York Central Partnership

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Access Options Study

Appendix D Acoustics Appendix

Issue | June 2017

Job number 251869-00

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D1 Glossary of Acoustic Terminology

D1.1 Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 106:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the ‘sound pressure level’ (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

D1.2 dB(A)

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The ‘A’ weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the ‘A’ weighting forms part of a subscript, such as LA10, LA90, and LAeq for the ‘A’ weighted equivalent continuous noise level.

D1.3 Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, Leq. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

D1.4 Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes the octave bands between 63Hz to 8kHz are generally used. 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. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

D1.5 Sound pressure level

The sound power emitted by a source results in pressure fluctuations in the air, which are heard as sound.

The sound pressure level (Lp) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of 2 x 10-5Pa (the threshold of hearing).

Thus Lp (dB) = 10 log (P1/Pref)2 where Pref, the lowest pressure detectable by the ear, is 0.00002 pascals (ie 2x10-5 Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dBLA and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

D1.6 Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L10, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that LAeq is used in BS 8233 for assessing traffic noise). The L90, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted LA10, dBLA90 etc. The reference time period (T) is normally included, e.g. dBLA10, 5min or dBLA90, 8hr.

D1.7 Typical levels

Some typical dB(A) noise levels are given below:

Noise Level, dB(A)	Example
130	Threshold of pain
120	Jet aircraft take-off at 100m
110	Chain saw at 1m
100	Inside disco
90	Heavy lorries at 5m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber

D2 Baseline Noise Survey

D2.1 Introduction

An assessment of the existing noise climate in and around the proposed development site has been conducted. This appendix details the baseline noise survey and results.

D2.2 Dates, personnel and conditions

The noise survey was conducted by Naomi Tansey and Iain Laird of Arup on Wednesday 12 April 2017. Meteorological conditions were mainly clear and dry and wind speeds did not exceed 5m/s.

D2.3 Methodology and instrumentation

Attended noise measurements were conducted at locations considered to be representative of the nearest existing noise sensitive receptors (dwellings) as shown in Figure E1. At each location, $L_{Aeq,T}$, L_{A10}, L_{A90} and L_{Amax} metric values were measured. All broadband measurements were A-weighted and used a fast time constant (0.125s).

The sound level meter was mounted on a tripod with the microphone set approximately at 1.2m-1.5m above local ground level under acoustically free-field conditions (i.e. at least 3.5m from any reflective surface other than the ground). A windshield was fitted to the microphone in order to minimise the effects of wind-induced noise across the microphone diagram.

Noise measurements were conducted for a duration of 15 minutes between 10:00-17:00hrs in accordance with the principals outlined in CRTN 'shortened measurement procedure' described in Section 43 of the Calculation of Road Traffic Noise (CRTN)[25].

The sound level meters and microphones are type 1 conforming to BS EN 61672-1:2013. The calibration of the sound level meters and microphones was checked before and after use to confirm that there was no significant drift in meter response. This verification indicated that there was less than 0.5dB variation between checks. The monitoring equipment is calibrated annually, according to international standards together with traceable records. The monitoring equipment used is described in Table E1.

Table E1: Instrumentation used for noise measurements

Equipment	Manufacturer	Model Number	Serial Number
Precision integrating sound level meter	Norsonic	NOR 140	1403429
Sound level meter microphone	Norsonic	1225	98521

[25] Calculation of Road Traffic Noise (CRTN). Department of Transport, Welsh Office (1988)

Equipment	Manufacturer	Model Number	Serial Number
Sound level meter preamp	Norsonic	1209	12625
Type I sound pressure level calibrator	Rion	NC74	35173564

D2.4 Measurement locations and results

Measurement locations are shown in Figure D1 relative to the proposed development site. These locations were selected to reflect the location of the proposed scheme access options.

Details of each measurement location are provided in the following sections alongside the noise survey results.

Figure D1: Measurement locations

D2.4.1 Location 1

The sound level meter was situated on Chancery Rise, approximately 4m south of Holgate Road (A59). Ambient noise at this location was dominated by road traffic on Holgate Road.

Figure D2: View from measurement Location 1 (view to north east)

Table D2: Noise survey results at Location 1

Date	**Time**		**Noise Level, dB (A)**				**Comments**
	Start	**Finish**	**L_{90}**	**L_{eq}**	**L_{10}**	**L_{max}**	
12/04/2017	10:47	11:02	57	69	72	85	Noise climate dominated by road traffic noise on A59, stopping occasionally for pedestrian crossing. Occasional pedestrian noise (talking etc).
	11:51	12:06	58	69	72	85	
	12:56	13:11	57	69	72	82	

D2.4.2 Location 2

Location 2 was considered representative of residential receptors on Wilton Rise, overlooking the Network Rail Holgate Depot to the north and west. The sound level meter was located on a side street approximately 10m north of the nearest dwellings.

Figure D4: View from measurement location 2 (view to north west)

Table D3: Noise survey results at Location 2

Date	Time		Noise Level, dB (A)				Comments
	Start	Finish	L_{90}	L_{eq}	L_{10}	L_{max}	
12/04/2017	10:25	10:40	49	53	56	71	Distant road traffic noise from A59 audible at this location.
	11:30	11:45	48	54	56	74	Industrial noise from Network Rail facility – Forklift movements on yard, reversing signals, occasional machinery noise from inside buildings (roller shutter doors open)
	12:35	12:50	50	55	58	72	Occasional sounds from train movements to north and east (train horns and engines)

D2.4.3 Location 3

The sound level meter was located in a park at the end of Cleveland Street, approximately 15m from the nearest residences. Ambient noise at this location was dominated by local train movements on the railway lines to the north and industrial noise from the Network Rail Holgate Depot to the west.

Figure D5: View from measurement location 3 (view to north)

Table D4: Noise survey results at Location 3

Date	**Time**		**Noise Level, dB (A)**				**Comments**
	Start	**Finish**	**L_{90}**	**L_{eq}**	**L_{10}**	**L_{max}**	
12/04/2017	09:58	10:13	45	48	50	62	Train movements to north/north-east audible at this location Noise level during 2nd and 3rd measurements dominated by local freight activity at nearby sidings (diesel engine moving freight around sidings to north) Whistle from Steam engine audible audible periodically (from Railway Museum) Distant road traffic audible to north west Occasional noise from Network Rail facility (bangs, reversing signals)
	11:01	11:16	49	58	57	85	
	12:14	12:29	47	51	54	64	

D2.4.4 Location 4

Location 4 was situated on a footpath approximately 20m south of Water End. Traffic on Water End was elevated relative (approximately 10m below road level) to the measurement position as the road traverses the railway line. Ambient noise at this location was dominated by road traffic on Water End and train movements on the railway line (approximately 150m south west of this location).

Figure D6: View from measurement location 4 (view to north west)

Table D5: Noise survey results at Location 4

Date	Time		Noise Level, dB (A)				Comments
	Start	Finish	L_{90}	L_{eq}	L_{10}	L_{max}	
12/04/2017	14:17	14:32	51	57	59	65	Road traffic noise on Water End, distant dog barking from RSPCA facility to North, Train movements on railway lines to the east consisting of commuter, intercity and freight trains (Diesel and Electric)
	15:20	15:35	52	58	60	75	
	16:26	16:41	52	57	59	63	

D2.4.5 Location 5

Location 5 was considered representative of residential receptors on Garnet Terrace. The sound level meter was situated opposite the end of Hanover Street West, approximately 8m from the nearest dwelling. Ambient noise at this location was dominated by road traffic on Water End, local traffic movements on Garnet Terrace and train movements on the railway line.

Figure D7: View from measurement location 5 (view to north)

Table D6: Noise survey results at Location 5

<table>
<tr><th rowspan="2">Date</th><th colspan="2">Time</th><th colspan="4">Noise Level, dB (A)</th><th rowspan="2">Comments</th></tr>
<tr><th>Start</th><th>Finish</th><th>L_{90}</th><th>L_{eq}</th><th>L_{10}</th><th>L_{max}</th></tr>
<tr><td rowspan="3">12/04/2017</td><td>14:38</td><td>14:53</td><td>54</td><td>58</td><td>61</td><td>69</td><td rowspan="3">Road traffic noise on Water End, distant dog barking from RSPCA facility to North, Train movements on railway lines to the east consisting of commuter, intercity and freight trains (Diesel and Electric), local traffic movements on Garnet Terrace</td></tr>
<tr><td>15:41</td><td>15:56</td><td>52</td><td>57</td><td>59</td><td>73</td></tr>
<tr><td>16:47</td><td>17:02</td><td>54</td><td>58</td><td>60</td><td>70</td></tr>
</table>

D2.4.6 Location 6

The sound level meter was located adjacent to the corner of Garfield Terrace and Garnet Terrace, approximately 11m from the nearest dwelling. Ambient noise at this location was dominated by train movements on the nearby railway line (approximately 20m away) and distant road traffic to the north.

Figure D8: View from measurement location 6 (south)

Table D7: Noise survey results at Location 6

Date	**Time**		**Noise Level, dB (A)**				**Comments**
	Start	**Finish**	**L_{90}**	**L_{eq}**	**L_{10}**	**L_{max}**	
12/04/2017	14:58	15:13	49	64	56	87	Road traffic noise on Water End, dogs barking from RSPCA facility to North, Train movements on railway lines to the east consisting of commuter, intercity and freight trains (Diesel and Electric),
	16:00	16:15	51	59	58	79	
	17:05	17:20	49	56	56	75	

D3 Modelling assumptions

Table D7 shows the predicted traffic data from the SATURN model, which has been used for the noise model. The Basic Noise Level (BNL) has been calculated in accordance with the CRTN methodology. Figure E8 and Figure E9 shown the links in the SATURN traffic model.

Table D7: Traffic data

Option	Link	%HGV	AAWT 18hr	Speed (km/h)	BNL (dB)	Total BNL (dB)	L_{Aeq} (dB)
1	9809-9807	0.68	3112	31	59.7	65.3	63.3
	9807-9809	1.30	7377	31	63.8		
	9807-9804	0.68	3112	31	59.7	65.3	63.3
	9804-9807	1.30	7377	31	63.8		
2	9704-1779	1.80	8075	31	64.5	66.6	64.6
	1779-9704	0.75	5597	31	62.3		

The road has been modelled as a line source with spectrum shape as provided in Table D8:, which was measured at Location 1.

Table D8: Road traffic noise spectrum shape (dB)

Octave band centre frequency (Hz)							
63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
5.0	-101	-2.8	-5.0	-3.4	-7.5	-14.8	-19.1

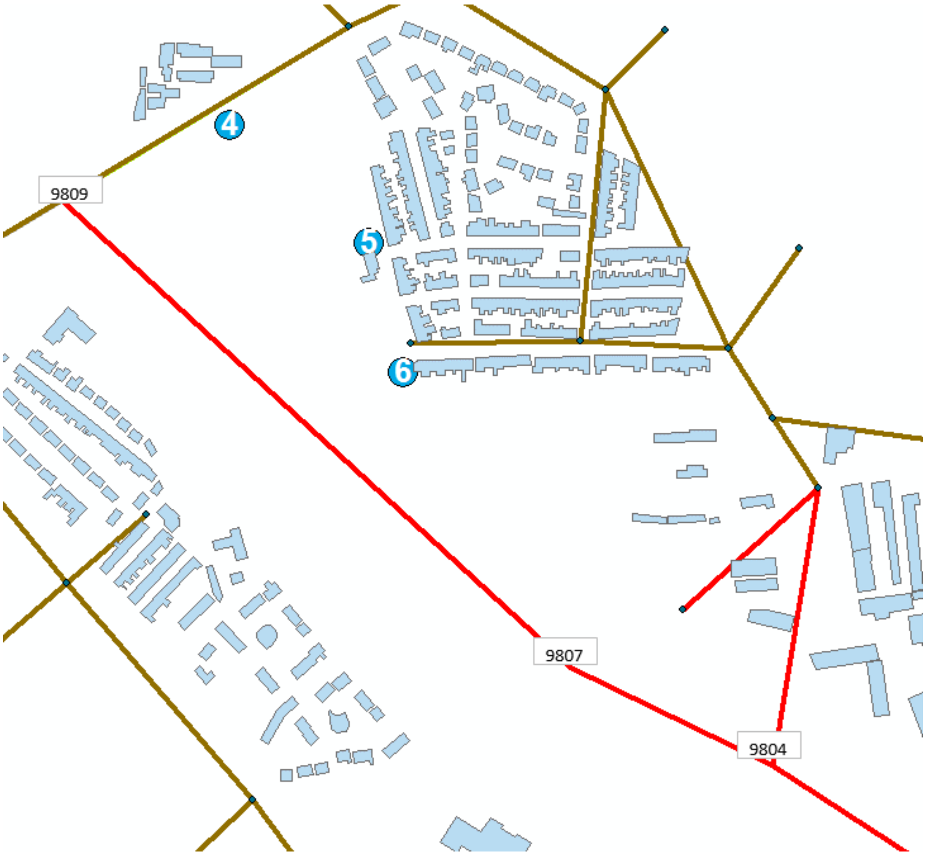

Figure D8: Option 1 SATURN model links

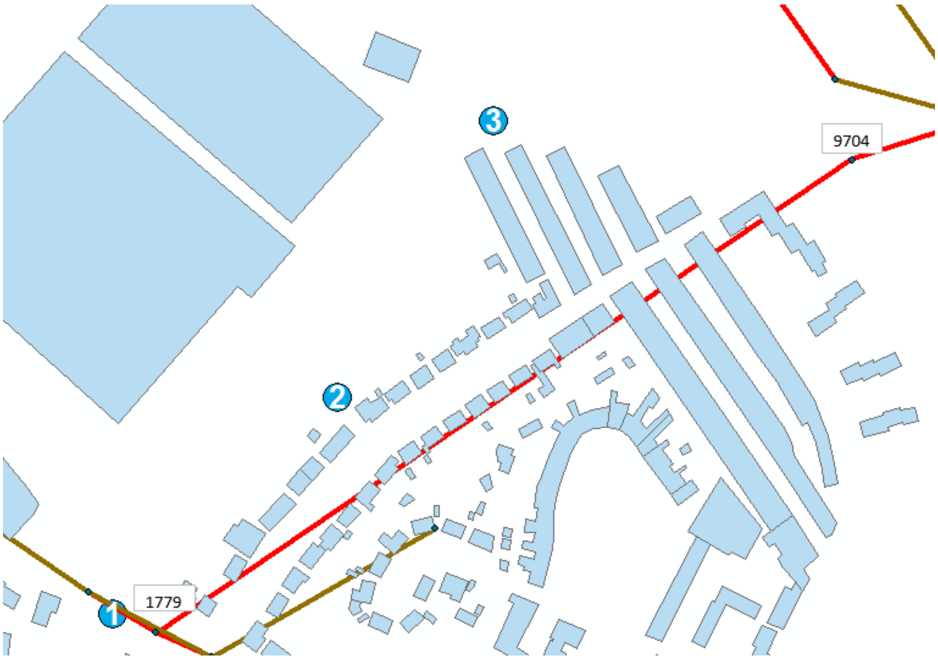

Figure D9:Option 3 SATURN model links