, it is considered that settlement, tilt and the torsional effects of the works are more likely to result in structural stress to the bridge than vibration.

The use of the empirical formula in order to estimate vibration levels is not deemed suitable as the distance x is less than 5m[4].

However, it has been conservativity assumed that there is potential for significant effects. At such close distances the most effective method of mitigation is through real-time vibration monitoring at the nearest piers along the bridge in compliance the limit values set out in Table 10.10. Vibration limits will be monitored on a continual basis during works at Arklow Bridge and in the event of vibration limits being exceeded, works will cease, be reassessed and where possible, alternative construction methods will be used. Monitoring locations will be specified in the Contractors NVMP.

10.4.2.13 Construction Traffic

No routes will experience increases of more than 25% in traffic volumes due to construction traffic, solely. For locations where significant changes to traffic are predicted due to diversions, Table 10.35 outlines the stages, durations and predicted increases.

Table 10.35: Significant traffic increases during construction phase.

Construction Stage	Duration	Traffic volume - existing	Traffic volume – due to rerouting	Road effected
Stage E South Quay / South Green	2 months	2,614	3,735	South Green Harbour Road
Stage F South Quay / Harbour Road	5 months	2,614	3,735	South Green Harbour Road
Stage H North Quay (East of Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue
Stage I North Quay (West of Bridgewater Ferrybank)	2 weeks	Estimated at 3,000	9,000 (6,000 above baseline)	Seaview Avenue

Table 10.36 presents the results for the predicted noise level increases from traffic during the construction phase.

Table 10.36: Predicted noise increases during construction phase.

Location	Distance to centre of road	Predicted existing noise level ($L_{A10,18hr}$)	Predicted construction noise level ($L_{A10,18hr}$)	Predicted increase (dB)	Impact Rating (refer to Table 10.3)
South Green	5m	63.0	64.8	1.8	Minor
Harbour Road	5m	63.0	64.8	1.8	Minor
Seaview Avenue	5m	63.8	68.6	4.8	Moderate

Receptors along South Green and Harbour Road may experience minor temporary negative impacts during traffic rerouting.

Receptors along Seaview Avenue may experience moderate temporary negative impacts during traffic rerouting.

10.4.3 Assessment of Effects During Operation

All equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. The acoustic performance data provided in Table 10.37 is based on predicted operational noise sources. The values quoted are for the highest noise emitters.

Table 10.37: Details of noise sources modelled

Location	Source	Number	Sound Power Level (dB) of Source	% of time in operation
Inlet Works Building	Fresh air fans	2	60	100%
	Pump	3	83	100%
	Fans	4	80	100%
Sludge Building	Pump	2	83	100%
	Fans	2	80	100%
Process Building	Fresh air fans	2	60	100%
	Pump	3	83	100%
	Transformer	1	85	100%
	Fans	4	80	100%
Admin Building	Air handling unit	1	60	25%
External	Generator [22]	1	100	100%[22]

The noise sources presented in Table 10.37 will be subject to noise attenuation that will reduce the overall noise levels at nearby receptors. This may be in the form of internal ducting, internal and external acoustic enclosures and cladding on external walls. The overall effect of these measures has been conservatively assumed to provide a Weighted Sound Reduction Index (R_w) of 15dB.

An assessment of the above noise sources was undertaken to predict noise levels at the proposed WwTP site boundary during night time, which is the most stringent noise limit. Assuming full-time operation, noise levels at the proposed WwTP site boundary are predicted at two locations and results presented in Table 10.38**.**

Changes in noise level have been given an impact rating.

[22] As the generator will only operate in emergency conditions, it has not been included in the operational noise assessment.

Table 10.38: Predicted operational noise levels at WwTP site boundary

Location (see Figure 10.1)	Predicted operational noise levels (L_{Aeq}, dB)	Background noise level (night-time) (L_{Aeq})[23]	Total noise level (L_{Aeq})	Change in noise level	Impact rating
L01	43.8	45	47.5	2.5	Imperceptible
L02	42.9	45	47.1	2.1	Imperceptible

Predicted noise levels are in compliance with the night time noise limit of 45dB at the proposed WwTP site boundary. The impact rating associated with the addition of the new noise sources is imperceptible over the long term, see Table 10.7. During the commissioning of the proposed WwTP noise monitoring will confirm compliance with the limit values.

10.4.3.1 Operational Traffic

No routes are predicted to experience increases of more than 25% in total traffic flows during the operational phase (refer to **Chapter 7**). Therefore, no detailed assessment is required, refer to **Section 10.3.1.1**.

10.4.4 Cumulative Assessment

This section considers the potential for in combination impacts arising from the proposed development in association with other developments. Specifically, it considers a worst-case scenario, where both the proposed development and the proposed Arklow Flood Relief Scheme (or section thereof) are under construction at the same time.

Based on the current level of understanding, construction of the Arklow Flood Relief Scheme (FRS) will consist of local river widening, construction of a flood containment embankment and flood wall and river dredging. While there may be physical and temporal cross over between the schemes, certain works will not be able to occur simultaneously e.g. the flood wall along the South Quay will be constructed after the sheet piling for the interceptor sewer. Table 10.39 outlines indicative equipment that may be used during the construction of the proposed Arklow Flood Relief Scheme. All the works outlined in Table 10.39 can occur at the edge of the Arklow River, therefore a minimum distance of 15m has been used for calculating the impacts.

[23] Background noise data has been taken from the nearest monitoring location.

Table 10.39: Estimated plant and equipment to be used during construction of proposed Arklow Flood Relief Scheme

Construction Phase for Arklow Flood Relief Scheme	Plant and Equipment	Location of Works	BS 5228 [4] reference	Number	Sound Power Level (L_w) dB	Percentage time in operation (%)
River Widening	Tracked Excavator	From R03 to R19 **(see Figure 10.2)**	C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50
Flood Wall Construction	Cement Mixer Truck	Along entire South Quay	C.4.18	1	103	50
	Water Pump		C.2.46	1	93	50
	Poker Vibrator		C.4.33	1	106	50
	Tracked Excavator		C.1.12	1	103	50
Flood Containment Embankment	Tracked Excavator	Western end of the proposed development north and south of the Arklow River	C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50
	Dozer		C.5.12	1	105	50
River Dredging	Digging out river bed	Along much of Arklow River.	D.12.2	1	112	50
	Tracked Excavator		C.2.18	1	103	50
	Articulated Dump Truck		C.5.16	1	104	50

Table 10.40 outlines the predicted construction noise levels from the proposed Arklow Flood Relief Scheme based on the data provided in Table 10.39**.**

Table 10.40: Predicted construction noise levels from the proposed Arklow Flood Relief Scheme

Phase	Predicted Noise Level ($L_{Aeq, 1\ hr}$) at various distances			
	15m	30m	45m	60m
River Widening	62	56	52	50
Flood Wall Construction	65	59	55	53
Flood Containment Embankment	64	58	55	52
River Dredging	69	63	63	57

Table 10.40 outlines the predicted construction noise levels from the proposed Arklow Flood Relief Scheme.

As identified in Table 10.40, the activity that is predicted to cause the greatest impact from works associated with the proposed Arklow Flood Relief Scheme is the river dredging.

Should dredging occur simultaneously with the activity that causes the greatest impact during the proposed development (shaft construction, see Table 10.25), the overall predicted impact would be 71 dB ($L_{Aeq, 1\ hr}$), 6 dB above the proposed noise limit, and categorised as a temporary significant impact.

In relation to construction traffic, the impacts associated with the proposed Arklow Flood Relief Scheme will not add significantly to the overall impact from the proposed development which includes the diversion of approximately 1,000 vehicles along South Quay and 6,000 vehicles along Seaview Avenue.

10.5 Mitigation Measures and Monitoring

10.5.1 Mitigation

10.5.1.1 Management Plans & Method Statements

As outlined in **Section 10.4.2.9**, detailed construction methodologies, phasing and equipment, mitigation measures and method statements, will be set out in the Noise and Vibration Management Plan NVMP, as part of the Outline CEMP. An outline NVMP is appended to Appendix 5.1.

The NVMP will outline how the appointed contractor(s) will comply with the noise criteria set out in this section and will deal specifically with construction activities in a strategic manner to remove or reduce significant noise and vibration impacts associated with the construction of the proposed development. The NVMP will detail the provision and installation of localised acoustic screens, the best practice noise measures that the appointed contractor(s) will be required to adhere to for construction activities and the noise and vibration monitoring programme that the appointed contractor(s) will be required to undertake during the construction works.

In addition, the appointed contractor(s) will prepare detailed method statements addressing the likely groundborne noise and vibration levels that will be generated as a result of the construction activities once the specific details of the proposed plant, equipment and construction methodologies are known.

Where considered necessary, structural surveys will be undertaken at sensitive receptors in close proximity to the works to establish their condition and tolerance for vibration impacts.

10.5.1.2 Mitigation During Construction

General

The following section describes measures to minimise the potential for noise and vibration disturbance to the surrounding area which will be employed by the contractor to ensure the construction noise and vibration criteria outlined herein are not exceeded.

The contractor will take specific noise abatement measures and comply with the recommendations of BS 5228-1 and 2:2009+A1:2014[4] and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001[24].

The following specific measures will be implemented during the construction of the proposed development:

- A site representative shall be appointed to be responsible for matters relating to noise and vibration;
- Construction of temporary infrastructure (e.g. haul roads) will be with materials that minimise noise and vibration and design of haul roads will minimise reversing;
- Internal haul roads shall be well maintained;
- Unnecessary revving of engines should be avoided and equipment should be switched off when not required;
- Rubber linings shall be used in chutes and dumpers etc. to reduce noise;
- Drop heights of materials shall be minimised;
- Generators will be located away from sensitive receivers and will be enclosed;
- Careful selection of equipment, construction methods and programming with the objective of reducing noise and vibration where possible. Only equipment, including road vehicles, conforming to relevant national or international standards, directives and recommendations on noise and vibration emissions, will be used;
- Plant and vehicles shall be started sequentially rather than all together;
- Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable;
- Fitting suitable anti-vibration mountings where practicable, to rotating and/or impacting equipment;
- Avoiding percussive piling, except where there is an overriding justification;
- Using noise-control equipment such as jackets, shrouds, hoods, and doors, and ensuring they are closed;
- Locating plant, as far as is reasonably practicable, away from receptors or as close as possible to noise barriers or hoardings where these are located between the source and receptor;
- Regular and effective maintenance by trained personnel shall be carried out to reduce noise and/or vibration from plant and machinery;
- Ensuring that all plant is maintained regularly to comply with relevant national or international standards and operation of plant and equipment that minimises noise emissions;

[24] European Communities (2001) *European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001*

- Ensuring that plant is shut down when not in use;
- Ensuring that air lines are maintained and checked regularly to prevent leaks;
- Designing all audible warning systems and alarms to minimise noise. Non-audible warning systems can be used in preference, i.e. cab-mounted CCTV or the use of banksmen.

  If required, ensure that audible warning systems are switched to the minimum setting required by the Health and Safety Authority and where practicable use 'white noise' reversing alarms in place of the usual 'siren' style reversing alert.
- A c. 2.4m hoarding of density of at least 7kg/m^2 shall be provided around construction works, including around the TBM launch site;
- Rotary drills and bursters actuated by hydraulic or electrical power will be used for excavating hard material. In some instances, chemical bursting can be used where nearby sensitive structures are particularly vulnerable to vibration from pneumatic breakers etc.;
- Handling all materials, particularly steelwork, in a manner that minimises noise. For example, storing materials as far as possible away from sensitive receptors and using resilient mats around steel handling areas;
- During construction, regular inspections will be undertaken to ensure that the noise and vibration minimising methods, plant and mitigation identified in the specimen design stage are adopted on site and are working effectively. If applicable, it is proposed that construction method inspections be integrated into any health and safety or quality surveillance regime;
- Typically, site activities shall be limited to 7am – 7pm, Monday to Friday; and 8am – 2pm, Saturday. However, during the interceptor sewer construction works, the TBM equipment (including generator) will operate on a 24-hour basis. No works are anticipated on Sundays and Bank Holidays (with the exception of tunnelling). Aside from the 24-hour use of the TBM equipment, it is anticipated that there will be times due to exceptional circumstances that construction work will be necessary outside of normal construction core working hours. Any such working hours outside the normal construction core working hours will be agreed with Wicklow County Council. The planning of such works will have regard to nearby sensitive receptors;
- A Communications Management Plan shall be prepared to provide for effective community liaison to help ensure the smooth running of construction activities and to address any issues that may arise;

Noise audits shall be carried out by a suitably qualified auditor, appointed by Irish Water in advance, at routine intervals to ensure that the mitigation measures are being correctly implemented.

Tunnelling

During tunnelling, the most effective pre-emptive measure that to reduce impacts is soil probing prior to tunnelling works. Probing prior to tunnelling will allow hard obstacles or rock to be identified.

If encountered pre- auguring will be undertaken at these locations where hard obstacles have been identified prior to tunnelling to minimise noise and vibration impacts. Where ground conditions may be unknown, this measure will be carried out prior to tunnelling.

Any requirement for temporary re-housing will be confirmed by the Contractor(s) in consultation with Irish Water and the affected stakeholder. The determination for such mitigation will be made after detailed construction methodologies, phasing and detailed equipment are known.

This information will be presented in the NVMP, as outlined in the **Appendix 5.1**. **Section 10.4.2.9** outlines the process in determining suitability for any temporary re-housing required, as per BS5228-1[4].

Sea Outfall Construction

During the construction of the long sea outfall, there is the potential for noise impacts on marine mammals. The Department of Arts, Heritage and the Gaeltacht have published guidance[25] on best practice construction mitigation measures that should be followed for construction in Irish waters.

The following summarised measures will be implemented during the construction of the marine outfall in Arklow Bay.

Pre- Drilling

A qualified and experienced marine mammal observer (MMO) shall be appointed to monitor for marine mammals and to log all relevant events using standardised data forms.

Drilling activity shall not commence if marine mammals are detected within a 500m radial distance of the drilling sound source, i.e., within the Monitored Zone.

Pre- Start Monitoring

Drilling activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring, as determined by the MMO, is not possible the sound-producing activities shall be postponed until effective visual monitoring is possible.

An agreed and clear on-site communication signal must be used between the MMO and the Works Superintendent as to whether the relevant activity may or may not proceed, or resume following a break (see below). It shall only proceed on positive confirmation with the MMO.

In waters up to 200m deep, the MMO shall conduct pre-start-up constant effort monitoring at least 30 minutes before the sound-producing activity is due to commence. Sound-producing activity shall not commence until at least 30 minutes have elapsed with no marine mammals detected within the Monitored Zone by the MMO.

[25] Department of Arts, Heritage and the Gaeltacht (2014) *Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters* https://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf.

This prescribed Pre-Start Monitoring shall subsequently be followed immediately by normal drilling operations. The delay between the end of Pre-Start Monitoring and the necessary full drilling output must be minimised.

Drilling

Once normal drilling operations commence, there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate nor if marine mammals occur within a 500m radial distance of the sound source, i.e., within the Monitored Zone.

Breaks in Sound Output

If there is a break in drilling sound output for a period greater than 30 minutes (e.g., due to equipment failure, shut-down or location change) then all Pre-Start Monitoring must be undertaken in accordance with the above conditions prior to the recommencement of drilling activity.

10.5.1.3 Mitigation During Operation

All equipment will be housed within buildings/chambers which will limit noise breakout to atmosphere. Therefore, a greater level of compliance than that presented in Table 10.38 would be expected and therefore no mitigation measures are considered necessary.

10.5.2 Monitoring

10.5.2.1 Monitoring During Construction

The contractor(s) shall be required to carry out continuous noise and vibration monitoring at the three closest sensitive receptors to the proposed WwTP and interceptor sewer works during the construction phase.

Vibration monitoring will be undertaken on the piers of the bridge and measured against the limits in Table 10.10. In the event of vibration limits being exceeded, works will cease and alternative construction methods will be used.

Noise and vibration levels will be compared to the limit values outlined in Table 10.5 and Table 10.10, respectively. If exceedances are recorded, the possibility of alternative construction methodologies will be examined to reduce impact at sensitive receptors.

10.5.2.2 Monitoring During Operation

Environmental emissions, including noise, will be regulated by Wicklow County Council. Although the WwTP will not be formally regulated by the EPA, Irish Water will be operating the plant in compliance with EPA licensing standards, as set out in **Section 10.2.4.4**. Monitoring at the site boundary will be undertaken during commissioning and at predetermined frequencies over the life time of the proposed development.

10.6 Residual Effects

10.6.1 Residual Effects During Construction

The noise assessment for the construction of the proposed development has shown that compliance with noise limit values in can be achieved at the nearest sensitive receptors to the WwTP site. However, noise limit values will be exceeded at the nearest sensitive receptor to the proposed interceptor sewer for some types of works.

The implementation of the mitigation measures outlined in **Section 10.6** will assist in reducing the impact on nearby sensitive receptors. Residual short-term, slight to significant negative impacts are predicted during the construction phase of the proposed development. Table 10.41 summaries the residual impacts during the construction phase.

Table 10.41: Summary of residual impacts during construction phase

Construction Phase	Summary of Impact Post Mitigation
WwTP construction.	Range from short term imperceptible negative impact to short term moderate negative impact
Revetment construction.	Range from short term slight negative impact to short term significant negative impacts
Sea Outfall construction. Impact of WwTP, Sea Outfall and Revetment construction.	Range from short term moderate negative impact to short term significant negative impacts
Impact assessment for residential receptors – trench works, shaft construction, tunnelling, ground borne noise and airborne noise	Short term significant negative impacts
Interceptor Sewer (Vibration) and Construction Traffic	Short term slight negative impacts
Sheet Piling (Vibration)	Short term moderate negative impacts
Arklow Bridge Works	Potential for short term significant effects

10.6.2 Residual Effects During Operation

It is predicted that the EPA limits will be complied with during the operational phase of the proposed development and that there will be no significant residual impacts.

10.7 References

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