Appendix A9.1
Noise & Vibration Survey

Contents

Appendix A9.1: Noise and Vibration Survey

1. Baseline Noise Monitoring

1.1 Introduction

This Report includes the relevant survey details and results associated with baseline noise monitoring undertaken as part of the Tallaght / Clondalkin to City Centre Core Bus Corridor Scheme (hereafter referred to as the Proposed Scheme). The survey has been undertaken to inform the noise and vibration chapter of the Proposed Scheme EIAR.

Survey details and results for each of the noise monitoring locations are included within this Report.

1.2 Survey Methodology

1.2.1 Study Area

The assessment study area is split into four geographical zones for the Tallaght Section and two geographical zones for the Clondalkin Section. The range of noise and vibration sensitive locations along the Proposed Scheme for the six geographic sections are discussed in Table 1.

Table 1: Description of noise and vibration sensitive locations along the Proposed Scheme

Geographical Section	Description of Study Area
Tallaght to Ballymount	Within this study area, the key NSLs are predominately residential NSLs in Belgard Square residential area. These residential NSLs are within 10m of the Proposed Scheme. Other sensitive NSLs in this zone include Tallaght Hospital and TUD Tallaght within 40m to 100m of the road edge. Community receptors include Saint Maelruain's Church of Ireland within 10m of the Proposed Scheme. The route passes through low sensitivity commercial NSLs within 50m of the road edge on the R819 Greenhills Road. Residential NSLs lining either side of R819 Greenhills Road are within 10m to 100m of the Proposed Scheme. There are a small number of NSLs in Parkview estate that may have an increase in noise levels due to a closer proximity to the proposed new Greenhills Road, east of the existing Treepark Road.
Ballymount to Crumlin	The majority of the Ballymount Avenue and Calmount Road section of the Proposed Scheme is routed through business parks with large scale business premises and offices within 20m to 50m of the road edge. Towards the Walkinstown Roundabout on the R819 Greenhills Road, a small number of residential NSLs line the Proposed Scheme, within 10m to 20m of the road edge. Other sensitive NSLs include Adorables School within 10m of the Proposed Scheme, NSLs lining R819 Walkinstown Road, R110 Drimnagh Road and R110 Crumlin Road, located within 7m to 20m of the Proposed Scheme, and Our Lady's Children's Hospital Crumlin and Old County Road Health Centre, both within 10m of the road edge. Educational NSLs include Little Tots Creche and Montessori, Crumlin College of Further Education, Loreto College and Scoil Mhuire Óg, all within 5m to 20m of the Proposed Scheme. Leisure NSLs include Guinness Pitch & Putt Club within 65m of road edge on R110 Crumlin Road.
Crumlin to Grand Canal	Within this study area, the key NSLs are predominately residential along the proposed cycle route, lining Bunting Road, St. Mary's Road, Kildare Road and Clogher Road, within 10m to 20m of the Proposed Scheme. Other NSLs include Marist National School, Pearse College of Further Education, St. Bernadette's Church and Mount Jerome Cemetery, within 15m to 100m of the Proposed Scheme.
Grand Canal to Christchurch	Within this study area, the key NSLs are predominately residential NSLs along R110 Dolphin's Barn, R110 Cork Street, R110 St. Luke's Avenue, R110 Dean Street, R137 Patrick Street and R137 Nicholas Street, within 15m to 40m of the Proposed Scheme. Other NSLs include Coombe Women's Hospital and Brú Chaoimhin Hospital, within 15m to 70m of the road edge. Community NSLs include Weaver Park, St. Patrick's Cathedral and Christ Church Cathedral, within 5 to 50m of the Proposed Scheme. St. Patrick's Park is between 100m to 150m from the Proposed Scheme.
Woodford Walk (R113) / New Nangor Road (R134) to Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction	The key NSLs are residential and high-density commercial receptors. The key residential NSLs are located along the R134 New Nangor Road, in the Yellowmeadows residential area, within 5m to 100m of the Proposed Scheme. The majority of this section of the Proposed Scheme is routed through business parks with large scale business premises and offices, within 10m to 50m of the road edge
Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction to Drimnagh	The key NSLs are predominately a small number of residential NSLs to the south of R110 Long Mile Road, within 10m to 100m of the Proposed Scheme. Other NSLs include Drimnagh Castle Primary and Secondary Schools, and Assumption Primary and Secondary Schools, within 20m to 50m either side of the road edge. The Parish of Walkinstown Church is a community receptor within 200m of the Proposed Scheme. High density, low sensitivity commercial NSLs are within 10m to 50m of the road edge.

1.2.2 Survey Locations

Baseline noise surveys have been conducted at locations representative of the nearest noise sensitive areas which have the potential to be impacted by construction works and / or those likely to be impacted during the Operational Phase of the Proposed Scheme. Baseline noise measurements were made over both long-term and short-term periods to inform the assessment.

Baseline noise measurements were made over both long-term and short-term periods to inform the assessment:

- Long-term surveys (typically one week in duration) were made at a total of two locations; and
- Short-term surveys (attended day-time measurements) were made at a total of 24 locations along the length of the Proposed Scheme.

Figure 9.2 in Volume 3 of this EIAR illustrates the baseline noise monitoring locations. Each is discussed in the relevant geographical zone in the following sections.

1.2.3 Survey Periods

Unattended noise surveys were undertaken between 27 August 2020 and 21 September 2020. The specific survey dates for each location are included in the survey result tables in Section 1.3.

Attended noise surveys were undertaken between 17 July 2020 and 8 September 2020. The specific survey dates and times for each location are included in the survey results tables in Section 1.3.

1.2.3.1 Tallaght to Ballymount

A total of seven attended survey locations and one unattended location were surveyed within this study area. The location references and a description of survey positions are included in Table 2.

Table 2: Noise Monitoring Locations – Tallaght to Ballymount

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0809ANML004	On a footpath in line with NSLs along Belgard Square West.
CBC0809ANML005	On a footpath in line with The Exchange Hall Apartments facades along Belgard Square North.
CBC0809ANML006	On footpath to east of St Mary's National School entrance. Located approximately 20m from R819 Greenhills Road.
CBC0809ANML007	On grass area in line with residential NSLs on Mayberry Road, approximately 25m set back from R819 Greenhills Road.
CBC0809ANML008	On a footpath in line with the façade of closest NSL to Birchview Avenue cul de sac.
CBC0809ANML009	On grass area to east of Treepark Road, in line with façade of NSL located in Parkview housing estate. R819 Greenhills Road located to the east.
CBC0809ANML010	On a footpath in line with residential NSL façade on Tymon Lane, set back approximately 55m from R819 Greenhills Road.
Unattended Monitoring Locations	
CBC0809UNML001	On hard ground in rear residential garden. Located approximately 35m from R819 Greenhills Road and 65m from Treepark Road edges.

1.2.3.2 Ballymount to Crumlin

A total of one long-term unattended monitoring locations and two attended survey locations were surveyed within this study area. The location references and a description of survey locations are included in Table 3.

Table 3: Noise Monitoring Locations – Ballymount to Crumlin

Location	Description of Survey Location
Unattended Monitoring Locations	
CBC0809UNML002	On hard ground in front residential garden, in line with façade of property. Located approximately 100 m from M50 and 100 m from R819 Greenhills Road.
Attended Monitoring Locations	
CBC0809ANML011	Located in green area of Tymon Park set back approximately 10m from R819 Greenhills Road.
CBC0809ANML012	Located on footpath to south of Walkinstown Roundabout, in line with facades of NSLs facing onto R819 Greenhills Road.

1.2.3.3 Crumlin to Grand Canal

A total of ten attended survey locations were surveyed within this study area. The location references and a description of survey positions are included in Table 4.

Table 4: Noise Monitoring Locations – Crumlin to Grand Canal

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0809ANML013	On a footpath on Wallace Road in line with façades of residential NSLs set back approximately 15m from Bunting Road.
CBC0809ANML014	On footpath on Kilnamanagh Road, in line with façade of house, set back approximately 15m from R819 Walkinstown Road.
CBC0809ANML015	On a footpath in line with NSLs along, located approximately 100m east of R110 Drimnagh Road and Balfe Road junction.
CBC0809ANML016	On a green area in line with façade of closest NSL on Rafter's Road to west, set back 10m from R110 Crumlin Road.
CBC0809ANML017	On footpath at junction Windmill Road and Kildare Road. Located in line with residential façade, set back approximately 15m from Kildare Road.
CBC0809ANML018	Located at entrance of St James Gaels in line with facades of NSLs set back approximately 8m from road edge on R110 Crumlin Road,
CBC0809ANML019	On footpath on Raleigh Square in line with façade of residential NSLs set back approximately 8m from Old Country Road.
CBC0809ANML020	On footpath on Downpatrick Road, in line with residential facades set back approximately 10m from Clonard Road.
CBC0809ANML021	On footpath on Downpatrick Road, in line with residential facades set back approximately 10m from Bangor Road.
CBC0809ANML022	On HSE grounds along R110 Crumlin Road, to east of Ardagh Road. Located approximately 10m from R110 and 35m from Ardagh Road edge.

1.2.3.4 Grand Canal to Christchurch

A total of two attended survey locations were surveyed within this study area. The location references and a description of survey positions are included in Table 5.

Table 5: Noise Monitoring Locations – Grand Canal to Christchurch

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0809ANML023	On footpath 35m to the north of Reilly's Avenue and Dolphin's Barn Street Junction, in line with façade of nearest NSL from Dolphin's Barn Street.
CBC0809ANML024	On footpath to north of R110 Dean Street, in line with façade of NSLs facing onto R137 Patrick Street.

1.2.3.5 Woodford Walk (R113) / New Nangor Road (R134) to Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction

A total of two attended survey locations were surveyed within this study area. The location references and a description of survey positions are included in Table 6.

Table 6: Noise Monitoring Locations – Woodford Walk / New Nangor Road to Long Mile Road / Naas Road / New Nangor Road Junction

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0809ANML001	On footpath on Woodford Walk in line with façade of Yellowmeadows apartment facade, approximately 30m to R134 New Nangor Road Junction.
CBC0809ANML002	On a footpath to the west of a busy roundabout between R110, R134 and R810 intersection in an industrialised area.

1.2.3.6 Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction to Drimnagh

One attended survey location was surveyed within this study area. The location reference and a description of survey positions are included in Table 7.

Table 7: Noise Monitoring Locations – Long Mile Road / Naas Road/ New Nangor Road junction to Drimnagh

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0809ANML003	On a footpath on Walkinstown Parade in line with façade of residential NSLs, set back approximately 15m to R110 Long Mile Road.

1.2.4 Survey Equipment and Personnel

The unattended surveys were undertaken using RION NL-52 sound level meters. The attended surveys were undertaken using either RION NL-52 and Brυel and Kjær 2250L sound level meters. The specific equipment details are summarised in Table 8.

Table 8: Noise Monitoring Equipment

Survey Type	Equipment	Serial Number	Calibration Date
Unattended	Rion NL-52	998413	22/01/2020
		976162	17/07/2020
Attended	Rion NL-52	998413	22/01/2020
	Brυel and Kjær 2250L	3008402	04/11/2019

Calibration certificate of the monitoring equipment are included within Section 4.

For unattended surveys, a Rion WS-15 Outdoor Microphone Protection System with microphone extension cable and outdoor peli-case was used. An image of the equipment install at each monitoring location is included in Section 5.

The surveys were conducted by Jack Brennan and Alex Ryan, acoustic technicians, AWN Consulting.

1.2.5 Survey Parameters

The following noise parameters were measured and are discussed within this Report.

$L_{Aeq,T}$ is the A-weighted equivalent continuous steady sound level during the sample period and effectively represents an average value of the defined measurement period, T.

$L_{Aeq,16hr}$ refers to the ambient daytime period between 07:00 and 23:00hrs.

$L_{A10,T}$ is the A-weighted sound level that is exceeded for 10% of the sample period; this parameter gives an indication of the upper limit of fluctuating noise such as that from road traffic. The T is the sample period the parameter is measured over.

$L_{A10,18hr}$ is the L_{A10} parameter between 06:00 and 00:00hrs as defined within the Calculation of Road Traffic Noise (hereafter referred to as CRTN) (UK Department of Transport 1998).

$L_{A90,T}$ is the A-weighted sound level that is exceeded for 90% of the sample period; generally used to quantify background noise. The T is the sample period the parameter is measured over.

$L_{A90,16hr,}$ refers to the background daytime noise level between 07:00 and 23:00hrs

$L_{A90,8hr}$, refers to the background night-time noise level between 23:00 and 07:00hrs

The L_{den} parameter is also discussed within the report. For long-term survey locations, this parameter is derived from the L_{Aeq} data over each 24 hour period as is defined as follows:

L_{den} is the 24hour noise rating level determined by the averaging of the L_{day} with the $L_{evening}$ (plus a 5dB penalty) and the L_{night} (plus a 10dB penalty). L_{den} is calculated using the following formula, as defined within the Environmental Noise Regulations (S.I.140 / 2006):

$$L_{\text{den}} = 10log\left(\frac{1}{24}\right)\left(12 * \left(10^{\frac{Lday}{10}}\right) + 4 * \left(10^{\frac{Levening+5}{10}}\right) + 8 * \left(10^{\frac{Lnight+10}{10}}\right)\right)$$

Where:

L_{day} is the A-weighted long-term average sound level as defined in ISO 1996-2:2017 Part 2: Determination of sound pressure levels (hereafter referred to as ISO 1996-2) (ISO 2017), determined over all the day periods of a year. The 12hr daytime period is between 07:00 to 19:00hrs.

$L_{evening}$ is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the evening periods of a year. The 4hr evening period is between 19:00 to 23:00hrs.

L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2, determined over all the night periods of a year. The 8hr night-time period is between 23:00 to 07:00hrs.

1.2.6 Survey Procedure

Noise measurements were conducted in general accordance with the guidance contained in ISO 1996-1:2016 Acoustics – Description measurement and assessment and environmental noise. Part 1: Basic quantities and assessment procedures (hereafter referred to as ISO 1996-1) (ISO 2016) and ISO 1996-2 (ISO 2017).

1.2.6.1 Unattended Measurements

For unattended noise surveys, the monitoring equipment was installed within the private grounds of residential properties. For single story buildings, the microphone was installed at the height of ground floor windows (typically 1.5m above ground). For all other locations, the microphone was extended to a height of approximately 3.8m above ground. The equipment was set to log for 15 minute intervals on a continual basis over a one week period.

1.2.6.2 Attended Measurements

Attended noise surveys were undertaken at public locations at positions representative of the adjacent noise sensitive locations (e.g., on green areas in residential areas, footpaths, parks etc.). For all attended surveys, the microphone was positioned at height of approximately 1.2m above ground.

The attended surveys were undertaken in accordance with the shortened measurement procedure described in CRTN (UK Department of Transport 1998) and Transport Infrastructure Ireland's (TII) document Guidelines for the Treatment of Noise and Vibration on National Road (TII 2004).

This methodology involves a method whereby $L_{A10(18hour)}$ and L_{den} values are obtained through a combination of measurement and calculation as follows:

- Noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00hrs and 17:00hrs;
- Each sample period was measured over a 15 minute duration;
- The $L_{A10(18hour)\ for}$ the location is derived by subtracting 1 dB from the arithmetic average of the three hourly sample values, i.e.:
  $L_{A10(18hour)} = ((\sum L_{A10(15\ minutes)}) \div 3) - 1$ dB.
- The derived L_{den} value is calculated from the $L_{A10(18hour)}$ value, i.e.:
  $L_{den} = 0.86 \times L_{A10(18hr)} + 9.86$ dB.

1.3 Survey Results

1.3.1 Tallaght to Ballymount

1.3.1.1 Attended Surveys

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 9.

Table 9: Attended Noise Survey Results for Tallaght to Ballymount Section

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0809ANML004	28/07/2020	10:32	65	69	57	68	Road traffic noise from Belgard Square West dominant noise source, with intermittent aircraft flyover and car horn.
		11:20	63	67	55		Road traffic noise from Belgard Square West dominant noise source, with reverse beacon intermittently.
		11:59	65	68	57		
CBC0809ANML005	28/07/2020	11:00	58	61	51	61	Road traffic noise from Belgard Square North dominant noise source.
		11:39	58	61	53		
		12:17	58	61	53		
CBC0809ANML006	08/09/2020	10:00	66	69	57	68	Road traffic noise from R819 Greenhills Road dominant noise source, intermittent aircraft flyover.
		11:15	65	69	53		Road traffic noise from R819 Greenhills Road dominant noise source.
		12:22	65	68	54		
CBC0809ANML007	28/07/2020	12:46	56	59	51	60	Road traffic noise from R819 Greenhills Road dominant noise source.
		14:11	65[Note 1]	60	53		Road traffic noise from R819 Greenhills Road dominant noise source, intermittent siren.
		15:10	56	59	52		Road traffic noise from R819 Greenhills Road dominant noise source.
CBC0809ANML008	28/07/2020	13:07	56	56	53	58	Road traffic noise from R819 Greenhills Road dominant noise source.
		14:31	55	57	53		Road traffic noise from R819 Greenhills Road dominant noise source, intermittent dog barking.

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
		15:31	55	57	53		Road traffic noise from R819 Greenhills Road dominant noise source.
CBC0809ANML009	28/07/2020	13:25	59	61	57	61	Road traffic noise from R819 Greenhills Road dominant noise source.
		14:49	60	61	58		
		15:49	59	60	56		
CBC0809ANML010	30/07/2020	15:32	61	63	58	63	Road traffic noise from R819 Greenhills Road dominant noise source, intermittent dog barking.
		16:10	57	59	54		Road traffic noise from R819 Greenhills Road dominant noise source.
	04/08/2020	14:10	65	67	59		

Note 1: Noise monitoring undertaken at CBC0809ANML002 during the second 15-minute measurement period was elevated due erroneous interference at end of measurement. Average calculated based on first and third measurement periods.

1.3.1.2 Unattended Survey

The noise survey results recorded during the baseline surveys within this study area are presented in Table 10.

Table 10: Unattended Noise Survey Results for Tallaght to Ballymount Section

Survey Date	Daytime				Evening	Night-Time			L_{den}
	$L_{Aeq,16hr}$	L_{day}	$L_{A10,16hr}$	$L_{A90,16hr}$	$L_{evening}$	L_{night}	$L_{A10,8hr}$	$L_{A90,8hr}$	
CBC0809UNML001									
14/09/2020	54	56	55	50	53	50	51	43	58
15/09/2020	55	55	54	48	54	54	49	41	60
16/09/2020	58	60	58	54	56	52	51	41	61
17/09/2020	57	59	57	52	54	52	50	42	60
18/09/2020	59	61	60	57	58	52	54	46	61
19/09/2020	61	63	59	56	56	53	51	43	63
20/09/2020	57	58	57	52	54	50	49	40	59
Average	**58**	**60**	**57**	**52**	**55**	**52**	**51**	**42**	**61**

Road traffic from the R819 Greenhills Road and M50 Motorway are the dominant noise sources at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were recorded in range of 54 to 61 dB $L_{Aeq,16hr}$. Average background daytime noise levels were measured in the range of 48 to 57 dB $L_{A90,16hr}$.

Night-time noise levels are dominated by road traffic from R819 and M50. Average ambient night-time noise levels were measured in the range of 50 to 54 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the range of 40 to 46 dB $L_{A90,8hr}$.

The measured L_{den} values ranged between 59 and 63 dB L_{den}.

1.3.2 Ballymount to Crumlin

1.3.2.1 Attended Survey

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 11.

Table 11: Attended Noise Survey Results for Ballymount to Crumlin Section

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0809ANML011	30/07/2020	15:12	64	67	60	66	Road traffic noise from R819 Greenhills Road dominant noise source, with intermittent car horn.
		15:51	65	68	60		
	31/07/2020	11:41	62	65	59		
CBC0809ANML012	30/07/2020	12:36	66	69	59	68	Road traffic noise from R110 Walkinstown Roundabout dominant noise source, birdsong.
		13:36	66	69	59		Road traffic noise from R110 Walkinstown Roundabout dominant noise source, birdsong (seagulls), pedestrian conversation.
		14:48	67	69	61		Road traffic noise from R110 Walkinstown Roundabout dominant noise source, birdsong.

1.3.2.2 Unattended Survey

The noise survey results recorded during the baseline surveys within this study area are presented in Table 12.

Table 12: Unattended Noise Survey Results for Ballymount to Crumlin Section

Survey Date	Daytime				Evening	Night-Time			L_{den}
	$L_{Aeq,16hr}$	L_{day}	$L_{A10,16hr}$	$L_{A90,16hr}$	$L_{evening}$	L_{night}	$L_{A10,8hr}$	$L_{A90,8hr}$	
CBC0809UNML002									
27/08/2020	50	51	50	48	48	48	48	43	55
28/08/2020	54	54	55	52	53	49	51	45	57
29/08/2020	54	56	55	51	51	49	51	44	57
30/08/2020	52	51	53	49	53	49	49	41	57
31/08/2020	55	56	56	53	54	47	48	40	57
01/09/2020	56	58	57	53	54	51	51	44	59
Average	**54**	**55**	**54**	**51**	**53**	**49**	**50**	**43**	**57**

Road traffic from the R819 Greenhills Road and M50 Motorway are the dominant noise sources at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were recorded in range of 52 to 56 dB $L_{Aeq,16hr}$. Average background daytime noise levels were measured in the range of 48 to 53 dB $L_{A90,16hr}$.

Night-time noise levels are dominated by road traffic from R819 and M50. Average ambient night-time noise levels were measured in the range of 47 to 54 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the range of 40 to 45 dB $L_{A90,8hr}$.

The measured L_{den} values ranged between 55 and 59 dB L_{den}.

1.3.3 Crumlin to Grand Canal

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 13.

Table 13: Attended Noise Survey Results Crumlin to Grand Canal Section

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0809ANML013	30/07/2020	12:15	59	62	49	64	Road traffic noise from Bunting Road dominant noise source, pedestrian conversation.
		13:16	62	67	50		Road traffic noise from Bunting Road dominant noise source.
		14:27	59	62	47		Road traffic noise from Bunting Road dominant noise source, pedestrian conversation.
CBC0809ANML014	30/07/2020	11:53	69[Note 2]	68	54	66	Road traffic noise from R819 Walkinstown Road dominant noise source, birdsong, pedestrian crossing beacon.
		12:57	63	66	54		
		14:08	62	66	54		Road traffic noise from R819 Walkinstown Road dominant noise source, birdsong, pedestrian crossing beacon, pedestrian conversation.
CBC0809ANML015	28/07/2020	13:27	64	67	59	67	Road traffic noise from R110 Drimnagh Road dominant noise source, intermittent bin lorry pass by.
		14:14	64	66	58		Road traffic noise from R110 Drimnagh Road dominant noise source, loud pedestrian conversation.
		15:00	66	68	58		
CBC0809ANML016	28/07/2020	13:03	61	64	54	64	Road traffic noise from R110 Crumlin Road dominant noise source.
		13:52	63	65	55		
		14:39	61	64	54		
CBC0809ANML017	28/07/2020	10:43	63	67	54	67	Road traffic noise from Kildare Road and Windmill Road junction dominant noise source.
		11:41	64	68	53		
		12:41	66	68	56		Road traffic noise from Kildare Road and Windmill Road junction dominant noise source, intermittent pedestrian conversation and dogs barking.
CBC0809ANML018	24/07/2020	10:34	70	71	55	70	Road traffic noise from R110 Crumlin Road dominant noise source, intermittent sirens.
		11:42	66	70	55		Road traffic noise from R110 Crumlin Road dominant noise source.
		12:46	67	70	56		
CBC0809ANML019	24/07/2020	10:52	57	61	43	61	Minor road traffic noise in estate, faint road traffic noise from R110 Crumlin Road dominant noise source, intermittent car horn.
		12:00	58	61	43		Minor road traffic noise in estate, faint road traffic noise from R110 Crumlin Road dominant noise source, child crying.
		13:04	57	60	43		Minor road traffic noise in estate dominant noise source, faint road traffic noise from R110 Crumlin Road.
CBC0809ANML020	28/07/2020	10:23	54	55	45	59	Road traffic noise from Clonard Road and Downpatrick Road dominant noise source.
		11:20	56	57	45		Road traffic noise from Clonard Road and Downpatrick Road dominant noise source.
		12:21	57	61	44		
CBC0809ANML021	28/07/2020	10:04	58	61	45	61	Road traffic noise from Bangor Road and Downpatrick Road dominant noise source.
		11:03	56	60	43		
		12:01	56	60	46		
CBC0809ANML022	08/09/2020	10:40	61	64	52	64	Road traffic noise from R110 Crumlin Road dominant noise source, hammering noise from nearby garden and faint strimmer noise.

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
		11:48	61	65	52		Road traffic noise from R110 Crumlin Road dominant noise source.
		13:05	60	64	49		Road traffic noise from R110 Crumlin Road dominant noise source, faint hammering from nearby house.

1.3.4 Grand Canal to Christchurch

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 14.

Table 14: Attended Noise Survey Results Grand Canal to Christchurch Section

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0809ANML023	24/07/2020	10:04	69	72	58	70	Road traffic noise from R110 Dolphin's Barn Street junction dominant noise source.
		11:19	67	70	58		Road traffic noise from R110 Dolphin's Barn Street junction dominant noise source, birdsong.
		12:23	68	72	59		Road traffic noise from R110 Dolphin's Barn Street junction dominant noise source.
CBC0809ANML024	17/07/2020	13:10	70	72	63	71	Road traffic noise from R110 Dean Street / R137 St. Patrick Street junction dominant noise source.
		14:02	70	72	63		Road traffic noise from R110 Dean Street / R137 St. Patrick Street junction dominant noise source, intermittent car horn.
		14:54	70	72	64		Road traffic noise from R110 Dean Street / R137 St. Patrick Street junction dominant noise source, pedestrian conversation.

1.3.5 Woodford Walk (R113) / New Nangor Road (R134) junction to Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 15.

Table 15: Noise Monitoring Results — Woodford Walk / New Nangor Road junction to Naas Road / New Nangor Road junction

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0809ANML001	04/08/2020	10:08	72	76	57	74	Road traffic noise from R134 New Nangor Road dominant noise source, with intermittent aircraft flyover.
		11:27	71	75	56		Road traffic noise from R134 New Nangor Road dominant noise source.
		12:45	72	77	60		
CBC0809ANML002	04/08/2020	10:32	69	70	65	68	Road traffic noise from R134, R810, R110 intersection dominant noise source, with an intermittent siren and reverse beacon present.
		11:50	67	69	64		Road traffic noise from R134, R810, R110 intersection dominant noise source, with intermittent car horns.

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
		13:10	66	68	64		Road traffic noise from R134, R810, R110 intersection dominant noise source.

1.3.6 Long Mile Road (R110) / Naas Road (R810) / New Nangor Road (R134) junction to Drimnagh

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 16.

Table 16: Noise Monitoring Results — Long Mile Road / Naas Road / New Nangor Road junction to Drimnagh

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0809ANML003	04/08/2020	10:59	63	67	55	65	Road traffic noise from R110 Long Mile Road dominant noise source.
		12:17	62	65	55		
		13:35	61	64	56		

2. Baseline Vibration Monitoring

2.1 Introduction

This Section includes the relevant survey details and results associated baseline vibration surveys conducted as part of the overall Bus Connects Dublin – Core Bus Corridor Infrastructure Works (hereafter referred to as the CBC Infrastructure Works). Baseline vibration data obtained from this study has been used to information all individual Core Bus Corridor Schemes.

2.2 Survey Methodology

2.2.1 Survey Locations

Attended vibration monitoring was undertaken at sample locations adjacent to existing bus lanes within Dublin City. The surveys were undertaken to obtain typical baseline vibration levels along roads with both mixed vehicular traffic lanes and individual bus lanes. This information has been used to inform the operational vibration impact assessment for the CBC Infrastructure Works.

Surveys were also undertaken along an access road to the Harristown Bus Depot, Horizon Logistics Park, Swords, Co. Dublin, to obtain a measurement of vibration relating to specific bus drive by in isolation at a controlled sampling location to characterise the specific vibration level associated with buses in the absence of other traffic. A description of the survey locations is set out in Table 17.

Table 17: Vibration Monitoring Locations

Vibration Monitoring Locations	Description of Survey Location
AVML001	Harristown – Entrance Road to Bus Depot, midway along inbound road, 5m from road edge
AVML002	Harristown – Roundabout at Bus Depot entrance, buses entering depot, 5m from road edge
AVML003	Harristown – Roundabout at Bus Depot entrance, buses exiting depot, 5m from road edge
AVML004	Harristown – Entrance Road to Bus Depot, midway along outbound road, 5m from road edge
AVML005	Harristown – Entrance Road to Bus Depot, midway along inbound road, 7m from road edge
AVML006	Malahide Road / St. Johns Court – 5m from edge of Inbound Bus Lane
AVML007	Malahide Road / St. Johns Court – 10m from edge of Inbound Bus Lane
AVML008	Malahide Road / Donnycarney Church – 2.5m from edge of Inbound Bus Lane
AVML009	Malahide Road– 2.5m from edge of outbound Bus Lane

The survey locations undertaken along the Harristown Bus Depot entrance are illustrated in Figure 1. The survey locations undertaken along the Malahide Road are illustrated in Figure 2.

Figure 1: Vibration Monitoring Locations Harristown Bus Depot (source Google Earth)

Figure 2: Vibration Monitoring Locations Malahide Road (source Google Earth)

2.2.2 Survey Periods

Vibration monitoring was undertaken on the following dates:

- AVML001 - AVML005: 30 July 2020; and
- AVML005 – AMML009: 13 August 2020.

2.2.3 Survey Equipment and Personnel

The survey was undertaken using a RION VM-56 vibration meter (S/N 680043) with PV-83D tri-axial accelerometer. Calibration certificate of monitoring equipment are included within Section 4.

The surveys were conducted Alex Ryan and David O'Donoghue, acoustic technicians, AWN Consulting.

2.2.4 Survey Procedure

Vibration measurements were conducted in general accordance with the guidance contained in British Standard BS 7385. Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings (1990).

Vibration was measured in the three orthogonal axes. The accelerometer was secured in place with a 5kg sandbag at all monitoring locations.

The equipment was set to log for 1 minute intervals on a continual basis with an instantaneous storage interval of 100ms. Vibration monitoring periods at AVML001 to AVML005 along the entrance road to Harristown Bus Depot were undertaken for a period of 15 minutes at each position. Vibration monitoring periods at AVML006 to AVML009 along the Malahide Road were undertaken for a period of 30 minutes at each position.

2.2.5 Survey Parameters

The following vibration parameters are discussed within this Report.

PPV Peak Particle Velocity (PPV) is a measure of the velocity of vibration displacement in terms of millimetres per second (mm/s). It is defined as follows within BS 7385: (1990) as:

> *"the maximum instantaneous velocity of a particle at a point during a given time interval"*

VDV Vibration Dose Value (VDV) is an evaluation of human exposure to vibration in buildings. It defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response. It is defined as follows within British Standard BS 6472: (2008) Guide to evaluation of human exposure to vibration in buildings (2008): Part 1 - Vibration sources other than blasting, as:

> *"The VDV is the fourth root of the integral of the fourth power of acceleration after it has been frequency-weighted (as defined in BS6472: 2008). The frequency-weighted acceleration is measured in m/s2 and the time period over which the VDV is measured is in seconds. This yields VDVs in m/s1.75"*

The frequency weightings used in the BS 6472 (2008) document is Wb weighting for vertical axis and Wd for the horizontal axes.

2.3 Survey Results – Harristown Bus Depot

The vibration survey results measured at each location are presented for each pass by event (bus drive by) in terms of the PPV parameter in mm/s and in terms of the VDV parameter in $m/s^{1.75}$ for each axis.

2.3.1 Location AVML001

Table 18 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 18: Vibration Monitoring Results at ANML001

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
14:57	0.05	0.05	0.06	0.0003	0.0003	0.0020
15:01	0.03	0.04	0.04	0.0002	0.0003	0.0016
15:02	0.03	0.03	0.03	0.0002	0.0002	0.0008
15:03	0.02	0.04	0.04	0.0001	0.0002	0.0016
15:04	0.03	0.02	0.06	0.0002	0.0002	0.0022
15:05	0.04	0.05	0.08	0.0002	0.0002	0.0028
15:06	0.03	0.04	0.03	0.0002	0.0002	0.0013
15:07	0.03	0.04	0.05	0.0002	0.0002	0.0018
Minimum event	0.02	0.02	0.03	0.0001	0.0002	0.0008
Maximum event	0.05	0.05	0.08	0.0003	0.0003	0.0028

2.3.2 Location AVML002

Table 19 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 19: Vibration Monitoring Results at ANML002

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
15:22	0.03	0.03	0.08	0.0002	0.0002	0.0019
15:26	0.02	0.03	0.03	0.0002	0.0002	0.0012
15:29	0.02	0.07	0.09	0.0002	0.0003	0.0014
15:30	0.02	0.02	0.07	0.0001	0.0002	0.0019
15:31	0.03	0.04	0.06	0.0002	0.0002	0.0024
15:32	0.02	0.03	0.07	0.0002	0.0002	0.0022
15:33	0.03	0.03	0.06	0.0002	0.0002	0.0014
15:34	0.02	0.02	0.04	0.0001	0.0002	0.0016
Minimum event	0.03	0.07	0.09	0.0002	0.0003	0.0024
Maximum event	0.02	0.02	0.03	0.0001	0.0002	0.0012

2.3.3 Location AVML003

Table 20 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 20: Vibration Monitoring Results at ANML003

Event Time	PPV, mm/s			$VDV_{,b,d}$, $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
15:40	0.06	0.06	0.09	0.0003	0.0003	0.0031
15:43	0.07	0.05	0.07	0.0003	0.0003	0.0027
15:44	0.04	0.05	0.06	0.0002	0.0003	0.0021
15:45	0.07	0.05	0.07	0.0003	0.0003	0.0032
15:49	0.03	0.03	0.03	0.0002	0.0002	0.0014
15:50	0.06	0.06	0.05	0.0003	0.0004	0.0027
Minimum event	0.07	0.06	0.09	0.0003	0.0004	0.0032
Maximum event	0.03	0.03	0.03	0.0002	0.0002	0.0014

2.3.4 Location AVML004

Table 21 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 21: Vibration Monitoring Results at ANML004

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
16:04	0.08	0.12	0.1	0.0006	0.0008	0.0060
16:06	0.09	0.1	0.13	0.0004	0.0006	0.0061
16:08	0.1	0.13	0.11	0.0005	0.0008	0.0049
16:09	0.07	0.1	0.12	0.0005	0.0006	0.0049
16:10	0.11	0.12	0.15	0.0006	0.0007	0.0072
16:11	0.08	0.09	0.1	0.0005	0.0006	0.0046
16:12	0.07	0.08	0.11	0.0004	0.0006	0.0059
16:13	0.07	0.09	0.11	0.0004	0.0005	0.0054
Minimum event	0.11	0.13	0.15	0.0006	0.0008	0.0072
Maximum event	0.07	0.08	0.1	0.0004	0.0005	0.0046

2.3.5 Location AVML005

Table 22 presents the results of vibration values associated with individual bus drive events by during the monitoring period at this location.

Table 22: Vibration Monitoring Results at ANML005

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$		
	X	Y	Z	X	Y	Z
16:36	0.03	0.02	0.03	0.0002	0.0002	0.0013
16:39	0.02	0.03	0.03	0.0002	0.0002	0.0017
16:40	0.03	0.04	0.04	0.0002	0.0003	0.0015
16:44	0.03	0.04	0.06	0.0002	0.0003	0.0021
16:46	0.03	0.03	0.03	0.0002	0.0002	0.0012
16:47	0.03	0.03	0.03	0.0002	0.0002	0.0013
16:48	0.03	0.03	0.04	0.0002	0.0002	0.0012
Minimum event	0.02	0.02	0.03	0.0002	0.0002	0.0012
Maximum event	0.03	0.04	0.06	0.0002	0.0003	0.0021

2.4 Survey Results – Malahide Road

2.4.1 Location AVML006

Table 23 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 23: Vibration Monitoring Results at ANML006

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
11:23	0.03	0.03	0.07	0.0002	0.0002	0.0020	
11:24	0.03	0.02	0.06	0.0002	0.0001	0.0018	
11:25	0.03	0.03	0.10	0.0002	0.0002	0.0030	Bus
11:26	0.02	0.02	0.06	0.0002	0.0002	0.0015	HGV
11:27	0.03	0.03	0.07	0.0002	0.0002	0.0030	
11:28	0.02	0.02	0.05	0.0001	0.0001	0.0019	
11:29	0.05	0.03	0.08	0.0002	0.0002	0.0033	Bus
11:30	0.04	0.16	0.17	0.0002	0.0008	0.0027	HGV
11:31	0.02	0.02	0.03	0.0001	0.0001	0.0017	
11:32	0.04	0.05	0.07	0.0002	0.0002	0.0029	HGV
11:33	0.03	0.03	0.05	0.0002	0.0002	0.0020	
11:34	0.02	0.02	0.04	0.0002	0.0001	0.0015	Bus
11:35	0.04	0.04	0.13	0.0002	0.0002	0.0050	HGV
11:36	0.02	0.02	0.04	0.0001	0.0002	0.0015	
11:37	0.02	0.02	0.05	0.0002	0.0002	0.0020	Bus
11:38	0.02	0.02	0.03	0.0001	0.0001	0.0014	
11:39	0.04	0.03	0.10	0.0002	0.0002	0.0037	
11:40	0.03	0.04	0.12	0.0002	0.0002	0.0026	
11:41	0.07	0.06	0.15	0.0003	0.0002	0.0056	
11:42	0.05	0.03	0.11	0.0002	0.0002	0.0040	
11:43	0.04	0.04	0.05	0.0002	0.0002	0.0023	HGV
11:44	0.03	0.08	0.08	0.0002	0.0004	0.0021	

Event Time	PPV, mm/s			VDV$_{,b}$, m/s$^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
11:45	0.03	0.03	0.05	0.0002	0.0002	0.0025	HGV
11:46	0.04	0.04	0.06	0.0002	0.0002	0.0027	HGV
11:47	0.02	0.03	0.04	0.0001	0.0002	0.0012	
11:48	0.04	0.04	0.10	0.0003	0.0002	0.0036	
11:49	0.06	0.04	0.08	0.0003	0.0002	0.0028	
11:50	0.03	0.02	0.05	0.0002	0.0002	0.0020	
11:51	0.03	0.04	0.05	0.0002	0.0003	0.0021	
11:52	0.04	0.05	0.21	0.0003	0.0003	0.0053	
Maximum all traffic	0.07	0.16	0.17	0.0003	0.0008	0.0056	
Maximum bus	0.05	0.03	0.10	0.0002	0.0002	0.0033	

2.4.2 Location AVML007

Table 24 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 24: Vibration Monitoring Results at ANML007

Event Time	PPV, mm/s			VDV$_{,b}$, m/s$^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
11:55	0.03	0.02	0.04	0.0002	0.0001	0.0011	HGV
11:56	0.03	0.04	0.03	0.0002	0.0002	0.0011	
11:57	0.02	0.06	0.06	0.0002	0.0003	0.0011	
11:58	0.03	0.03	0.02	0.0002	0.0002	0.0004	
11:59	0.02	0.03	0.03	0.0001	0.0002	0.0008	
12:00	0.02	0.02	0.02	0.0001	0.0001	0.0005	
12:01	0.02	0.03	0.02	0.0001	0.0002	0.0005	
12:02	0.03	0.02	0.03	0.0002	0.0002	0.0009	
12:03	0.03	0.03	0.02	0.0002	0.0002	0.0008	
12:04	0.02	0.03	0.02	0.0001	0.0001	0.0004	
12:05	0.02	0.02	0.03	0.0002	0.0002	0.0011	
12:06	0.03	0.03	0.02	0.0002	0.0002	0.0006	Bus
12:07	0.02	0.05	0.05	0.0001	0.0002	0.0008	Bus
12:08	0.02	0.02	0.02	0.0002	0.0001	0.0007	Bus
12:09	0.02	0.02	0.03	0.0001	0.0002	0.0008	
12:10	0.02	0.03	0.02	0.0002	0.0002	0.0005	Bus
12:11	0.02	0.02	0.02	0.0001	0.0002	0.0009	
12:12	0.02	0.02	0.02	0.0001	0.0002	0.0003	
12:13	0.02	0.02	0.02	0.0001	0.0001	0.0007	Bus
12:14	0.02	0.02	0.02	0.0001	0.0002	0.0009	
12:15	0.02	0.02	0.02	0.0001	0.0001	0.0008	
12:16	0.02	0.02	0.02	0.0001	0.0001	0.0005	
12:17	0.02	0.02	0.02	0.0001	0.0001	0.0005	Bus

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
12:18	0.02	0.03	0.03	0.0002	0.0002	0.0008	
12:19	0.03	0.03	0.03	0.0002	0.0002	0.0010	
12:20	0.02	0.02	0.02	0.0002	0.0002	0.0009	Bus
12:21	0.02	0.02	0.04	0.0001	0.0001	0.0012	
12:22	0.02	0.03	0.03	0.0001	0.0002	0.0010	
Maximum all traffic	0.03	0.06	0.06	0.0002	0.0003	0.0012	
Maximum bus	0.03	0.05	0.05	0.0002	0.0002	0.0009	

2.4.3 Location AVML008

Table 25 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or Heavy Goods Vehicle (HGV) drive by noted.

Table 25: Vibration Monitoring Results at ANML008

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
12:31	0.02	0.02	0.06	0.0001	0.0001	0.0004	Bus
12:32	0.02	0.06	0.08	0.0001	0.0003	0.0009	
12:33	0.02	0.03	0.04	0.0001	0.0002	0.0012	Bus
12:34	0.02	0.02	0.02	0.0001	0.0001	0.0004	HGV
12:35	0.02	0.02	0.04	0.0002	0.0002	0.0010	
12:36	0.02	0.02	0.02	0.0002	0.0002	0.0006	
12:37	0.02	0.02	0.02	0.0001	0.0001	0.0003	
12:38	0.02	0.03	0.03	0.0001	0.0002	0.0005	
12:39	0.02	0.03	0.02	0.0001	0.0002	0.0005	
12:40	0.03	0.03	0.02	0.0002	0.0002	0.0006	
12:41	0.04	0.03	0.02	0.0003	0.0002	0.0005	
12:42	0.03	0.02	0.03	0.0002	0.0001	0.0013	Bus
12:43	0.06	0.07	0.18	0.0003	0.0003	0.0057	
12:44	0.01	0.02	0.02	0.0001	0.0001	0.0004	Bus
12:45	0.02	0.03	0.05	0.0001	0.0002	0.0015	
12:46	0.02	0.02	0.03	0.0001	0.0001	0.0010	
12:47	0.02	0.03	0.03	0.0001	0.0001	0.0007	HGV
12:48	0.02	0.03	0.03	0.0001	0.0002	0.0010	HGV
12:49	0.02	0.02	0.02	0.0001	0.0001	0.0005	
12:50	0.02	0.02	0.02	0.0001	0.0001	0.0004	
12:51	0.02	0.02	0.02	0.0001	0.0002	0.0004	
12:52	0.02	0.02	0.02	0.0001	0.0002	0.0005	Bus
12:53	0.02	0.02	0.03	0.0001	0.0002	0.0009	
12:54	0.02	0.03	0.04	0.0001	0.0002	0.0012	
12:55	0.02	0.02	0.02	0.0001	0.0002	0.0003	
12:56	0.04	0.05	0.23	0.0002	0.0003	0.0056	HGV

Event Time	PPV, mm/s			VDV$_{,b}$, m/s$^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
12:57	0.02	0.03	0.05	0.0001	0.0002	0.0017	Bus
12:58	0.02	0.02	0.04	0.0001	0.0001	0.0012	
12:59	0.02	0.03	0.02	0.0001	0.0002	0.0006	
Maximum all traffic	0.06	0.07	0.23	0.0003	0.0003	0.0057	
Maximum bus	0.03	0.03	0.06	0.0002	0.0002	0.0017	

2.4.4 Location AVML009

Table 26 presents the results of vibration values measured during each 1 minute sample period at this location with periods during a bus or HGV drive by noted.

Table 26: Vibration Monitoring Results at ANML009

Event Time	PPV, mm/s			VDV$_{,b}$, m/s$^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
13:05	0.03	0.02	0.05	0.0001	0.0001	0.0012	
13:06	0.02	0.04	0.03	0.0002	0.0001	0.0011	Bus
13:07	0.04	0.05	0.08	0.0002	0.0002	0.0028	HGV
13:08	0.04	0.05	0.06	0.0002	0.0002	0.0019	
13:09	0.04	0.03	0.03	0.0002	0.0002	0.0011	
13:10	0.03	0.04	0.04	0.0002	0.0001	0.0012	
13:11	0.03	0.04	0.04	0.0002	0.0001	0.0011	
13:12	0.02	0.03	0.04	0.0002	0.0001	0.0012	Bus
13:13	0.03	0.06	0.04	0.0002	0.0003	0.0013	
13:14	0.03	0.04	0.03	0.0002	0.0002	0.0012	Bus
13:15	0.04	0.04	0.04	0.0002	0.0003	0.0014	Bus
13:16	0.04	0.04	0.09	0.0002	0.0001	0.0028	HGV
13:17	0.06	0.06	0.05	0.0002	0.0002	0.0016	
13:18	0.03	0.04	0.05	0.0002	0.0002	0.0016	Bus
13:19	0.02	0.03	0.03	0.0001	0.0001	0.0008	
13:20	0.04	0.04	0.03	0.0002	0.0002	0.0011	Bus
13:21	0.03	0.03	0.03	0.0001	0.0001	0.0011	Bus
13:22	0.04	0.04	0.09	0.0002	0.0002	0.0030	
13:23	0.03	0.03	0.03	0.0001	0.0001	0.0013	
13:24	0.02	0.03	0.05	0.0001	0.0002	0.0012	HGV
13:25	0.03	0.03	0.05	0.0002	0.0002	0.0014	
13:26	0.03	0.05	0.05	0.0002	0.0003	0.0015	Bus
13:27	0.03	0.04	0.04	0.0002	0.0002	0.0012	
13:28	0.02	0.04	0.04	0.0001	0.0002	0.0008	Bus
13:29	0.04	0.05	0.04	0.0003	0.0003	0.0022	
13:30	0.03	0.03	0.08	0.0002	0.0002	0.0022	
13:31	0.04	0.04	0.03	0.0002	0.0002	0.0011	
13:32	0.02	0.02	0.04	0.0001	0.0001	0.0011	

Event Time	PPV, mm/s			$VDV_{,b}$, $m/s^{1.75}$			Notes
	X	Y	Z	X	Y	Z	
13:33	0.02	0.03	0.04	0.0002	0.0002	0.0014	
13:05	0.03	0.02	0.05	0.0001	0.0001	0.0012	
Maximum all traffic	0.06	0.06	0.09	0.0003	0.0003	0.0030	
Maximum bus	0.04	0.05	0.05	0.0002	0.0003	0.0016	

3. References

British Standard Institute (BSI) British Standard (BS) 7385: 1990: Evaluation and measurement for vibration in buildings. Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings. (BSI 1990)

BS 6472-1: 2008 Guide to evaluation of human exposure to vibration in buildings. Part 1 Vibration sources other than blasting (BSI 2008)

ISO 1996-1:2016 Acoustics - Description, measurement and assessment of environmental noise. Part 1: Basic quantities and assessment procedures (ISO 2016)

ISO 1996-2:2017 - Description, measurement and assessment of environmental noise - Part 2: Determination of sound pressure levels (ISO 2017)

Transport Infrastructure Ireland (TII) (previously National Roads Authority (NRA)) Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1 (TII 2004)

The UK Department of Transport Calculation of Road Traffic Noise (UK Department of Transport 1998)

Directives and Legislation

S.I. No. 140/2006 – European Communities (Environmental Noise) Regulations 2006

4. Calibration Certificates for Monitoring Equipment

4.1 Rion NL-52 S/N 998413

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 22 January 2020

Certificate Number: UCRT20/1095

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

Customer	AWN Consulting The Tecpro Building IDA Business and Technology Park Clonshaugh Dublin 17			
Order No.	AWNC150120QTE			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	00998413
	Rion	Firmware		2.0
	Rion	Pre Amplifier	NH-25	98627
	Rion	Microphone	UC-59	15920
	Rion	Calibrator	NC-74	34536109
		Calibrator adaptor type if applicable		NC-74-002
Performance Class	1			
Test Procedure	TP 2.SLM 61672-3 TPS-49 *Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*			
Type Approved to IEC 61672-1:2002	YES	Approval Number	21.21 / 13.02	
	If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003			
Date Received	17 January 2020	ANV Job No.	UKAS20/01036	
Date Calibrated	22 January 2020			

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	Initial Calibration		

CERTIFICATE OF CALIBRATION

Certificate Number
UCRT20/1095

UKAS Accredited Calibration Laboratory No. 0653

Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter NL-42 / NL-52		
SLM instruction manual ref / issue	11-03		
SLM instruction manual source	Manufacturer		
Internet download date if applicable	N/A		
Case corrections available	Yes		
Uncertainties of case corrections	Yes		
Source of case data	Manufacturer		
Wind screen corrections available	Yes		
Uncertainties of wind screen corrections	Yes		
Source of wind screen data	Manufacturer		
Mic pressure to free field corrections	Yes		
Uncertainties of Mic to F.F. corrections	Yes		
Source of Mic to F.F. corrections	Manufacturer		
Total expanded uncertainties within the requirements of IEC 61672-1:2002	Yes		
Specified or equivalent Calibrator	Specified		
Customer or Lab Calibrator	Lab Calibrator		
Calibrator adaptor type if applicable	NC-74-002		
Calibrator cal. date	21 January 2020		
Calibrator cert. number	UCRT20/1082		
Calibrator cal cert issued by	0653		
Calibrator SPL @ STP	93.98	dB	Calibration reference sound pressure level
Calibrator frequency	1001.97	Hz	Calibration check frequency
Reference level range	25 - 130	dB	

Accessories used or corrected for during calibration - Extension Cable & Wind Shield WS-15
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End			
Temperature	22.18	22.19	±	0.30	°C
Humidity	38.7	37.6	±	3.00	%RH
Ambient Pressure	102.72	102.74	±	0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	93.9	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	11.7	dB	UR	16.3	dB	UR	23.2	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: B. Bogdan R 2

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

4.2 Bruel and Kjaer 2250L

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

ilac-MRA UKAS CALIBRATION 0653

Date of Issue: 04 November 2019

Certificate Number: UCRT19/2218

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

CUSTOMER	AWN Consulting Limited The Tecpro Building IDA Business and Technology Park Clonshaugh Dublin 17 Ireland
ORDER No	DOD/19/Cal013 Job No UKAS19/11718
DATE OF RECEIPT	01 November 2019
PROCEDURE	Calibration Engineer's Handbook, section 25: periodic testing of sound level meters to IEC 61672-3:2006 (BS EN 61672-3:2006) as modified by UKAS TPS 49 Edition 2:June 2009
IDENTIFICATION	Sound level meter Brüel & Kjær type 2250-L serial No 3008402 connected via a preamplifier type ZC 0032 serial No 22882 to a half-inch microphone type 4950 serial No 3016830. Associated calibrator Brüel & Kjær type 4231 serial No 2263026 with a one-inch housing and adapter type UC 0210 for half-inch microphone.
CALIBRATED ON	04 November 2019
PREVIOUS CALIBRATION	Calibrated on 16 October 2017, Certificate No. UCRT17/1897 issued by this laboratory.

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate No UCRT19/2218

The sound level meter was set up using the type 4231 sound calibrator supplied; it was set to frequency weighting A, and initially read 94.1 dB. It was then adjusted to read 93.9 dB (corresponding to 93.9 dB at standard atmospheric pressure). This reading was derived from Calibration Certificate no. UCRT19/2217 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter. The calibration check frequency was 1kHz. The final microphone sensitivity calculated and stored by the instrument was 45.25 mV/Pa.

Procedures from IEC 61672-3:2006 (BS EN 61672-3:2006) as modified by UKAS TPS 49 Edition 2:June 2009 were used to perform the periodic tests.

RESULTS

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006 (BS EN 61672-3:2006), for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2 : 2003 (BS EN 61672-2 : 2003), to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1 : 2002 (BS EN 61672-1 : 2003), the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1 : 2002 (BS EN 61672-1 2003).

The self-generated noise recorded with the microphone replaced by the electrical input device was:

13.4 dB (A) 13.8 dB (C) 19.5 dB (Z)

The environmental conditions recorded at the start and end of testing were:

Start: 23 to 24 °C, 31 to 41 %RH and 97.2 to 97.3 kPa
End: 24 to 25 °C, 34 to 44 %RH and 97.2 to 97.3 kPa

Technical information including adjustment data specified in the manufacturers' Instruction Manual BE 1774-11 (2007) and User Manual BE 1766 has been used to carry out this verification. These data include manufacturer-specified uncertainties.

Publicly-available evidence has been found that the B&K 2250-L sound level meter design has successfully undergone pattern evaluation in accordance with IEC 61672-2:2002 (BS EN 61672-2:2003) by Physikalisch-Technische Bundesanstalt (PTB), an independent testing organisation responsible for pattern approvals.

All measurement data are held at ANV Measurement Systems for a period of at least six years.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k*=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

4.3 Rion VM-56 (S/N 680043)

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Date of Issue: 01 November 2019 **Certificate Number: TCRT19/1825**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

Client	AWN Consulting Limited The Tecpro Building, IDA Business & Technology Park, Clonshaugh Dublin 17 Ireland
Purchase Order No.	DOD/19/Cal03
Instrument	Rion VM-56 Tri-Axial Vibration Meter
Serial No.	00680043
Accelerometer Type	VM-56
Accelerometer Serial No.	80047
Program	2.0
Client Asset No.	N/A
Procedure ID.	VM-56 Issue 1
Job Number	TRAC19/11477
Date of Calibration	01 Nov 2019
Previous Cert. number	N/A
Date of Previous Cert.	N/A
Rig Number	6
Kit Number	24
Calibration Status	**Passed Calibration**

This calibration is traceable to National Standards. ANV Measurement Systems sources used to perform calibrations are calibrated at the National Physical Laboratory or by UKAS laboratories accredited for the purpose.

The performance of the system (the meter, accelerometer) was found to be within the manufacturer's specification.

Comment
This certificate reports recorded values for the instrument 'As Received'.

CERTIFICATE OF CALIBRATION

Certificate Number
TCRT19/1825
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Environment
The ambient environmental conditions at the time of the calibration were;
Temperature: 22.9 ± 1°C, Humidity: 40 ± 5%RH, Atmospheric pressure 98.2 ± 1 kPa

Test results
Each accelerometer axis was mounted co-axially with a Rion LS-10C servo accelerometer, and tests conducted for the dynamic range, PPV linearity and frequency response of the complete system. Additional electrical tests were carried out on the amplitude linearity of the instrument.

PPV linearity response for the complete system at 16 Hz With PV-83CW serial No. 80047
Weightings for all channels turned OFF

Target Vel. mm/s	Actual Vel. mm/s	Indicated (X) mm/s	Error (X) %	Indicated (Y) mm/s	Error (Y) %	Indicated (Z) mm/s	Error (Z) %
0.50	0.51	0.57	11.56	0.55	7.65	0.54	5.69
1.00	1.02	1.09	6.67	1.08	5.69	1.06	3.73
2.50	2.55	2.67	4.51	2.66	4.12	2.60	1.77
5.00	5.11	5.31	3.93	5.30	3.73	5.18	1.38
10.00	10.13	10.59	4.50	10.43	2.92	10.35	2.13
20.00	20.27	21.24	4.80	21.03	3.76	20.61	1.69

Permitted tolerance ± 10% ± 1 LSD (Least Significant Digit).

Linearity errors in dB measured electrically at 40 Hz
Weightings for all channels turned OFF
Level changes in dB; reading error in dB given for each axis. "m/s^2" is actual reading in m/s^2.

1 m/s^2 Range

Level dB	Error (X) dB	m/s^2 (X)	Error (Y) dB	m/s^2 (Y)	Error (Z) dB	m/s^2 (Z)
0	REF	0.98154	REF	0.98129	REF	0.98130
-20	-0.01	0.09805	-0.01	0.09802	-0.01	0.09803
-40	-0.02	0.00979	-0.02	0.00979	-0.02	0.00979
-60	-0.10	0.00097	-0.10	0.00097	-0.10	0.00097
-66	-0.03	0.00049	-0.21	0.00048	-0.03	0.00049
-72	-0.23	0.00024	-0.23	0.00024	-0.23	0.00024

Permitted tolerance ±1.0 dB.

10 m/s^2 Range

Level dB	Error (X) dB	m/s^2 (X)	Error (Y) dB	m/s^2 (Y)	Error (Z) dB	m/s^2 (Z)
20	-0.03	9.79122	-0.03	9.75526	-0.03	9.73534
0	REF	0.98208	REF	0.97857	REF	0.97679
-20	-0.01	0.09808	-0.01	0.09775	-0.01	0.09758
-30	-0.01	0.03102	-0.03	0.03085	-0.06	0.03067
-40	0.04	0.00987	-0.02	0.00976	0.02	0.00979
-52	-0.31	0.00238	0.69	0.00266	-0.01	0.00245

Permitted tolerance ±1.0 dB.

CERTIFICATE OF CALIBRATION

Certificate Number
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Frequency Responses For Complete System

Measured on the 1 m/s^2 range with weightings as indicated in the table and PV-83CW serial No. 80047

Frequency Hz	Applied Acc. m/s^2	X (Wd) rms m/s^2	Error X %	VDV (X) m/s$^{1.75}$	Error X %
3.981	0.285	0.15654	5.4	0.30765	5.3
5.012	0.355	0.15445	5.2	0.30359	5.1
6.310	0.355	0.12187	5.1	0.23974	5.0
7.943	0.355	0.09586	4.5	0.18849	4.4
10.00	0.355	0.07622	4.9	0.14987	4.8
12.59	0.355	0.06052	5.3	0.11912	5.3
15.85	0.355	0.04836	6.2	0.09515	6.2
19.95	0.550	0.06014	7.3	0.11834	7.3

Frequency Hz	Applied Acc. m/s^2	Y (Wd) rms m/s^2	Error Y %	VDV (Y) m/s$^{1.75}$	Error Y %
3.981	0.285	0.15640	5.3	0.30743	5.2
5.012	0.355	0.15372	4.7	0.30199	4.5
6.310	0.355	0.12149	4.7	0.23878	4.6
7.943	0.355	0.09627	5.0	0.18928	4.9
10.00	0.355	0.07622	4.9	0.14987	4.8
12.59	0.355	0.06054	5.3	0.11907	5.3
15.85	0.355	0.04850	6.5	0.09539	6.5
19.95	0.550	0.06064	8.2	0.11932	8.2

Frequency Hz	Applied Acc. m/s^2	Z (Wb) rms m/s^2	Error Z %	VDV (Z) m/s$^{1.75}$	Error Z %
3.981	0.285	0.26307	3.0	0.52192	3.8
5.012	0.355	0.37779	2.4	0.74853	3.1
6.310	0.355	0.38731	2.1	0.76723	2.7
7.943	0.355	0.37632	2.0	0.74338	2.4
10.00	0.355	0.35641	1.6	0.70262	1.7
12.59	0.355	0.32928	1.2	0.64883	1.3
15.85	0.355	0.29668	1.3	0.58400	1.3
19.95	0.550	0.39872	0.8	0.78497	0.8
25.12	0.550	0.33640	3.3	0.66184	3.3
31.62	0.550	0.27597	2.9	0.54310	2.9
39.81	0.550	0.21843	1.0	0.42982	1.0
50.12	0.550	0.17703	3.4	0.34836	3.3
63.10	0.550	0.13695	3.8	0.26950	3.8
79.43	0.550	0.10077	4.1	0.19832	4.1

Tolerance required @ 4 Hz to 63 Hz +12%/-11% ; @ 80 Hz +26%/-21%

All results meet the manufacturer's specification.

END OF CALIBRATION **CALIBRATED BY :- A. Lloyd**

5. Unattended Monitoring Equipment Set Up

Location	Equipment Set Up
CBC0809UNML001 On hard ground in rear residential garden. Located approximately 35m to R819 Greenhills Road and 65m to Treepark Road egdes.	
CBC0809UNML002 On hard ground in front residential garden, in line with façade of property. Located approximately 100 m from M50 and 100 m from R819 Greenhills Road.