Appendix A9.1
Noise & Vibration Survey

Contents

Appendix A9.1: Baseline Noise and Vibration Surveys

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 Swords to City Centre Core Bus Corridor (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 five geographical zones, as described in **Table 1**.

Table 1: Description of Noise Sensitive Locations (NSLs) Across the Study Area

Geographical Zone	Description of Study Area
Pinnock Hill Junction to Airside Junction	The key noise sensitive receptors are residential receptors at Boroimhe Willows and Carlton Court. In addition to these estates, there are a small number of detached houses within 50m of the R132. This zone also includes the Premier Inn Dublin Airport hotel and Travelodge Dublin Airport Hotel.
Airside Junction to Northwood Avenue	The key noise sensitive receptors are medium sensitivity commercial properties. There are a low number of high sensitivity residential properties south of the Airside Junction within 10m to 20m of the R132. The study area includes the Tara Winthrop Private Clinic, which is a high sensitivity receptor located to the south of the R132 junction with the L2305 within 100m of the R132.
Northwood Avenue to Shantalla Road	Within this study area the key noise sensitive receptors are predominately residential dwellings which bound the east and west of the R132. A large number of these residential receptors are within 10m of the road edge.
Shantalla Road to Botanic Avenue	Within this study area, the key noise sensitive receptors are predominately residential dwellings which bound the R132 to the east and west. Highfield Hospital, Whitehall Holy Child Church and Plunkett College are sensitive receptors located within 50m of the Proposed Scheme.
Botanic Avenue to Granby Row	Within this study area, the key noise sensitive receptors are predominately residential dwellings in addition to the Rotunda, Mater Private and Temple Street Hospitals which are also within 50m of the Proposed Scheme. St Mary's Primary School is located within 10m of the alignment; Gardiner Street School and Belvedere College are also within 200m of the Proposed Scheme.

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. Both attended and unattended noise surveys were undertaken to inform the assessment:

- Unattended surveys (typically one week in duration) were made at one location; and
- Attended surveys (day-time measurements), were made at a total of nine 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.

1.2.2.1 Pinnock Hill to Airside Junction

One attended survey location was surveyed within this study area. The location reference and a description of survey position are included in Table 2.

Table 2: Noise Monitoring Locations – Pinnock Hill to Airside Roundabout

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0002ANML001	Green area to west of Carlton Court housing estate, in line with closest residential façade facing onto R132 Swords Road screened by 6ft wall. Located approximately 25m from R132 road edge.

1.2.2.2 Airside Junction to Northwood Avenue

Three long-term unattended monitoring locations and five attended locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 3.

Table 3: Noise Monitoring Locations – Airside Junction to Northwood Avenue

Location	Description of Survey Location
Unattended Monitoring Locations	
CBC0002UNML001	In residential front garden approximately 100m southeast of R132 Swords Road / R125 junction.
CBC0002UNML002	In carpark area to side of Private Clinic in Nevinstown West to east of R132 Swords Road. Located approximately 45m from R132 road edge.
CBC0002UNML003	In residential front garden to southeast of R132 Swords Road / Old Airport Road junction. Located approximately 50m from R132 road edge. Closest façade of property approximately 30m from R132 road edge.
Attended Monitoring Locations	
CBC0002ANML002	On footpath to north of Boroimhe Willows positioned to west of R132 Swords Road, in line with closest residential façades facing onto R132 Swords Road. Located approximately 15m from R132 road edge.
CBC0002ANML003	Residential garden in Nevinstown West off R132 Swords Road, opposite Glenmore House. Located approximately 60m from R132 road edge.
CBC0002ANML004	Green verge 160m to south of R132 Swords Road / Naul Road roundabout junction, in line with commercial NSL façade facing onto R132 Swords Road. Located approximately 15m from R132 road edge.
CBC0002ANML005	On footpath 150m to north of R132 Swords Road / Corballis Road South Junction, in line with commercial façade. Located approximately 12m from R132 road edge.
CBC0002ANML006	Green area to north of Carlton Hotel to west of R132 Swords Road, in line with hotel closest façade facing onto R132 Swords Road. Located approximately 18m from R132 road edge.

1.2.2.3 Northwood Avenue to Shantalla Road

A total of one long-term unattended monitoring location and five attended survey locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 4.

Table 4: Noise Monitoring Locations – Northwood Avenue to Shantalla Road

Location	Description of Survey Location
Unattended Monitoring Locations	
CBC0002UNML004	In residential rear garden of Santry Villas housing estate with a direct line of sight to the R132 Swords Road. Located approximately 45m from R132 road edge.
Attended Monitoring Locations	
CBC0002ANML007	On hard ground in Morton Stadium to west of R132 Swords Road, in line with closest façade facing R132 Swords Road. Located approximately 30m from R132 road edge.
CBC0002ANML008	On footpath to east of R132 Swords Road, opposite Morton Stadium, in line with closest residential façades facing onto R132 Swords Road. Located approximately 20m from R132 road edge.
CBC0002ANML009	Green area to south of R132 Swords Road / Magenta Crescent junction, in line with closest residential façades facing onto R132 Swords Road. Located approximately 15m from R132 Swords Road.
CBC0002ANML010	Green area to south of Magenta Hall housing estate, in line with closest residential façades facing onto R132 Swords Road. Located approximately 30m from R132 road edge, separated by a wall.
CBC0002ANML011	Footpath to northeast of R132 Swords Road / Shanrath Road junction, in line with residential façades facing onto R132 Swords Road. Located approximately 10m from R132 Swords Road.

1.2.2.4 Shantalla Road to Botanic Avenue

One long-term unattended monitoring location and six attended survey locations were surveyed within this study area. The location reference and a description of survey positions are included in Table 5.

Table 5: Noise Monitoring Locations – Shantalla Road to Botanic Avenue

Location	Description of Survey Location
Unattended Monitoring Locations	
CBC0002UNML005	In rear residential garden in Millmount Place housing estate. Located approximately 5m from River Tolka and 60m from R132 Drumcondra Road Lower.
Attended Monitoring Locations	
CBC0002ANML012	Green area to northeast of R132 Swords Road / R103 Collins Avenue junction, in line with closest residential façades facing onto R132 Swords Road. Located approximately 70m from R132 road edge.
CBC0002ANML013	On footpath to southwest of R132 Swords Road / Iveragh Road junction, in line with commercial façades facing onto R132 Swords Road. Located approximately 7m from R132 road edge.
CBC0002ANML014	Green area to south of Plunkett College, in line with closest façade of school facing onto R132 Swords Road. Located approximately 55m from R132 road edge.
CBC0002ANML015	On footpath to south of Seven Oaks housing estate, in line with residential façades facing into R132 Swords Road. Located approximately 25m from R132 road edge.
CBC0002ANML016	On footpath to southeast of R132 Drumcondra Road Upper / R102 Griffith Avenue junction, in line with closest residential façades facing onto R132 Drumcondra Road Upper. Located approximately 15m from N1 road edge.
CBC0002ANML017	On hard ground to south of Millmount Terrace, in line with residential façades facing onto River Tolka and R132 Drumcondra Road Lower. Located approximately 25m from R132 road edge.

1.2.2.5 Botanic Avenue to Granby RRow

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

Table 6: Noise Monitoring Locations – Botanic Avenue to Granby Row

Location	Description of Survey Location
Attended Monitoring Locations	
CBC0002ANML018	On footpath to southeast of R132 Dorset Street Lower / Eccles Street junction, in line with commercial façades facing onto R132 Dorset Street Lower / Upper. Located approximately 3m from R132 road edge.
CBC0002ANML019	On footpath to west of Parnell Square East / Parnell Square North junction, in line with façades facing onto Frederick Street North. Located approximately 5m from Parnell Square East road edge.

1.2.3 Survey Periods

Unattended noise surveys were undertaken between 24 January 2019 and 20 September 2020. The specific survey dates for each location are included in the survey result tables in Section 0

Attended noise surveys were undertaken between 22 October 2018 and 7 October 2020. The specific survey dates and times for each location are included in the survey results tables in Section 0.

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 7.

Table 7: Noise Monitoring Equipment

Survey Type	Equipment	Serial Number	Calibration Date
Unattended	Rion NL-52	998410	22/01/2020
		764925	19/08/2020
		998413	22/01/2020
		1076328	15/08/2018
		586940	15/08/2018
Attended	Brυel and Kjær 2250L	3008402	04/11/2019
	Rion NL-52	1076330	15/08/2018
		586944	16/08/2018

Calibration certificate of the monitoring equipment are included within Section 3.

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 3.9.

The surveys were conducted by Jack Brennan, Alex Ryan and Donal Heavey, 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 (ISO 2016) and ISO 1996-2:2017 Part 2: Determination of sound pressure levels (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 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 10:00 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 Pinnock Hill to Airside Junction

1.3.1.1 Attended Surveys

The attended noise survey results recorded during the baseline surveys within this study area are presented in Table 8.

Table 8: Attended Noise Survey Results for Pinnock Hill to Airside Junction

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived dB L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0002ANML001	22/10/2018	15:03	61	62	57	61	Road traffic noise from R132 Swords Road dominant noise source, rustling foliage, aircraft flyover, pedestrian conversations.
		16:07	58	59	55		
		17:12	62	59	55		

1.3.2 Airside Junction to Northwood Avenue

1.3.2.1 Unattended Surveys

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

Table 9: Unattended Noise Survey Results for Airside Roundabout to Northwood Avenue

Survey Date	Daytime				Evening	Night-Time			L_{den}
	$L_{Aeq,16hr}$	L_{day}	$L_{A10,16hr}$	$L_{A90,16hr}$	$L_{evening}$	L_{night}	$L_{A10,8hr}$	$L_{A90,8hr}$	
CBC0002UNML001									
24/01/2019	62	63	64	58	61	55	58	45	64
25/01/2019	61	62	63	57	60	55	59	47	64
26/01/2019	62	62	64	58	61	59	62	52	66
27/01/2019	61	62	63	56	59	55	58	45	64
28/01/2019	61	62	63	57	60	56	58	45	64
29/01/2019	62	63	64	58	61	55	57	44	64
30/01/2019	62	63	64	58	61	57	59	48	65
Average	**62**	**62**	**63**	**57**	**61**	**56**	**59**	**47**	**65**
CBC0002UNML002									
09/05/2019	61	61	62	57	61	57	59	49	65
10/05/2019	59	60	61	55	58	56	59	49	63
11/05/2019	58	60	60	54	56	56	58	49	63
12/05/2019	58	59	60	54	58	55	57	49	63
13/05/2019	59	60	60	55	58	56	58	48	63
14/05/2019	59	60	61	55	58	55	57	48	63
15/05/2019	59	59	61	56	59	55	57	49	63
Average	**59**	**60**	**61**	**55**	**58**	**56**	**58**	**49**	**63**
CBC0002UNML003									
09/09/2020	57	58	58	50	55	53	54	44	60
10/09/2020	58	59	60	54	57	55	57	49	62
11/09/2020	60	61	61	56	57	54	56	48	62
12/09/2020	59	61	61	55	58	57	60	51	64
13/09/2020	57	58	59	53	56	-	-	-	57
Average	**58**	**59**	**60**	**54**	**57**	**55**	**57**	**48**	**62**

Road traffic from R132 Swords Road is the dominant noise source at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were recorded in range of 58 to 62 dB $L_{Aeq,16hr}$. Average background daytime noise levels were measured in the range of 54 to 57 dB $L_{A90,16hr}$.

Night-time noise levels at the monitoring locations are dominated by road traffic from R132 Swords Road. Average ambient night-time noise levels were measured in the range of 55 to 56 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the range of 47 to 49 dB $L_{A90,8hr}$.

The measured L_{den} values in this geographical section ranged between 62 and 65 dB L_{den}.

1.3.2.2 Attended Surveys

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

Table 10: Attended Noise Survey Results for Airside Junction to Northwood Avenue

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0002ANML002	19/06/2020	14:08	60	62	55	62	Road traffic noise from R132 Swords Road dominant noise source, rustling leaves, hammering nearby.
		15:40	59	62	52		Road traffic noise from R132 Swords Road dominant noise source, rustling leaves, pedestrian conversation.
	24/06/2020	10:00	57	60	46		Road traffic noise from R132 Swords Road dominant noise source, rustling leaves, birdsong, children playing.
CBC0002ANML003	17/04/2019	11:04	57	59	52	60	Road traffic noise from R132 Swords Road dominant noise source.
		12:04	58	60	52		
		13:04	58	60	53		
CBC0002ANML004	19/06/2020	14:39	62	64	57	64	Road traffic noise from R132 Swords Road dominant noise source, rustling leaves.
		16:04	62	64	57		Road traffic noise from R132 Swords Road dominant noise source, rusting leaves, aircraft take off.
	24/06/2020	10:24	59	63	50		Road traffic noise from R132 Swords Road dominant noise source, rustling leaves, birdsong.
CBC0002ANML005	07/10/2020	13:30	65	68	54	68	Road traffic noise from R132 Swords Road dominant noise source.
		14:30	65	68	54		
		15:30	66	70	55		
CBC0002ANML006	19/06/2020	15:11	65	68	55	68	Road traffic noise from R132 Swords Road dominant noise source, occasional beeping from pedestrian crossing, gate knocking in wind, aircraft take-off and landing occasionally.
		16:31	65	69	55		Road traffic noise from R132 Swords Road dominant noise source, occasional beeping from pedestrian crossing, aircraft landing, pedestrian conversation.
	24/06/2020	10:50	66	69	54		Road traffic noise from R132 Swords Road dominant noise source, occasional beeping from pedestrian crossing.

.

1.3.3 Northwood Avenue to Shantalla Road

1.3.3.1 Unattended Surveys

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

Table 11: Unattended Noise Survey Results for Northwood Avenue to Shantalla Road

Survey Date	Daytime				Evening	Night-Time			L_{den}
	$L_{Aeq,16hr}$	L_{day}	$L_{A10,16hr}$	$L_{A90,16hr}$	$L_{evening}$	L_{night}	$L_{A10,8hr}$	$L_{A90,8hr}$	
CBC0002UNML004									
14/09/2020	53	54	54	49	51	52	53	45	59
15/09/2020	53	53	53	48	53	50	50	44	57
16/09/2020	55	56	56	52	54	50	51	44	58
17/09/2020	54	55	55	51	53	52	52	45	59
18/09/2020	57	58	58	54	55	52	53	47	60
19/09/2020	56	57	57	53	54	50	51	44	58
20/09/2020	54	55	55	50	53	47	49	39	56
Average	**55**	**56**	**55**	**51**	**54**	**50**	**51**	**44**	**58**

Road traffic from R132 Swords Road is the dominant noise source at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were recorded in the order of 55 dB $L_{Aeq,16hr}$. Average background daytime noise levels were measured in the order of 51 dB $L_{A90,16hr}$.

Night-time noise levels at the monitoring locations are dominated by road traffic from R132 Swords Road. Average ambient night-time noise levels were measured in the order of 50 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the order of 44 dB $L_{A90,8hr}$.

The measured L_{den} values in this study area were in the order of 58 dB L_{den}.

1.3.3.2 Attended Surveys

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

Table 12: Attended Noise Survey Results for Northwood Avenue to Shantalla Road

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0002ANML007	22/09/2020	13:44	59	61	55	61	Road traffic noise from R132 Swords Road dominant noise source.
		14:38	58	61	54		Road traffic noise from R132 Swords Road dominant noise source, distant construction noise.
		15:30	58	61	54		Road traffic noise from R132 Swords Road dominant noise source.
CBC0002ANML008	24/06/2020	11:15	63	66	51	66	Road traffic noise from R132 Swords Road dominant noise source, birdsong, pedestrian conversation.
		12:03	63	67	52		
		12:46	63	67	53		Road traffic noise from R132 Swords Road dominant noise source, birdsong.
CBC0002ANML009	24/06/2020	11:40	64	67	56	67	Road traffic noise from R132 Swords Road dominant noise source, construction noise, car horn.
		12:25	64	67	57		Road traffic noise from R132 Swords Road dominant noise source, construction noise.
		13:08	64	67	57		
CBC0002ANML010	22/09/2020	14:10	56	59	53	59	Road traffic noise from R132 Swords Road dominant noise source.
		15:04	56	58	52		
		15:57	56	58	52		
CBC0002ANML011	24/06/2020	13:32	63	66	53	66	Road traffic noise from R132 Swords Road dominant noise source, birdsong, beeping from pedestrian crossing, car horn, children playing nearby.
		14:53	63	66	55		Road traffic noise from R132 Swords Road dominant noise source, birdsong, beeping from pedestrian crossing, car horn.
		16:02	63	66	54		Road traffic noise from R132 Swords Road dominant noise source, birdsong, beeping from pedestrian crossing, pedestrian conversation.

1.3.4 Shantalla Road to Botanic Avenue

1.3.4.1 Unattended Surveys

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

Table 13: Unattended Noise Survey Results for Shantalla Road to Botanic Avenue

Survey Date	Daytime				Evening	Night-Time			L_{den}
	$L_{Aeq,16hr}$	L_{day}	$L_{A10,16hr}$	$L_{A90,16hr}$	$L_{evening}$	L_{night}	$L_{A10,8hr}$	$L_{A90,8hr}$	
CBC0002UNML005									
26/08/2020	58	58	59	51	58	56	58	49	63
27/08/2020	59	60	61	53	58	58	60	50	64
28/08/2020	59	60	61	54	58	55	58	50	63
29/08/2020	59	58	60	53	60	55	58	49	63
30/08/2020	58	58	60	51	58	56	59	48	63
31/08/2020	59	58	59	50	59	58	61	48	65
01/09/2020	59	59	59	50	59	57	59	47	64
02/09/2020	59	61	60	53	56	56	59	49	63
Average	**59**	**59**	**60**	**52**	**58**	**57**	**59**	**49**	**64**

Road traffic noise from R132 Drumcondra Road Lower is the dominant noise source, with water noise from River Tolka also present at the monitoring position in the vicinity of the Proposed Scheme. During daytime periods, average ambient noise levels were measured in the order of 59 dB $L_{Aeq,16hr}$. Average background daytime noise levels were measured in the order of 52 dB $L_{A90,16hr}$.

Night-time noise levels at the monitoring locations are dominated by road traffic from R132 Drumcondra Road Lower is the dominant noise source, with water noise from River Tolka also present. Average ambient night-time noise levels were measured in the order of 57 dB $L_{Aeq,8hr}$. Average background noise levels during this time period were measured in the order of 49 dB $L_{A90,8hr}$.

The measured L_{den} values in this geographical section were in the order of 64 dB L_{den}.

1.3.4.2 Attended Surveys

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

Table 14: Attended Noise Survey Results for Shantalla Road to Botanic Avenue

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0002ANML012	24/06/2020	14:02	60	62	56	62	Road traffic noise from R132 Swords Road dominant noise source, occasional noise from bottle bank nearby, ice cream truck music.
		15:16	59	62	55		Road traffic noise from R132 Swords Road dominant noise source, occasional noise from bottle bank nearby.
		16:21	59	61	55		Road traffic noise from R132 Swords Road dominant noise source, occasional noise from bottle bank nearby, ice cream truck music, loud pedestrian conversation, car horn.
CBC0002ANML013	24/06/2020	14:22	66	69	58	68	Road traffic noise from R132 Swords Road dominant noise source.
		15:35	66	69	57		Road traffic noise from R132 Swords Road dominant noise source, car horn.
		16:41	65	69	57		Road traffic noise from R132 Swords Road dominant noise source.
CBC0002ANML014	09/09/2020	11:36	57	59	52	58	Road traffic noise from R132 Swords Road dominant noise source, rustling leaves.
		13:15	53	55	49		
		14:50	55	57	49		
CBC0002ANML015	25/06/2020	10:00	58	59	49	60	Road traffic noise from R132 Swords Road dominant noise source, birdsong, rustling leaves, sirens.
		11:17	56	59	49		Road traffic noise from R132 Swords Road dominant noise source, rustling leaves.
		12:34	59	59	49		Road traffic noise from R132 Swords Road dominant noise source, rustling leaves. birdsong, pedestrian conversation, refuse truck pass-by.
CBC0002ANML016	25/06/2020	10:20	70	71	59	69	Road traffic noise from R132 Drumcondra Road Upper / R102 Griffith Avenue dominant noise source, intermittent truck horn and car horn.
	14/09/2020	14:56	71	70	59		Road traffic noise from R132 Drumcondra Road Upper / R102 Griffith Avenue dominant noise source, siren.
		16:04	68	70	59		Road traffic noise from R132 Drumcondra Road Upper / R102 Griffith Avenue dominant noise source, siren.
CBC0002ANML017	25/06/2020	10:53	57	60	51	60	Road traffic noise from R132 Drumcondra Road Lower dominant noise source, water noise from River Tolka.
		12:09	57	59	50		Road traffic noise from R132 Drumcondra Road Lower dominant noise source, water noise from River Tolka, car horn.
		13:20	62	60	51		Road traffic noise from R132 Drumcondra Road Lower dominant noise source, water noise from River Tolka, car horn, siren, pedestrian conversation.

1.3.5 Botanic Avenue to Granby Row

1.3.5.1 Attended Surveys

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

Table 15: Attended Noise Survey Results for Botanic Avenue to Granby Road

Attended Location	Date	Start Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived L_{den}	Survey Notes
			L_{Aeq}	L_{A10}	L_{A90}		
CBC0002ANML018	14/09/2020	15:29	67	70	60	70	Road traffic noise from R132 Dorset Street Lower / Eccles Street junction dominant noise source, frequent beeping from pedestrian crossing.
	25/06/2020	14:45	69	72	62		Road traffic noise from R132 Dorset Street Lower / Eccles Street junction dominant noise source, frequent beeping from pedestrian crossing, truck parked in idle.
	14/09/2020	16:36	68	70	62		Road traffic noise from R132 Dorset Street Lower / Eccles Street junction dominant noise source, frequent beeping from pedestrian crossing.
CBC0002ANML019	25/06/2020	14:16	65	69	57	69	Road traffic noise from Parnell Square East / Parnell Square North junction dominant noise source, pedestrian conversation, car horn, loud music from car pass-by.
		15:08	68	70	56		Road traffic noise from Parnell Square East / Parnell Square North junction dominant noise source, pedestrian conversation, siren, bus reversing and street cleaner pass-by.
		15:54	66	70	58		Road traffic noise from Parnell Square East / Parnell Square North junction dominant noise source, pedestrian conversation.

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 Proposed Works). Baseline vibration data obtained from this study has been used to information all individual Bus Connects 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 Proposed Scheme.

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 16.

Table 16: 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: 30th July 2020; and
- AVML005 – AMML009: 13th 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 3

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

Table 17: 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 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 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 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 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 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 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 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 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 22 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 22: 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	
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 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 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
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 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 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
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 25 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 25: 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	
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	

2.5 References

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)

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)

Directives and Legislation

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

S.I. No. 549/2018 – European Communities (Environmental Noise) Regulations 2018

3. CALIBRATION CERTIFICATES FOR MONITORING EQUIPMENT

3.1 Rion NL-52 S/N 998410

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 22 January 2020

Certificate Number: UCRT20/1096

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	00998410
	Rion	Firmware		2.0
	Rion	Pre Amplifier	NH-25	98624
	Rion	Microphone	UC-59	15916
	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 UCRT20/1096

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	22.46	22.19	±	0.30	°C
Humidity	42.2	37.2	±	3.00	%RH
Ambient Pressure	102.71	102.74	±	0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.0	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		
	11.4	dB	UR	15.3	dB	UR	21.3	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: A.Escalona R 3

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

3.2 Rion NL-52 S/N 764925

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 19 August 2020

Certificate Number: UCRT20/1788

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.	PO 2062			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	00764925
	Rion	Firmware		2.0
	Rion	Pre Amplifier	NH-25	65051
	Rion	Microphone	UC-59	09853
	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	19 August 2020	ANV Job No.	UKAS20/08452	
Date Calibrated	19 August 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*
	22 August 2018	UCRT18/1863	0653

CERTIFICATE OF CALIBRATION	Certificate Number UCRT20/1788
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	15 July 2020		
Calibrator cert. number	UCRT20/1634		
Calibrator cal cert issued by	0653		
Calibrator SPL @ STP	94.00	dB	Calibration reference sound pressure level
Calibrator frequency	1001.92	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	23.88	24.01	± 0.30	°C
Humidity	51.1	52.1	± 3.00	%RH
Ambient Pressure	99.17	99.12	± 0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.3	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		
	12.9	dB	UR	17.7	dB	UR	22.9	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. Giles R 1

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

3.3 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

3.4 Rion NL-52 S/N 1076328

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION
0653

Date of Issue: 15 August 2018 **Certificate Number: UCRT18/1836**

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

Page 1 of 2 Pages
Approved Signatory
J. Harriman

Customer	AWN Consulting Limited The Tecpro Building IDA Business and Technology Park Dublin 17 Ireland			
Order No.	1869			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	01076328
	Rion	Firmware		1.9
	Rion	Pre Amplifier	NH-25	76545
	Rion	Microphone	UC-59	12271
	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	13 August 2018	ANV Job No.	UKAS18/08513	
Date Calibrated	15 August 2018			

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 UCRT18/1836
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	06 August 2018		
Calibrator cert. number	UCRT18/1784		
Calibrator cal cert issued by	0653		
Calibrator SPL @ STP	93.99	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	22.84	22.87	± 0.30 °C
Humidity	49.8	49.7	± 3.00 %RH
Ambient Pressure	100.67	100.63	± 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		
	11.5	dB	UR	15.5	dB	UR	21.4	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: A Patel R 1

Additional Comments
None

3.5 Rion NL-52 S/N 586940

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION
0653

Date of Issue: 15 August 2018

Certificate Number: UCRT18/1831

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

Page 1 of 2 Pages

Approved Signatory

J. Harriman

Customer	AWN Consulting Limited The Tecpro Building IDA Business and Technology Park Dublin 17 Ireland			
Order No.	1869			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	00586940
	Rion	Firmware		1.9
	Rion	Pre Amplifier	NH-25	87059
	Rion	Microphone	UC-59	13402
	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	13 August 2018	ANV Job No.	UKAS18/08513	
Date Calibrated	15 August 2018			

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 UCRT18/1831
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	06 August 2018		
Calibrator cert. number	UCRT18/1784		
Calibrator cal cert issued by	0653		
Calibrator SPL @ STP	93.99	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	21.89	22.52	± 0.30	°C
Humidity	61.4	53.7	± 3.00	%RH
Ambient Pressure	100.71	100.68	± 0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.0	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		
	11.4	dB	UR	15.5	dB	UR	21.5	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: A Patel R 1

Additional Comments
None

3.6 Rion NL-52 S/N 1076330

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION
0653

Date of Issue: 15 August 2018

Certificate Number: UCRT18/1834

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

Page 1 of 2 Pages

Approved Signatory

J. Harriman

Customer	AWN Consulting Limited The Tecpro Building IDA Business and Technology Park Dublin 17 Ireland			
Order No.	1869			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	01076330
	Rion	Firmware		1.9
	Rion	Pre Amplifier	NH-25	76547
	Rion	Microphone	UC-59	12273
	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	13 August 2018	ANV Job No.	UKAS18/08513	
Date Calibrated	15 August 2018			

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 UCRT18/1834
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	06 August 2018		
Calibrator cert. number	UCRT18/1784		
Calibrator cal cert issued by	0653		
Calibrator SPL @ STP	93.99	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	22.73	22.92	± 0.30 °C
Humidity	52.2	50.8	± 3.00 %RH
Ambient Pressure	100.66	100.65	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.0	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		
	11.5	dB	UR	15.4	dB	UR	21.6	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: A Patel R 1

Additional Comments
None

3.7 Rion Nl-52 S/N 586944

ANV MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION 0653

Date of Issue: 16 August 2018 **Certificate Number: UCRT18/1839**

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

Page 1 of 2 Pages

Approved Signatory

J. Harriman

Customer	AWN Consulting Limited The Tecpro Building IDA Business and Technology Park Dublin 17 Ireland
Order No.	1869
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00586944
Rion	Firmware		1.9
Rion	Pre Amplifier	NH-25	87063
Rion	Microphone	UC-59	13407
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 15 August 2018 ANV Job No. UKAS18/08525
Date Calibrated 16 August 2018

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

UKAS Accredited Calibration Laboratory No. 0653

Certificate Number UCRT18/1839

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	06 August 2018		
Calibrator cert. number	UCRT18/1784		
Calibrator cal cert issued by	0653		
Calibrator SPL @ STP	93.99	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	21.53	22.10	± 0.30	°C
Humidity	60.5	62.5	± 3.00	%RH
Ambient Pressure	100.16	100.15	± 0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.0	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		
	11.3	dB	UR	15.3	dB	UR	21.4	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: A Patel R 1

Additional Comments
None

3.8 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.

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate No UCRT19/2218

NOTES

Any opinions or interpretations which may be expressed in the following notes are not UKAS Accredited.

1 All tests were carried out in "Broad Band".

2 Windscreen correction was set to "None", soundfield to "Free-field" and microphone to "4950".

3 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method. This response in isolation is not UKAS Accredited.

4 It was noted that in order to obtain the correct A-weighted response to the sound calibrator, the relevant software setting in the meter had to be changed from '4231' to 'custom' with the appropriate calibration level entered.

5 The electrical tests have been carried out with the instrument set for the nominal microphone sensitivity, as specified in the Instruction Manual. This may mean that the instrument has a slightly different linearity range when in normal use.

6 Typical case reflection factors specified by the manufacturer have been used for this verification.

The instrument was running on hardware version 4.0

The instrument firmware settings were:

Module i.d.	Function	Version	Active?	Licenced?	Template used?
BZ 7130	SLM	4.7.5	Y	Y	Y
BZ 7131	Octave analysis	4.7.5	Y	N	N/A
BZ 7132	1/3-oct analysis	4.7.5	Y	Y	N/A
BZ 7133	Logging	4.7.5	Y	Y	N/A
BZ 7226	Signal Recording Option	4.7.5	Y	N	N/A
BZ 7231	Tone Assessment	4.7.5	Y	N	N/A
BZ 7232	Noise Monitoring Software	4.7.5	Y	N	N/A
BZ	N/A	N/A	N/A	N/A	N/A
BZ	N/A	N/A	N/A	N/A	N/A
BZ	N/A	N/A	N/A	N/A	N/A

The results on this certificate only relate to the items calibrated as identified above.

END R 3

3.9 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
Page 2 of 3 Pages

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/s²" is actual reading in m/s².

1 m/s² Range

Level dB	Error (X) dB	m/s² (X)	Error (Y) dB	m/s² (Y)	Error (Z) dB	m/s² (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/s² Range

Level dB	Error (X) dB	m/s² (X)	Error (Y) dB	m/s² (Y)	Error (Z) dB	m/s² (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
TCRT19/1825
Page 3 of 3 Pages

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

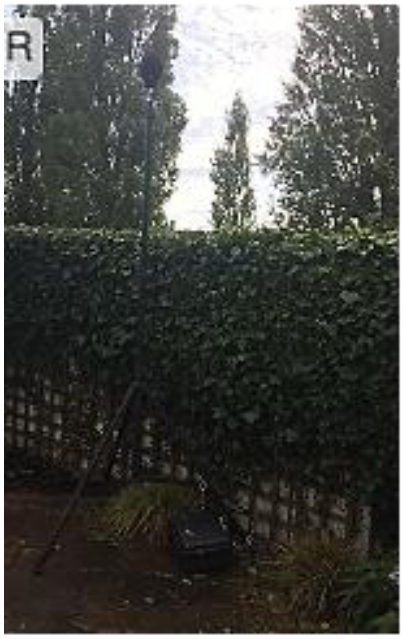
Tolerance required @ 4 Hz to 63 Hz +12%/-11% ; @ 80 Hz +26%/-21%

All results meet the manufacturer's specification.

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

4. Unattended Monitoring Equipment Set Up

Location	Equipment Set up
CBC0002UNML001 In residential front garden approximately 100m southeast of R132 Swords Road / R125 junction.	
CBC0002UNML002 In carpark area to side of Private Clinic in Nevinstown West to east of R132 Swords Road. Located approximately 45m from R132 road edge.	
CBC0002UNML003 In residential front garden to southeast of R132 Swords Road / Old Airport Road junction. Located approximately 50m from R132 road edge. Closest façade of property approximately 30m from R132 road edge.	
CBC0002UNML004	

Location	Equipment Set up
In residential rear garden of Santry Villas housing estate with a direct line of sight to the R132 Swords Road. Located approximately 45m from R132 road edge.	
CBC0002UNML005 In rear residential garden in Millmount Place housing estate. Located approximately 5m from River Tolka and 60m from R132 Drumcondra Road Lower.