

Appendix 8.2: Detailed Baseline Noise Survey Results

1 Introduction

- 1.1 This appendix provides additional details of the baseline noise surveys which were undertaken as part of the Design Manual for Roads and Bridges (DMRB) Noise and Vibration Stage 3 Environmental Impact Assessment (EIA).
- 1.2 Due to demolition works planned at Stratton Farm, baseline noise monitoring was not undertaken at Stratton Farmhouse or Rose Cottage (located next to Stratton Farm). It was considered that if noise monitoring was undertaken at either location, the noise levels gathered would not be representative of the typical noise climate experienced at either property as a consequence of the close proximity of the demolition works and the haul route to the demolition site.
- 1.3 Noise monitoring was undertaken between 9 March 2018 and 23 March 2018 and consisted of noise level measurements at the following locations:
- measurement Location NV0001: Elderslie, 5A Inshes Holdings, Inshes, Inverness, IV2 5BA;
 - measurement Location NV0002: Castlehill, Inshes, Inverness, IV2 5BA;
 - measurement Location NV0003: 17 Castlehill Court, Inverness, IV2 5GS;
 - measurement Location NV0004: 6 Cradlehall Meadows, Inverness, IV2 5GD;
 - measurement Location NV0005: Annfield, Caulfield Road North – Smithton Road, Inverness, IV2 7NH;
 - measurement Location NV0006: Ashton Farm, Caulfield Road North – Smithton Road, Inverness, IV2 7NH; and
 - measurement Location NV0007: 49 Cranmore Drive, Inverness, IV2 7FL.
- 1.4 Regular site visits and additional short-term spot measurements were undertaken at all measurement locations. Due to the lack of a secure location to leave noise monitoring equipment unattended, only attended short-term measurements were undertaken at 17 Castlehill Court.
- 1.5 The following equipment was used when undertaking noise measurements. Calibration certificates for this equipment are provided at the end of this appendix:
- Rion NC-74 Calibrator serial number (s/n) 00830793;
 - Castle Mirrus GA607 Dual Level Calibrator s/n 035748;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00751323;
 - Rion NL-32 Class 1 Sound Level Meter s/n 00482602;
 - Rion NL-52 Class 1 Sound Level Meter s/n 00642983; and
 - Castle Mirrus GA117 Class 1 Sound Level Meter s/n 35769.
- 1.6 For each measurement location, two tables have been provided to detail the measured daily noise levels for the following time periods:
- the 18-hour daytime period (between 06:00 and 00:00), which is the time period that is used to describe road traffic noise in Calculation of Road Traffic (CRTN);
 - the 16-hour daytime period (between 07:00 and 23:00), which corresponds to the time period used in World Health Organisation (WHO) guidance and BS 8233 when describing the daytime period; and
 - the eight-hour night-time period (between 23:00 and 07:00), which corresponds to the time period used in WHO guidance and BS 8233 when describing the night-time noise period.

- 1.7 The measured daily noise levels, both with and without periods of rainfall and high wind speeds, are presented for each monitoring location. To minimise the effect of rainfall on noise levels measured during unattended measurements, noise levels measured during periods of rainfall have been removed from the data set. For each 15-minute time period where rainfall has been measured, the noise levels corresponding to that time period and the following 30 minutes have been discarded. The following 30 minutes have been excluded to help mitigate effects of standing water on road traffic noise on nearby roads. To minimise the effect of wind generated noise on noise levels measured during unattended measurements, noise levels measured during periods of high wind speeds (peak wind speeds of greater than 5ms^{-1}) have been removed from the dataset. Each 15-minute period where peak wind speeds of greater than 5ms^{-1} have been measured, the noise levels corresponding to that time period have been discarded.
- 1.8 Daily noise levels are presented only for periods where noise levels were measured for the full duration of the period, i.e. the full 18 (06:00 to 00:00), 16 (07:00 to 23:00) or eight (23:00 to 07:00) hours. Where data for the full 18-hour (06:00 to 00:00) period is not available, the shortened measurement procedure (defined in CRTN) has been used to calculate the $\text{LA}_{10,18\text{h}}$. It should be noted that the measurement locations do not necessarily meet the CRTN shortened measurement procedure requirements in terms of microphone position relative to roads and therefore the $\text{LA}_{10,18\text{h}}$ levels calculated using this method should be considered as estimates. The shortened measurement procedure has been used where there are three consecutive hours, between 10:00 and 17:00, which have at least 15 minutes (and the following 30 minutes if rainfall has occurred) free of rain and peak wind speeds greater than 5ms^{-1} per hour.

2 Summary of Unattended Long-Term Measurements

Measurement Location NV01: Elderslie, 5A Inshes Holdings, Inshes, Inverness, IV2 5BA

- 2.1 The measurement location was as shown in Photograph 1. A Rion NL-32 sound level meter (s/n 00751323) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was located approximately 5m from the north-western corner of the building, which faces the A9/Culloden Road Interchange.



Photograph 1: Noise Monitoring Equipment at Elderslie

- 2.2 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 00830793) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.3 At this location the most significant contributor to the noise climate was road traffic noise from the B9006 Culloden Road and A9 Interchange. Noise from the A9 and birdsong also contributed to the noise climate. Additional noise sources included the adjacent steel fabricators (people talking, van movements and forklift truck reversing alarms) and occasional aeroplane flyovers.
- 2.4 Between 9 March and 14 March, 15-minute average wind speeds did not exceed 2.3ms^{-1} , however 15-minute average wind speeds of up to 3.9ms^{-1} were recorded on 15 March. Gusts of greater than 5ms^{-1} were recorded on 14 March and 15 March. No rainfall was recorded on 14 March and 15 March. Occasional rainfall was recorded on 9 March, 11 March, 12 March and 13 March where peak 15-minute total rainfall was 0.08mm, 0.24mm, 0.03mm and 0.04mm, respectively. More frequent rainfall was recorded on 10 March, where peak 15-minute total rainfall was 0.86mm.
- 2.5 Table 1 and Table 2 provide the measured daily noise levels at this location, with and without noise levels measured during periods of rainfall and high wind speeds.

Table 1: Daily Summarised Noise Levels at Elderslie, Including Periods of Rainfall and High Wind Speeds

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
09/03/2018	Friday	-	59.1*	-	-	-	-	51.1	53.4	41.1
10/03/2018	Saturday	56.5	58.7	50.6	56.8	59.2	51.3	50.1	52.4	38.5
11/03/2018	Sunday	54.6	56.4	48.1	54.8	56.7	49.0	49.7	50.6	35.7
12/03/2018	Monday	56.1	57.2	50.1	56.4	57.7	51.0	50.0	51.1	35.3
13/03/2018	Tuesday	58.2	57.5	50.4	58.5	57.8	51.1	50.3	52.3	36.7
14/03/2018	Wednesday	58.3	57.7	50.9	58.7	58.3	52.0	53.4	53.1	41.5

* Estimated level using CRTN shortened measurement procedure period

Table 2: Daily Summarised Noise Levels at Elderslie, with Periods of Rainfall and High Wind Speeds Removed

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
09/03/2018	Friday	-	59.1*	-	-	-	-	51.1	53.4	41.1
10/03/2018	Saturday	-	58.7*	-	-	-	-	-	-	-
11/03/2018	Sunday	54.6	56.4	48.1	54.8	56.7	49.0	49.7	50.7	35.7
12/03/2018	Monday	56.2	57.3	50.1	56.1	57.8	51.1	50.0	51.1	35.3
13/03/2018	Tuesday	58.4	57.4	50.3	58.3	57.8	51.0	50.3	52.3	36.7
14/03/2018	Wednesday	58.3	57.7	51.0	58.5	58.3	52.0	-	-	-

* Estimated level using CRTN shortened measurement procedure period

- 2.6 It should be noted that in Table 1 and Table 2 the reported L_{Aeq,T} level is the logarithmically averaged noise level, whereas the L_{A10,T} and L_{A90,T} levels are the arithmetically averaged noise levels.
- 2.7 In addition to long-term measurements, a series of short-term attended measurements were also undertaken and the results are provided in Table 3. A Castle Mirrus GA117 sound level meter (s/n 35769) was positioned at a height of 1.4m in free-field conditions adjacent to the long-term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 acoustic calibrator (s/n 035748), which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.

Table 3: Additional Attended Noise Level Measurements at Elderslie

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
09/03/2018	10:25	00:15	57.6	59.8	54.0	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	10:40	00:15	57.7	59.8	54.5	Noise sources included road traffic noise (mainly from the Culloden Road and A9 interchange but road traffic from A9 also audible), birdsong and geese. Additionally, people talking near the steel fabricators was audible throughout the monitoring period. Postal delivery audible at 10:40. Dog started to bark halfway through the survey and continued until the end. Sirens audible at 10:48-10:49.
	18:48	00:15	56.9	59.0	53.3	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	19:03	00:15	57.1	58.9	53.4	Noise climate dominated by road traffic noise, primarily the B9006 Culloden Road and A9 interchange but road traffic from A9 was also audible. Car radio audible at 18:57. Helicopter Air Ambulance flyover audible at 19:02. Aircraft flyover audible at 19:03. Loud motorbike audible at 19:04. Car engine and car movement at monitoring location at 19:08.
12/03/2018	15:14	00:15	56.2	58.4	52.4	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	15:29	00:15	60.4	59.1	52.5	Noise sources included road traffic noise, birdsong and people talking at the nearby steel fabricators. Movement of a van at the steel fabricators audible at 15:20. Aircraft flyover audible at 15:21. Dog barking in the distance audible at 15:25. Emergency sirens audible on interchange and A9 at 15:36.
13/03/2018	10:00	00:15	55.1	57.5	50.8	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	10:15	00:15	55.5	57.7	51.2	Noise climate dominated by road traffic noise, primarily the B9006 Culloden Road and A9 interchange but road traffic from A9 was also audible. Birdsong and sheep in a nearby field were also audible. Van arriving at the steel fabricators audible between 10:02 and 10:03. Geese audible between 10:08 and 10:13. Forklift truck reversing alarm audible in steel fabrication yard at 10:17 and 10:26. Post delivery audible at 10:19. Truck horn audible at 10:28.
	18:27	00:15	58.8	59.9	51.7	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	18:42	00:15	57.8	59.8	53.2	Noise sources include road traffic noise primarily from the B9006 Culloden Road and A9 interchange but road traffic from A9 was also audible. Noise from interchange becomes less apparent from 18:40 and the A9 becomes more dominant. Fire Service vehicles audible between 18:27 and 18:29. Air ambulance audible between 18:32 and 18:35.
14/03/2018	14:26	00:15	57.1	59.3	53.8	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	14:41	00:15	57.7	59.8	54.1	Noise sources include road traffic noise (mainly from the B9006 Culloden Road and A9 interchange but road traffic from A9 was also audible) and birdsong. Car horn audible at 14:31. Aircraft audible at 15:54.

Measurement Location NV02: Castlehill, Inshes, Inverness, IV2 5BA

- 2.8 The measurement location was as shown in Photograph 2. A Rion NL-32 sound level meter (s/n 00482602) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was located approximately 50m north-west of the front building façade.



Photograph 2: Noise Monitoring Equipment at Castlehill

- 2.9 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 00830793) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.10 Primarily the noise climate was dominated by road traffic noise from B9006 Culloden Road. Other noise sources include distant road traffic noise (particularly from the A9), birdsong, train pass-by and helicopters.
- 2.11 Between 9 March and 14 March, 15-minute average wind speeds did not exceed 2.3ms^{-1} , however 15-minute average wind speeds of up to 3.9ms^{-1} were recorded on 15 March. Gusts of greater than 5ms^{-1} were recorded on 14 March and 15 March. No rainfall was recorded on 14 March and 15 March. Occasional rainfall was recorded on 9 March, 11 March, 12 March and 13 March where peak 15-minute total rainfall was 0.08mm, 0.24mm, 0.03mm and 0.04mm, respectively. More frequent rainfall was recorded on 10 March, where peak 15-minute total rainfall was 0.86mm.
- 2.12 Table 4 and Table 5 provide the measured daily noise levels at this location, with and without noise levels measured during periods of rainfall and high wind speeds.

Table 4: Daily Summarised Noise Levels at Castlehill, Including Periods of Rainfall and High Wind Speeds

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
09/03/2018	Friday	-	57.1*	-	-	-	-	48.0	50.7	40.1
10/03/2018	Saturday	53.6	55.7	49.2	53.9	56.0	49.9	47.5	51.1	38.0
11/03/2018	Sunday	52.6	54.9	46.6	52.9	55.2	47.3	46.6	48.1	36.6
12/03/2018	Monday	53.4	55.2	47.5	53.7	55.5	48.3	46.8	47.7	35.9
13/03/2018	Tuesday	53.6	55.3	48.3	53.9	55.6	48.9	46.3	48.4	36.8
14/03/2018	Wednesday	53.7	55.2	49.1	54.0	55.6	50.1	57.3	54.6	43.5

* Estimated level using CRTN shortened measurement procedure period

Table 5: Daily Summarised Noise Levels at Castlehill, with Periods of Rainfall and High Wind Speeds Removed

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
09/03/2018	Friday	-	57.1*	-	-	-	-	48.0	50.7	40.1
10/03/2018	Saturday	-	55.4*	-	-	-	-	-	-	-
11/03/2018	Sunday	52.6	54.9	46.6	52.9	55.2	47.3	46.6	48.1	36.6
12/03/2018	Monday	53.4	55.2	47.6	53.2	55.5	48.4	46.8	47.7	35.9
13/03/2018	Tuesday	53.6	55.3	48.2	53.4	55.6	48.8	46.3	48.4	36.8
14/03/2018	Wednesday	53.6	55.2	49.1	53.4	55.6	50.1	-	-	-

* Estimated level using CRTN shortened measurement procedure period

2.13

In addition to long-term measurements, a series of short-term attended measurements were also undertaken and the results are provided in Table 6. A Castle Mirrus GA117 sound level meter (s/n 35769) was positioned at a height of 1.4m in free-field conditions adjacent to the long-term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 acoustic calibrator (s/n 035748), which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.

Table 6: Additional Attended Noise Level Measurements at Castlehill

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
09/03/2018	18:14	00:15	55.3	57.0	52.9	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources include road traffic noise, primarily from B9006 Culloden Road, but road traffic on the A9 was also audible. Other noise sources include birdsong. Aircraft audible at 18:20. Loud vehicle on Culloden Road at 18:27 and bus on Culloden Road at 18:29. Aircraft flyover audible at 18:35.
	18:29	00:15	55.4	56.9	53.3	
12/03/2018	14:37	00:15	54.8	56.6	49.3	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources include road traffic noise from B9006 Culloden Road. Other noise sources include birdsong. Emergency vehicle sirens audible between 14:45 and 14:46 and between 14:47 and 14:48. Aircraft flyover audible at 14:49. Train in the distance audible at 14:50. Car leaving property at 14:57.
	14:52	00:15	53.1	55.6	48.4	
13/03/2018	10:35	00:15	55.5	59.4	49.2	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise sources include road traffic noise primarily from B9006 Culloden Road, however, road traffic from other nearby roads contributed to the noise climate. Other noise sources include birdsong. Noise relating to the construction traffic at Inverness Campus was audible throughout the monitoring period. Aircraft flyover audible at 10:46. Lawn tractor on drive audible at 10:37, 10:44 and 10:46.
	10:50	00:15	53.4	55.8	49.0	
	17:52	00:15	53.8	55.9	49.7	
	18:07	00:15	54.2	56.4	51.0	
14/03/2018	10:42	00:15	52.4	54.9	48.3	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by road traffic noise from B9006 Culloden Road but road traffic on the A9 and possibly A96 was also audible. Noise relating to the construction traffic at the Inverness Campus was audible throughout the monitoring period. Birdsong was also audible. Southbound train at 10:48. Loud motorbike at 11:00.
	10:57	00:15	53.0	55.0	49.4	
	13:50	00:15	56.0	57.7	53.6	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by road traffic noise from B9006 Culloden Road but road traffic on the A9 and birdsong was also audible. Residents talking in the distance audible at 14:00. Electric planer and circular saw was sporadically audible between 14:00 and 14:12. Aircraft flyover audible at 14:16 and 14:19.
	14:05	00:15	55.6	57.3	53.3	

Measurement Location NV03: 17 Castlehill Court, Inshes, Inverness, IV2 5GS

- 2.14 Short-term noise measurements were undertaken at 17 Castlehill Court on 9 March 2018, 12 March 2018 and 13 March 2018.
- 2.15 The measurement location was as shown in Photograph 3. A Castle Mirrus GA117 sound level meter (s/n 35769) was positioned at a height of approximately 1.4m in free-field conditions. The equipment was located approximately 8m north of the north-eastern corner of the building.



Photograph 3: Noise Monitoring Equipment at 17 Castlehill Court

- 2.16 The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 (s/n 035748) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.17 The results provided in Table 7 illustrate the predicted $L_{A10,18h}$.

Table 7: Attended Noise Level Measurements at 17 Castlehill Court

Start Date	Start Time (hh:mm)	Duration (mm:ss)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
09/03/2018	13:03	00:15	53.0	54.7	50.0	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by road traffic noise from Castlehill Road and the Business Park. Additional road traffic noise was audible from the A9 and A96. Regular buses were audible on Castlehill Road throughout the monitoring period. Birdsong also audible. Aircraft flyover audible at 13:15, 14:21 and 14:47. Air ambulance audible at 13:50. Aircraft audible at 14:00, 15:02, 15:21 and 15:59.
	13:18	00:15	52.9	54.8	50.4	
	13:33	00:15	52.0	54.1	49.2	
	13:48	00:15	53.9	55.1	49.6	
	14:03	00:15	51.1	53.5	48.0	
	14:18	00:15	52.0	54.0	49.4	
	14:33	00:15	52.5	54.3	50.0	
	14:48	00:15	53.7	55.4	51.0	
	15:03	00:15	53.1	55.3	50.2	
	15:18	00:15	54.5	55.6	50.5	
	15:33	00:15	53.5	55.6	50.2	
	15:48	00:15	54.0	55.4	50.0	
12/03/2018	10:00	00:15	52.4	54.8	47.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by road traffic noise from Castlehill Road and the Business Park. Faint road traffic was also audible from the A9 and A96. Regular buses were audible on Castlehill Road and birdsong was audible throughout the monitoring period. The noise from distant traffic and the business park was subjectively noted to be quieter than measurements undertaken on 9 March 2018. Mobile car wash in business park audible between 10:00 and 10:08. Helicopter audible in the distance at 10:09, 10:12, 10:30 and 11:43. Aircraft audible at 10:10, 10:30, 10:36, 10:55, 11:06, 11:12, 11:32, 12:09, 12:27, 12:58 and 12:59. Waste collection in business park audible between 12:23 and 12:29. Loud car at 12:08. Police siren audible between 12:46 and 12:48.
	10:15	00:15	49.7	52.7	44.4	
	10:30	00:15	47.9	50.7	42.1	
	10:45	00:15	46.8	49.8	41.3	
	11:00	00:15	45.5	48.6	41.2	
	11:15	00:15	47.2	49.5	41.5	
	11:30	00:15	54.6	52.4	39.6	
	11:45	00:15	54.6	53.1	41.5	
	12:00	00:15	48.4	50.8	41.0	
	12:15	00:15	51.2	54.2	41.4	
	12:30	00:15	48.8	51.4	44.1	
12:45	00:15	49.4	51.7	43.6		
13/03/2018	12:44	00:15	47.4	50.7	41.0	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by road traffic noise from Castlehill Road and the Business Park. Distant road traffic from the A9 and A96 was also audible. Regular buses were audible on Castlehill Road and birdsong were audible throughout the monitoring period. Postman audible between 14:25 and 14:39. Helicopter audible at 14:18, 14:47, 15:36, 15:38 and 15:39. Train pass-by at 14:08 and 13:08. Aircraft audible at 12:50, 13:28, 13:44, 14:06 and 14:08 and 14:32. Music in the distance between 14:34 and 14:38. Emergency sirens audible between 14:35 and 14:38.
	12:59	00:15	47.2	50.4	40.5	
	13:14	00:15	47.1	50.7	39.6	
	13:29	00:15	45.9	49.4	38.8	
	13:44	00:15	47.0	49.9	38.8	
	13:59	00:15	45.4	48.5	37.9	
	14:14	00:15	47.1	50.5	40.2	
	14:29	00:15	45.0	47.8	38.5	
	14:44	00:15	47.9	50.2	39.8	
	14:59	00:15	45.3	48.2	40.0	
	15:14	00:15	46.0	49.1	40.3	
15:29	00:15	54.4	51.4	41.5		

2.18 Using the data provided in Table 7, the following L_{A10,18h} has been calculated for each day:

- 9 March 2018 – 53.8dB(A);
- 12 March 2018 – 50.6dB(A); and
- 13 March 2018 – 48.7dB(A).

Measurement Location NV04: 6 Cradlehall Meadows, Inverness, IV2 5GD

- 2.19 The measurement location was as shown in Photograph 4. A Rion NL-32 sound level meter (s/n 00482602) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was positioned in the back garden approximately 8m from the north eastern façade of the building and approximately 7m from the garage.



Photograph 4: Noise Monitoring Equipment at 6 Cradlehall Meadows

- 2.20 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 00830793) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.21 Primarily the noise climate consisted of distant road traffic and birdsong with occasional train pass-bys and construction activity at Inverness Campus.
- 2.22 Throughout the monitoring period, average 15-minute wind speeds did not exceed 2.0ms^{-1} but gusts greater than 5ms^{-1} were recorded on 22 March during one 15-minute period. No rainfall was recorded on 19 March, 20 March and 22 March. Occasional rainfall was recorded on 21 March and 23 March where peak 15-minute total rainfall was 0.14mm and 0.63mm, respectively.
- 2.23 Table 8 and Table 9 provide the measured daily noise levels at this location, with and without the periods of rainfall and high wind speeds.

Table 8: Daily Summarised Noise Levels at 6 Cradlehall Meadows, Including Periods of Rainfall and High Wind Speeds

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/03/2018	Monday	-	43.5*	-	-	-	-	46.6	46.3	38.1
20/03/2018	Tuesday	50.3	49.1	44.6	50.5	49.3	45.1	44.0	44.2	37.2
21/03/2018	Wednesday	51.8	51.6	47.9	52.1	52.2	48.7	43.4	43.6	36.5
22/03/2018	Thursday	51.7	50.6	46.3	52.0	51.0	46.9	43.1	42.9	35.4

* Estimated level using CRTN shortened measurement procedure period

Table 9: Daily Summarised Noise Levels at 6 Cradlehall Meadows, with Periods of Rainfall and High Wind Speeds Removed

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/03/2018	Monday	-	43.5*	-	-	-	-	46.6	46.3	38.1
20/03/2018	Tuesday	50.3	49.1	44.6	50.5	49.3	45.1	44.0	44.2	37.2
21/03/2018	Wednesday	-	52.7*	-	-	-	-	43.4	43.6	36.5
22/03/2018	Thursday	51.7	50.6	46.3	52.0	51.0	46.9	-	-	-

* Estimated level using CRTN shortened measurement procedure period

2.24

In addition to long-term measurements, a series of short-term attended measurements were also undertaken and the results are provided in Table 10. A Castle Mirrus GA117 sound level meter (s/n 35769) was positioned at a height of 1.4m in free-field conditions adjacent to the long-term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 acoustic calibrator (s/n 035748), which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.

Table 10: Additional Attended Noise Level Measurements at 6 Cradlehall Meadows

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
19/03/2018	11:48	00:15	41.1	39.7	35.0	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise, birdsong and occasional construction activity at the Inverness Campus.
	12:03	00:15	48.9	50.7	35.1	Aircraft audible at 11:05 and 11:13. Northbound train audible at 11:08.
	13:03	00:15	49.1	47.3	34.6	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consist of distant road traffic, birdsong and occasional construction activity at the Inverness Campus.
	13:18	00:15	44.1	39.6	34.1	Southbound freight train audible at 13:12. Aircraft audible at 13:17 and 13:32. Northbound passenger train audible at 13:27.
	15:17	00:15	44.5	39.7	33.6	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise, birdsong, occasional construction activity at the Inverness Campus and family playing in the front garden. Additionally, a dog barking in the distance was also audible.
	15:32	00:15	50.5	45.1	35.1	Train horn audible at 15:32. Dog barking and kids shouting at 15:31. Aircraft audible at 15:40.
	18:26	00:15	46.8	48.7	38.2	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise, birdsong and family playing in the front garden.
	18:41	00:15	49.3	52.1	39.1	Activity at the front of the house reduced at 18:40 but still audible throughout the survey. Geese flying overhead audible between 18:43 and 18:44. Wood chopping next to the garage audible from 18:45 until

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
						18:56. Southbound train audible at 18:48. Residents talking at 18:49.
20/03/2018	10:00	00:15	45.8	46.9	43.9	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise, birdsong and occasional construction activity at the Inverness Campus.
	10:15	00:15	45.8	46.9	43.3	Motorbike audible on Caulfield Road North at 10:05. HGV audible on Caulfield Road North at 10:17. Aircraft audible at 10:19. Northbound passenger train audible at 10:22.
	13:10	00:15	50.9	48.9	43.8	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise and birdsong.
	13:25	00:15	46.9	48.7	44.6	Southbound freight train audible at 13:12. Aircraft audible at 13:20. Northbound passenger train audible at 13:24. Hammering in residential area audible between 13:27 and 13:28 and between 13:35 and 13:37. Electric wood planer audible in residential area at 13:39.
	16:57	00:15	49.3	50.4	46.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise and birdsong.
	17:12	00:15	48.7	50.2	46.5	Vehicle horn audible at 17:03. Northbound train audible at 17:04. Aircraft audible at 17:18. Motorbike audible on Caulfield Road North at 17:19. Seagulls audible above measurement location between 17:18 and 17:20.

Measurement Location NV05: Annfield, Caulfield Road North – Smithton Road, IV2 7NH

- 2.25 The measurement location was as shown in Photograph 5. A Rion NL-52 sound level meter (s/n 00642983) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was positioned approximately 10m south-west of the building.



Photograph 5: Noise Monitoring Equipment at Annfield

- 2.26 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 00830793) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.27 Noise climate primarily consisted of distant road traffic, birdsong, occasional aircraft movements and occasional railway pass-bys.
- 2.28 Between 9 March and 14 March, 15-minute average wind speeds did not exceed 2.3ms^{-1} , however 15-minute average wind speeds of up to 4.1ms^{-1} were recorded on 15 March. Gusts of greater than 5ms^{-1} were recorded on 14 March and 15 March. No rainfall was recorded on 14 March and 15 March. Occasional rainfall was recorded on 9 March, 11 March, 12 March and 13 March where peak 15-minute total rainfall was 0.08mm, 0.24mm, 0.03mm and 0.04mm, respectively. More frequent rainfall was recorded on 10 March, where peak 15-minute total rainfall was 0.86mm.
- 2.29 Table 11 and 12 provide the measured daily noise levels at this location, with and without the periods of rainfall and high wind speeds.

Table 11: Daily Summarised Noise Levels at Annfield, Including Periods of Rainfall and High Wind Speeds

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
09/03/2018	Friday	-	47.2*	-	-	-	-	42.8	40.7	33.5
10/03/2018	Saturday	47.3	46.4	40.0	47.4	46.7	40.5	40.5	37.4	29.5
11/03/2018	Sunday	45.9	44.9	35.8	45.9	45.1	36.0	45.1	37.6	30.3
12/03/2018	Monday	48.2	45.8	37.4	47.8	45.9	37.8	44.1	38.6	30.8
13/03/2018	Tuesday	48.3	47.3	38.6	48.1	47.4	38.7	40.6	38.9	31.7
14/03/2018	Wednesday	47.7	47.9	40.5	48.0	48.9	41.2	61.1	51.8	39.8

* Estimated level using CRTN shortened measurement procedure period

Table 12: Daily Summarised Noise Levels at Annfield, with Periods of Rainfall and High Wind Speeds Removed

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
09/03/2018	Friday	-	47.2*	-	-	-	-	42.8	40.7	33.5
10/03/2018	Saturday	-	48.2*	-	-	-	-	-	-	-
11/03/2018	Sunday	45.9	44.9	35.8	45.9	45.1	36.0	45.1	37.6	30.3
12/03/2018	Monday	48.1	45.5	37.3	47.5	45.6	37.7	44.1	38.6	30.8
13/03/2018	Tuesday	47.8	46.7	38.3	47.0	46.7	38.4	40.6	38.9	31.7
14/03/2018	Wednesday	47.8	48.0	40.5	47.7	49.0	41.2	-	-	-

* Estimated level using CRTN shortened measurement procedure period

2.30

In addition to long-term measurements, a series of short-term attended measurements were also undertaken and the results are provided in Table 13. A Castle Mirrus GA117 sound level meter (s/n 35769) was positioned at a height of 1.4m in free-field conditions adjacent to the long-term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 acoustic calibrator (s/n 035748), which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.

Table 13: Additional Attended Noise Level Measurements at Annfield

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
09/03/2018	16:56	15:00	45.9	47.3	44.2	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise, birdsong and dogs barking in the distance. Aircraft flyover audible at 16:58, 17:07 and 17:11. Voices audible from a nearby house at various points throughout the measurement period.
	17:11	15:00	46.6	47.9	44.5	
12/03/2018	13:59	15:00	45.5	41.2	35.8	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise, birdsong and distant construction traffic. Train pass-by at 14:06. Aircraft approaching airport at 14:19 and flyover at 14:22.
	14:14	15:00	49.7	48.8	35.3	
13/03/2018	11:53	15:00	43.2	42.9	39.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise and birdsong. Distant police siren audible between 12:02 and 12:05 and between 12:14 and 12:15. Talking audible at 12:13. Clatter in the distance audible at 12:13. Aircraft departing at 12:18.
	12:08	15:00	42.9	45.3	39.7	

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
	17:09	15:00	53.8	57.4	39.9	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of road traffic noise and birdsong. Helicopter in the distance audible between 17:09 and 17:11. A helicopter close to the monitoring site was audible at 17:13 and 17:18. Aircraft audible at 17:22. Train pass by at 17:33. Local residents talking at 17:36.
	19:24	15:00	43.0	44.2	39.3	
14/03/2018	11:25	15:00	48.3	50.8	43.7	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of road traffic noise and birdsong. A tractor ploughing in a nearby field was also audible throughout the measurement period. Aircraft audible at 11:27 and 11:52. Reversing alarm audible in the distance at 11:34 and 11:36. Northbound train audible at 11:51.
	11:40	15:00	47.7	50.4	40.6	
	12:58	15:00	47.4	48.3	40.6	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic and birdsong. Aircraft flyover audible at 12:40, 12:56 and 12:59. Train horn audible at 12:50. Southbound train audible at 12:57. Helicopter in the distance audible between 13:02 and 13:05. Southbound freight train audible at 13:08.
	12:13	15:00	43.5	45.8	38.4	
	12:28	15:00	48.5	52.1	39.1	
	12:43	15:00	47.0	49.5	43.7	

Measurement Location NV06: Ashton Farm, Caulfield Road North-Smithton Road, Inverness, IV2 7NH

- 2.31 The measurement location was as shown in Photograph 6. A Rion NL-32 sound level meter (s/n 00751323) was positioned at a height of approximately 1.5m in free-field conditions. The equipment was positioned approximately 6m from the eastern building façade.



Photograph 6: Noise Monitoring Equipment at Ashton Farm

- 2.32 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 00830793) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.33 The noise climate primarily consisted of distant road traffic noise, occasional train pass-bys, birdsong, demolition works at Stratton Farm and farm animal noises.
- 2.34 Throughout the monitoring period, average 15-minute wind speeds did not exceed 2.0ms^{-1} but gusts greater than 5ms^{-1} were recorded on 22 March during one 15-minute period. No rainfall was recorded on 19 March, 20 March and 22 March. Occasional rainfall was recorded on 21 March and 23 March where peak 15-minute total rainfall was 0.14mm and 0.63mm, respectively.
- 2.35 Table 14 and Table 15 provide the measured daily noise levels at this location, with and without the periods of rainfall and high wind speeds.

Table 14: Daily Summarised Noise Levels at Ashton Farm, Including Periods of Rainfall and High Wind Speeds

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/03/2018	Monday	-	48.5	-	-	-	-	43.7	38.2	31.1
20/03/2018	Tuesday	45.8	44.0	38.2	45.5	44.1	38.6	41.8	37.9	31.9
21/03/2018	Wednesday	47.8	47.7	42.3	47.9	48.2	43.2	40.9	39.3	32.6
22/03/2018	Thursday	45.5	45.4	40.0	45.6	45.7	40.6	43.2	39.0	31.9

* Estimated level using CRTN shortened measurement procedure period

Table 15: Daily Summarised Noise Levels at Ashton Farm, with Periods of Rainfall and High Wind Speeds Removed

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/03/2018	Monday	-	48.5*	-	-	-	-	43.7	38.2	31.1
20/03/2018	Tuesday	45.8	44.0	38.2	45.5	44.1	38.6	41.8	37.9	31.9
21/03/2018	Wednesday	-	51.5*	-	-	-	-	40.9	39.3	32.6
22/03/2018	Thursday	45.5	45.4	40.0	45.5	45.7	40.6	-	-	-

* Estimated level using CRTN shortened measurement procedure period

2.36

In addition to long-term measurements, a series of short-term attended measurements were also undertaken and the results are provided in Table 16. A Castle Mirrus GA117 sound level meter (s/n 035748) was positioned at a height of 1.4m in free-field conditions adjacent to the long-term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 acoustic calibrator (s/n 035748), which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.

Table 16: Additional Attended Noise Level Measurements at Ashton Farm

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
19/03/2018	10:27	00:15	43.3	44.9	40.2	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	10:42	00:15	43.3	45.4	40.2	Noise climate consists of distant road traffic noise and birdsong. Distant demolition noise from Stratton Farm was also audible throughout the monitoring period. Northbound train audible at 10:38. Southbound train audible at 10:49.
	13:48	00:15	59.3	51.5	39.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	14:03	00:15	43.1	44.9	39.4	Noise climate consists of distant road traffic noise, sheep in a nearby field and demolition noise from Stratton Farm. Loud truck horn audible at 13:55. Aircraft flyover audible at 13:59. Coastguard helicopter audible at 14:00. Train horn audible at 14:05. Aircraft audible in the distance at 14:05 and 14:10. Vehicle movement in driveway at 14:17.
	17:05	00:15	48.1	49.3	44.4	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	17:20	00:15	46.8	48.7	44.3	Noise climate consists of distant road traffic noise, sheep in a nearby field, birdsong and distant demolition noise from Stratton Farm. Train pass-by at 17:25. Aircraft flyover audible at 17:27. Coastguard helicopter audible at 17:30. Southbound train at 17:34.
20/03/2018	10:42	00:15	43.3	44.5	36.6	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	10:57	00:15	40.8	42.7	38.1	Noise climate consists of distant road traffic noise, sheep in a nearby field, birdsong and distant demolition noise from Stratton Farm area. Reversing alarm audible at 10:50
	13:53	00:15	42.0	44.2	37.2	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	14:08	00:15	42.2	43.4	38.3	Noise climate consists of distant road traffic noise, sheep in a nearby field, birdsong and distant demolition noise from Stratton Farm. Aircraft audible at 13:59 and 14:05. Northbound passenger train audible at 14:10. Loud motorbike at 14:22.
	17:40	00:15	44.8	46.1	42.4	Weather conditions remained conducive for noise monitoring throughout the monitoring period.
	17:55	00:15	47.0	47.2	42.2	Noise climate consists of distant road traffic noise, distant demolition noise from Stratton Farm and birdsong. Loud vehicles audible on A96 at 17:56. Aircraft flyover at 17:57. Geese audible at 18:05. Aircraft audible at 18:08.

Measurement Location NV07: 49 Cranmore Drive, Inverness, IV2 7FL

- 2.37 The measurement location was as shown in Photograph 7. A Rion NL-52 sound level meter (s/n 00642983) was positioned at a height of approximately 1.5m in as near to free-field conditions as was practically possible. The equipment was positioned at the end of the garden, approximately 12m from the north facing façade of the property.



Photograph 7: Noise Monitoring Equipment at 49 Cranmore Drive

- 2.38 The monitoring equipment was calibrated both before and after the measurement period using a Rion NC-74 (s/n 00830793) acoustic calibrator, which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.
- 2.39 Noise climate primarily consists of distant road traffic (primarily from the A96 and C1032 Barn Church Road), distant demolition noise from Stratton Farm and birdsong.
- 2.40 Throughout the monitoring period, average 15-minute wind speeds did not exceed 2.0ms^{-1} but gusts greater than 5ms^{-1} were recorded on 22 March during one 15-minute period. No rainfall was recorded on 19 March, 20 March and 22 March. Occasional rainfall was recorded on 21 March and 23 March where peak 15-minute total rainfall was 0.14mm and 0.63mm, respectively.
- 2.41 Table 17 and Table 18 provide the measured daily noise levels at this location, with and without the periods of rainfall and high wind speeds.

Table 17: Daily Summarised Noise Levels at 49 Cranmore Drive, Including Periods of Rainfall and High Wind Speeds

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/03/2018	Monday	-	43.5*	-	-	-	-	41.3	41.7	34.3
20/03/2018	Tuesday	49.3	48.9	43.4	49.7	49.5	44.0	41.0	40.5	34.7
21/03/2018	Wednesday	48.1	48.8	44.7	48.4	49.4	45.6	39.3	39.5	33.8
22/03/2018	Thursday	45.0	45.3	41.5	45.3	45.6	42.1	41.9	40.8	33.3

* Estimated level using CRTN shortened measurement procedure period

Table 18: Daily Summarised Noise Levels at 49 Cranmore Drive, with Periods of Rainfall and High Wind Speeds Removed

Date	Day	18-hour daytime period (between 06:00 and 00:00)			16-hour daytime period (between 07:00 and 23:00)			8-hour night-time period (between 23:00 and 07:00)		
		L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)
19/03/2018	Monday	-	43.5*	-	-	-	-	41.3	41.7	34.3
20/03/2018	Tuesday	49.3	48.9	43.4	49.7	49.5	44.0	41.0	40.5	34.7
21/03/2018	Wednesday	-	49.9*	-	-	-	-	39.3	39.5	33.8
22/03/2018	Thursday	45.0	45.4	41.5	45.2	45.6	42.1	-	-	-

* Estimated level using CRTN shortened measurement procedure period

2.42

In addition to long-term measurements, a series of short-term attended measurements were also undertaken and the results are provided in Table 19. A Castle Mirrus GA117 sound level meter (s/n 35769) was positioned at a height of 1.4m in free-field conditions adjacent to the long-term monitoring equipment. The monitoring equipment was calibrated both before and after the measurement period using a Castle GA607 acoustic calibrator (s/n 035748), which has itself been calibrated against a reference set traceable to national and international standards. There was no significant shift in the observed calibration level.

Table 19: Additional Attended Noise Level Measurements at 49 Cranmore Drive

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
19/03/2018	11:06	00:15	44.9	45.1	38.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate consists of distant road traffic noise (primarily from the A96 and Barn Church Road), and distant demolition noise from Stratton Farm. Birdsong audible throughout the monitoring period. Aircraft audible at 11:12 and 11:31. Dog barking within housing scheme at 11:23. Helicopter audible at 11:24.
	11:21	00:15	48.1	49.2	37.3	
	14:30	00:15	40.8	42.4	38.1	
	14:45	00:15	42.8	45.3	38.4	
	17:45	00:15	49.8	51.8	47.0	
	18:00	00:15	48.9	51.0	45.8	
20/03/2018	11:22	00:15	51.8	54.3	47.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate predominately consists of demolition works at Stratton Farm, however, road traffic noise and birdsong are also audible throughout the monitoring period. Aircraft audible at 11:49. Seagulls
	11:37	00:15	52.4	54.4	45.7	

Start Date	Start Time (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	L _{A10,T} (dB)	L _{A90,T} (dB)	Comments
						audible between 11:48 and 11:50. Aircraft audible at 11:51. Construction noise was subjectively noted to ease from 11:35 onwards.
	14:32	00:15	58.4	60.4	49.3	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate predominately consists of demolition noise from Stratton Farm, however, road traffic noise and birdsong are also audible throughout the monitoring period. Coastguard helicopter audible at 14:42. Aircraft flyover audible at 14:59.
	14:47	00:15	52.8	55.5	47.8	
	18:18	00:15	54.2	56.2	51.1	Weather conditions remained conducive for noise monitoring throughout the monitoring period. Noise climate dominated by demolition works at Stratton Farm, however, road traffic noise also audible throughout the monitoring period. Aircraft flyover audible at 18:18. Neighbour moving bins at 18:22. Vehicle movement in Cranmore Drive at 18:23. Southbound train at 18:48.
	18:33	00:15	54.0	56.0	50.5	

Annex 1: Calibration Certificates

<h1>Calibration Certificate</h1>	
With Results	
Issued By: Castle Group Ltd	
Date Of Issue : 11/07/17	Page 1 of 5
Certificate No : 35769/70609	



All instruments are tested to check compliance with particular specifications. These specifications may be appropriate British Standards, or if the instrument was not originally designed to meet any British Standard, or when the instrument was originally manufactured a relevant British Standard did not exist, the instrument will be tested to the manufacturer's original specification.

Absolute acoustic calibration of acoustic calibrators and sound level meters is checked at one or more standard frequencies against an independent sound source with calibration directly traceable to the National Physical Laboratory (NPL) in the United Kingdom. The NPL reference applicable for the calibration of the test equipment is shown below.

The performance of the instrument was determined by comparison with the manufacturers' specification as found in the instrument handbook or other technical publication. Any significant uncertainty of the measuring system will also be included.

The instrument was allowed to stabilise for a period of 30 minutes prior to measurements made.

The ambient temperature and relative humidity throughout calibration were 22 ± 2 °C and 49% RH respectively.


Instruments used to carry out this calibration are as follows: -
Multifunction Calibrator 4226 Serial No: 1551589
Applicable Reference: S6645.


Subject of Calibration: GA117
Instrument: Integrating 1/1 + 1/3 Octave Band SLM
Serial No: 35769

Preamplifier Data
Preamplifier Type: SV 18
Preamplifier Serial No: 41663

Microphone Data
Microphone Type: 7052E
Microphone Serial No: 58860

Basis Of Test: Compliance to IEC 61672-1 : 2002 Class 1, & IEC 61260: 1995 Class 1

Calibrated By: 
O. L. Wrightson
(Approved Signatory)
Date of Calibration: 11 Jul 2017
Completed Status: Pass

Checked By: 
M. Mann
(Approved Signatory)
Recalibration Due: 01 Aug 2018

Client: Ian Stanworth
Address:

Client Reference:

Castle Group Ltd
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www.castlegroup.co.uk



CALIBRATION RESULTS

Page 2 of 5 Pages

Date: 11/07/17 Certificate No: 35769/70609 Calibrated By: O L Wrightson

ACOUSTICAL RESPONSE TO SUPPLIED CALIBRATOR

The following reading was obtained from the supplied calibrator. Type: GA607 Serial Number: 035748

Frequency	Reference	Indicated SPL	Adjusted SPL
1kHz	94.0 dBA	94.0dBA	93.8dBA *

*Includes microphone cavity correction at 1kHz. Calibrate to this level when used with supplied calibrator.

ACOUSTICAL REFERENCE The method of calibration employed was a direct-coupled acoustic reference source.

Frequency	Reference	Indicated SPL	Adjusted SPL
1kHz	94.0 dBA	94.0dBA	94.0dBA

ACOUSTICAL SCALING The method of calibration employed was a direct-coupled acoustic reference source.

SPL (1kHz)	HIGH RANGE	TOLERANCE
94 dBA	94.0dBA	± 0.7dB
104 dBA	104.0dBA	± 0.7dB
114 dBA	114.0dBA	± 0.7dB

ACOUSTICAL RANGE The method of calibration employed was a direct-coupled acoustic reference source.

SPL (1kHz)	Low Range	High Range	TOLERANCE
94 dBA	94.0dBA	94.0dBA	± 0.5 dB

FREQUENCY WEIGHTING The method of calibration employed was a direct-coupled acoustic reference source.

FREQ (Hz)	1K	2K	4K	8K	12.5K	500	250	125	63	31.5
A (dB)	94.0	94.9	94.8	89.9	84.8	90.9	85.6	78.1	68.1	55.0
C (dB)	94.0	93.5	93.0	88.0	82.9	94.1	94.2	94.0	93.5	91.4
Z (dB)	94.0	93.7	93.8	90.9	89.2	94.1	94.2	94.2	94.2	94.2
TOL ±	1.0 dB	1.0 dB	1.0 dB	+1.5, -3dB	+3.0, -6dB	1.0 dB	1.0 dB	1.0 dB	1.5 dB	1.5 dB

INVERSE A-WEIGHTING The method of calibration employed was a direct-coupled acoustic reference source.

FREQ (Hz)	1K	2K	4K	8K	12.5K	500	250	125	63	31.5
Reading	94.0	93.9	93.9	91.0	89.0	94.1	94.2	94.3	94.4	94.6

INFERRED MICROPHONE RESPONSE Pressure correction factor. To be added to acoustic response.

FREQ (Hz)	1K	2K	4K	8K	12.5K	500	250	125	63	31.5
	0.0	-0.1	-0.1	-3.0	-5.0	+0.1	+0.2	+0.3	+0.4	+0.6

* Notes

CALIBRATION RESULTS

Page 3 of 5 Pages

Date: 11/07/17 Certificate No: 35769/70609 Calibrated By: O L Wrightson



LINEARITY RESPONSE The method employed was a direct electrical signal injection on the reference range.

SPL (8KHz) 10 dB Steps WRT scale		SPL (8KHz) 10 dB Steps WRT scale +5		SPL (8KHz) 1 dB Steps WRT MSD for 10dB		SPL (8KHz) 1 dB Steps WRT FSD for 10dB	
Target	Reading	Target	Reading	Target	Reading	Target	Reading
35.0	35.2	40.0	40.0	36.0	36.2	126.0	126.0
45.0	45.0	50.0	50.0	37.0	37.1	127.0	127.0
55.0	55.0	60.0	60.0	38.0	38.1	128.0	128.0
65.0	65.0	70.0	70.0	39.0	39.1	129.0	129.0
75.0	75.0	80.0	80.0	40.0	40.0	130.0	130.0
85.0	85.0	90.0	90.0	41.0	41.0	131.0	131.0
95.0	95.0	100.0	100.0	42.0	42.0	132.0	132.0
105.0	105.0	110.0	110.0	43.0	43.0	133.0	133.0
115.0	115.0	120.0	120.0	44.0	44.0	134.0	134.0
125.0	125.0	130.0	130.0				
135.0	135.0						

LINEARITY RESPONSE The method employed was a direct electrical signal injection on the reference range.

LEQ (8KHz) 10 dB Steps WRT scale		LEQ (8KHz) 10 dB Steps WRT scale +5		LEQ (8KHz) 1 dB Steps WRT MSD for 10dB		LEQ (8KHz) 1 dB Steps WRT FSD for 10dB	
Target	Reading	Target	Reading	Target	Reading	Target	Reading
35.0	35.2	40.0	40.0	36.0	36.2	126.0	126.0
45.0	45.0	50.0	50.0	37.0	37.1	127.0	127.0
55.0	55.0	60.0	60.0	38.0	38.1	128.0	128.0
65.0	65.0	70.0	70.0	39.0	39.1	129.0	129.0
75.0	75.0	80.0	80.0	40.0	40.0	130.0	130.0
85.0	85.0	90.0	90.0	41.0	41.0	131.0	131.0
95.0	95.0	100.0	100.0	42.0	42.0	132.0	132.0
105.0	105.0	110.0	110.0	43.0	43.0	133.0	133.0
115.0	115.0	120.0	120.0	44.0	44.0	134.0	134.0
125.0	125.0	130.0	130.0				
135.0	135.0						

* Notes

CALIBRATION RESULTS

Page 4 of 5 Pages

Date: 11/07/17 Certificate No: 35769/70609 Calibrated By: O.L Wrightson

TIME WEIGHTING

TONE BURST The method employed was a direct electrical signal injection on the reference range.

Time Weighting Tone Burst	Reference Level [dBA] -3dB WRT FSD	Response	Tolerance
Fast [200 ms]	131.0dBA [Ref -1 dB]	131.0dBA	± 0.8dB
Fast [2 ms]	114.0dBA [Ref -18 dB]	113.9dBA	+1.3, -1.8 dB
Fast [0.25 ms]	105.0dBA [Ref - 27 dB]	103.7dBA	+1.3, -3.3 dB
Slow [200 ms]	124.6dBA [Ref -7.4 dB]	124.0dBA	± 0.8dB
Slow [2 ms]	105.0dBA [Ref -27 dB]	104.0dBA	+1.3, -3.3 dB

TIME AVERAGING

TONE BURST The method employed was a direct electrical signal injection on the reference range.

Tone Burst Duty Factor	Target Level [dBA]	Response	Tolerance
1/1000 (60 Seconds)	105.0dBA (FSD-30)	104.8dBA	± 1.0dB
1/10,000 (6 Minutes)	95.0dBA (FSD-40)	94.8dBA	± 1.0dB

OCTAVE FILTER

INSERTION LOSS The method employed was a direct electrical signal injection

TESTED AGAINST 1/1 OCTAVE MODE

FREQUENCY (Hz)	SPL [dBlin]	OCTAVE [dBlin]	TOLERANCE [dB]
31.5	94.0	94.0	+0.5 / -1.0
63	94.0	94.0	+0.5 / -1.0
125	94.0	94.0	+0.5 / -1.0
250	94.0	94.0	+0.5 / -1.0
500	94.0	94.0	+0.5 / -1.0
1,000	94.0	94.0	+0.5 / -1.0
2,000	94.0	94.0	+0.5 / -1.0
4,000	94.0	94.0	+0.5 / -1.0
8,000	94.0	94.0	+0.5 / -1.0

Linear response tested electrically without microphone 'pressure correction' for reference purposes.

* Notes



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CALIBRATION RESULTS

Page 5 of 5 Pages

Date: 11/07/17 Certificate No: 35769/70609 Calibrated By: O L Wrightson

1/1 OCTAVE RESPONSE The method employed was a direct electrical signal injection

ATTENUATION:

FREQUENCY CENTRE (Fm)	REFERENCE (dB)	Fm x 2 (dB)	Fm/2 (dB)	TOLERANCE (dB)
31.5Hz	94.0	61.8	40.9	≥18
63Hz	94.0	61.9	40.9	≥18
125Hz	94.0	61.4	43.3	≥18
250Hz	94.0	62.9	49.8	≥18
500Hz	94.0	61.7	51.5	≥18
1,000Hz	94.0	61.3	51.8	≥18
2,000Hz	94.0	60.7	51.3	≥18
4,000Hz	94.0	61.1	52.6	≥18
8,000Hz	94.0	61.1	45.2	≥18

1/3 OCTAVE RESPONSE The method employed was a direct electrical signal injection

ATTENUATION:

FREQUENCY CENTRE (Fm)	REFERENCE (dB)	Fm x '1.3'	Fm x '1.6'	Fm x 2	Fm/'1.3'	Fm/'1.6'	Fm/2
31.5Hz	94.0	76.1	57.1	48.6	67.0	51.0	31.3
63Hz	94.0	76.0	57.1	49.4	67.0	51.0	32.3
125Hz	94.0	75.1	56.7	48.5	68.2	51.6	33.5
250Hz	94.0	75.1	56.9	48.2	68.2	51.6	33.5
500Hz	94.0	75.1	56.6	48.2	68.0	51.6	33.5
1,000Hz	94.0	75.0	56.8	48.2	68.1	51.7	33.5
2,000Hz	94.0	74.9	56.2	48.1	68.0	51.5	32.3
4,000Hz	94.0	74.9	56.5	48.0	68.0	51.5	32.3
8,000Hz	94.0	75.0	56.6	48.1	68.1	51.5	30.0

'Abridged' test of 1/3 octave function conducted to confirm filter response

Uncertainties of the measurement

The uncertainties in the table of results correspond to an estimated confidence probability of not less than 95%.

* Notes



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Calibration Certificate

Issued By: Castle Group Ltd

Date Of Issue : 11/07/17

Certificate No : 035748/70609



All instruments are tested to check compliance with particular specifications. These specifications may be appropriate British Standards, or if the instrument was not originally designed to meet any British Standard, or when the instrument was originally manufactured a relevant British Standard did not exist, the instrument will be tested to the manufacturer's original specification.

Absolute acoustic calibration of acoustic calibrators and sound level meters is checked at one or more standard frequencies against an independent sound source with calibration directly traceable to the National Physical Laboratory (NPL) in the United Kingdom. The NPL reference applicable for the calibration of the test equipment is shown below.

The performance of the instrument was determined by comparison with the manufacturers' specification as found in the instrument handbook or other technical publication. Any significant uncertainty of the measuring system will also be included.

The instrument was allowed to stabilise for a period of 30 minutes prior to measurements made.

The ambient temperature and relative humidity throughout calibration were 22 ±2 °C and 49% RH respectively.

Instruments used to carry out this calibration are as follows: -

Multifunction Calibrator 4226 Serial No: 1551589

Applicable Reference: S6645.

Sound Level Meter 2260 Serial No: 1875415

Applicable Reference: 08277

Subject of Calibration: GA607

Instrument: Dual Level Calibrator

Serial No: 035748

Supplied Barometer Data (if applicable)

Barometer Type: -

Barometer Serial No: -

Output Data Corrected for test conditions at 1kHz.

Reference Level [dB] : 94.0 & 104.0

Refer to calibrator handbook for any applicable microphone cavity insertion correction.

Basis Of Test: Compliance to Manufacturer's Original Specification

Calibrated By:

O. L. Wrightson
(Approved Signatory)

Date of Calibration: 11 Jul 2017

Completed Status: Pass

Checked By:

H. Aistrop
(Approved Signatory)

Recalibration Due: 01 Aug 2018

Client: Ian Stanworth

Address:

Client Reference:

— Indicates item or information not available

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CERTIFICATE OF CALIBRATION

Date of Issue: 31 August 2016

Certificate Number: TCRT16/1234

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

Page 1 of 2 Pages
Approved Signatory

M. Breslin [] K. Mistry [] J. Harriman [✓]

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Customer Jacobs UK Limited
 95 Bothwell Street
 Glasgow
 G2 7HX

Order No. UK/B3553T36/00000001
Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator
Identification

Manufacturer	Instrument	Type	Serial No. / Version
Rion	Sound Level Meter	NL-52	00642983
Rion	Firmware		1.7
Rion	Pre Amplifier	NH-25	43011
Rion	Microphone	UC-59	06690
Rion	Calibrator	NC-74	00830793
	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 25 August 2016 ANV Job No. TRAC16/08145
Date Calibrated 31 August 2016

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		

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION



Certificate Number
TCRT16/1234
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		Customers Calibrator	
Calibrator adaptor type if applicable		NC-74-002	
Calibrator cal. date		30 August 2016	
Calibrator cert. number		TCRT16/1233	
Calibrator cal cert issued by		ANV Measurement Systems	
Calibrator SPL @ STP	94.03	dB	Calibration reference sound pressure level
Calibrator frequency	1002.01	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	22.24	22.58	± 0.20 °C
Humidity	41.8	40.5	± 3.00 %RH
Ambient Pressure	100.90	100.93	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.			
Initial indicated level	94.1	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			
	12.2	dB UR	16.3	dB UR	22.0	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 the Guide to the Expression of Uncertainty in Measurement published by ISO.

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



CERTIFICATE OF CALIBRATION

Date of Issue: 26 June 2017

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
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Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Certificate Number: TCRT17/1402

Page 1 of 4 Pages

Approved Signatory

J. Harriman

A handwritten signature in blue ink, appearing to read 'J. Harriman'.

CUSTOMER	Jacobs UK Limited The Pinnacle 170 Midsummer Boulevard Milton Keynes MK9 1BP
-----------------	--

ORDER No	MK-000085	Job No	TRAC17/06221
-----------------	-----------	---------------	--------------

DATE OF RECEIPT	22 June 2017
------------------------	--------------

PROCEDURE	Calibration Engineer's Handbook section 3
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IDENTIFICATION	Sound level meter Rion type NL-32 serial No 00482602 connected via extension lead type EC-04 and preamplifier type NH-21 serial No 27706 to a half-inch microphone type UC-53A serial No 321107 fitted with a foam windshield type WS-03. Associated calibrator Rion type NC-74 serial No 00830793 with a one-inch housing and adapter type NC-74-002 for half-inch microphone.
-----------------------	---

CALIBRATED ON	26 June 2017
----------------------	--------------

PREVIOUS CALIBRATION	Calibrated on 22 May 2015, Certificate No. 1505285 issued by AV Calibration
-----------------------------	---

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1402

Page 2 of 4 Pages

The sound level meter was set to frequency weighting A and adjusted to read 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure) in response to the sound calibrator supplied. This reading was derived from the Calibration Certificate No. TCRT17/1398 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter when fitted with the windshield.

The sound level meter was then tested, and its overall sensitivity adjusted as required.

An acoustic calibration at 1kHz was performed by application of a standard sound calibrator, whilst the tests at 125Hz and 8kHz were performed by the electrostatic actuator method.

At the end of the test, the sound calibrator was reapplied to the sound level meter and the meter reading was recorded.

RESULTS

The sound level meter was found to conform to the type 1 requirements of BS EN 60651:1994* and BS EN 60804:1994* for those tests carried out.

The self-generated noise recorded was:

9.7 dB (A)

14.8 dB (C)

22.3 dB (Lin)

The sound level meter reading obtained at the end of the test in response to the sound calibrator was 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure). This reading, corrected for ambient pressure, should be used henceforth to set up the sound level meter for field use.

The expanded level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.10 dB; that of the calibrator supplied with the sound level meter is ± 0.10 dB.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the *Guide to the Expression of Uncertainty in Measurement* published by the International Organisation for Standards (ISO).

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

The case reflection factors have been taken as zero, since an extension lead has been used for this verification.

The reference range, linearity range and primary indicator range specified by the manufacturer have been used. See note 5 Below.

The Rion NL-32 sound level meter design has successfully undergone pattern evaluation at Physikalisch-Technische Bundesanstalt (PTB). It was found to meet the requirements of BS EN 60651* and BS EN 60804* and was granted pattern approval as a Type 1 sound level meter.

No component of uncertainty for manufacturer-specified corrections has been included in the uncertainty budget and, in accordance with amendments to the standards, the measured values obtained during the verification have not been extended by any measurement uncertainty when assessing conformance to each standard.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1402

Page 3 of 4 Pages

NOTES

- *1 BS EN 60651:1994 and BS EN 60804:1994 were formerly numbered BS 5969:1981 and BS 6698:1986 respectively.

- 2 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method.

- 3 The instrument was tested with integral software as received.

- 4 The NL-32 does not have a "max hold" function available when operating with time weighting I. The results recorded for the test of time weighting I are therefore the highest instantaneous reading shown on the display. Whilst these results meet the requirements of the standard, those for response to a single tone burst in particular may give a misleading impression of the accuracy of time weighting I on this instrument.

- 5 The specifications given in the standard English-language handbook for the NL-32 is incomplete. An addendum to the handbook based on the PTB tests has been provided by Rion, and this revised specification has been used for the purposes of the present verification. For information, extracts from the addendum have been appended as page 4 of this certificate.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1402

Page 4 of 4 Pages

The following data supplied by Rion are included for completeness:

Addendum to the NL-32 Instruction Manual

Errata (page 133):

- Total range: 23 to 137 dB(A).
- Linearity range (on 30 - 120 dB reference range): 99 dB (28 to 127).

Additional information

- Primary indicator range (on 30 - 120 dB reference range): 32 - 111 dB, allowing a crest factor of 10 for Impulse time weighting.
- Pulse range: > 63 dB
- Measurement range for various LEVEL settings: See table below.

Measurement ranges				
Measurement range for various "LEVEL" range settings (dB) * Frequency weighting A-, C- and Lin.				
"LEVEL" Setting (dB)	Time weighting			Leq
	Fast/Slow	Impulse	Peak	
20 - 80	23 - 80 **	23 - 70 **	50 - 90	23 - 87 **
20 - 90	23 - 90 **	23 - 80 **	50 - 100	23 - 97 **
20 - 100	23 - 100 **	23 - 90 **	50 - 110	23 - 107 **
20 - 110	23 - 110 **	23 - 100 **	50 - 120	23 - 117 **
30 - 120	28 - 120 **	28 - 110 **	50 - 130	28 - 127 **
40 - 130	38 - 130	38 - 120	50 - 140	38 - 137

* For time weighting Fast and Slow a crest factor 3, and for time weighting Impulse a crest factor 10, is taken into account.
 ** The lower limit of the measurement range is 30 dB(C) for C-weighting and 35 dB(Lin) for Lin weighting.



CERTIFICATE OF CALIBRATION

Date of Issue: 23 June 2017

Certificate Number: TCRT17/1401

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 4 Pages

Approved Signatory

J. Harriman

A handwritten signature in blue ink, appearing to read 'J. Harriman', is written over a horizontal line.

CUSTOMER Jacobs UK Limited
The Pinnacle
170 Midsummer Boulevard
Milton Keynes
MK9 1BP

ORDER No MK-000085 Job No TRAC17/06221

DATE OF RECEIPT 22 June 2017

PROCEDURE Calibration Engineer's Handbook section 3

IDENTIFICATION Sound level meter Rion type NL-32 serial No 00751323 connected via extension lead type EC-04 and preamplifier type NH-21 serial No 23663 to a half-inch microphone type UC-53A serial No 308645 fitted with a foam windshield type WS-03. Associated calibrator Rion type NC-74 serial No 00830793 with a one-inch housing and adapter type NC-74-002 for half-inch microphone.

CALIBRATED ON 23 June 2017

PREVIOUS CALIBRATION Calibrated on 22 May 2015, Certificate No. 1505281 issued by AV Calibration

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CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1401

Page 2 of 4 Pages

The sound level meter was set to frequency weighting A and adjusted to read 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure) in response to the sound calibrator supplied. This reading was derived from the Calibration Certificate No. TCRT17/1398 supplied by this laboratory and manufacturers' information on the free-field response of the sound level meter when fitted with the windshield.

The sound level meter was then tested, and its overall sensitivity adjusted as required.

An acoustic calibration at 1kHz was performed by application of a standard sound calibrator, whilst the tests at 125Hz and 8kHz were performed by the electrostatic actuator method.

At the end of the test, the sound calibrator was reapplied to the sound level meter and the meter reading was recorded.

RESULTS

The sound level meter was found to conform to the type 1 requirements of BS EN 60651:1994* and BS EN 60804:1994* for those tests carried out.

The self-generated noise recorded was:

10.2 dB (A)

15.3 dB (C)

20.8 dB (Lin)

The sound level meter reading obtained at the end of the test in response to the sound calibrator was 93.6 dB (corresponding to 93.6 dB at standard atmospheric pressure). This reading, corrected for ambient pressure, should be used henceforth to set up the sound level meter for field use.

The expanded level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.10 dB; that of the calibrator supplied with the sound level meter is ± 0.10 dB.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with the *Guide to the Expression of Uncertainty in Measurement* published by the International Organisation for Standards (ISO).

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

The case reflection factors have been taken as zero, since an extension lead has been used for this verification.

The reference range, linearity range and primary indicator range specified by the manufacturer have been used. See note 5 Below.

The Rion NL-32 sound level meter design has successfully undergone pattern evaluation at Physikalisch-Technische Bundesanstalt (PTB). It was found to meet the requirements of BS EN 60651* and BS EN 60804* and was granted pattern approval as a Type 1 sound level meter.

No component of uncertainty for manufacturer-specified corrections has been included in the uncertainty budget and, in accordance with amendments to the standards, the measured values obtained during the verification have not been extended by any measurement uncertainty when assessing conformance to each standard.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1401

Page 3 of 4 Pages

NOTES

- *1 BS EN 60651:1994 and BS EN 60804:1994 were formerly numbered BS 5969:1981 and BS 6698:1986 respectively.

- 2 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method.

- 3 The instrument was tested with integral software as received.

- 4 The NL-32 does not have a "max hold" function available when operating with time weighting I. The results recorded for the test of time weighting I are therefore the highest instantaneous reading shown on the display. Whilst these results meet the requirements of the standard, those for response to a single tone burst in particular may give a misleading impression of the accuracy of time weighting I on this instrument.

- 5 The specifications given in the standard English-language handbook for the NL-32 is incomplete. An addendum to the handbook based on the PTB tests has been provided by Rion, and this revised specification has been used for the purposes of the present verification. For information, extracts from the addendum have been appended as page 4 of this certificate.

CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1401

Page 4 of 4 Pages

The following data supplied by Rion are included for completeness:

Addendum to the NL-32 Instruction Manual

Errata (page 133):

- Total range: 23 to 137 dB(A).
- Linearity range (on 30 - 120 dB reference range): 99 dB (28 to 127).

Additional information

- Primary indicator range (on 30 - 120 dB reference range): 32 - 111 dB, allowing a crest factor of 10 for Impulse time weighting.
- Pulse range: > 63 dB
- Measurement range for various LEVEL settings: See table below.

Measurement ranges				
Measurement range for various "LEVEL" range settings (dB) * Frequency weighting A-, C- and Lin.				
"LEVEL" Setting (dB)	Time weighting			Leq
	Fast/Slow	Impulse	Peak	
20 - 80	23 - 80 **	23 - 70 **	50 - 90	23 - 87 **
20 - 90	23 - 90 **	23 - 80 **	50 - 100	23 - 97 **
20 - 100	23 - 100 **	23 - 90 **	50 - 110	23 - 107 **
20 - 110	23 - 110 **	23 - 100 **	50 - 120	23 - 117 **
30 - 120	28 - 120 **	28 - 110 **	50 - 130	28 - 127 **
40 - 130	38 - 130	38 - 120	50 - 140	38 - 137

* For time weighting Fast and Slow a crest factor 3, and for time weighting Impulse a crest factor 10, is taken into account.
 ** The lower limit of the measurement range is 30 dB(C) for C-weighting and 35 dB(Lin) for Lin weighting.

END

R 3



CERTIFICATE OF CALIBRATION

Date of Issue: 23 June 2017

Certificate Number: TCRT17/1398

Issued by:

ANV Measurement Systems

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Page 1 of 2 Pages

Approved Signatory

K. Mistry

Customer
Jacobs UK Limited
The Pinnacle
170 Midsummer Boulevard
Milton Keynes
MK9 1BP

Order No. MK-000085

Test Procedure Procedure TP 1 Calibration of Sound Calibrators

Description Acoustic Calibrator

Identification	Manufacturer	Instrument	Model	Serial No.
	Rion	Calibrator	NC-74	00830793

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No. TRAC17/06221

Date Received 22 June 2017

Date Calibrated 23 June 2017

Previous Certificate
Dated 30 August 2016
Certificate No. TCRT16/1233
Laboratory ANV Measurement Systems

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CERTIFICATE OF CALIBRATION



Certificate Number

TCRT17/1398

Page 2 of 2 Pages

Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

Test Microphone	<i>Manufacturer</i>	<i>Type</i>
	Brüel & Kjær	4134

Results

The level of the calibrator output under the conditions outlined above was

94.03 ± 0.10 dB rel 20 µPa

Functional Tests and Observations

The frequency of the sound produced was	1002.08 Hz	±	0.13 Hz
The total distortion was	1.27 %	±	6.7 % of Reading

During the measurements environmental conditions were

Temperature	22	to	22 °C
Relative Humidity	49	to	57 %
Barometric Pressure	100.4	to	100.5 kPa

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 the Guide to the Expression of Uncertainty in Measurement published by the International Organisation for Standards (ISO).

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

END

Note:

Calibrator adjusted prior to calibration?	NO	
Initial Level	N/A	dB
Initial Frequency	N/A	Hz

Additional Comments

None

Calibrated by: B. Bogdan

R 2