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SOCIAL DEPRIVATION AND ACCESSIBILITY TO QUIET AREAS IN SOUTHAMPTON

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1 INTRODUCTION

It has been suggested that access to so-called "Quiet Areas" could be beneficial to subjects with health problems. A number of studies have also indicated a correlation between social deprivation and exposure to noisy environments. The European Noise Directive (END) provides a framework for identifying Quiet Areas in urban agglomerations. This study proposes a new indicator that characterises accessibility to quiet spaces, using Geographical Information System software in conjunction with END noise mapping results. This metric is applied to determine correlations between social deprivation and access to quiet areas in the city of Southampton.

2 SOCIAL DEPRIVATION AND NOISE EXPOSURE

2.1 Deprivation indices in England

In order to identify the most disadvantaged areas in England deprivation indices are used so that resources can be appropriately targeted.

Poverty can be defined as not having enough financial means to meet needs. On the other hand, deprivation refers to unmet need, which is caused by a lack of resources of all kinds, not just financial.

To be able to measure deprivation at a smaller spatial scale, studies have been conducted at Lower Super Output Area (LSOA) level.

Super Output Areas (SOAs) are a unit of geography used in the UK for statistical analysis. They are developed and released by Neighbourhood Statistics.

SOAs were created with the intention that they would not be subject to frequent boundary change. This makes SOAs more suitable than other geography units (such as wards) because they are less likely to change over time, and thus SOAs are more suitable to change over time analysis.

There are three layers of SOAs (i.e. three different but related geography boundaries). These are:

- Lower Layer - Minimum population 1000, mean population 1500. Built from groups of Output Areas. Commonly known as Lower Layer Super Output Area (LSOA).There are 34,378 LSOAs in England and Wales.

- Middle Layer - Minimum population 5000, mean population 7200. Built from Lower Layer SOAs. Commonly known as Middle Layer Super Output Area and abbreviated to MSOA. There are 7,193 MSOAs in England and Wales.

- Upper Layer - Commonly known as Upper Layer Super Output Area (USOA).

The Indices of Deprivation 2007 for England take into account seven domains of deprivation[4]:

- Income deprivation
- Employment deprivation
- Health deprivation and disability
- Education, skills and training deprivation
- Barriers to housing and services
- Living environment and deprivation
- Crime

Each domain is assessed using a number of indicators, such as household overcrowding, criminal damage, houses without central heating and so on. 38 indicators have been used in total. None of these indicators take into account environmental noise pollution[4,5].

2.2 The impact of noise exposure

It has been widely document that environmental noise has a cumulative adverse effect on health[1]. It is now accepted that continuous noise exposure above certain levels correlate with an increase in annoyance and sleep disturbance. Furthermore, it has been shown that environmental noise near schools can have a detrimental effect on the academic attainments of primary school children[2].

However, environmental noise exposure is not used as an indicator for social deprivation studies in England. Therefore the question arises: are the most vulnerable people in cities more likely to live in areas with a high environmental noise exposure?

Subjectively it would appear that this is not necessarily the case. One needs only to walk along a very affluent area of London such as Knightsbridge to see that it suffers from very high levels of road traffic noise.

Therefore it would appear that high levels of traffic noise do not deter affluent individuals to buy property in desirable parts of a city. There may be several reasons for this. For example wealthy people can afford to spend extra money on high standards of acoustic insulation, they may own other properties in quieter locations in which they can retire when a more tranquil environment is desirable or there may be a “quiet space”, such as a park, in the vicinity of their property. Following our previous example, one of the reasons that Knightsbridge is such a desirable location in London is the vicinity of Hyde Park.

So the question regarding the relationship between social disadvantage and exposure to noise should be reassessed. It could be said that “noise poverty” reflects the lack of resources to mitigate noise exposure, and these resources are effective noise insulation at home and easy access to quiet spaces.

3 QUIET AREAS AND THE EUROPEAN NOISE DIRECTIVE

Through the realisation that noise pollution is still a worsening problem; the European Union has started to coordinate policies that aim to tackle this problem. It has stipulated continuous noise monitoring in urban agglomerations, implemented public information campaigns and requested Local Authorities to produce long term noise action plans.

The European Parliament and the Council adopted Directive 2002/49/EC relating to the assessment and management of environmental noise. Its general aim being 'to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise'.

3.1 Definition of a Quiet Area

Based on the recommendations[3] from the Department for Environment, Food and Rural Affairs, Quiet Areas are identified in agglomerations based on the selection of an appropriate, existing dataset, e.g. public and open spaces in the UK, and subsequent reduction of the dataset by the successive application of filters related to for example, land type, a pre-determined noise level (at least part of the candidate area must fall within the noise band < 55 dB L_{day}, as determined from the first round of noise mapping) and a minimum area (the candidate area must be at least 9 hectares).

3.2 Southampton parkland

Southampton is the largest city in the county of Hampshire on the south coast of England. It lies at the northernmost point of Southampton Water at the confluence of the River Test and River Itchen, which divides the city into an eastern and a western half, with the River Hamble joining to the south of the urban area. The local authority is Southampton City Council.

For the purposes of the END, the city is part of the Southampton Agglomeration, which also comprises Eastleigh to the North and other smaller conurbations totalling 295,000 inhabitants. This paper will focus on the city of Southampton exclusively.

Southampton's parks make it the one of the greenest cities in Southern England. Close to the Old Town are seven formal parks which were originally common land in medieval times. The large 133 hectares Common, located relatively close to the city centre, is designated a Site of Special Scientific Interest.

Other large parks are Mayfield Park and Riverside Park (figure 1). The table below summarises all parks in Southampton sorted by their extension.

Name	Extension (hectares)
The Common	133.5
Southampton Municipal	52.0
Riverside Park	26.9
Mayfield Park	26.2
Peartree Green	12.1
Mansel Park	10.0
Green Park	6.6
Andrews Park	6.1
Hoglands Park	5.2
Mayflower Park	4.6
Freemantle Common	3.6
Palmerston Park	3.3
Hinkler Green	2.9
Watts Park	2.6
Houndwell Park	1.8
Freemantle Lake Park	1.7
St James Park	1.5
Queen's Park	1.5

Table 1. - Parks in Southampton

The first five parks in table 1 are larger than nine hectares. Unfortunately the results of the first round of END for Southampton do not include noise exposure modelling for Southampton Municipal, Riverside Park and Mayfield Park (figure 2). At the time of writing this the authors could not establish the reasons why three of the largest parks in the city were left out from the L_{den} calculations.

From these three parks that have no END data available, Riverside Park may not be considered a Quiet Area due to its location under the noise footprint of Southampton-Eastleigh Airport and its proximity to the M27 motorway. Southampton Municipal's is mostly occupied by a golf court and other sport fields. Mayfield Park is located in an area of relative low noise and could be considered a candidate for "Quiet Area" designation.

There exists END noise data available for three parks larger than 9ha: the Common, Mansel Park and Peartree Green. Mansel Park's L_{den} due to road traffic is larger than 55dB. Peartree Green's L_{den} is also larger than 55dB but in this case rail noise is the dominant source. This leaves the Common as the clear candidate for "Quiet Area" designation.

Therefore in this paper the Common (in the western half of the city) and Mayfield Park (in the eastern half) will be considered Quiet Areas for the purpose of calculating accessibility.

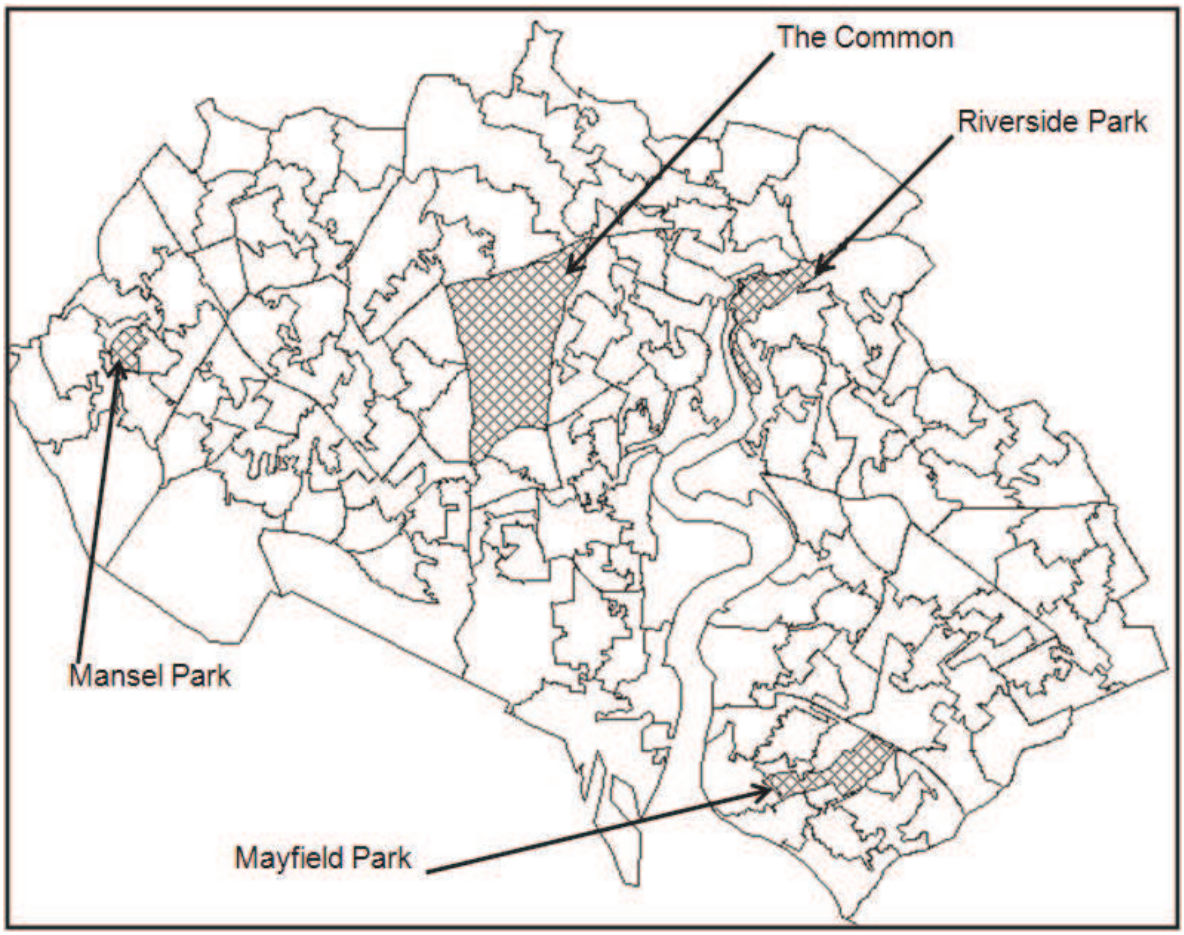

Figure 1.- Southampton city Lower Super Output Area divisions and main parks

3.3 First round END results

Figure 2 shows modelled L_{den} road noise levels for Southampton. The areas not modelled are shown in white and are not populated. Crucially, some of these areas are parks that may be candidates for Quiet Area designation.

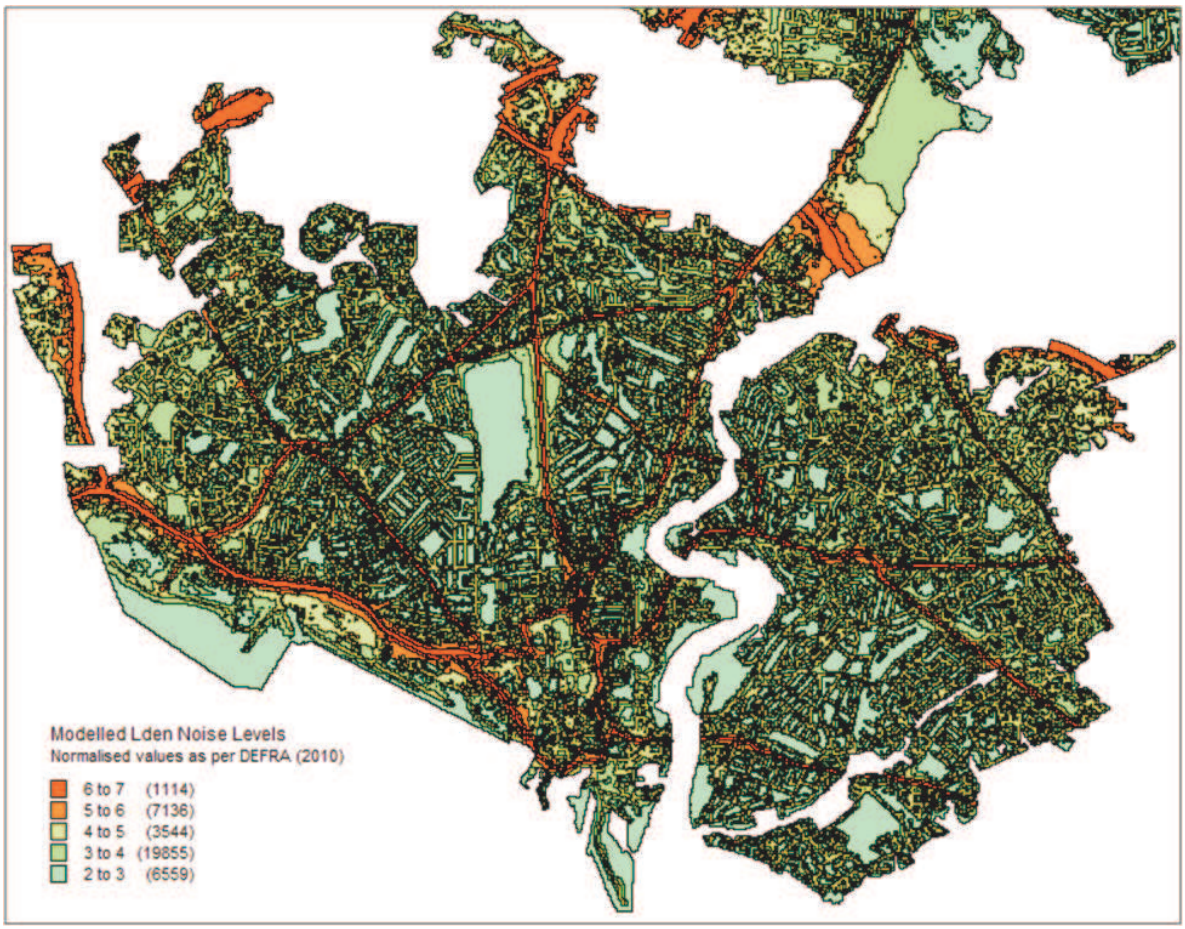

Figure 2.- Road noise Lden for Southampton

Grid Code	Lden Level (dB)
7	≥ 75
6	70.0-74.9
5	65.0-69.9
4	60.0-64.9
3	55.0-59.9
2	< 55

3.3.1 Calculating mean exposure for each LSOA

Initial noise data was sourced from the DEFRA noise model. The resulting GIS file took the form of semi-contiguous regions of modelled noise data, which, in itself was difficult to disaggregate back into the individual 10x10m grid used to model the data. Therefore, the relevant data were forced into a 100x100m grid, the decreased resolution being due to processing restrictions within our GIS

software package (MapInfo). An average for each 100x100m square was calculated from the initial noise data. This data was then used to calculate a mean noise level per LSOA (figure 3).

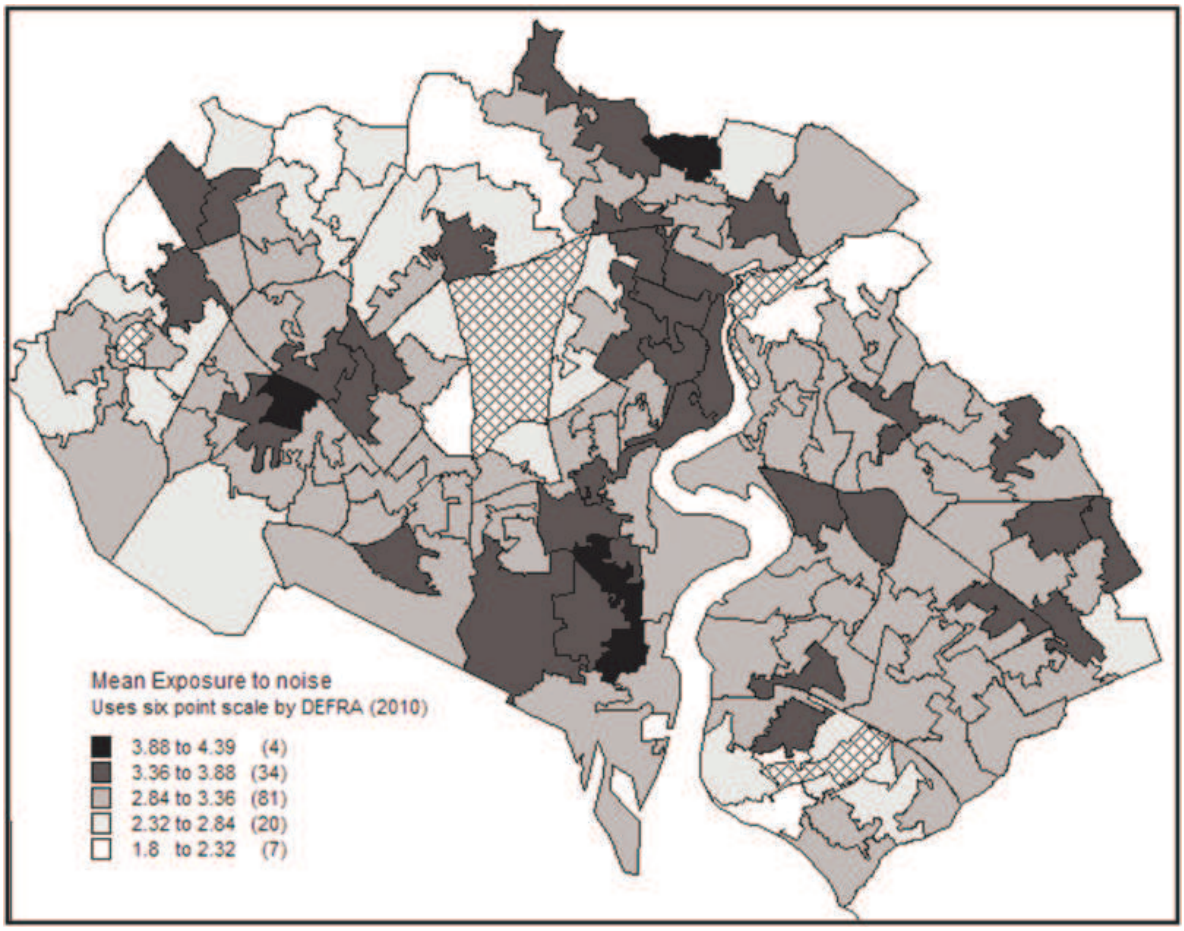

Figure 3.- Calculated Mean Noise Exposure at LSOA level

With this data in hand it is possible to search for correlations with any deprivation index. However noise exposure alone is not a deprivation quality, but the lack of means to combat noise exposure is.

4 ACCESIBILITY TO QUIET SPACES

4.1 The need for an accessibility metric

As it has been mentioned, the detrimental effect that noise has on the public is not taken into account in social deprivation indices. We propose to use the lack of access to quiet spaces relative to noise exposure as an indicator of deprivation.

This indicator may help planners in identifying the value of Quiet Areas in the urban social context and may be used as a tool to implement action plans as mandated by the END.

4.2 Combined noise exposure and accessibility metric

In order to combine noise exposure data with accessibility the distance to the nearest Quiet Area (either the Common or Mayfield Park) were calculated for every LSOA.

The *accessibility level* is then computed using the following formula:

$$L_{acc}=10\log(D/D_{min}) \quad [1]$$

Where D is the distance to the nearest Quiet Area and D_{min} is the shortest from all distances D. The accessibility indicator is then calculated by taking the average of the L_{den} noise exposure and L_{acc} for each LSOA. The results are shown in figure 4 below.

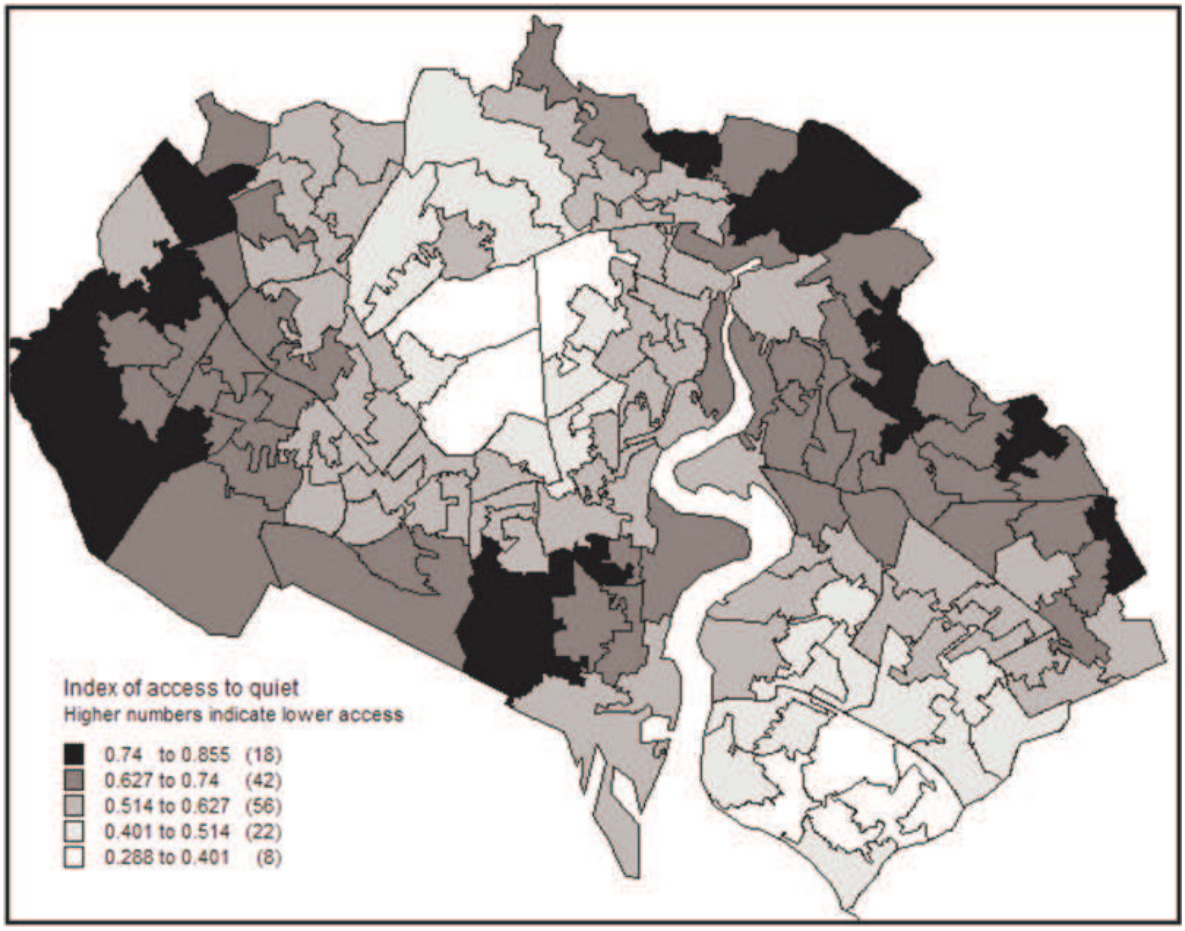

Figure 4.- Calculated accessibility indicator at LSOA level

5 CORRELATIONS WITH DEPRIVATION INDICATORS

All social data was sourced through the Office of National Statistics (ONS), from their 2007 dataset relating Indices of Deprivation, available at <http://www.neighbourhood.statistics.gov.uk>

The correlation test used is a Spearman's Rank Correlation (ρ) test, corrected for ties. All variables tested for rank correlation with the proposed accessibility index:

Variable correlated against accessibility indicator	ρ
Mean exposure	0.420**
Score of housing in poor condition	0.063
Score of health, deprivation and disability	-0.291**
Score of Multiple Index of Deprivation	-0.354**

** denotes significant correlation at ρ<0.01, with a two tailed test.

The correlation with mean exposure is high, perhaps, not unsurprising, given how we have calculated our indicator The correlation with housing might be expected to be positive, but this is complicated by the fact that mean exposure and deprivation are not correlated (ρ = -0.145), and deprivation and housing condition are highly significantly correlated (ρ = -0.486).

This lack of correlation is somewhat surprising at face value, yet is understandable given the urban development of Southampton, with relatively affluent suburbs being fringed by major roads, such as the M3, M27, and M271. Also, since distance from Mayfield Park is also factored into our indicator, areas with relatively poor housing, such as Woolston, possibly benefit from their geographical location i.e. being relatively close to a 'quiet area'. However, the highly significant negative correlations the accessibility indiactor with deprivation in its broad sense and health deprivation, suggest that there is some concern that those who are most deprived socially experience greater levels of noise.

6 ACKNOWLEDGEMENTS

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7 REFERENCES

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