Azymuth Acoustics UK

Professional Acoustic Services

Date: 21/09/21

Noise Assessment Report

Ref : AA0345.1

Noise Assessment :

Land off Brightside Road

Crumpsall

Manchester

M8 5XJ

For

Hargreaves Contracting

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Document Status – Final

Document Verification	**Project Reference**		**AA0345**
Document Revision / Status	First Issue		
Version Date	21/09/2021		
Filename	AA0345,1 SVH Crumpsall Substation Noise Impact Assessment Report 210921		
Description of Revisions			
	Prepared by	**Checked by**	**Approved by**
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1.0 Introduction

Azymuth Acoustics UK is appointed by Hargreaves Contracting to provide a noise assessment in relation to 2no. substations associated with newly constructed MOT service centre for Salford Van Hire, at land off Brightside Road, Crumpsall, M8 5XJ. The report addresses the potential noise impact from the proposed substations on nearby residential receptors.

A previous continuous environmental noise survey had been carried out of the site in June 2021, as such the noise assessment will supplement this noise data. The previously measured noise data is included in Appendix C.

Manchester City Council have provided three planning conditions regarding noise control. These are reproduced below:

Condition 26
"Any externally mounted ancillary equipment shall be selected and/or acoustically insulated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location. The scheme shall be submitted to and approved in writing by the City Council as local planning authority in order to secure a reduction in the level of noise emanating from the equipment."

This noise assessment includes the following aspects:

- The results of a baseline noise survey at the site in order to assess the impact of the substations on local background sound levels.
- Criteria developed to set acceptable noise levels at sensitive receptors in nearby properties.
- Assessment of results laid out in the context of relevant guidance to inform the resulting conclusions.

2.0 Baseline Noise Survey

2.1 Measurement Procedures

The instrumentation used for the environmental noise survey consisted of a SvanTek 959 Type 1 precision sound level meter. The equipment was calibrated before and after the noise measurements. The sound level meter measured A-weighted noise levels as well as octave bands levels for all measurements recorded.

The ambient noise measurements were undertaken using the sound level meter at the location shown in Figure 1, which would be representative of the noise climate at 1 m distance to each substation, within the substation building and at the nearest proposed residences to the installed substations. It has been confirmed by Hargreaves that the substation was fully operational and drawing load at the time of the survey.

The survey was undertaken during the daytime of Monday 13th September 2021. Local road traffic noise had an influence on the measured BSL L_{A90}.

2.2 Measurement Results

The results of the noise measurements are summarised below, and the full results are set out in Appendix B. Table 1a summarises the results of the noise measurements undertaken in the vicinity of the substations in terms of averaged statistical noise levels. Table 1b shows the daytime / night-time background sound levels of the site (measured in April 2021).

Measurement Location	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
A1: External to North unit @ 1m distance	51	45	48	46	45	44
A2: Internal to North Unit	43	39	41	40	39	38
A3: External to South Unit @ 1m distance	55	47	51	49	47	45
A4: Hawkins Close approx. 70m from closest substation building	56	46	52	49	46	41

Table 1a: Summary of noise measurement results, Azymuth Acoustics 2021 (dBA)

Figure 1: Noise measurement positions (marked in red), Azymuth Acoustics 2021

Date	Period	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
16/04/2021	16:15 – 19:00	66	42	51	43	40	38
16/04/2021	19:00 – 23:00	60	40	46	41	39	38
17/04/2021	After construction work stopped for the day 13:20 – 23:00	77	40	50	40	36	34
17/04/2021	19:00 – 23:00	62	38	44	39	37	36
18/04/2021	07:00 – 19:00	69	39	49	42	36	34
18/04/2021	19:00 – 23:00	59	37	45	39	36	34

Table 1b: Summary of averaged noise measurement results at position F1, Azymuth Acoustics April 2021 (dBA)

2.3 Description of Noise Climate

The daytime noise climate in the area, outside of construction hours consists of general industrial noise, as well as traffic noise on local roads. Industrial activity was noted on Brightside road, such as the use of pressure washers and fan units.

During the survey, it was extremely difficult to hear any noise produced by the substations. This is shown as noise internal to the transformer buildings was much lower than external to the buildings. This shows that background sound levels are much higher than the noise from the substations even at 1 m from the substations.

3.0 Assessment Criteria

In order to assess the extent of the noise levels produced by the substation with suitable conditions relating to industrial and commercial sound, Azymuth Acoustics has reviewed the following guidance documents and standards:

- British Standard 8233: 2014
- World Health Organisation Guidelines on Community Noise
- British Standard 4142: 2014

3.1 British Standard 8233: 2014

BS 8233 provides a code of practice for the sound insulation of a variety of building types affected by general environmental noise. It provides recommendations for control of noise in and around buildings and suggests appropriate internal ambient noise level criteria / limits for a variety of different situations including residential properties.

The following table summarises the noise limits suggested by BS 8233 applying to residential properties:

Activity	Room	Good Design Range $L_{Aeq,T}$ dB	
		07:00-23:00hrs	23:00-07:00hrs
Resting	Living rooms	35	-
Dining	Dining room / area	40	-
Sleeping (daytime resting)	Bedroom (at night)	35	30

Table 2: Noise Limits for Residential Properties Suggested in BS 8233

3.2 W.H.O Guidelines on Community Noise

In 1980 the World Health Organisation proposed environmental health criteria for community noise including consideration of noise levels at which sleep disturbance may take place. These guidelines were amended by the World Health Organisation in 1999. The guidance suggests that an internal L_{Aeq} below 30dB is required to preserve the restorative process of sleep. This is equivalent to a free-field level of around 42 to 45dB L_{Aeq} or a façade level of 45 to 48dB L_{Aeq}, assuming open windows.

3.4 British Standard 4142: 2014

British Standard 4142: 2014 “Methods for assessing and rating industrial sound” describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

a) Typically, the greater this difference, the greater the magnitude of the impact.

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

BS 4142 notes that: *Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.*

3.5 Recommended Noise Assessment Criteria

Based on local council criteria and the guidance above it is recommended that the following criterion would be reasonable with the aim of minimising the impact of the proposed operation:

- The free field rating noise level from the new substation should by 5dB below the typical measured background sound level (BSL, L_{A90}) at the nearest noise sensitive locations.

4.0 Assessment of Existing Substation Levels using BS4142.

4.1 Substation Transformer Noise Levels

It is understood that the substation consists of 1no. 500kVA transformer unit and 1 no. 45kVA unit. Based on manufacturers noise data is understood the transformer will have a maximum permitted (worst-case) noise level of 56dBA @ 1 m (assumed to be the noise level of the unit itself, excluding the effect of the enclosure). As the measured sound levels were much lower than the manufacturers stated levels, the worst-case levels will be incorporated into the noise assessment.

4.2 Review of Enclosure

The transformer units are enclosed in GRP enclosures. The enclosure includes entrances doors to the South and a vent slot on each wall of the enclosure.

Using manufacturer's data for similarly built enclosures, GRP buildings have a noise reduction of 24 dB(A) (i.e. R_w 26 – 27dB), as such an estimated noise reduction of R_w 26dB has been given to the substation enclosure (noise data used is shown in figure to below). Additionally, the vent slots have been incorporated into the calculation as fully transmissible areas.

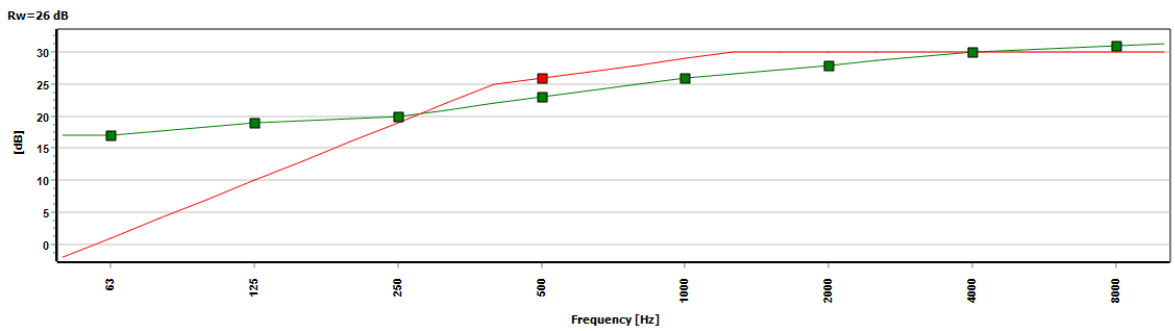

Figure 2: Estimated sound reduction 1/1 octave band noise data for GRP enclosure.

Red data line / points = R_w rating curve

Green data line / points = 1/1 octave sound reduction index values

4.3 BS4142:2014 Assessment of Noise Impact from Proposed Substations

A 3D noise model has been created in SoundPLAN 8.2 to assess the specific noise levels of the proposed Substation on the closest Noise Sensitive Receptors (NSRs). The model assumes a worst-case operation from the substation I.e. an internal noise level of 56 dBA @ 1 m from each substation.

This internal noise level together with the estimated noise reduction of Rw 26dB provided by the substation enclosure results in an external noise level of 23dBA @1m from each substation.

Table 3 below provides predicted noise impacts generated by SoundPLAN and compares the results with existing worst-case background sound levels in the vicinity of noise sensitive receptors.

Location / Receiver	Predicted Specific Noise Level at NSR dB(A)	Background Sound Level at Noise Sensitive Receptor dB(A)	Rating Level relative to BSL dB(A)	Compliance with Condition
Wallbrooke Drive	-7	34	-41	Yes
Newcroft Drive	-3	34	-37	Yes
Hawkins Close	9	34	-25	Yes
Slack Road	-4	34	-38	Yes
North Manchester General Hospital	-1	34	-35	Yes

Table 3: Assessment of noise impact on nearest noise sensitive receptors in accordance with BS4142:2014

It can be seen from table 3 above that rating noise level at the nearest residential receptor (Hawkins Close) is likely to be -25dB below the measured worst-case background sound level. At these levels, the noise from the substations will not contribute to the noise climate at any NSR. Therefore, the condition has been met.

At such low levels below prevailing background sound levels, no tones, or characteristics of the noise will be perceptible, therefore no penalties are applied to the noise.

The contour map in figure 3 below presents the calculated noise impact of worst-case operational at the nearest residential receptors at ground floor:

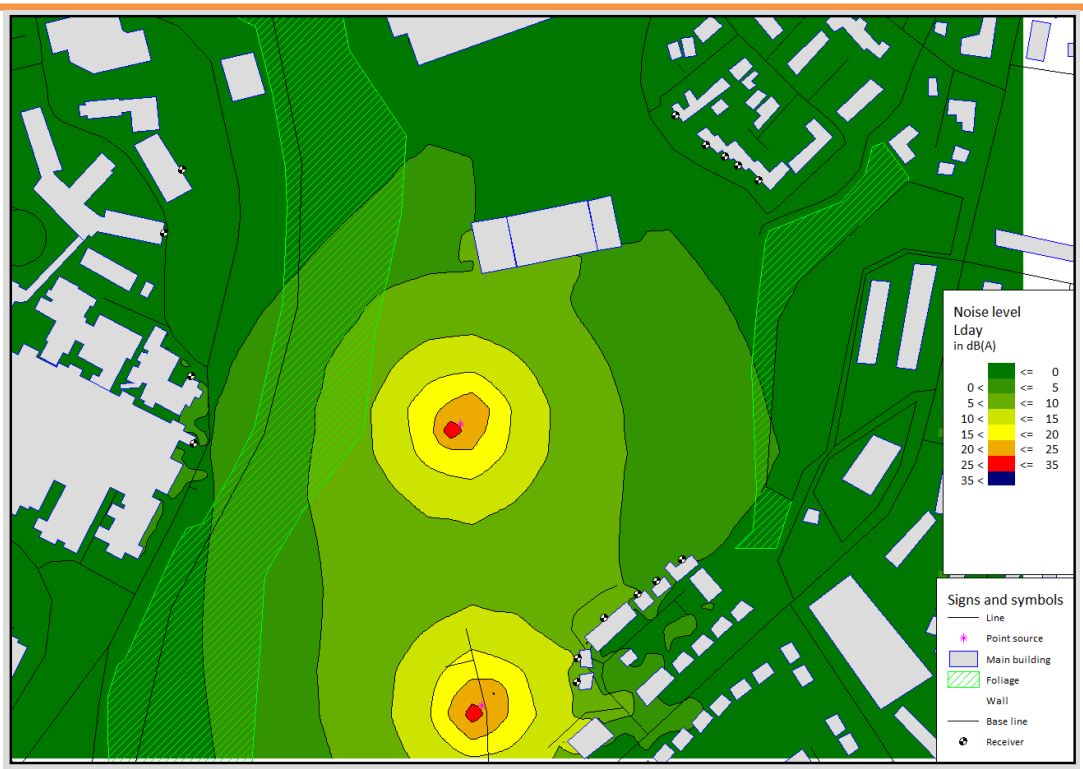

Figure 3: Predicted Noise Grid Map from proposed substation.

5.0 Conclusions

Azymuth Acoustics has undertaken an assessment of the potential noise impact of 2 no. substations associated with the new Salford Van Hire MOT Centre, Crumpsall. Night-time background sound levels in the area are generally affected by road traffic using local roads at levels of 34 dB(A) L_{A90} during the survey period.

The assessment indicates that the rating noise level at the nearest residential receptor (Hawkins Close) is calculated to be -25dB below the measured worst-case background sound level.

Based on this noise assessment it is considered further noise mitigation will be not be required to protect the nearest noise sensitive receptors from noise emanating from the substations, and as such the planning condition has been met.

Appendix A – Glossary of Terms

Decibel (dB)
this is the unit used to measure sound. The human ear has an approximately logarithmic response to acoustic pressure over a very large dynamic range (typically 20 micro Pascal to 100 Pascal).

dB (A)
This is a measure of the overall noise level of sound across the audible spectrum with a frequency weighting (i.e. A-weighting) to compensate for the sensitivity of the human ear to sound of different frequencies. The A-weighting curve is implemented in sound level meters using an electronic filter that approximately corresponds to the frequency response of the ear.

Octave Band Noise Level
The human ear is sensitive to sound over a range of frequencies between approximately 20 Hz to 20 kHz. The ear is also generally more sensitive to medium and high frequencies than to low frequencies. In order to define the frequency content of a noise, the spectrum can be divided into frequency bands. The most commonly used frequency bands are octave bands, in which the mid-frequency of each band is twice that of the band below it.

L_{Aeq}
this is the equivalent steady sound level in dB (A) containing the same acoustic energy as the actual fluctuating sound level over a given time period.

Reverberation Time (RT or sometimes T_{30} or T_{60})
This is the time taken for the reverberant sound energy in an enclosure to decay one millionth of its equilibrium value, i.e. by 60 dB, after the source has been switched off, is known as the reverberation time. The reverberation time is frequency dependent and it is customary to measure its value in octave or one-third octave bands. Reverberation occurs when sound waves are repeatedly reflected from each surface of the room.

Sound Reduction Index (SRI)
Difference measured between the amount of energy flowing towards the wall in the source room and the total amount of energy flowing towards the wall in the source room and the total amount of energy entering the receiving room (usual range 100 – 3150 Hz for one third octave band values). The SRI varies with frequency and is measured in a laboratory in either octave or one-third octave bands.

SRI = L1 – L2 + 10 log (S/A)

Where: L1 = Noise level in the source room
L2 = Noise levels in the receiving room
S = Surface area of test specimen
A = Equivalent acoustic absorption area in the receiving room

Weighted Sound Reduction Index (R_w)
this is a weighted single figure descriptor of the sound insulation performance of a partition measured under laboratory conditions. The procedure used to quantify the R_w is to compare the sound reduction index (SRI) in each of the one-third octave bands from 100Hz to 3150Hz against a set of standard reference curves.

Appendix B – Full Tabulation of Noise Survey Results, Azymuth Acoustics

Start Date / Time	Position	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
13/09/2021 08:54	1 m from north transformer enclosure	47.3	43.8	46.5	44.7	43.6	42.7
13/09/2021 08:55		48.0	44	48.2	45.1	43.6	42.5
13/09/2021 08:55		50.9	47.6	51.3	48.5	47.5	46.8
13/09/2021 08:56		47.9	45.6	47	46.5	45.5	44.7
13/09/2021 08:59	1 m from south transformer enclosure	48.9	45.9	48.9	47.5	45.7	44.1
13/09/2021 08:59		45.6	43.6	45.8	44.7	43.5	42.6
13/09/2021 09:00		54.9	47.9	53.6	49.3	47.2	45.8
13/09/2021 09:00		53.9	50.8	53.7	52.6	50.4	49.1
13/09/2021 09:05	Internal of north transformer enclosure	41.3	38.9	41	39.9	38.7	37.6
13/09/2021 09:05		40.8	39.4	41	40.2	39.3	38.3
13/09/2021 09:06		42.8	38.3	40.9	39.7	38.1	37
13/09/2021 09:25	Hawkins Close	56.2	46	52	49	46	41
13/09/2021 09:30		47.1	45	47.7	46.7	44.6	43.2

Table 4: Attended measurements during substations in operation

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
16/04/2021	15:48:32	74	47	50	47	45	42
16/04/2021	15:58:32	58	45	51	48	44	41
16/04/2021	16:08:32	50	42	47	44	41	39
16/04/2021	16:18:32	50	43	48	46	43	40
16/04/2021	16:28:32	58	47	55	49	46	43
16/04/2021	16:38:32	56	47	52	49	47	44
16/04/2021	16:48:32	55	44	51	48	43	39
16/04/2021	16:58:32	57	39	48	41	38	36
16/04/2021	17:08:32	55	38	45	39	37	36
16/04/2021	17:18:32	54	38	48	39	36	35
16/04/2021	17:28:32	57	39	50	39	36	35
16/04/2021	17:38:32	49	37	42	38	36	35
16/04/2021	17:48:32	66	46	60	43	36	35
16/04/2021	17:58:32	43	37	40	38	36	35
16/04/2021	18:08:32	59	38	47	39	36	35
16/04/2021	18:18:32	63	40	50	41	37	36
16/04/2021	18:28:32	47	37	41	38	36	35
16/04/2021	18:38:32	53	39	48	40	37	35
16/04/2021	18:48:32	47	37	42	39	36	35
16/04/2021	18:58:32	46	37	42	39	37	35
16/04/2021	19:08:32	56	40	48	41	39	37
16/04/2021	19:18:32	56	41	49	43	39	38
16/04/2021	19:28:32	51	40	48	42	39	38
16/04/2021	19:38:32	55	40	47	42	39	38
16/04/2021	19:48:32	51	41	48	43	40	38

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
16/04/2021	19:58:32	51	40	44	41	39	38
16/04/2021	20:08:32	48	39	43	40	39	38
16/04/2021	20:18:32	48	39	42	40	39	38
16/04/2021	20:28:32	44	39	42	40	39	38
16/04/2021	20:38:32	45	39	42	40	39	38
16/04/2021	20:48:32	45	39	42	40	39	38
16/04/2021	20:58:32	52	39	45	41	39	38
16/04/2021	21:08:32	57	41	49	41	39	38
16/04/2021	21:18:32	46	39	41	40	39	38
16/04/2021	21:28:32	50	40	44	41	39	38
16/04/2021	21:38:32	60	42	53	41	39	38
16/04/2021	21:48:32	50	39	44	40	39	38
16/04/2021	21:58:32	46	39	42	40	39	38
16/04/2021	22:08:32	42	39	41	40	39	38
16/04/2021	22:18:32	49	40	45	41	39	38
16/04/2021	22:28:32	47	39	44	40	39	37
16/04/2021	22:38:32	42	39	40	39	38	37
16/04/2021	22:48:32	51	39	45	40	39	38
16/04/2021	22:58:32	55	40	45	40	39	38
16/04/2021	23:08:32	46	39	41	40	39	38
16/04/2021	23:18:32	54	40	44	41	39	38
16/04/2021	23:28:32	44	39	42	40	39	38
16/04/2021	23:38:32	50	40	42	41	40	39
16/04/2021	23:48:32	44	40	42	41	40	39
16/04/2021	23:58:32	44	40	43	41	40	39
17/04/2021	00:08:32	51	41	43	42	40	39
17/04/2021	00:18:32	45	41	43	42	41	39
17/04/2021	00:28:32	45	41	43	42	41	40
17/04/2021	00:38:32	45	41	43	42	41	40
17/04/2021	00:48:32	45	41	43	42	41	40
17/04/2021	00:58:32	43	41	43	42	41	40
17/04/2021	01:08:32	45	41	42	42	41	40
17/04/2021	01:18:32	44	41	43	42	41	40
17/04/2021	01:28:32	46	41	43	42	40	39
17/04/2021	01:38:32	45	41	43	42	41	40
17/04/2021	01:48:32	44	41	44	42	41	40
17/04/2021	01:58:32	47	41	45	43	41	40
17/04/2021	02:08:32	46	40	44	41	40	39
17/04/2021	02:18:32	44	40	42	41	40	39
17/04/2021	02:28:32	49	41	46	42	40	39
17/04/2021	02:38:32	50	41	44	43	41	40
17/04/2021	02:48:32	46	41	43	42	40	39
17/04/2021	02:58:32	46	41	44	42	41	39
17/04/2021	03:08:32	46	41	44	42	41	39
17/04/2021	03:18:32	46	41	44	42	41	39
17/04/2021	03:28:32	46	41	44	42	41	40
17/04/2021	03:38:32	46	42	45	43	42	40
17/04/2021	03:48:32	50	42	46	44	42	40
17/04/2021	03:58:32	48	41	45	42	41	40

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
17/04/2021	04:08:32	48	41	45	43	41	40
17/04/2021	04:18:32	46	41	44	42	40	39
17/04/2021	04:28:32	63	43	50	44	41	40
17/04/2021	04:38:32	46	41	44	42	41	40
17/04/2021	04:48:32	47	42	45	43	41	40
17/04/2021	04:58:32	55	44	53	45	42	41
17/04/2021	05:08:32	59	49	57	53	46	42
17/04/2021	05:18:32	61	50	57	53	48	44
17/04/2021	05:28:32	59	49	56	53	47	44
17/04/2021	05:38:32	63	48	56	51	46	43
17/04/2021	05:48:32	58	48	57	52	45	42
17/04/2021	05:58:32	59	49	57	54	45	43
17/04/2021	06:08:32	60	50	59	55	45	42
17/04/2021	06:18:32	61	50	59	56	45	42
17/04/2021	06:28:32	68	50	59	54	45	43
17/04/2021	06:38:32	60	47	58	48	44	43
17/04/2021	06:48:32	60	49	58	52	45	43
17/04/2021	06:58:32	63	45	51	47	44	42
17/04/2021	07:08:32	54	44	51	46	44	42
17/04/2021	07:18:32	53	44	48	46	44	42
17/04/2021	07:28:32	55	45	52	48	44	42
17/04/2021	07:38:32	58	45	53	48	43	42
17/04/2021	07:48:32	69	55	63	58	49	44
17/04/2021	09:18:32	66	48	55	49	46	44
17/04/2021	09:28:32	61	48	55	50	47	44
17/04/2021	09:38:32	72	57	70	59	50	44
17/04/2021	09:48:32	73	58	69	61	54	52
17/04/2021	09:58:32	91	68	78	71	65	61
17/04/2021	10:08:32	89	65	74	68	62	39
17/04/2021	10:18:32	57	42	50	45	40	38
17/04/2021	10:28:32	50	41	47	43	40	38
17/04/2021	10:38:32	51	41	46	43	39	38
17/04/2021	10:48:32	59	49	54	53	48	40
17/04/2021	10:58:32	74	60	70	65	51	41
17/04/2021	11:08:32	75	66	73	70	65	61
17/04/2021	11:18:32	82	65	74	68	62	58
17/04/2021	11:28:32	85	60	68	60	57	56
17/04/2021	11:38:32	85	67	77	70	64	50
17/04/2021	11:48:32	84	70	82	73	64	52
17/04/2021	11:58:32	78	60	70	65	53	39
17/04/2021	12:08:32	81	67	76	70	63	55
17/04/2021	12:18:32	56	44	50	46	42	39
17/04/2021	12:28:32	62	47	51	49	47	40
17/04/2021	12:38:32	88	65	76	67	48	41
17/04/2021	12:48:32	93	68	80	69	55	45
17/04/2021	12:58:32	85	58	69	59	48	40
17/04/2021	13:08:32	79	55	68	55	43	40
17/04/2021	13:18:32	55	40	47	43	38	36
17/04/2021	13:28:32	60	39	44	39	37	36

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
17/04/2021	13:38:32	51	38	43	39	38	36
17/04/2021	13:48:32	57	40	48	42	37	35
17/04/2021	13:58:32	51	38	44	38	37	36
17/04/2021	14:08:32	50	38	47	39	37	36
17/04/2021	14:18:32	58	39	47	39	37	36
17/04/2021	14:28:32	51	38	44	39	37	35
17/04/2021	14:38:32	54	39	47	40	37	35
17/04/2021	14:48:32	50	36	41	38	35	33
17/04/2021	14:58:32	51	37	46	40	35	33
17/04/2021	15:08:32	49	37	44	39	36	34
17/04/2021	15:18:32	61	41	52	43	37	35
17/04/2021	15:28:32	53	45	51	49	38	35
17/04/2021	15:38:32	50	36	41	37	35	34
17/04/2021	15:48:32	49	36	44	39	35	33
17/04/2021	15:58:32	53	36	42	37	35	34
17/04/2021	16:08:32	51	36	43	37	34	33
17/04/2021	16:18:32	51	36	42	36	35	33
17/04/2021	16:28:32	57	38	46	40	36	33
17/04/2021	16:38:32	61	36	43	37	34	32
17/04/2021	16:48:32	47	34	39	35	34	32
17/04/2021	16:58:32	44	35	40	37	35	33
17/04/2021	17:08:32	50	36	42	38	35	33
17/04/2021	17:18:32	48	36	43	37	35	33
17/04/2021	17:28:32	49	35	41	36	34	33
17/04/2021	17:38:32	67	40	46	40	36	34
17/04/2021	17:48:32	77	48	59	41	36	34
17/04/2021	17:58:32	56	38	47	40	36	35
17/04/2021	18:08:32	75	49	61	43	37	34
17/04/2021	18:18:32	72	47	58	43	36	34
17/04/2021	18:28:32	52	36	42	37	35	33
17/04/2021	18:38:32	52	36	41	38	35	34
17/04/2021	18:48:32	53	37	42	39	36	35
17/04/2021	18:58:32	56	39	43	40	38	36
17/04/2021	19:08:32	58	39	44	40	38	36
17/04/2021	19:18:32	53	39	44	41	38	37
17/04/2021	19:28:32	44	38	42	39	37	36
17/04/2021	19:38:32	51	39	47	41	38	36
17/04/2021	19:48:32	59	40	46	41	38	37
17/04/2021	19:58:32	53	40	47	42	39	37
17/04/2021	20:08:32	52	38	44	40	38	36
17/04/2021	20:18:32	58	39	49	40	37	36
17/04/2021	20:28:32	51	39	44	40	38	36
17/04/2021	20:38:32	55	38	43	39	37	36
17/04/2021	20:48:32	43	37	40	38	37	36
17/04/2021	20:58:32	54	37	41	38	36	35
17/04/2021	21:08:32	43	36	39	37	36	35
17/04/2021	21:18:32	46	36	41	37	36	35
17/04/2021	21:28:32	45	37	41	38	36	35
17/04/2021	21:38:32	54	38	45	38	37	35

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
17/04/2021	21:48:32	44	37	40	38	37	35
17/04/2021	21:58:32	56	39	49	41	37	35
17/04/2021	22:08:32	56	39	45	40	38	36
17/04/2021	22:18:32	43	38	41	39	38	36
17/04/2021	22:28:32	46	37	43	38	37	36
17/04/2021	22:38:32	42	37	40	38	37	36
17/04/2021	22:48:32	62	39	45	39	37	36
17/04/2021	22:58:32	54	38	44	38	37	36
17/04/2021	23:08:32	47	37	41	38	37	36
17/04/2021	23:18:32	50	38	42	39	37	36
17/04/2021	23:28:32	43	36	39	38	36	35
17/04/2021	23:38:32	54	37	41	37	36	34
17/04/2021	23:48:32	42	36	39	37	36	34
17/04/2021	23:58:32	41	35	37	36	35	34
18/04/2021	00:08:32	40	35	37	36	35	34
18/04/2021	00:18:32	41	35	38	36	35	33
18/04/2021	00:28:32	43	35	39	36	34	33
18/04/2021	00:38:32	43	35	39	36	34	33
18/04/2021	00:48:32	40	35	37	36	35	33
18/04/2021	00:58:32	43	35	40	37	35	34
18/04/2021	01:08:32	45	35	39	37	35	34
18/04/2021	01:18:32	42	35	39	36	35	34
18/04/2021	01:28:32	44	35	41	37	35	33
18/04/2021	01:38:32	43	34	38	35	34	33
18/04/2021	01:48:32	48	34	40	35	33	32
18/04/2021	01:58:32	40	33	36	34	33	32
18/04/2021	02:08:32	39	34	36	35	33	32
18/04/2021	02:18:32	38	33	36	34	33	32
18/04/2021	02:28:32	46	34	39	35	33	32
18/04/2021	02:38:32	39	34	36	35	33	32
18/04/2021	02:48:32	48	34	38	35	33	32
18/04/2021	02:58:32	45	34	37	35	34	32
18/04/2021	03:08:32	40	34	37	36	34	33
18/04/2021	03:18:32	42	35	38	36	35	34
18/04/2021	03:28:32	41	35	39	36	35	34
18/04/2021	03:38:32	43	36	40	37	36	34
18/04/2021	03:48:32	41	36	39	38	35	34
18/04/2021	03:58:32	43	38	41	39	38	36
18/04/2021	04:08:32	43	36	39	38	36	34
18/04/2021	04:18:32	40	36	38	37	35	34
18/04/2021	04:28:32	51	37	44	39	36	35
18/04/2021	04:38:32	54	38	47	39	36	35
18/04/2021	04:48:32	45	38	43	39	37	35
18/04/2021	04:58:32	53	40	49	43	38	36
18/04/2021	05:08:32	57	46	55	51	42	38
18/04/2021	05:18:32	57	49	56	52	47	42
18/04/2021	05:28:32	58	48	55	51	46	42
18/04/2021	05:38:32	57	47	54	51	45	41
18/04/2021	05:48:32	57	47	56	51	44	39

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
18/04/2021	05:58:32	61	48	58	53	42	38
18/04/2021	06:08:32	59	48	58	54	41	37
18/04/2021	06:18:32	60	51	59	57	42	37
18/04/2021	06:28:32	54	43	52	48	40	36
18/04/2021	06:38:32	54	44	52	49	39	36
18/04/2021	06:48:32	61	48	59	52	40	36
18/04/2021	06:58:32	60	45	57	47	40	37
18/04/2021	07:08:32	54	44	52	48	40	37
18/04/2021	07:18:32	58	44	53	48	41	37
18/04/2021	07:28:32	61	48	59	53	39	36
18/04/2021	07:38:32	56	41	50	45	39	35
18/04/2021	07:48:32	53	41	52	44	37	34
18/04/2021	07:58:32	53	41	52	43	36	34
18/04/2021	08:08:32	58	41	53	42	37	35
18/04/2021	08:18:32	49	39	47	42	36	34
18/04/2021	08:28:32	52	39	49	42	36	34
18/04/2021	08:38:32	53	38	48	41	36	34
18/04/2021	08:48:32	51	37	43	39	36	34
18/04/2021	08:58:32	52	39	48	42	36	34
18/04/2021	09:08:32	54	38	45	40	36	34
18/04/2021	09:18:32	52	39	48	43	36	34
18/04/2021	09:28:32	53	39	48	42	37	34
18/04/2021	09:38:32	51	38	45	41	36	34
18/04/2021	09:48:32	49	38	45	40	36	34
18/04/2021	09:58:32	53	40	50	43	37	35
18/04/2021	10:08:32	58	39	49	40	36	34
18/04/2021	10:18:32	53	38	45	40	36	34
18/04/2021	10:28:32	53	37	45	39	36	34
18/04/2021	10:38:32	50	37	45	40	36	34
18/04/2021	10:48:32	51	39	46	42	38	35
18/04/2021	10:58:32	49	38	45	40	36	34
18/04/2021	11:08:32	59	38	44	40	36	34
18/04/2021	11:18:32	53	36	41	38	35	34
18/04/2021	11:28:32	57	38	48	40	35	33
18/04/2021	11:38:32	62	40	50	43	36	33
18/04/2021	11:48:32	55	40	50	42	36	32
18/04/2021	11:58:32	51	37	47	39	35	33
18/04/2021	12:08:32	51	38	46	40	36	33
18/04/2021	12:18:32	45	36	41	38	35	33
18/04/2021	12:28:32	61	41	54	39	36	34
18/04/2021	12:38:32	47	36	43	39	35	33
18/04/2021	12:48:32	48	37	45	39	35	33
18/04/2021	12:58:32	52	37	47	39	35	33
18/04/2021	13:08:32	52	38	46	41	35	33
18/04/2021	13:18:32	52	37	44	39	35	33
18/04/2021	13:28:32	51	37	45	40	36	34
18/04/2021	13:38:32	51	35	43	36	34	32
18/04/2021	13:48:32	51	37	46	39	35	33
18/04/2021	13:58:32	55	36	44	37	34	33

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
18/04/2021	14:08:32	50	36	43	37	34	32
18/04/2021	14:18:32	61	39	49	40	35	34
18/04/2021	14:28:32	46	36	41	37	35	33
18/04/2021	14:38:32	58	37	46	38	35	33
18/04/2021	14:48:32	60	39	49	39	36	34
18/04/2021	14:58:32	52	37	44	40	36	34
18/04/2021	15:08:32	69	45	59	41	36	34
18/04/2021	15:18:32	63	43	57	42	36	34
18/04/2021	15:28:32	58	37	45	39	35	33
18/04/2021	15:38:32	57	40	51	41	36	34
18/04/2021	15:48:32	48	35	41	37	35	33
18/04/2021	15:58:32	52	37	46	39	35	33
18/04/2021	16:08:32	53	40	50	43	36	34
18/04/2021	16:18:32	51	37	46	38	34	32
18/04/2021	16:28:32	53	35	42	37	34	32
18/04/2021	16:38:32	52	35	44	36	33	31
18/04/2021	16:48:32	45	34	41	37	33	32
18/04/2021	16:58:32	52	36	44	38	35	33
18/04/2021	17:08:32	47	36	42	38	35	33
18/04/2021	17:18:32	58	41	52	43	35	33
18/04/2021	17:28:32	54	38	48	40	34	32
18/04/2021	17:38:32	53	37	46	40	35	33
18/04/2021	17:48:32	53	38	47	39	35	33
18/04/2021	17:58:32	48	37	45	40	35	33
18/04/2021	18:08:32	50	36	43	38	35	33
18/04/2021	18:18:32	48	36	42	37	35	33
18/04/2021	18:28:32	55	39	48	41	36	34
18/04/2021	18:38:32	52	38	47	41	36	33
18/04/2021	18:48:32	54	38	48	40	35	33
18/04/2021	18:58:32	55	39	48	41	35	33
18/04/2021	19:08:32	48	37	44	39	35	33
18/04/2021	19:18:32	52	36	43	38	34	32
18/04/2021	19:28:32	59	39	50	41	36	33
18/04/2021	19:38:32	47	37	42	39	36	34
18/04/2021	19:48:32	52	40	49	42	38	36
18/04/2021	19:58:32	56	39	47	41	38	36
18/04/2021	20:08:32	57	39	49	40	37	35
18/04/2021	20:18:32	55	38	48	39	36	35
18/04/2021	20:28:32	57	39	48	40	37	35
18/04/2021	20:38:32	58	38	46	40	36	34
18/04/2021	20:48:32	47	34	38	35	34	32
18/04/2021	20:58:32	53	37	45	40	34	32
18/04/2021	21:08:32	47	37	43	38	36	35
18/04/2021	21:18:32	44	36	39	37	36	35
18/04/2021	21:28:32	49	37	42	39	37	35
18/04/2021	21:38:32	49	37	41	38	36	35
18/04/2021	21:48:32	43	36	40	37	36	35
18/04/2021	21:58:32	41	35	38	36	35	34
18/04/2021	22:08:32	43	36	38	37	35	34

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
18/04/2021	22:18:32	44	36	38	37	36	34
18/04/2021	22:28:32	45	36	38	37	36	34
18/04/2021	22:38:32	51	37	47	37	36	34
18/04/2021	22:48:32	43	35	37	36	35	34
18/04/2021	22:58:32	43	35	37	36	35	34
18/04/2021	23:08:32	43	35	38	36	35	34
18/04/2021	23:18:32	39	34	36	35	34	33
18/04/2021	23:28:32	39	34	36	35	34	33
18/04/2021	23:38:32	50	35	39	35	34	33
18/04/2021	23:48:32	40	34	37	35	34	33
18/04/2021	23:58:32	43	35	38	36	34	33
19/04/2021	00:08:32	40	34	36	35	33	32
19/04/2021	00:18:32	42	34	37	35	34	33
19/04/2021	00:28:32	51	34	36	35	34	33
19/04/2021	00:38:32	44	34	36	35	34	33
19/04/2021	00:48:32	42	34	37	35	34	33
19/04/2021	00:58:32	43	34	36	35	34	33
19/04/2021	01:08:32	41	35	37	36	34	33
19/04/2021	01:18:32	49	35	37	36	35	33
19/04/2021	01:28:32	41	34	37	35	34	33
19/04/2021	01:38:32	43	34	37	35	34	33
19/04/2021	01:48:32	42	34	37	35	34	33
19/04/2021	01:58:32	43	35	37	36	34	33
19/04/2021	02:08:32	42	35	38	36	35	34
19/04/2021	02:18:32	47	36	39	38	36	35
19/04/2021	02:28:32	46	36	39	37	36	35
19/04/2021	02:38:32	45	36	41	38	36	35
19/04/2021	02:48:32	41	36	38	37	36	35
19/04/2021	02:58:32	43	37	40	38	36	35
19/04/2021	03:08:32	44	37	42	39	37	35
19/04/2021	03:18:32	43	36	40	37	36	35
19/04/2021	03:28:32	47	37	42	38	36	35
19/04/2021	03:38:32	42	37	41	38	37	36
19/04/2021	03:48:32	47	38	44	39	37	36
19/04/2021	03:58:32	48	37	42	38	37	36
19/04/2021	04:08:32	44	38	41	39	38	37
19/04/2021	04:18:32	49	39	42	40	38	37
19/04/2021	04:28:32	45	38	41	40	38	37
19/04/2021	04:38:32	50	39	45	41	39	37
19/04/2021	04:48:32	51	40	47	42	39	38
19/04/2021	04:58:32	53	42	50	44	40	38
19/04/2021	05:08:32	57	46	54	50	44	40
19/04/2021	05:18:32	59	48	55	52	46	43
19/04/2021	05:28:32	58	48	55	51	46	43
19/04/2021	05:38:32	59	49	57	53	46	42
19/04/2021	05:48:32	59	47	53	50	45	43
19/04/2021	05:58:32	55	47	53	51	46	43
19/04/2021	06:08:32	53	45	52	48	44	42
19/04/2021	06:18:32	60	49	59	53	45	43

Start Date	Start Time	L_{Amax}	L_{Aeq}	L_{A1}	L_{A10}	L_{A50}	L_{A90}
19/04/2021	06:28:32	57	46	52	48	45	44
19/04/2021	06:38:32	57	48	55	51	46	44
19/04/2021	06:48:32	57	46	52	48	45	44
19/04/2021	06:58:32	52	46	50	47	45	44
19/04/2021	07:08:32	52	45	48	46	45	43
19/04/2021	07:18:32	54	46	51	48	45	44
19/04/2021	07:28:32	53	46	52	49	45	44
19/04/2021	07:38:32	54	46	51	48	45	43
19/04/2021	07:48:32	68	49	61	51	45	43
19/04/2021	07:58:32	74	55	66	56	49	46

Appendix C – Full Tabulation of Noise Survey Results, Echo Affiliates

Start	Position	Time	L_{Amax}	L_{Aeq}	L_{A10}	L_{A90}
18/09/2015 00:30	F1	15:00	71.7	52.3	53.2	37.3
18/09/2015 00:45	F1	15:00	74.0	52.4	51.0	36.1
18/09/2015 01:00	F1	15:00	68.5	48.0	45.6	35.4
18/09/2015 01:15	F1	15:00	70.6	49.9	47.1	34.3
18/09/2015 01:30	F1	15:00	75.0	48.9	42.9	34.8
18/09/2015 01:45	F1	15:00	69.0	46.6	44.4	34.5
18/09/2015 02:00	F1	15:00	68.2	48.7	44.7	34.2
18/09/2015 02:15	F1	15:00	68.6	48.8	43.6	33.5
18/09/2015 02:30	F1	15:00	67.2	47.3	42.9	32.4
18/09/2015 02:45	F1	15:00	69.2	48.2	43.6	31.8
18/09/2015 03:00	F1	15:00	68.1	45.8	40.6	33.6
18/09/2015 03:15	F1	15:00	73.8	49.8	41.0	33.2
18/09/2015 03:30	F1	15:00	69.8	47.3	41.0	32.8
18/09/2015 03:45	F1	15:00	47.2	36.3	38.4	33.7
18/09/2015 04:00	F1	15:00	69.3	46.1	41.1	34.6
18/09/2015 04:15	F1	15:00	66.7	42.8	41.5	34.0
18/09/2015 04:30	F1	15:00	72.4	50.6	46.7	35.2
18/09/2015 04:45	F1	15:00	69.8	45.1	41.7	36.4
18/09/2015 05:00	F1	15:00	73.0	54.0	57.3	36.6
18/09/2015 05:15	F1	15:00	72.3	52.9	52.8	37.7
18/09/2015 05:30	F1	15:00	71.9	51.1	50.3	38.1
18/09/2015 05:45	F1	15:00	73.3	52.4	52.8	39.3
18/09/2015 06:00	F1	15:00	74.0	55.8	59.6	39.6
18/09/2015 06:15	F1	15:00	72.4	55.8	60.2	41.5
18/09/2015 06:30	F1	15:00	72.4	56.1	60.5	42.8
18/09/2015 06:45	F1	15:00	72.9	59.0	64.1	44.1
18/09/2015 07:00	F1	15:00	72.8	60.3	64.9	47.0
18/09/2015 07:15	F1	15:00	75.8	61.0	65.4	47.5
18/09/2015 07:30	F1	15:00	72.7	61.8	66.1	47.3
18/09/2015 07:45	F1	15:00	72.6	62.3	66.1	49.5
18/09/2015 08:00	F1	15:00	71.6	61.7	64.9	53.4
18/09/2015 08:15	F1	15:00	73.3	59.4	62.8	51.8
18/09/2015 08:30	F1	15:00	74.6	60.9	65.0	47.8
18/09/2015 08:45	F1	15:00	74.4	61.3	65.0	48.2
18/09/2015 09:00	F1	15:00	71.5	60.9	64.9	49.0
18/09/2015 09:15	F1	15:00	95.5	66.2	64.7	47.7
18/09/2015 09:30	F1	15:00	79.6	60.6	64.4	46.4
18/09/2015 09:45	F1	15:00	75.4	59.7	63.8	44.4
18/09/2015 10:00	F1	15:00	91.9	64.8	64.4	45.3
18/09/2015 10:15	F1	15:00	73.6	59.4	63.6	45.5
18/09/2015 10:30	F1	15:00	74.4	59.4	63.5	45.6
18/09/2015 10:45	F1	15:00	71.8	58.2	62.8	42.0
18/09/2015 11:00	F1	15:00	72.0	59.2	63.5	44.3
18/09/2015 11:15	F1	15:00	70.5	58.7	63.0	44.1
18/.09/2015 11:30	F1	15:00	73.7	59.8	63.5	48.4

18/09/2015 11:45	F1	15:00	71.2	58.5	63.0	43.4
18/09/2015 12:00	F1	15:00	73.1	59.5	63.5	47.4
18/09/2015 12:15	F1	15:00	70.3	58.7	63.4	43.7
18/09/2015 12:30	F1	15:00	76.4	59.6	63.6	46.5
18/09/2015 12:45	F1	15:00	78.4	60.7	64.7	46.6
18/09/2015 13:00	F1	15:00	73.5	59.8	63.9	46.8
18/09/2015 13:15	F1	15:00	73.9	59.6	63.7	44.0
18/09/2015 13:30	F1	15:00	73.2	58.8	63.0	43.6
18/09/2015 13:45	F1	15:00	72.3	58.5	63.2	43.8
18/09/2015 14:00	F1	15:00	70.9	61.1	65.1	48.5
18/09/2015 14:15	F1	15:00	71.4	60.9	64.9	47.9
18/09/2015 14:30	F1	15:00	73.0	62.4	65.7	51.5
18/09/2015 14:45	F1	15:00	71.8	60.9	64.8	49.3
18/09/2015 15:00	F1	15:00	76.4	61.3	65.3	47.9
18/09/2015 15:15	F1	15:00	74.2	61.4	65.2	48.6
18/09/2015 15:30	F1	15:00	72.4	60.7	64.6	48.8
18/09/2015 15:45	F1	15:00	75.2	61.8	65.5	50.2
18/09/2015 16:00	F1	15:00	71.5	61.4	65.6	46.2
18/09/2015 16:15	F1	15:00	77.0	61.8	65.6	47.8
18/09/2015 16:30	F1	15:00	78.1	61.9	65.6	49.0
18/09/2015 16:45	F1	15:00	79.9	61.1	64.6	47.7
18/09/2015 17:00	F1	15:00	72.8	60.9	64.9	48.6
18/09/2015 17:15	F1	15:00	75.0	61.4	65.1	49.5
18/09/2015 17:30	F1	15:00	76.0	61.3	65.3	47.2
18/09/2015 17:45	F1	15:00	74.0	61.5	65.5	48.1
18/09/2015 18:00	F1	15:00	78.9	61.3	65.3	48.7
18/09/2015 18:15	F1	15:00	71.7	61.5	65.4	49.2
18/09/2015 18:30	F1	15:00	72.3	60.9	65.1	46.8
18/09/2015 18:45	F1	15:00	72.4	61.1	65.3	47.0