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# NOISE TRENDS IN AN URBAN ENVIRONMENT

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## 1. INTRODUCTION

In recent years there have been significant changes in the sources, character and pervasiveness of environmental noise in the United Kingdom. For example, there has been a substantial increase in the volume of traffic on most existing roads. New roads and motorways have been constructed with a large proportion of these in previously 'quiet' areas. However, reductions have been achieved in the levels of noise emitted by individual vehicles and further curtailments are planned in the near future.

There have also been significant changes in railway operations in recent years. There has been a steady trend of moving freight from rail to road. On many rail routes the number of passenger trains has been substantially reduced, while on others a more frequent service has been introduced. A switch from jointed track to continuously welded track has occurred on many lines and diesel powered drive units have been replaced with electrically powered alternatives. The latter two developments have resulted in faster train speeds in many instances. Finally, several light rail systems have been introduced into urban areas and several more are at the advanced planning stage.

Over recent years there has been a decline in traditional industries particularly in recognised manufacturing areas. Many of the industries which remain have reduced the environmental impact of their operations in response to both internal and external pressures. These industries have generally become leaner and more efficient and may now no longer operate night shifts or evening (so called 'twilight') shifts.

Increasing numbers of aircraft are flying into and out of the established airports in the United Kingdom. However, some of the noisier pure jet aircraft have been silenced, banned or phased out of use to be replaced with quieter wide bodied aircraft.

The object of the project described in this paper is to establish whether or not the above changes and other less obvious changes, have resulted in an increase or decrease in general environmental noise in a large urban area, like Birmingham, over recent years. This objective is achieved by comparing the noise levels recorded at 28 sites in Birmingham in the early 1980s with the noise levels obtained at the same or adjacent sites in 1994.

## 2. PREVIOUS WORK

Several studies have been carried out in recent years into community response to environmental noise from various sources (1, 2 and 3). The latest of these (3), carried out by the Building Research Establishment, indicates that around 28% of the population of the United Kingdom object in some way to road traffic noise, 16% object to aircraft noise and 4% object to railway noise (industrial and commercial noise was not covered in the survey). This, coupled to the fact that Local Authorities receive an escalating number of noise complaints each year (4), shows the level of public concern about environmental noise issues.

However, there is little objective data on how general environmental noise levels, particularly in densely populated urban areas which normally experience most noise pollution, have changed in recent years. Most of the limited evidence which is currently available relies on the results of two studies. The first of these was carried out by the Transport and Road Research Laboratory in 1972 (5). The arithmetic mean LA10 (18 hour) noise level for the whole of this survey was 57dB. The second study, by the Building Research Establishment, was started in 1990 and reported in 1993 (6). This study was broadly carried out in a similar manner to the study of 1972. The arithmetic mean LA10(18 hour) noise level for this survey was 55.6dB. Therefore it could be concluded that tighter noise restrictions of new vehicles, enforced under the Construction and Use Regulations (7), have had an overall beneficial effect. This is despite the fact that the volume of traffic on roads approximately doubled and the length of public road increased by around a quarter in between the two surveys.

## 3. DESCRIPTION OF THE PROJECT AND SURVEY PROCEDURES

In the late 1970s, there was a general perception that the noise climate in the City of Birmingham was deteriorating, particularly as a result of increased noise from transportation sources and an increasing number of noise problems arising from industrial premises, which were not always tackled effectively with nuisance legislation. Therefore, in the early 1980s a decision was made to undertake a transportation and background noise survey at various sites across the City. Eventually 28 sites were selected in a somewhat random manner. However, all the sites were adjacent to existing transporation noise sources and were in well established areas where the effect of future local developments on the existing noise climate was judged to be insignificant. Seventeen of the sites were adjacent to 'A' class roads. Two were adjacent to minor, though relatively busy roads. Three were close to either the M6 or M5 motorways. One was adjacent to a heavily trafficked junction of two 'A' class roads. Five were close to railway lines. Many of these sites were also close to major industrial areas/premises where the night time background levels were controlled by noise from industrial processes.

The original intention was to repeat the entire monitoring exercise on a regular basis to establish trends in transportation noise and background noise levels. Unfortunately, due to other more pressing commitments, the project was 'shelved' shortly after its inception. However, to help fulfill Birmingham City Councils Green Action Plan commitment to regularly monitor noise levels in the City, the initial programme of noise monitoring was repeated in 1994. Efforts were made to carry out the monitoring at precisely the same locations as used in the 1980s. In the relatively few cases where this was impossible, sites as close as practical to the original sites where selected. During every monitoring exercise, the noise monitoring equipment was installed with the microphone placed one metre outside a window overlooking the dominant day time noise source.
In both the 1980s and 1994 the monitoring units were programmed to record at least the hourly LA10, LA50, LA90 and LAeq levels for a minimum period of 48 hours at each site. All measurements were undertaken during the normal working week but excluding Monday mornings and Friday afternoons.

## 4. STATISTICAL ANALYSIS OF RESULTS

From the hourly based data the LA10, LA90 and LAeq levels for the following time periods have been calculated.
LA10(18 hour) 0600 to 0000, LA10(6 hour) 0000 to 0600
LA10(2 hour) 0700 to 0900, LA10(3 hour) 1600 to 1900
LA90(2 hour) 0200 to 0400, LA90(6 hour) 1000 to 1600
LAeq(24 hour), LAeq(6 hour) 0000 to 0600
LAeq(18 hour) 0600 to 0000
As 48 hours of data was normally obtained during each monitoring exercise it has generally been possible to calculate 2 values for each of the above indices (period 1 and period 2 values). The results have been analysed to produce the change in each noise index at each site, between the early 1980s and 1994, from the average of the period 1 and period 2 values. In this analysis, account has been taken of any errors, anomalies or inconsistencies in the primary noise data and of the influence of adverse weather conditions. As a consequence of this, data from a small number of sites has been excluded from the final results.
The changes in noise levels obtained as described above, have been used to derive the mean changes in noise level in all the indices as shown in Table 1. The standard deviations of the results used to calculate these mean values are also shown.

## 5. DISCUSSION

Changes in LA10 Levels

It is clear from the results in Table 1 that there has been no significant change in noise levels measured in the index normally used to evaluate and describe traffic noise levels in the United Kingdom, i.e. the LA10(18 hour) level. This is despite the fact that generally traffic flows appear to have increased significantly in Birmingham since the early 1980s. Possible explanations include the fact that noise from individual vehicles has been reduced in recent years (7) and that average traffic speeds may well have decreased due to additional congestion which is particularly evident in major cities during peak traffic flow periods. This is highlighted, to a certain degree, by the marginal decrease in traffic noise shown by the LA10(2 hour) for the morning 'rush hour' period and the LA10(3 hour) for the evening 'rush hour' period. However, one of the more important conclusions which may be drawn from the results of the study is that road traffic noise during night time periods has increased quite significantly according to the 2.1dB increase in LA10(6 hour) levels shown in Table 1. This must throw further doubt on the continued use of a noise index to access the impact of traffic noise, which excludes noise data from this sensitive night time period and is based on social survey data obtained in the 1960s and reported by the Wilson Committee (8).

Changes in LA90 Levels

The results in Table 1 indicate that night time LA90(2 hour) background noise levels have increased significantly since the early 1980s. This is despite the fact that in Birmingham, many industrial processes which controlled or at least influenced the night time background noise levels in the early 1980s are now closed down, are not operating at night, or have reduced noise emissions. Therefore it must be concluded that the increase in background noise levels is in the main due to increased road traffic. There has also been a small increase in LA90(6 hour) day time background levels which may be explained by an increase in general (distant) road traffic noise which is not accounted for by the LA10(18 hour) index.

Changes in LAeq Levels

The change in LAeq(24 hour) levels shown in Table 1 are insignificant. If the train noise sites are excluded there is a small increase in average noise levels with a relatively low standard deviation (1.3) across the individual sites. When the five train noise sites are included there is a marginal decrease in average noise level. This suggests that the most marked changes in LAeq levels have occurred at these sites. This fact is confirmed by the changes in LAeq(6 hour) night time and LAeq(18 hour) day time noise levels measured at these five train noise sites as both these indices show a marked decrease in level of around 5dB. If this is the case nationwide it could be suggested that people are unlikely to complain about or object in some way to train noise even if they live close to a railway line. Therefore it may be unwise to use the results of recent social surveys to assess the potential impact of new railway lines or to develop noise insulation standards for railways.

## 6. CONCLUSIONS

The conclusions which may be drawn from this study are as follows:

a) The general noise levels in an industrial urban environment, like that found in Birmingham, have not changed significantly over the last decade to decade and a half when assessed in terms of LAeq (24 hour) levels.

b) Day time road traffic noise levels have not changed significantly over the same period. Furthermore, road traffic noise levels during 'rush hour' periods have, if anything, decreased. This is probably the result of increased congestion on many of the roads surveyed.

c) Night time road traffic noise levels have increased quite significantly over the period in question (by around 2dBA). This undoubtedly brings into question the continued use of the LA10(18 hour) levels to evaluate traffic noise as this index completely discounts the night time period and at best, was only loosely derived from social surveys carried out in the 1960s.

d) There has been an increase in LA90 night time background noise levels of around 2dB over the last decade to decade and a half. This must be viewed in the context of a general decline in industrial activity at night over the period in question. The most likely explanation is an increase in night time background traffic noise throughout areas like Birmingham. Therefore, the so called 'creeping ambient' is still in evidence in urban areas but is now apparently controlled by road traffic rather than industry.

e) Finally, there appears to have been a very significant reduction in train noise over the period in question (of the order of -5dBA). This is for a variety of reasons including the reduction in passenger and freight train services which has occurred in recent years. It could be suggested that people are unlikely to complain about or object to a source of environmental noise which has, in the main, decreased in magnitude. This therefore must throw some doubt on the validity of using the results of recent social surveys on train noise to assess the potential impact of new railway lines or to produce noise insulation criteria for residential developments affected by railway noise.

## 7. REFERENCES

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TABLE 1
MEAN CHANGES AND STANDARD DEVIATION OF CHANGE

| | Noise Index | Number of sites | Mean change in index | Std deviation of individual changes |
|---|---|---|---|---|
| 1) | LA10(18 hour) (0600 to 0000) | 20 road traffic sites | +0.0dB | 1.5 |
| 2) | LA10(6 hour) (0000 to 0600) | 20 road traffic sites | +2.1dB | 2.4 |
| 3) | LA10 (2 hour) (0700 to 0900) | 20 road traffic sites | -0.4dB | 1.6 |
| 4) | LA10(3 hour) (1600 to 1900) | 20 road traffic sites | -0.3dB | 1.8 |
| 5) | LA90(2 hour) (0200 to 0400) | 20 road traffic + 1 train site | +2.1dB | 4.1 |
| 6) | LA90(6 hour) (1000 to 1600) | 20 road traffic sites | +0.7dB | 2.3 |
| | | 20 road traffic + 3 train sites | +0.6dB | 2.4 |
| 7) | LAeq(24 hour) | 20 road traffic sites | +0.3dB | 1.3 |
| | | 20 road traffic + 5 train sites | -0.8dB | 2.6 |
| 8) | LAeq(6 hour) (0000 to 0600) | 5 train sites | -5.2dB | 3.5 |
| 9) | LAeq(18 hour) (0600 to 0000) | 5 train sites | -4.9dB | 2.0 |

N.B. The LA10 and LA90 levels are not the levels over the periods quoted. They are the arithmetic mean of the hourly levels over the periods quoted.