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A REVIEW OF NOISE MEASUREMENTS TAKEN WITHIN GREATER LONDON DURING THE 1990 NATIONAL NOISE INCIDENCE STUDY

CJ Skinner Acoustics Centre, BRE, Garston, Watford, WD25 9XX
CJ Grimwood Acoustics Centre, BRE, Garston, Watford, WD25 9XX

1. INTRODUCTION

In 1990 BRE carried out a national study of environmental noise levels for the then Department of the Environment[1]. The study generated objective estimates of the pattern of the noise exposure of the population of England and Wales, based on 24-hour measurements outside 1000 dwellings.

The 140 sites included within Greater London allow regional estimates of the statistics calculated for the whole country to be made for London. Further insight into the noise climate of London can be obtained by comparing these estimates with the results from the country as a whole. Similar comparisons with other cities are not considered to be useful due to the much smaller number of sites measured in any other city.

This paper reviews the findings of this survey with respect to the sites measured in Greater London, and compares these with the national picture obtained for England and Wales.

2. MEASUREMENTS

2.1 Measurement Locations

The sample of dwellings used for the national study consisted of 1000 dwellings within 50 Local Authority districts over the whole of England and Wales. The sub-sample under consideration in this paper contains 7 districts, and hence 140 sites, within Greater London. Figure 1 shows the locations of these districts.

The sample was stratified into regions of the country, to ensure that the sample size in each region was proportional to that region's total population. Similarly, at district level, the probability of selecting each individual district was proportional to that district's population.

All measurements were taken during normal working days during the school term time, and were of 24 hours duration. Measurement positions were at a distance of 1 m from the front façade of the dwelling. The measurement height was 1.2 m above ground for houses, bungalows and ground floor flats, or suspended from a window for flats at higher levels, achieving a nominal height of 1.2 m above floor level. Measurements were taken in good weather only, by means of close attention to weather forecasts and local conditions.

2.2 Data Recorded

Sound level data was recorded at each site in a series of 24 consecutive one-hour time frames. The specific indicators recorded were L_{Aeq}, L_{Amax}, L_{Amin} and statistical levels (L_{A01}, L_{A10}, L_{A50}, L_{A90} and

L_{A95}). During the survey, Cirrus 702 logging sound level meters were used, together with MK245 outdoor microphone systems and CRL5.11D sound level calibrators.

In this paper the results are reported as indices covering a longer time period than one hour. These were calculated by means of a logarithmic average of the levels from the constituent hours for L_{Aeq} indices, or an arithmetic mean for statistical levels.

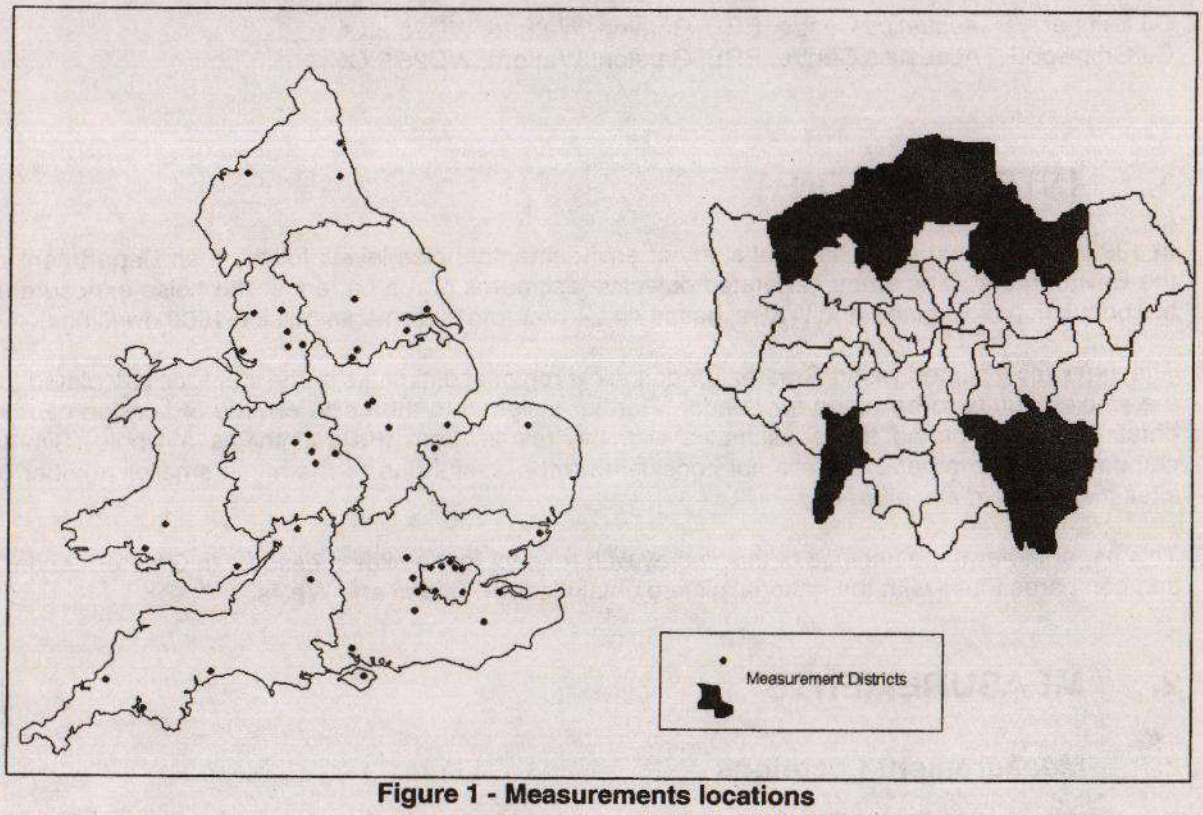

Figure 1 - Measurements locations

2.3 Corrections to Measured Data

Since the survey in 1990, further experiments have been undertaken which involved comparing the performance of the instrumentation used in 1990 with that of more modern instruments (Norsonic 121 environmental noise analysers). These comparisons showed that the Norsonic instruments achieved close to the "ideal" performance laid down in IEC 651:1979 and IEC 804:1985, whilst the Cirrus meters in general gave lower readings, with a larger variation between individual meters than was seen for the Norsonic analysers. It should be noted that the electro-acoustic characteristics of both instrument types were found to be within the tolerances allowed in the relevant standards and no criticism of the performance of the instrumentation is intended. Rather, the implications for this type of noise measurement of the tolerances allowed by the IEC standards may need to be considered further. The results from the experiments where a number of sets of both types of meters were exposed to the same noise environment enabled a mean correction term to be calculated, together with a standard error in this correction.

A separate correction was calculated for each index measured over various time periods (e.g. 16-hour day, 8-hour night). These corrections were then applied to the data from 1990, in order to obtain the best estimate of the readings that would be obtained from the Norsonic analysers in the same environment. The uncertainty in the correction was carried through all calculations as a

systematic error. Correction terms were calculated for these periods in preference to individual hours to account for systematic trends in the differences between instruments over consecutive hours.

3. CALCULATION METHODS

Mean levels and their uncertainties were calculated for the whole of England and Wales and for Greater London, accounting for the clustered nature of the sample, and weighting for population of clusters where this had not been accounted for in the sampling methodology. The uncertainty within a region of the country is purely a function of the variance between mean levels in the districts making up that region[2]. For the whole of England and Wales, these regional uncertainties are then combined to form the national uncertainty, weighting for the regional populations.

Cumulative distributions were calculated indicating the estimate proportion of the population exposed above given limits for various indices. Uncertainties and hence 95% confidence limits in these distributions were also calculated for the central region of the distribution. In the tails of the distributions, the number of sites concerned was too small to enable an accurate measure of the uncertainty in the distribution to be made.

Mean 24-hour time histories were also calculated, based on the hourly indices measured. As the corrections described in section 2.3 above were only calculated for longer time periods, the 24-hour correction and its associated uncertainty were applied to each period of this data.

4. LIMITS OF VALIDITY

The increase in variance due to the clustered nature of the Greater London sub-sample has been accounted for in calculations of uncertainties and statistical significances. However, an assumption is also being made in this paper that the sub-sample of sites used is representative of the entirety of Greater London in terms of the mean noise exposure and the variance of this exposure (both within and between districts). As all the districts sampled were outer London districts, this is probably not the case, and hence our estimates are likely to be subject to larger uncertainties than the purely statistical standard errors calculated.

5. RESULTS

5.1 Mean Levels

Table 1 shows the mean levels calculated from this survey for both Greater London and the whole of England and Wales, indicating differences between the two which are significant at the 95% confidence level. In general it can be seem that the mean level within Greater London is higher than that for England and Wales as a whole, particularly in the case of indices used to measure background noise levels.

5.2 Time-histories

Figure 2 shows the 24-hour time history for the L_{Aeq} index. For clarity, it has been plotted as a line, with the data for each hour period represented by a single point at the centre point of that hour.

In comparing the data for the whole of England and Wales with that from Greater London, it can clearly be seen that the evening decrease in London appears to start later at night than for the mean of the whole country. The night-time period of relatively constant low level is also seen to be shorter in Greater London than the national average.

16 hour day-time (0700-2300)

Index	London		England and Wales		Significant Difference at 95% confidence level
	Mean Level (dB)	Standard Error (dB)	Mean Level (dB)	Standard Error (dB)	
L_{Aeq}	57.0	0.7	57.2	0.34	-
L_{A01}	66.3	0.7	66.1	0.35	-
L_{A10}	58.2	0.8	57.2	0.41	-
L_{A50}	51.2	0.9	48.9	0.50	Higher
L_{A90}	47.0	0.8	43.9	0.54	Higher
L_{A95}	46.1	0.7	42.8	0.54	Higher

8 hour night-time (2300-0700)

Index	London		England and Wales		Significant Difference at 95% confidence level
	Mean Level (dB)	Standard Error (dB)	Mean Level (dB)	Standard Error (dB)	
L_{Aeq}	49.1	1.1	48.2	0.36	-
L_{A01}	56.5	1.0	55.3	0.47	-
L_{A10}	47.4	1.2	45.4	0.48	-
L_{A50}	40.7	1.1	38.3	0.51	Higher
L_{A90}	37.0	1.0	34.7	0.47	Higher
L_{A95}	36.3	1.0	34.1	0.45	Higher

Table 1 - Mean Levels

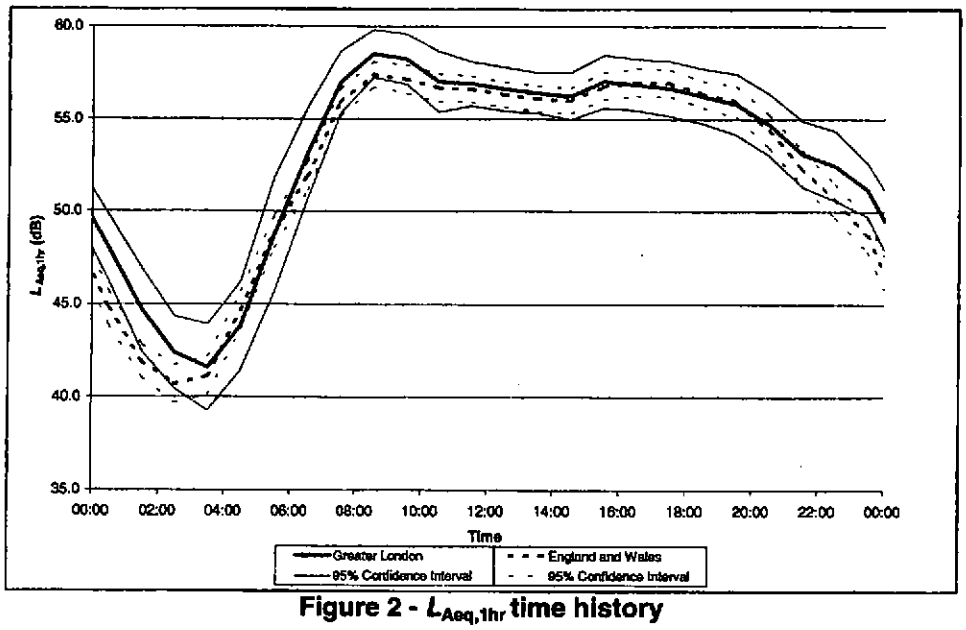

Figure 2 - $L_{Aeq,1hr}$ time history

5.3 Cumulative Distributions.

Figure 3 and Figure 4 show cumulative distributions for 24-hour L_{Aeq} and L_{A90} indices, comparing Greater London with the whole of England and Wales. It can be seen that the two $L_{Aeq,24hr}$ distributions shown in Figure 3 are quite similar.

The plot for $L_{A90,24hr}$ does indicate that the higher levels are mostly at the quieter sites in Greater London. That is the noisier sites in Greater London experience similar levels to those equivalent sites in the country as a whole, whilst the quieter sites in Greater London experience significantly higher noise levels than the quietest sites in England and Wales as a whole.

Figures 3 and 4 both indicate the much larger uncertainties associated with these estimates for Greater London than are seen for the whole of England and Wales, mostly as a consequence of the much smaller sample size.

These cumulative distributions were used to estimate the proportions of the population of England and Wales living in dwellings falling into various bands of exposure. The results for $L_{Aeq,\ 24hr}$ are included in Table 2.

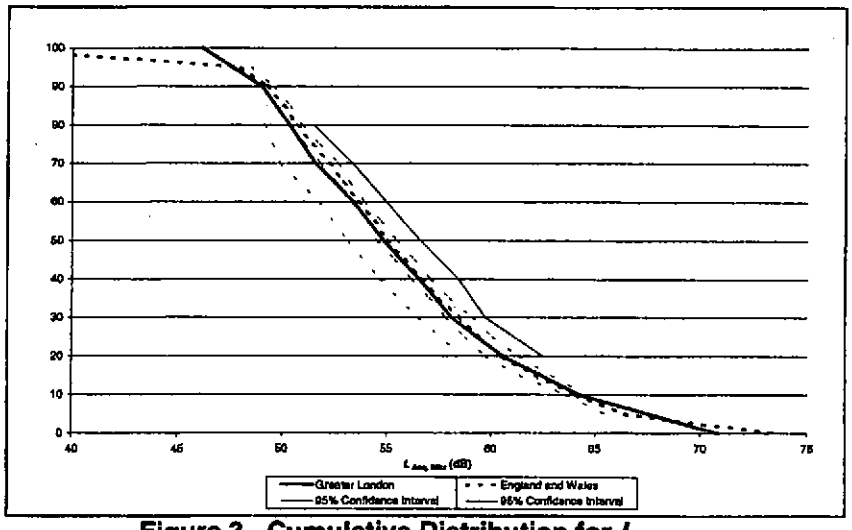

Figure 3 - Cumulative Distribution for $L_{Aeq,24hr}$

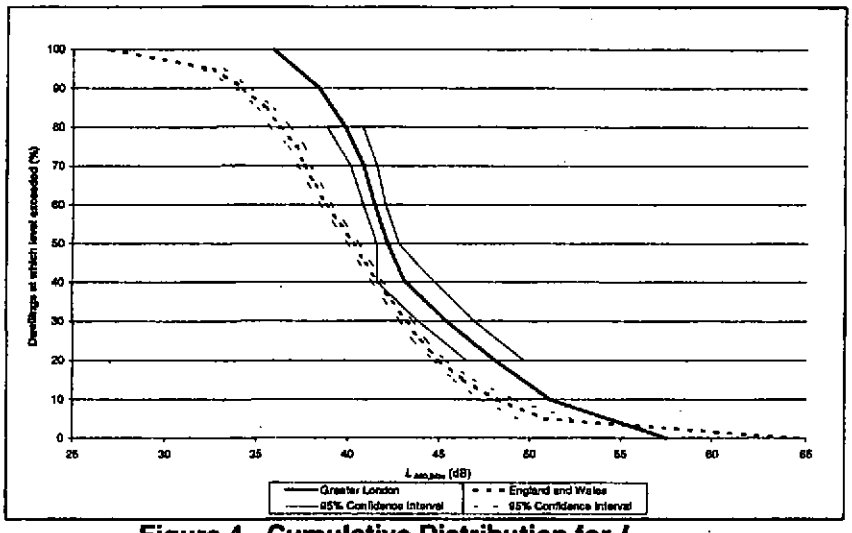

Figure 4 - Cumulative Distribution for $L_{A90,24hr}$

Level dB(A)	1990	
	Proportion in band	95% confidence interval
$L<50$	15%	12 – 18%
$50 \le L < 55$	35%	31 – 39%
$55 \le L < 60$	27%	23 – 31%
$L \ge 60$	23%	20 – 26%

Table 2 – National population exposure - $L_{Aeq,24hr}$

Due to the much increased uncertainties in the cumulative distributions within Greater London, it was not considered instructive to calculate similar proportions in the various exposure bands for the Greater London population. However we have calculated the level exceeded at 50% of dwellings, and found this to be 55 dB $L_{Aeq,24hr}$ for both Greater London and the whole of England and Wales.

6. CONCLUSION

In general it has been shown from a review of noise measurements taken within Greater London during the 1990 National Noise Incidence Study that noise levels are significantly higher in Greater London than the national average. In particular this is seen for indices used to measure background levels, such as L_{A90}. It can also be seen from the cumulative distributions that the majority of this difference is due to the quieter sites within Greater London experiencing higher levels than the quieter sites in the country, whilst the sites experiencing the highest noise levels in Greater London experience similar levels to the noisiest sites nationally. When 24-hour time histories are viewed, these also indicate a shorter night-time quiet period within Greater London than is seen on average over England and Wales. In particular the decrease in levels in the evening appears to start later in London, and the quietest period in the early morning is also shorter.

More recently, during the year 2000, a repeat study has been carried out, which will allow changes over the intervening 10 years to be tracked, and up to date noise exposure patterns to be estimated. The data from this study will be available in the near future, together with corresponding data for Greater London.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

[1] BRE IP 21/93 – The noise climate around our homes.
[2] Thompson, S.K., Sampling, John Wiley & Sons, 1992.