10 NOISE & VIBRATION

10.1 Noise

10.1.1 Introduction

A noise impact assessment was carried out on the proposed pipeline corridor to assess whether the environmental noise generated during both the construction and operational phases of the proposed project could cause an impact to the human environment.

The likelihood and significance rating of environmental noise impacts for both phases of the proposed project prior to mitigation are described in this section of the EIS. Proposed mitigation measures are described in Section 10.6 and the residual impacts after the proposed mitigation measures have been implemented are described in Section 10.7.

10.2 Study Area

The study area was based on the location of noise sensitive receivers adjacent to the proposed pipeline corridor.

10.3 Methodology

A noise impact assessment is carried out by assessing predicted noise levels for different phases of the project and comparing these to applicable noise limits (if available) or to the existing noise levels (if suitable). As noise will be generated by both the projects construction and operational phases (operational noise at the AGIs at Dublin Port and Dublin Airport only), existing noise levels will either increase or remain as is (depending on a sufficient distance to attenuate to negligible levels) in the environs of the proposed pipeline corridor due to these phases.

The noise impact assessment predicts noise levels arising from the construction and operational phases and determines whether these predicted levels are compliant with relevant limits and/or will determine the magnitude of the impact.

As noise is typically generated during each project phase whenever activity occurs, the timescale and probability of noise impacts relates to the length of the relevant stage, i.e. the operational noise impact will last for the entirety of the pipeline operation.

10.3.1 Noise Background and Terminology

Noise is defined as unwanted sound. The impacts of noise are subjective and vary from person to person. Factors such as frequency, tonal patterns, existing background noise levels and other activities being carried out, all impact on how noise levels are experienced by individuals.

To assist in the understanding of the noise measurement scales, Table 10.1 is presented overleaf. This illustrates the A-weighted decibel scale (dB(A)) for some common place activities.

Table 10.1: Examples of Indicative Noise Levels[7]

Situation/Noise Source	Approximate Noise Level dB(A)	Sound Pressure μPa	Subjective Description
30 m from a military jet aircraft take-off	140	200,000,000	Painful, intolerable
Rock/ Pop concert	105	3,500,000	
Nightclub	100	2,000,000	
Pop/ Concert at mixer desk	98	1,600,000	
Passing Heavy Goods Vehicle at 7 m	90	630,000	Very noisy
Ringing Alarm Clock at 1 m	80	200,000	
Domestic Vacuum cleaner at 3 m	70	63,000	Noisy
Busy Office	60	20,000	
Normal Conversation at 1 m	55	11,000	
Reading room of the British National Museum	35	1,100	
Bedroom in a quiet area with the windows shut	30	360	Very quiet
Remote location without any identifiable sound	20	200	
Theoretical threshold of hearing	0	20	Uncanny Silence

10.3.2 Establishing Baseline Noise

To establish noise levels in the existing environment around the study area and to determine relative threshold noise limits, sound level measurements were taken along the proposed pipeline corridor at ten noise sensitive locations during daytime and night-time hours. This allowed for comparison of the noisiest and quietest times of the day respectively. Noise Sensitive Locations (NSLs) are defined as *"… any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels."* (EPA, 2012)[8].

The monitoring locations selected were identified as sensitive locations along the route and are principally represent residential areas. The monitoring locations are described in Table 10.2 and shown in Figure 10.1.

[7] Environment Agency. (2002). Integrated Pollution Prevention and Control (IPPC) Horizontal Guidance for Noise Part 2 – Noise Assessment and Control

[8] Environmental Protection Agency, 2012. Guidance Note For Noise Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

Table 10.2: Baseline Noise Monitoring Locations

Monitoring Location Reference	Easting	Northing	Description
N1	317635.61	235620.30	Located at junction of East Wall Road and Alfie Byrne Road
N2	317819.65	235862.10	Located on Alfie Byrne Road
N3	318335.45	236229.07	Located on Clontarf Road between junction with Alfie Byrne Road and Clontarf Rail Station
N4	318230.93	236637.54	Located on Copeland Road
N5	318294.59	237156.60	Located at Nazareth Nursing Home on Malahide Road
N6	319640.74	238741.81	Located at Brookville Road that runs parallel to the Malahide Road north of the Artane Roundabout
N7	320738.88	240310.00	Located at Buttercup Park that runs parallel to the Malahide Road at Clarehall Junction
N8	320228.45	240762.87	Located at Darndale Park
N9	319530.44	241167.76	Located at St Michaels House along R139
N10	318793.09	241783.02	Located on Clonshaugh Road north of R139

Noise monitoring was carried out in accordance with the following international standards:

- ISO 1996-1 Acoustics - Description and Measurement of Environmental Noise Part 1 2003: Basic Quantities and Assessment Procedures
- ISO 1996-2 Acoustics - Description and Measurement of Environmental Noise Part 2 2007: Determination of Environmental Noise Levels

Daytime measurements were taken for a period of 30 minutes, while night-time measurements were taken over a period of 15 minutes.

The monitoring was carried out using a Brüel and Kjær 2250 Type 1 Sound Level Meter (SLM)[9] with an outdoor microphone unit Type 4189[10]. The SLM was calibrated using a Brüel and Kjær Type 4231 calibrator[11] prior to commencing the survey using the recommended calibration procedure and a known pure tone noise source. The SLM was again calibrated on completion of the surveys to identify any drift during the course of the monitoring periods. Drift is normally associated with battery fade and temperature. The unit had not drifted during either survey.

All measurements were taken outdoors and are considered representative of the external noise levels in the area. To minimise the influence of reflections all measurements were taken at least 3.5 m from reflecting surfaces such as walls. All measurements were taken on a tripod at a height of approximately 1.2 m above the ground and a microphone wind guard was used.

Good measurements require calm conditions to avoid spurious effects on the microphone. An average wind speed of less than 5 metres per second (m/s) is the preferred limit when noise measurements are being taken, with an upper limit of 7 m/s. Weather conditions during the daytime and night time monitoring were dry and calm and wind speed was observed to be less than 5 m/s for each monitoring period.

[9] Sound Level Meter – serial no. 2506904; Calibration Certificate No. C1204140
[10] Outdoor Microphone - serial no. 2542881; Calibration Certificate No. C1204140
[11] Calibrator - serial no. 2545489; Calibration Certificate No. CDK1307148

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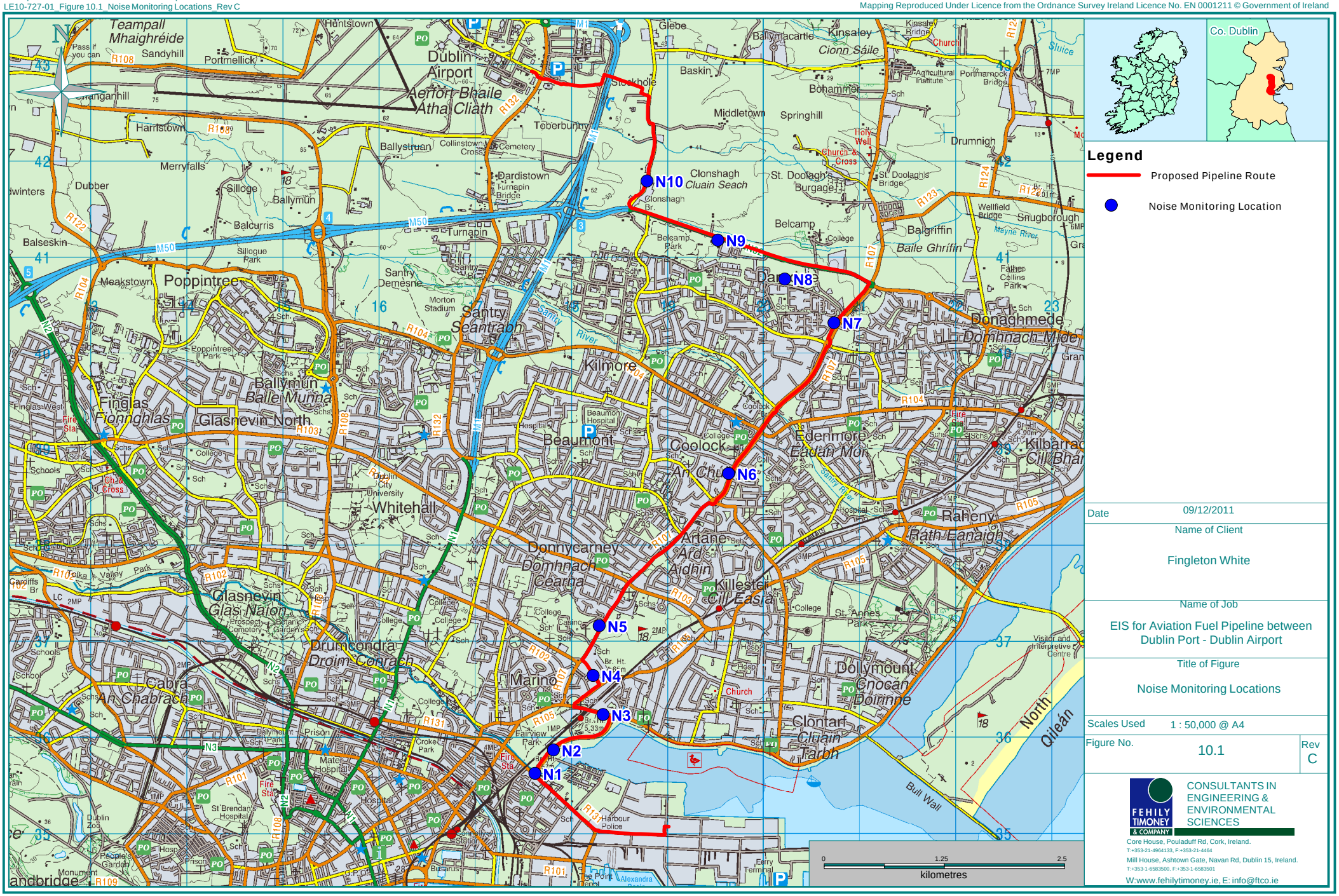

Date	09/12/2011
Name of Client	Fingleton White
Name of Job	EIS for Aviation Fuel Pipeline between Dublin Port - Dublin Airport
Title of Figure	Noise Monitoring Locations
Scales Used	1 : 50,000 @ A4
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FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland.
T:+353-1-6583500, F:+353-1-6583501
W:www.fehilytimoney.ie, E: info@ftco.ie

10.3.3 Construction Noise Assessment

Construction noise sources on site typically include saw cutters, excavators, HGVs from activities such as material excavation, material delivery and backfilling of trenches. Construction activities will vary depending on the section of the route (i.e. open cut or trenchless techniques) and the associated TIN of sections of the pipeline occurring in public roadway (refer to Chapter 3 – Description of the Proposed Development).

While each TIN classification carries varying restrictions in relation to when works can be carried out, deviation from these restrictions will be required in order to facilitate timely construction of the pipeline along the route. This will be agreed with the Local Authorities through road opening licence application(s).

The assessment of construction noise is undertaken by determining typical separation distances from the proposed construction areas to the nearest NSLs, predicting a representative construction noise level at the separation distances and assessing the predicted levels against best practice limits for construction activities.

Construction Noise Guidance and Standards

The following standards and guidance are employed in the construction noise assessment:

Modelling Standard and Technical Advice:

- British Standard 5228 Part 1:2009 Code of practice for noise and vibration control on construction and open sites Part 1 Noise, 2009

Guideline Limits:

- British Standard 5228 Part 1:2009 Code of practice for noise and vibration control on construction and open sites Part 1 Noise, 2009
- National Roads Authority Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004

Prediction of Construction Noise

Stationary construction noise is predicted using the Activity L_{Aeq} method from BS 5228-1:2009 Annex F, Estimating Noise from Sites. This models stationary noise sources such as plant used for excavation, construction and reinstatement activities. The modelling predicts the typical sound pressure levels which will be experienced during typical construction activities.

Construction Noise Evaluation Criteria

There are no legal or statutory criteria relating to the maximum permissible noise levels which may be generated by construction projects. Normally a local authority controls noise emissions by imposing time limits on the daily duration of operation on construction sites. It may impose noise limits for the construction phases by means of planning permission conditions.

BS 5228-1:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites Part 1: Noise provides two methods of determining whether a significant impact will occur from construction noise. The first is a 'significant effect threshold value' whereby the ambient noise level is initially rounded to the nearest 5 dB. Based on the threshold values provided in Table 10.3, a significant effect is deemed to occur if the total L_{Aeq} value (rounded existing L_{Aeq} value and the predicted construction noise) exceeds the threshold value appropriate to the ambient noise level.

Table 10.3: Maximum Permissible Noise Levels at the Façade of Dwellings during Construction

Threshold Value Period		Threshold Value, dB(A)		
		Category A [i]	Category B [ii]	Category C[iii]
Night-time	23:00 – 07:00	45	50	55
Evenings Weekends	19:00 – 23:00 weekdays 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays	55	60	65
Daytime Saturdays	07:00 – 19:00 07:00 – 13:00	65	70	75

[i] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
[ii] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
[iii] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

The other method from BS 5228-1:2009 to determine whether a significant impact can occur, is if the total noise (pre-construction ambient noise and the predicted construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ for daytime, evening time and night-time periods.

The only published guidelines on construction noise in Ireland are those issued by the NRA which sets out indicative daytime noise values only. The NRA Noise Guidelines[ii] provide indicative noise limits allowable at dwelling facades during road construction, as shown in Table 10.4. These limits can be lowered depending on sensitivity of receptors, duration of construction activities and existing noise levels.

Table 10.4: Recommended Road Construction Noise Guidelines (NRA, 2004) [iii]

Days And Times	$L_{Aeq,1\ hr}$ (dB)	$L_{pA,Max,\ Slow}$ (dB)
Monday To Friday - 07:00 To 19:00	70	80
Monday To Friday - 19:00 To 22:00	60	65
Saturday - 08:00 To 16:30	65	75
Sunday And Bank Holidays - 08:00 To 16:30	60	65

10.3.4 Operational Noise Assessment

Once the pipeline is constructed, operational noise will be limited to the operation of the AGIs at Dublin Airport and Dublin Port. Since these areas are not considered to be noise sensitive and there are no nearby noise sensitive locations, the noise from the AGI operations at these locations will not have a negative impact and the operational impact can be scoped out of the EIS. Therefore an operational noise assessment is not considered necessary.

10.4 Existing Environment - Noise

10.4.1 Baseline Noise Descriptions

Noise level and frequency varies constantly with time. It cannot be described with a single number. As a result, statistical metrics are commonly used to describe the noise levels. To understand the terms used in this section, definitions of the terms used are provided as follows:

L_{A10} Refers to those noise levels in the top 10 percentile of the sampling interval; it is the level which is exceeded for 10% of the measurement period. It is used to determine the intermittent high noise level features of locally generated noise and usually gives an indicator of the level of traffic.

L_{A90} Refers to those noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level.

L_{Aeq} The energy equivalent continuous sound level recorded over the sampling period. The closer the L_{Aeq} value is to either the L_{A10} or L_{A90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

Impulsive noise: a noise of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.

Tonal noise: A noise source that is concentrated in a narrow band of the frequency spectrum.

10.4.2 Baseline Noise Survey

Daytime noise measurements were carried out on the 27 May 2014 at the noise monitoring locations described in Table 10.2 and Figure 10.1.

Night-time noise measurements were carried out on the 12 and 13 June 2014 at the noise monitoring locations.

A summary of the baseline noise levels are presented in Tables 10.5 and 10.6 and the full data set is provided in Appendix 10.1 of Volume 3 of the EIS.

Daytime L_{Aeq} levels ranging from 56 to 72 dB(A) were recorded with L_{A90} levels ranging from 44 to 61 dB(A). The dominant noise sources at locations N1 through to N9 was traffic with air traffic being the dominant noise source at N10.

Night time L_{Aeq} levels ranging from 54 to 71 dB(A) were recorded with the L_{A90} results ranging from 39 to 50 dB(A). Similarly to the daytime observations, the dominant noise source during night-time hours was traffic, including location N10 where air traffic was no longer a contributing source.

Table 10.5: Summary of Daytime Noise Levels

Location	Start Date	Start Time	$L_{Aeq,30\ min}$ (dB)	$L_{A90,\ 30min}$ (dB)	$L_{A10,\ 30\ min}$ (dB)	Comments
N1	27/05/2014	08:38	65	60	68	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was the circa 1,000 traffic movements at the intersection of East Wall Road and Alfie Byrne Road adjacent to the monitoring location. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Train movements at approximately 100 m, voices and a flag hitting against a flag pole could be heard intermittently, contributing to the background noise environment.
N2	27/05/2014	09:21	72	58	77	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 500 traffic movements on the Alfie Byrne Road. Movements entailed primarily cars with interspersed vans, motorbikes, trucks, buses and a tractor. Train movements at approximately 150 m, voices and loud bird song could be heard intermittently, contributing to the background noise environment. A train horn was heard on two occasions.
N3	27/05/2014	09:59	67	55	71	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 750 traffic movements on the Clontarf Road. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Train movements at approximately 300 m, voices and loud bird song could be heard intermittently, contributing to the background noise environment. Glass being thrown into glass recycling banks at approximately 50 m was heard on three occasions.
N4	27/05/2014	10:39	64	44	68	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise source observed during monitoring was the persistent passing vehicles on the Copeland Road. Movements entailed primarily cars with interspersed vans. A faint sound from pedestrian traffic and car doors closing was occasionally audible during the period.
N5	27/05/2014	11:25	66	55	70	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 1000 traffic movements on the Malahide Road and cars entering and leaving the nursing home. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Voices and bird song could be heard intermittently, contributing to the background noise environment.

Location	Start Date	Start Time	$L_{Aeq,30\ min}$ (dB)	$L_{A90,\ 30min}$ (dB)	$L_{A10,\ 30\ min}$ (dB)	Comments
N6	27/05/2014	12:12	67	60	70	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 1000 traffic movements on the Malahide Road. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Voices from passing pedestrians, birdsong and car doors closing could be heard intermittently, contributing to the background noise environment.
N7	27/05/2014	13:04	63	57	65	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from heavy traffic movements on the Malahide Road and circa 50 cars on the Buttercup Park Road. Movements entailed primarily cars with interspersed vans, motorbikes, trucks, buses and a tractor. Noise from planes passing overhead, police sirens in the distance, voices from passing pedestrians and birdsong could be heard intermittently, contributing to the background noise environment.
N8	27/05/2014	13:43	56	48	59	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise source observed during monitoring was from road traffic on the R139 and Darndale Housing Estate, children playing in a playground at 50 m, a motorbike moving in the park and shouting from passing pedestrians. Noise from planes passing overhead, police sirens in the distance and dogs barking could be heard intermittently, contributing to the background noise environment.
N9	27/05/2014	14:25	66	61	69	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 2000 traffic movements on the R139 and mini-buses entering St. Michaels House. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Planes passing overhead and bird song could be heard intermittently, contributing to the background noise environment.
N10	27/05/2014	15:01	71	47	76	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise source observed during monitoring was the persistent sound of planes landing and taking off from the nearby airport and intermittent vehicle traffic on the Clonshaugh Road. Dogs barking and bird song could be heard intermittently, contributing to the background noise environment. Additionally, the noise of a motor-bike entering the house adjacent to the monitoring location and voices could be heard for a five minute period.

Table 10.6: Summary of Night-time Noise Levels

Location	Start Date	Start Time	$L_{Aeq,15\ min}$	$L_{A90,15\ min}$	$L_{A10,15\ min}$	Comments
N1	13/06/2014	00:45	57	42	62	Clear, dry, calm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the traffic movements at the intersection of East Wall Road and Alfie Byrne Road adjacent to the monitoring location. Movements entailed primarily cars (28) with interspersed trucks (2). Voices and sirens could be heard intermittently, contributing to the background noise environment.
N2	13/06/2014	00:22	62	43	65	Clear, dry, calm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the traffic movements on the Alfie Byrne Road during the monitoring period. Movements entailed primarily cars (17) with interspersed vans (1), motorbike (1) and trucks (1). Train movements at approximately 150 m, sirens and hum from overhead road lamp could be heard intermittently, contributing to the background noise environment. A train horn was heard on 8 occasions.
N3	12/06/2014	23:59	65	46	69	Clear, dry, calm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 120 traffic movements on the Clontarf Road. Movements entailed primarily cars with interspersed trucks and buses. Train movements at approximately 300 m could be heard intermittently, contributing to the background noise environment.
N4	12/06/2014	23:33	56	39	61	Clear, dry, calm conditions throughout the monitoring period. The dominant noise source observed during monitoring was the traffic movements on the Copeland Road. Movements entailed primarily cars (21). A faint sound from pedestrian traffic, sirens and a train in the background and car doors closing was occasionally audible during the period.
N5	12/06/2014	23:10	66	49	70	Clear, dry, calm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 190 traffic movements on the Malahide Road. Movements entailed primarily cars with interspersed vans, trucks and buses. Loud voices from passing pedestrians, a dog barking and music from a car on 2 occasions could be heard intermittently, contributing to the background noise environment.

Location	Start Date	Start Time	$L_{Aeq,15\ min}$	$L_{A90,15\ min}$	$L_{A10,15\ min}$	Comments
N6	12/06/2014	22:44	63	50	67	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 165 traffic movements on the Malahide Road. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Voices from passing pedestrians could be heard intermittently, contributing to the background noise environment.
N7	12/06/2014	22:21	56	47	57	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise observed during monitoring was from traffic movements on the Malahide Road and cars passing on the Buttercup Park Road. Movements entailed primarily cars with interspersed vans, motorbikes, trucks and buses. Noise from planes passing overhead, sirens in the distance, voices from passing pedestrians and dogs barking could be heard intermittently, contributing to the background noise environment.
N8	12/06/2014	22:02	54	46	57	Clear, dry, calm, warm conditions throughout the monitoring period. The dominant noise source observed during monitoring was from road traffic on the R139 and Darndale Housing Estate and children playing in the park and playground. Shouting from passing pedestrians, noise from planes passing overhead, police sirens in the distance, loud banging from houses and distant road traffic could be heard intermittently, contributing to the background noise environment.
N9	13/06/2014	01:21	71	45	75	Clear, dry, calm conditions throughout the monitoring period. The dominant noise observed during monitoring was from the circa 60 traffic movements on the R139. Movements entailed primarily cars with interspersed vans and trucks. Planes passing overhead could be heard intermittently, contributing to the background noise environment.
N10	13/06/2014	01:41	58	45	52	Clear, dry, calm conditions throughout the monitoring period. The dominant noise source observed during monitoring was from intermittent vehicle traffic (5 cars) on the Clonshaugh Road. Noise from traffic at the nearby M50/M1 interchange contributed to the background noise environment.

10.5 Summary of Key Possible Impacts - Noise

This section of the report presents a summary of the key possible impacts associated with the construction of the proposed pipeline. As described previously, operational noise is not considered as the AGIs are not in noise sensitive locations, and with no nearby noise sensitive locations, are not expected to cause an impact.

10.5.1 Construction Phase

The most noticeable noise impact will potentially occur during the construction phase of the proposed development. Due to the residential nature of the proposed pipeline route corridor, construction activities will be completed as quickly as possible to minimise disturbance. The construction schedule will be approximately 10 months (refer to Chapter 3 – Description of the Proposed Development).

The linear and repetitive nature of the works lends itself to a progressive and sequential form of construction. It is proposed that at any one time, four 'crews' will be in operation.

The programming of the works and the sequencing of sections within each area has been based on minimising the impact of the works on affected parties. The programme has been accelerated to minimise delays and inconvenience to traffic along the major commuter routes and therefore it is expected that works will occur outside of the respective TIN restrictions and may require weekend works in agreement with the respective local authority.

The construction phase of the project will introduce additional noise sources to the surrounding environment by way of mobile and stationary plant used for site preparation, trenchless crossings (at river and stream crossings), pipe laying, reinstatement of the pipe trench and commissioning of the pipeline. Each phase of construction will entail the use of various machinery and plant which will be deployed at various locations along the pipeline corridor. Noise generated during this phase will be temporary to short-term in duration, 2 days at road based trenching and 2 - 4 weeks at river crossings.

The predicted noise levels outlined in the following sections are based on a consideration of the potential plant and activities that are required for construction works and are representative of the likely levels at the short separation distances unavoidable for the pipeline's location.

Standard Construction Noise Impacts Applying BS 5228 Part 1

The threshold values described in BS 5228 Part 1 based on the ambient noise levels measured at each location are presented in Table 10.7. The threshold values are derived from the threshold structure previously presented in Table 10.4.

Table 10.7: Summary of BS5228 Part 1 Daytime and Evening-time Construction Noise Threshold Values

Monitoring Location Reference	Description	Daytime dB $L_{Aeq,30\ min}$	Daytime Threshold Values, dB L_{Aeq}	Evening-time $L_{Aeq,15\ min}$	Evening-time Threshold Values, dB L_{Aeq}
N1	Located at junction of East Wall Road and Alfie Byrne Road	65	70	57	60
N2	Located on Alfie Byrne Road	72	75	62	65
N3	Located on Clontarf Road between junction with Alfie Byrne Road and Clontarf Rail Station	67	75	65	65
N4	Located on Copeland Road	64	70	56	60
N5	Located at Nazareth Nursing Home on Malahide Road	66	70	66	65
N6	Located at Brookville Road that runs parallel to the Malahide Road north of the Artane Roundabout	67	70	63	65
N7	Located at Buttercup Park that runs parallel to the Malahide Road at Clarehall Junction	63	70	56	60
N8	Located at Darndale Park	56	65	54	55
N9	Located at St Michaels House along R139	66	70	71	65
N10	Located on Clonshaugh Road north of R139	71	75	58	65

The majority of the pipeline corridor will be constructed using standard construction techniques using open cut trenching methodology. Reference sound pressure levels for the assessment calculation are taken from BS 5228 Part 1 Annex C (Current sound level data on site equipment and site activities). The reference sound pressure levels for the proposed construction activities and necessary plant are presented in Table 10.8 (presented as per the standard's A-weighted sound pressure levels, L_{Aeq} dB at a reference distance of 10 m).The prediction method contained in Annex F is the basis of the sound pressure level predictions used in the calculation of impacts. The standard calculates a 10 hour L_{Aeq} value.

It should be noted that the construction noise predictions are based on best estimates of equipment/ plant to be used and inherent assumptions regarding operating times and scheduling of activities as follows:

- All activities (based on modelled plant) are carried for 50% of the 10-hour calculated period except for cutting pavement and pulverising surface which are assumed to be carried out for 10% of the time
- Full reflection
- No screening attenuation
- Separation distances of 3 m to 10 m

Since it is impossible to accurately describe the actual construction activities at each section of the pipeline, it is assumed that activities and associated plant will operate for either 10% or 50% of the 10-hour period (as described above). This is a conservative assumption since the construction activities will take place over 2 days at each section rather than a single 10-hour period.

As the construction activities will take place in relatively close proximity to the noise sensitive locations, the predicted noise levels have been calculated at distances of 3 m to 10 m from the construction activities to the sensitive receptors (from the BS 5228 Part 1 reference distance of 10 m). Screening will be needed by the appointed contractor due to the limited separation distances. 10 to 20 dB(A) reduction can be attained through use of absorptive screens and this has been applied to the overall predicted noise levels.

Table 10.8: Summary of Construction Activities and Related Equipment Sound Pressure Levels from BS 5228 Part 1

Equipment description	BS 5228 Part 1 reference	L_{Aeq} at reference distance of 10m, dB
Cutting Pavement	Hand-held circular saw (cutting paving slabs) Table C4 No 73	84
Pulverising surface	Breaker mounted on wheeled backhoe Table C1 No 1	92
Pipe cutting, bending	Gas cutter (cutting top of pile) Table C3 No 34	68
Welding & Radiography	Generator for welding Table C3 No 32 (2no)	73
Trenching	Tracked excavator Table C4 No 65 (2no)	71
Pipe laying & backfill	Cement mixer truck (discharging) Table C4 No 18	75
	Rigid road lorry Table C6 No 23	82
	Vibratory roller Table C2 No 40	73
Reinstatement	Asphalt paver (+ tipper lorry) Table C5 No 31	77
	Vibratory roller Table C5 No 22	81
SED Crossings Directional Drilling	Directional drill (generator) Table C2 No 44	77
Tolka River Pumping Water	Water pump Table C2 No 46	62

Table 10.9: Summary of Standard Construction Predicted Noise Levels (dB $L_{Aeq,\ 10\ hour}$)

Equipment Description	BS 5228 reference	dB L_{Aeq}							
Separation Distances		3m	4m	5m	6m	7m	8m	9m	10m
Cutting Pavement	Hand-held circular saw (cutting paving slabs) Table C4 No 73	87	85	83	81	80	79	78	77
Pulverising surface	Breaker mounted on wheeled backhoe Table C1 No 1	95	93	91	89	88	87	86	85
Pipe cutting, bending	Gas cutter (cutting top of pile) Table C3 No 34	78	76	74	72	71	70	69	68
Welding & Radiography	Generator for welding Table C3 No 32 (2 no.)	86	84	82	80	79	78	77	76
Trenching	Tracked excavator Table C4 No 65 (2 no.)	84	82	80	78	77	76	75	74
Pipe laying & backfill	Cement mixer truck (discharging) Table C4 No 18	85	83	81	79	78	77	76	75
	Rigid road lorry Table C6 No 23	92	90	88	86	85	84	83	82
	Vibratory roller Table C2 No 40	83	81	79	77	76	75	74	73
Reinstatement	Asphalt paver (and tipper lorry) Table C5 No 31	87	85	83	81	80	79	78	77
	Vibratory roller Table C5 No 22	91	89	87	85	84	83	82	81
Combined Predicted Noise Level		100	97	95	94	92	91	90	89
Combined Predicted Noise Level with Screening		85	82	80	79	77	76	75	74

.

In all cases, the predicted construction noise levels exceed the daytime and evening-time threshold limits provided in Table 10.9.

There are some individual activities which are lower than the upper daytime threshold limit of 75 dBA such as tracked excavators used during trenching and a vibratory roller during pipe-laying at the 10 m separation distance.

The exceedance of these limits indicate a temporary significant impact externally will occur at the nearest noise sensitive locations during construction over the 2 day period.

These noise levels are calculated as external values and would not be audible at these levels within buildings due to building attenuation. Conservative external to internal attenuation for a modern building with windows open is 15dBA therefore internal noise levels will be 70dB(A) or less for the short periods where construction activities are closest to receivers. As such, there is no human health risk to residents.

Mitigation will be discussed in Section 10.6.

Specialist Construction

The crossing of the rivers/streams will require specialist construction methods, as well as a longer duration of impact at major crossings such as the Tolka River, which could last 2 to 4 weeks. The plant used and therefore noise emissions of these crossings will be different to that employed during the standard construction methods of the pipeline as indicated in Table 10.10.

Specialist construction will be completed using trenchless technology, comprising the excavation of pits on either side of the crossing and drilling underneath the culvert/river bed.

Table 10.10: Summary of Specialist Construction Calculations (L_{Aeq}, 10 hour)

Equipment description	BS 5228 reference	dB L_{Aeq}							
Separation Distances		3m	4m	5m	6m	7m	8m	9m	10m
SED Crossings Directional Drilling	Directional drill (generator) Table C2 No 44	87	85	83	81	80	79	78	77
Tolka River Pumping Water	Water pump Table C2 No 46	72	70	68	66	65	64	63	62

The directional drilling exceeds the daytime and evening-time limits and is expected to cause a temporary significant impact at the nearest noise sensitive locations when this activity is being carried out. Again, mitigation will be discussed in Section 10.6.

The water pumping however not cause a significant impact during daytime and evening-time hours based on the threshold limits.

Standard Construction Noise Impacts Applying NRA's Road Construction Noise Limit

Although the NRA guidance limits (presented in Table 10.4) were designed for road construction, they are the only available limits for construction noise in Ireland.

However, using this criteria significant impacts are predicted from this assessment when the predicted noise levels for the road-based construction activities (Table 10.9) are compared with the weekday daytime (07:00 To 19:00 hrs) limit of 70 dB L_{Aeq} and the lower 60 dB L_{Aeq} limit for the more sensitive periods of evening-time (19:00 To 22:00 hrs) and Sundays/ bank holidays.

Summary of Construction Impacts

In general, it can be seen that the construction phase will result in significant noise impacts, of a temporary adverse nature, during daytime and evening-time periods based on the BS 5228 Part 1 impact assessment and comparison with the NRA road construction guideline limits.

It is important to note that the residences and noise sensitive locations along the proposed pipeline corridor will not suffer high noise levels on a continuous basis. In general an increase in noise levels will be present for a short time period, due to the sequential nature of the works (typically 2 days in open-cut sections). Progression will be on a daily basis, therefore construction impacts at each section will be limited in duration and therefore the impact is assessed as a major temporary impact.

Construction activities at the river crossings will also incur a significant noise impact, albeit for a longer period of 2 to 4 weeks.

Since these are significant impacts in largely residential areas, mitigation of construction noise is necessary and is described in Section 10.6.

10.6 Mitigation Measures - Noise

10.6.1 Construction Phase

With respect to Condition 5 of the 2001 consent, An Bord Pleanála required that:

> *"All work shall be carried out in accordance with Directions for the Control and Management of Roadwork's in Dublin City" produced by the Office of the Director of Traffic, Dublin Corporation (Now Dublin City Council). In this regard, a detailed schedule of working hours and related requirements shall be submitted to the planning authority for agreement prior to commencement of development"*

It is proposed that a similar approach will be taken for this project and specific work programmes for individual sections along the route, will be agreed in advance with the relevant local authorities as part of the road opening licence(s).

The linear and repetitive nature of the works lends itself to a progressive and sequential form of construction, with a number of sections (4 no.) being progressed simultaneously. This will assist in reducing the duration of the works and noise impacts on the receiving environment.

During the construction phase of the development, the noise generated on the site will be managed so as to minimise potential impacts on any local noise sensitive location. All plant and equipment used during the construction phase will comply with noise regulations for outdoor plant and machinery. Particularly noisy activities will be carefully planned and timed to cause the least impact. Noise monitoring will be carried out, as necessary, during the construction phase to ensure the site is operating without undue noise impact.

The construction phase has recognised significant impacts on the ambient noise levels based on best estimates of proposed equipment/ plant and while these noise impacts are temporary in nature and short in duration, mitigation will be required.

The most suitable form of mitigation for this type of construction work is absorbent screening, to be erected around sections of construction. Typical attenuation of 10 to 20 dBA can be attained. If an average value of 15 dBA is obtained from this screening, the predicted noise levels from construction will still exceed the BS 5228 Part 1 threshold values.

It is recommended that noise monitoring is carried out during the first stage of construction to determine the actual noise emissions generated by the construction activities. As there are several construction steps at each section, an attended logging survey should be carried out which will correlate construction steps with noise levels. This data can be interrogated to determine which (and if any) steps do result in a significant noise impact (i.e. exceedance of the BS 5228 Part 1 noise threshold values).

Therefore additional mitigation may be required and will be based on the logging survey carried out. Further noise reduction can be attained through replacement with quieter plant where specific activities allow it, such as replacement of a breaker mounted on wheeled backhoe with a quieter pulveriser.

To ensure that these changes can be made at the early construction stage, the contractor should be made aware of the construction noise issues and that equipment may need to be replaced.

A noise management plan will also be developed for the construction phase to ensure that best practice in the reduction of noise is implemented during the construction phase by the contractor and will include the following:

- A noise monitoring programme which will set out the duration and frequency at which monitoring will occur. This will be agreed with the local authorities. Results of this monitoring will be submitted to both DCC and FCC
- Construction activities to be undertaken in such a way as to minimise noise levels using the best available techniques. These include:
    - Ongoing maintenance of plant and equipment to ensure optimum noise attenuation performance
    - Preclude equipment/ plant modifications which could potentially increase noise emissions
    - Tool box talks to site staff on the importance of noise control including prevention of unnecessary revving of engines, reduced heights for dropping loads of fill and routine checks of noise screening (if required)
- A communications protocol will be in place to ensure that residents have a single point of contact throughout the contract (Liaison Officer) for receipt and action of complaints. This point of contact will also have ongoing communication with the local community bodies to inform them of upcoming working areas which may allow for consideration of community activities where noise could be undesirable.

10.6.2 Operations

There are no significant noise sources associated with the operation of a buried pipeline and therefore no mitigation is required. The inlet and reception stations will be sources of operational noise but the impacts will be imperceptible given their location within the port and Dublin Airport.

10.7 Residual Impacts after Mitigation

Construction impacts at each section although limited in duration are assessed as a temporary significant impact. With screening in place, the predicted levels indicate that impacts can still occur at distances of up to 10 m which will effect some 30 dwellings only. Further mitigation will be utilised such as equipment replacement and monitoring will be conducted upon commencement of the construction works.

There are no residual operational impacts.

10.8 Do-Nothing Impact

In the event that this project was not undertaken, there would no impacts on the ambient noise environment, either temporarily or permanently.

10.9 Monitoring

Noise monitoring will be carried out at the commencement of the construction stage to enable greater noise mitigation to be provided as described above. Furthermore, monitoring will be carried out particularly in residential and amenity areas and in the event that night-time or weekend work is required. The results of this monitoring will be provided to the local authorities.

10.10 Vibration

10.10.1 Introduction

This section of the EIS has been prepared by Byrne Environmental Consulting Ltd to identify and assess the potential vibrational impacts associated with the proposed aviation fuel pipeline during the construction, operational and decommissioning phases of the development.

This section includes a comprehensive description of the existing receiving environment with respect to vibration in the vicinity of the proposed development; a description of how the construction, operational and decommissioning phases may impact the receiving environment and finally; the mitigation measures that will be implemented to control and minimise the impact that the proposed aviation fuel pipeline may have on vibration levels at the receiving environment.

The mitigation measures will demonstrate how the development will be constructed and operated in an environmentally sustainable manner in order to ensure its minimal impact on the receiving environment.

10.11 Methodology

The general assessment methodology of the potential impact of the proposed development on the vibration environment has been devised in accordance with the Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002) and Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements) (EPA 2003).

The methodology for the assessment of potential vibration impacts from works associated with the proposed development included a review of relevant best practice, international standards and guidelines and a review of the proposed construction methodologies.

10.11.1 Assessment Methodology

The receiving vibration environment has been defined through a desktop study including a review of aerial photography (2012) and a walkover of the proposed pipeline corridor in July 2014.

In addition, the receiving vibration environment has been characterised with information obtained from site specific baseline vibration surveys conducted in the vicinity of the closest sensitive receptors to the proposed development. The baseline vibration survey was conducted generally in accordance with the requirements of:

- BS 7385 Evaluation and measurement for vibration in buildings: Part 1 1990 Guide for measurement of vibrations and evaluation of their effect on buildings
- BS 6472 Guide to the evaluation of human exposure to vibration in buildings: Part 1 2008 Vibration sources other than blasting
- BS ISO 4866 Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures 2010.

10.11.2 Impact Assessment Methodology

Within this assessment, vibration impacts have been considered on the human environment, buildings and sensitive equipment. In all instances, it is appropriate to consider the magnitude of vibration in terms of Peak Particle Velocity (PPV). Peak Particle Velocity is defined as the instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position and is measured as metres per second (m/s).

Construction impacts have been assessed in accordance with BS 5228 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration 2009+A1:2014 and BS 7385-2:1993 – Evaluation and Measurement for Vibration in Buildings: Part 2 – Guide to Damage Levels from Groundborne Vibration.

Construction Impact Assessment Criteria - Human Beings

Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV (Peak Particle Velocity) range of 0.14 mm/s to 0.3 mm/s (BS 5228 Part 2:2009+A1:2014). Table 10.11, reproduced from BS 5228 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration 2009+A1:2014, outlines the vibration levels (in terms of Peak Particle Velocity, PPV) from construction activities and their likely effect on humans.

Table 10.11: Guidance on the Effect of Construction Vibration Levels on Humans

Vibration Level (PPV) [A,B,C]	Effect
0.14mm/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.
0.30mm/s	Vibration might be just perceptible in residential environments.
1.0mm/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 in most building environments.

Notes:
A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.
B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.
C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

With consideration of Note B above, in general, vibration levels appear to reduce from the free field external situation to foundations, typically reducing by up to 60% and both attenuation and amplification is likely for the vertical and horizontal directions (Association of Noise Consultants). Within this assessment the typical transfer function has been reduced by fifty percent. Therefore, a conservative transfer function of a 30% reduction from the free field value has been utilised within this assessment. Whilst this a conservative assumption, vibration levels experienced from construction activities on site will be a function of the construction vibration characteristics, ground conditions, foundation types, building construction, particularly floor construction, and loading, all of which are variable.

Buildings

It is rare for vibration from well-controlled construction works to result in building damage, even minor cosmetic damage. Table 10.12 shows the limits above which cosmetic damage could occur for transient vibration. Minor damage is possible at vibration magnitudes which are greater than twice those shown in Table 10.12, and major damage to a building structure would only generally occur at values greater than four times the tabulated values. These values only relate to transient vibration e.g. an isolated hammer blow during piling or the bucket of an excavator removing material from a trench. If there is continuous vibration, the guide values shown in Table 10.2 might need to be reduced by up to 50%.

This guidance is reproduced from BS 5228-2:2009+A1:2014 – Code of Practice for Noise and Vibration Control on Construction and Open Sites: Part 2 – Vibration and BS 7385-2:1993 – Evaluation and Measurement for Vibration in Buildings: Part 2 – Guide to Damage Levels from Groundborne Vibration.

Table 10.12: Transient Vibration Guide Values for Cosmetic Damage

Type of building	PPV (mm/s) in frequency range of predominant pulse	
	4-15Hz	15Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50mm/s at 4Hz and above.	50mm/s at 4Hz and above.
Unreinforced or light framed structures. Residential or light commercial buildings.	15mm/s at 4Hz increasing to 20mm/s at 15Hz.	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above.

Sensitive Equipment

Vibrations, even of very low magnitude, can interfere with the satisfactory conduct of certain activities, e.g., use of very sensitive laboratory weighing equipment. The sensitivity of such equipment depends upon a number of factors such as the specification and exact use of the equipment, the building it is located in, and any specific vibration isolation that has been installed.

Table 10.13 shows the limits above which cosmetic damage could occur from transient vibration. This guidance is reproduced from BS 5228-2:2009+A1:2014 – Code of Practice for Noise and Vibration Control on Construction and Open Sites: Part 2 – Vibration

Table 10.13: Vibration Criteria for Sensitive Equipment

Facility, Equipment or Use	rms vibration velocity (μm/s)
Bench microscopes at up to 400× magnification; optical and other precision balances; coordinate measuring machines; metrology laboratories; optical comparators. Microelectronics manufacturing equipment – Class A: Inspection, probe test, and other manufacturing support equipment.	50
Micro surgery, eye surgery, neurosurgery; bench microscopes at magnification greater than 400×; optical equipment on isolation tables. Microelectronics manufacturing equipment – Class B: aligners, steppers, and other critical equipment for photolithography with line widths of 3μm or more.	25
Electron microscopes at up to 30 000× magnification; microtomes; magnetic resonance imagers. Microelectronics manufacturing equipment – Class C: aligners, steppers, and other critical equipment for photolithography with line widths of 1μm.	12
Electron microscopes at greater than 30 000× magnification; mass spectrometers; cell implant equipment. Microelectronics manufacturing equipment – Class D: aligners, steppers, and other critical equipment for photolithography with line widths of 0.5μm; includes electron-beam systems.	6
Microelectronics manufacturing equipment – Class E: aligners, steppers, and other critical equipment for photolithography with line widths of 0.25μm; includes electron-beam systems; un-isolated laser and optical research systems.	3

Ecologically Sensitive Receptors

Potential impacts on fauna (avian and non-avian) from vibration during the construction of the proposed scheme including trenchless techniques at the open channel crossings of the Tolka River and Santry River and the culverted crossings of the Mayne, Naniken, Wad Rivers and the Kilbarrack and Cuckoo streams are assessed in Chapter11 Flora and Fauna.

Operational Impact Assessment Methodology

As detailed in Section 3.2 the pipeline will be designed, constructed and operated in accordance with I.S. EN 14161:2011 – Petroleum and Natural Gas Industries – Pipeline transportation systems (ISO 13623:2009 modified). The trench will be backfilled with 300 mm of sand and pea gravel, then 700 mm of lean mix concrete to 200 mm below ground surface. Once operational the pipeline will transport aviation fuel.

The transport of aviation fuel within the well-designed and constructed pipeline will not act as a source of vibration. Therefore, there will be no vibration impacts on human beings, buildings, sensitive equipment or ecologically sensitive receptors during the operational of the proposed scheme.

In addition, the Above Ground Stations, designed to pump and receive fuel, will be located at both Dublin Port and Dublin Airport. The Above Ground Stations will be located inside existing facilities and will not have a significant vibration impact on human beings, buildings, sensitive equipment or ecologically sensitive receptors during the operational of the proposed scheme.

Decommissioning Impact Assessment Methodology

There will be no vibration generated by the proposed development during the decommissioning phase. In the unlikely event that the pipeline is decommissioned, the pipe will be emptied of fuel and flushed with water. There will be no perceptible vibration generated during the emptying and flushing of the proposed pipeline.

There will be no vibration impacts on human beings, buildings, sensitive equipment or ecologically sensitive receptors during the decommissioning of the proposed scheme.

10.12 Receiving Environment

10.12.1 Description of the Receiving Environment

The receiving environment, along which the proposed pipeline will be located, runs predominantly within the road carriageway and passes through areas which are residential and commercial in nature.. There are a number of residential areas located along the East Wall Road and a significant number of residential properties along Howth Road, Copeland Avenue and Malahide Road.

In addition to residential receptors, amenity areas, business centres (East Point Business Park and Portside Business Centre), schools, churches (and other amenities including the Clontarf Private Nursing Home, Clontarf Golf Club, Mayfield Park, and the Odeon Cinema Coolock amongst others) will be passed by the proposed pipeline.

10.12.2 Baseline Environmental Vibration Survey

Baseline vibration data in the vicinity of the closest sensitive receptors to the proposed pipeline has been obtained from vibration monitoring surveys conducted by Byrne Environmental Consulting Ltd during June and July 2014. The baseline monitoring locations selected included locations in proximity to buildings including residential receptors and utility services buildings adjacent to the planning corridor of the proposed development.

Measurements were conducted at fourteen locations in the vicinity of the proposed pipeline corridor. Figure 10.1 included in Appendix 10.2 of Volume 3 of the EIS, details the approximate locations of the measurement positions.

Vibration Location 1:	Measurement location was located at ESB Sub Station, East Wall Rd
Vibration Location 2:	Measurement location was located at 186 East Wall Rd (House)
Vibration Location 3:	Measurement location was located at Clontarf Rd Pumping Station
Vibration Location 4:	Measurement location was located at 49 Copeland Avenue (House)

Vibration Location 5:	Measurement location was located at 90 Malahide Rd (House)
Vibration Location 6:	Measurement location was located at 1 Malahide Rd (House)
Vibration Location 7:	Measurement location was located at 52 Dunree Park (House)
Vibration Location 8:	Measurement location was located at Cuckoo Stream, Clonshaugh
Vibration Location 9:	Measurement location was located at Railway Bridge Clontarf Road
Vibration Location 10:	Measurement location was located at Tolka River, East Wall Road
Vibration Location 11:	Measurement location was located at Naniken River, Malahide Road
Vibration Location 12:	Measurement location was located at Wad River, Malahide Road
Vibration Location 13:	Measurement location was located at Kilbarrack Stream, Malahide Road
Vibration Location 14:	Measurement location was located at Mayne River, Clonsaugh

Note: It was not possible to conduct a baseline vibration survey in proximity to the M1 Motorway crossing due to safety issues.

Monitoring was conducted for 60 minute periods at the Vibration Locations (VL) 1-8 between 09:00hrs–17:00hrs during weekday periods when normal traffic movements were occurring and when no other transient or intermittent vibration sources were occurring such as road works and building works in proximity to the selected baseline monitoring locations.

Vibration measurements were conducted at the monitoring locations using a calibrated twin channel Vibrock V901 seismograph fitted with a Peak Particle Velocity (PPV) tri-axial geophone and a Vibration Dose Value (VDV) tri-axial accelerometer to allow for the simultaneous monitoring of PPV and VDV levels. All recorded data was reviewed and assessed using Vibrock software.

10.12.3 Measurement parameters

The vibration parameters used to describe the existing vibration climate are described as follows:

Peak Particle Velocity (PPV)	Instantaneous maximum velocity reached by a vibrating element as it oscillates about its rest position
Vibration Dose Value (VDV)	Measure of the total vibration experienced over a specified period of time

10.12.4 Measurement Results

The measurement results obtained during the baseline vibration survey are detailed in Table 10.14 below.

Table 10.14: Baseline Vibration Survey Results

Location	Time	Measured vibration values				
		PPV (mm/s)	VDVx ($mm/s^{-1.75}$)	VDVy ($mm/s^{-1.75}$)	VDVz ($mm/s^{-1.75}$)	Observations
VL 1	08:15 – 09:15	0.250	0.0003	0.0005	0.0122	Heavy Traffic
VL 2	09:35 – 10:35	0.200	0.0009	0.0005	0.0098	Heavy Traffic
VL 3	11:15 – 12:15	0.275	0.0012	0.0001	0.0120	Heavy Traffic
VL 4	12:25 – 13:35	0.150	0.0001	0.0001	0.0095	Heavy Traffic
VL 5	09:40 – 10:40	0.175	0.0003	0.0005	0.0089	Heavy Traffic
VL 6	10:55 –	0.275	0.0004	0.0003	0.0105	Heavy Traffic

	11:55					
VL 7	12:35 – 01:35	0.150	0.0001	0.0001	0.0035	Heavy Traffic
VL 8	09:15 – 10:15	0.150	0.0004	0.0002	0.0019	Light Traffic
VL 9	08:15	0.250	0.0007	0.0005	0.0009	Heavy Traffic
VL 10	09:50	0.275	0.0015	0.0005	0.0055	Heavy Traffic
VL 11	12:15	0.175	0.0003	0.0002	0.0008	Heavy Traffic

Location	Time	Measured vibration values	Location	Time	Measured vibration values	Location
VL 12	09:20	0.200	0.0003	0.0002	0.0002	Heavy Traffic
VL 13	11:35	0.200	0.0005	0.0006	0.0010	Heavy Traffic
VL 14	14:45	0.250	0.0007	0.00040	0.0011	Heavy Traffic

Existing baseline vibration is limited to the effects of road traffic in proximity to the baseline monitoring locations. Given that all roads along the proposed alignment are well maintained, vibration levels from road traffic were not significant. No other significant sources of vibration were observed during monitoring surveys.

The results of the baseline vibration monitoring presented in Table 10.14 identify that the baseline vibration levels at sensitive receptors are just perceptible. The highest vibration level (PPV) measured during the survey was 0.275 mm/s at Location VL3 and VL10. This level was due to road traffic movements. In all other instances the maximum PPV levels recorded ranged between 0.150mm/sec to 0.250mm/sec.

VDV levels were greatest in the x axis and are significantly below levels which would result in adverse comment from residential receptors during the day and night time periods as defined in BS 6472.

10.12.5 Sensitive Equipment

The identification of any sensitive equipment within 100 m either side of the proposed alignment by means of desktop studies and field surveys was conducted. This review has not identified any vibration sensitive equipment.

10.13 Potential Impacts - Vibration

Elements of the construction phase of the proposed development have the potential to impact on the human beings, buildings and other sensitive receptors. The likely potential impacts from the construction of the proposed scheme prior to mitigation are described in this section of the EIS. The mitigation measures are described in Section 10.14.

10.13.1 Construction Impacts

The construction of the pipeline will be conducted in the following phased stages as detailed with Chapter 3 – Description of the Proposed Development:

- Establishment of temporary construction compounds
- Establishment of a Traffic Management Plan in agreement with DCC and FCC
- Route proving & open cut trench excavation including the sawing of carriageway, breakout of the surface, excavation to a depth to allow 1.2m of cover above the pipeline
- Pipe laying operations and reinstatement of the trench and road surface

Potential sources of ground borne vibrations that may be generated during the construction phase of the development of this nature will be during the establishment of temporary construction compound(s), route proving, open cut trench excavations and reinstatement of the trench and road surface, excavation of launch and reception pits for trenchless crossings and the boring activity.

There will be no vibration impacts on human beings, buildings or sensitive equipment during the establishment of traffic management or pipeline installation works. Therefore, these stages of construction are not considered further within this assessment.

Establishment of Temporary Construction Compounds

Works activities associated with the establishment of temporary construction compounds will be undertaken prior to route proving and open cut trench excavations. The location of the temporary construction compounds will be identified by the appointed contractor in consultation with the Developer. There are currently vacant secure sites located at Dublin Port and at the Malahide Industrial Park, off Greencastle Road, which would be suitable for pipe compounds. Temporary compounds will have a minimal potential to generate excessive vibration levels. There will be no vibration impacts on human beings or buildings associated with the establishment and operation of the temporary construction compound.

Construction & Reinstatement

The excavation of trial holes and slit trenches associated with route proving and open cut trench excavations and reinstatement may result in vibration impacts on sensitive receptors.

An open-cut approach using trenching, of width 500 mm to 700 mm will be adopted as it is a standard method for the excavation of trial holes, and in the construction of a steel pipeline of this nature. Excavations will be to a depth of approximately 1,500 mm. This method of construction is similar to the works required to provide other utility infrastructure such as water, drainage, gas, telecoms and electricity. Further details are included in the Construction Plan included as Appendix 3.3 of this EIS.

Human Beings - Vibration impacts have been considered from any particular plant items that have the potential to generate levels of vibration perceptible to human beings. A review of the construction equipment that is likely to be utilised has concluded that there is the potential for vibration impacts from the use of the pneumatic breakers (both hand held and mounted on wheeled excavators), tracked excavators, disc cutters and vibratory rollers.

The pipeline will be located predominantly within the road carriageway. As detailed in Chapter 3 – Description of the Proposed Development the developer is applying for a planning corridor, to include public road, footway and verges to allow for micrositing at construction stage around existing services. Where the route passes through green areas and private amenity areas the planning corridor will be 8 m in width.

A very conservative assessment has been assessed and it has been assumed that human receptors, and in particular people within their dwellings will be located within 4 m of the construction works sites at two particular locations.

Based on a review of extensive monitoring data from other similar linear utility construction projects conducted by Byrne Environmental Consulting Ltd, including the Luas Cross City utility diversion works and the Dublin watermains rehabilitation works and slit trenching works undertaken for local authorities, it is estimated that vibration levels generated by tracked excavators and disc cutters will not exceed 0.8mm/s beyond 4 metres from the proposed works sites at the facade of any building. Employing the transfer function detailed in Section 10.11.2, vibration levels of 0.5mm/s are predicted at ground floor level internally. Comparing this value with Table 10.11 indicates that this level is likely to cause complaints in residential environments, but can be tolerated if prior warning and explanation has been given to residents.

It is estimated**,** following a review of monitoring data from the projects identified above, that levels of vibration generated by hand held pneumatic breakers and pneumatic breakers mounted on wheeled excavators will not exceed 1.8 mm/s beyond 4 m from the proposed works sites.

Employing the transfer function detailed in Section 10.2.1.2 above, internal vibration levels of 1.2 mm/s are predicted at ground floor level. Comparing this value with Table 10.11 indicates that this level is likely to cause complaints in residential environments, but can be tolerated if prior warning and explanation has been given to residents.

It is estimated, following a review of monitoring data from the projects identified above, that vibration levels generated by large vibratory rollers will not exceed 11 mm/s beyond 4 m from the proposed works sites. Maximum vibration levels of 7.1 mm/s are predicted at ground floor level internally. Comparing this value with Table 10.11 indicates that vibration is likely to be intolerable for any more than a very brief exposure (5-10 minutes) to this level.

As noted in Table 10.11 above, single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. Given that the sources of vibration identified above will be temporary and intermittent in nature in conjunction with the Contractors rate of progress, residents will be exposed to levels of perceptible vibration for no more than a maximum of 2 days.

Vibration levels generated during construction will occur primarily during daytime hours which will serve to minimise the vibration impacts at local residential receptors. However, the proposed pipeline route will pass through routes classified as strategic traffic routes, and will be subject to working hour restrictions. To progress the works in an efficient manner and to ensure project viability, discussions will take place with Dublin City Council, to reach agreement on working hours. Whilst any relaxation of the working hours would facilitate acceleration in programme delivery and minimise the duration of any potential nuisance to sensitive receptors along the route, works which may be undertaken outside of daytime hours may result in increased temporary and intermittent impacts on local residents, especially if works are undertaken throughout the night time period. However, such works will not have a significant impact on sensitive receptors, in particular residents.

It is concluded that construction vibration impacts from construction equipment will range from imperceptible to moderate on human receptors. There will no likely significant impacts on human beings during the construction phase of the proposed pipeline.

During the construction of the pipeline there will be an increase in the volume of HGVs within the immediate area of each working crew and along the proposed haul routes to deliver materials and remove the excavated material off-site. Vibrations associated with road traffic movements is perceptible to human beings at around 0.5mm/s and may become disturbing or annoying at higher magnitudes.

As a vehicle travels along a road, vibration can be generated in the road and subsequently 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.

Reinstatement undertaken by the Contractor, including temporary reinstatements, will ensure that road surfaces are smooth. Ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Vibration impacts associated with road traffic can therefore be largely avoided by good maintenance of the road surface.

There will be no significant vibration impacts on human beings from construction traffic.

Buildings - Extensive studies have shown that documented proof of actual damage to structures or their finishes resulting solely from well controlled construction vibrations is rare (BS 5228 Part 2:2009+A1:2014). Based on a review of extensive monitoring data from other similar linear utility construction projects, vibration levels will not exceed the transient vibration guide values for cosmetic damage set out in Table 10.12 beyond 5 m from the proposed works sites.

It is concluded that construction vibration impacts will be minimal on buildings. There will be no significant impacts on buildings during the construction phase of the proposed pipeline.

Sensitive Equipment - As detailed in Section 10.11.2 above, the Project Team did not identify any vibration sensitive equipment within 100 m either side of the proposed alignment. Therefore there will be no vibration impacts during the construction stage of the proposed development on vibration sensitive equipment.

Recorded Monuments - Chapter 15 - Archaeology, Architecture and Cultural Heritage of the EIS identifies 33 Recorded Monuments within 750 m of the pipeline corridor, the closest of which is located 50 m from the pipeline corridor. With regard to the extended separation distance of 50m between the closest monument and the pipeline corridor, there will be no vibrational impact on this recorded monument (RMP DU018:67) (given that the latter no longer exists above ground).

Special Crossings

A number of Special Engineering Difficulties have been identified along the route as detailed in Chapter 3 - Description of the Proposed Development.

Within the FCC administrative area there will be the crossing of the M1 –FAI Grounds to DAA Long Term Car Park (Red) and the Swords Road Crossing (R132) at Corballis entrance to Airport. Crossings of these sections will be completed using trenchless technologies will for example:

- Horizontal Directional Drilling (HDD)
- Microtunelling
- Pipe Jacking
- Auger Boring

These crossings will comprise the excavation of pits on either side of the crossing and boring underneath the structure. Details of each crossing, including launch and reception pits are provided in the Construction Plan included as Appendix 3.3 of Volume 3 of this EIS.

Vibration levels associated with trenchless technologies such as pipe jacking are generally low but can vary depending on whether the construction is passing through soil or rock. Vibrations will be higher in stiffer ground with lower damping properties. It is expected that greater levels of vibration will be generated when passing through rock when compared to passing through boulder clay and gravel. However, the presence of obstructions e.g. boulders within soil, can increase vibration levels.

Given the duration of the works in conjunction with the distance from the proposed works to the nearest sensitive receptors it is unlikely that there will be significant impacts on humans and buildings during the crossings of rivers and streams.

Vibration monitoring will be undertaken at the Clontarf Road railway bridge. Vibration surveys will be conducted at trenchless crossings where boulders are encountered or where ground conditions may lead to increased vibration levels. All vibration surveys will be conducted by an Independent Acoustic consultant.

River/Stream Crossings

In addition, there are seven river/stream crossings. The Tolka River and the Santry River are open channels whilst the remaining rivers and streams are culverted. All of these will be crossed using trenchless techniques.

The potential impacts on fauna (avian and non-avian) from vibration during the construction of the proposed scheme including tunnelling at Tolka River and Santry River and the culverted Mayne River, Naniken River, Wad River, Kilbarrack stream, Cuckoo stream are assessed in Chapter 11 Flora and Fauna.

10.13.2 Operational Phase

There will be no vibration generated by the proposed development during the operational phase. The trench will be backfilled with 300 mm of sand and pea gravel, then 700 mm of lean mix concrete to 200 mm below ground surface. There will be no perceptible vibration from the movement of aviation fuel through the proposed pipeline.

There will be no vibration impacts on human beings, buildings, sensitive equipment or ecologically sensitive receptors during the operational of the proposed scheme.

10.13.3 Decommissioning Impacts

There will be no vibration generated by the proposed development during the decommissioning phase. In the unlikely event that the pipeline is decommissioned, the pipe will be emptied of fuel and flushed with water. There will be no perceptible vibration generated during the emptying and flushing of the proposed pipeline.

There will be no vibration impacts on human beings, buildings, sensitive equipment or ecologically sensitive receptors during the decommissioning of the proposed scheme.

10.13.4 Do-Nothing Impact

The proposed pipeline corridor is located along a number of main commuter routes. Ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Vibration impacts associated with increased road traffic can therefore be largely avoided by good maintenance of the road surface. This increase above the existing situation would not result in a perceptible change in the existing vibration climate at any local receptor.

Should the proposed development not proceed, it is considered that there would be no significant change on the receiving vibration environment.

10.14 Mitigation Measures - Vibration

10.14.1 Construction Phase Mitigation

The following vibration management measures will be implemented from the outset of site activities to control and manage vibration levels during the construction phase of the proposed pipeline:

- Application of construction vibration limits, as set out in Tables 10.1-10.3
- Limiting the hours during which site activities likely to create high levels of vibration are permitted. The hours of operation for the development will be agreed with DCC and FCC
- Night-time activities will be avoided as much as is reasonably practicable. Residents, business owners, community organistions will be notified should night-time/weekend works be agreed with DCC and FCC
- The Contractor in conjunction with the Developer will appoint a designated person to manage environmental complaints including those relating to vibration
- A vibration complaint procedure will be implemented in which the details of any vibration related complaint are logged, investigated and where required, measures are taken to ameliorate the source of the vibration complaint
- Breaking out of concrete will be undertaken using low vibration tools wherever possible
- Vibratory plant will be located as far away from sensitive properties and structures as permitted
- Construction plant with a low inherent potential for generation of vibration will be selected where possible
- Public roads were possible will be temporarily reinstated during the course of construction works so as to mitigate the potential for vibration from traffic

- An independent acoustic consultant will be engaged by the contractor in conjunction with the Developer prior to the commencement of site activities
- In order to ensure that site construction activities are conducted to minimise the vibration impacts on the receiving environment, vibration monitoring will be conducted during the course of the construction works at Clontarf Road Bridge and where boulders or ground conditions are encountered during trenchless techniques which could give rise to increased vibration levels. Calibrated vibration monitors and geophones with audible and/or visual alarm will be installed to ensure that if vibration levels approach or exceed specified warning and limit values, site personnel will be alerted to cease at the earliest instance and appropriate mitigation measures may then be implemented to minimise vibrational impacts. As set out in Section 10.13.1 the construction phase of the development will have an imperceptible impact on buildings adjacent to the site. Therefore, no mitigation measures above those set out above are required.

As detailed in Section 10.11.2 above, the Project Team did not identify any vibration sensitive equipment within 100 m either side of the proposed alignment. Therefore there will be no vibration impacts during the construction stage of the proposed development on vibration sensitive equipment. Therefore, no mitigation measures above those set out above are required.

However, should sensitive equipment be identified during construction works, the Contractor will ensure, by selection of construction methods and timing, monitoring and control, that vibration levels do not exceed levels set out in Table 10.13 above or tolerances agreed with the manufacturer, supplier or operators of such equipment.

10.14.2 Operational Phase Mitigation

As set out in Section 10.11.2 the operational phase of the development will not have an adverse vibration impact on human beings, buildings or sensitive equipment during the operational phase of the scheme. Therefore, no mitigation measures are required.

10.14.3 Decommissioning Phase Mitigation

As set out in Section 10.11.2 the decommissioning phase of the development will not have an adverse vibration impact on human beings, buildings or sensitive equipment during the operational phase of the scheme. Therefore, no mitigation measures are required.

10.14.4 Cumulative Vibration Impacts

There are currently no other sources of infrastructural vibration in the vicinity of the proposed pipeline, therefore there are no predicted cumulative impacts associated with the proposed pipeline development

10.15 Residual Impacts Vibration

There will be no residual impacts during the construction, operational or decommissioning phases of the proposed development.

10.16 References

- Guidelines on the Information to be Contained in Environmental Impact Statements (EPA, 2002)
- Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements) (EPA 2003)
- British Standard 5228 Part 1:2009 Code of practice for noise and vibration control on construction and open sites Part 1 Noise, 2009

- British Standard 5228 Part 1:2009 Code of practice for noise and vibration control on construction and open sites Part 1 Noise, 2009
- National Roads Authority Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004
- BS 6472-1 Guide to the evaluation of human exposure to vibration in buildings: Part 1 2008 Vibration sources other than blasting
- BS 7385-1 Evaluation and measurement for vibration in buildings: Part 1 1990 Guide for measurement of vibrations and evaluation of their effect on buildings
- BS 7385-2:1993 – Evaluation and Measurement for Vibration in Buildings: Part 2 – Guide to Damage Levels from Groundborne Vibration
- BS ISO 4866 Mechanical vibration and shock – Vibration of fixed structures – Guidelines for the measurement of vibrations and evaluation of their effects on structures 2010
- BS 5228 Code of Practice for noise and vibration control of construction and open sites - Part 2: Vibration 2009+A1:2014
- BS PD 8010 – 1:2004: Code of Practice for Pipelines Part 1: Steel Pipelines on Land
- Guidelines for the Treatment of Noise and Vibration in National Road Schemes (2004)
- Measurement & Assessment of Groundborne Noise & Vibration Association of Noise Consultants