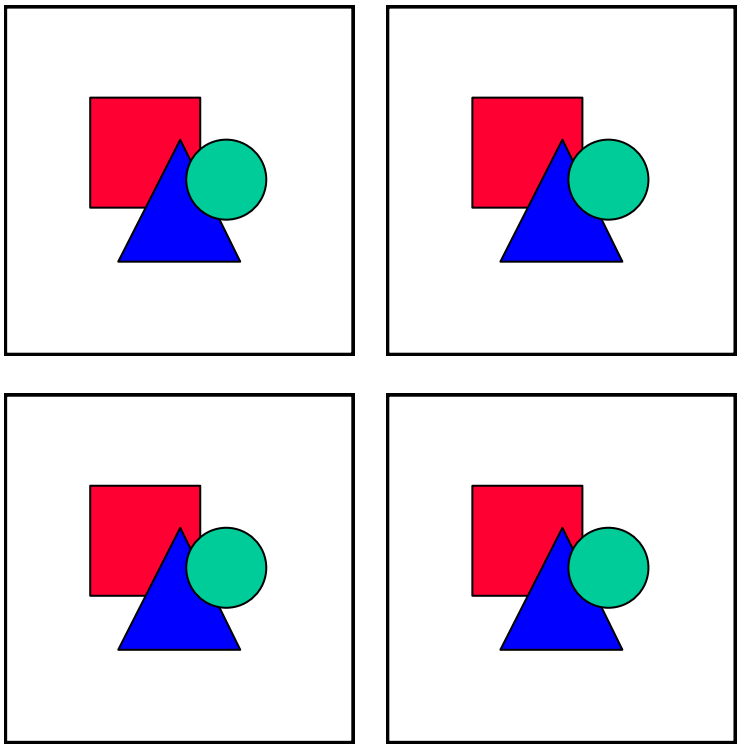
AEAT-5624 Issue 2

Pilot Study of Exposure of Households to Roadside NO_2

Report to the Department of Environment Transport and the Regions, The Welsh Office, The Scottish Office and the Department of Environment for Northern Ireland

Katie King, John Stedman and Ray Goodwin



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AEA Technology Environment
D5 Culham
Abingdon
OX14 3ED
Telephone +44 (0)1235 463715
Facsimile +44 (0)1235 463574

	Name	Signature	Date
Author	Katie King John Stedman Ray Goodwin		
Reviewed by	John Stedman		
Approved by	Garry Hayman		

Executive Summary

The Government has recently published a consultation document on the Review of the NAQS which sets out proposals for amending the NAQS following a review carried out during 1998. The national modelling of roadside NO_2 concentrations, carried out as part of this review, indicated that policies currently in place or to take effect before 2005 will lead to the annual average objective being achieved at all background locations, except inner London, and at most roadside locations by 2005. However, the national modelling identified a number of major urban road links where concentrations at the roadside may exceed the objective of 21 ppb annual mean in 2005.

This report describes the methodology used and the results of a pilot study to further analyse some of the road links where concentrations at the roadside may exceed the objective in 2005. The study provides a semi-quantitative estimate of the population likely to be exposed to roadside NO_2 concentrations greater than 21 ppb annual mean in 2005, as a result of housing adjacent to major roads (within 10 m of the edge of the road) in UK cities outside London. Fieldwork has been undertaken in 14 cities, including a case study area in London.

Previous work indicated that 761 road links in the UK were predicted to exceed the NO_2 objective for 2005. In this pilot study 103 road links have been surveyed, involving collecting information on the presence of houses within 10 m of the kerb and approximate numbers of these. 23 road links have been found to have houses within this distance of the kerb, with a total estimate of more than 1,200 houses. Further analysis has been undertaken on these 23 road links, using detailed postcode data. A total of over 2,600 houses were found to exist along these road links using this method, but the datasets are not detailed enough to determine how many of these are within 10 m of the kerb.

A comparison of local and national traffic flow data for Manchester, Salford and Birmingham has also been undertaken. This has shown that the datasets of actual flow measurements in Manchester and Salford correspond reasonably well with the national data, whereas modelled traffic flows on road links in Birmingham show considerable differences from the national dataset. A comparison has also been made between predicted roadside NO_2 concentrations for 2005 using the local traffic flow data and that using the original national figures. 71% of the links analysed in this way have been estimated to have concentrations based on the local trafic flow data within a 10% range of the national modelled NO_2 concentration.

It is recommended that further work is carried out to provide a more complete analysis of potential population exposure to roadside concentrations of NO_2 or other air pollutants. Additional detailed GIS data should soon be available from the Ordnance Survey, to provide more accurate locations of houses along road links. The detailed ground truth survey data obtained during the current study could provide an excellent comparison with detailed GIS or aerial photography analysis. It is recommended that additional work be carried out to compare these methods of analysis with the results of this study so that a robust and systematic technique can be developed for use on subsequent reviews of the NAQS.

Contents

1 Introduction

1.1 BACKGROUND

The UK Government is taking active measures to improve air quality through the National Air Quality Strategy (NAQS). This Strategy defines Air Quality Standards and Objectives for eight pollutants and identifies their major sources. The NAQS gives the following objectives for nitrogen dioxide (NO_2) to be achieved by the end of 2005:

- Annual mean: The annual mean must not exceed 21 ppb.
- Hourly mean: The hourly mean must not exceed 150 ppb.

In addition the European Union 'Daughter Directive' gives the following proposed limit values for NO_2 to be achieved by 1 January 2010:

- Annual mean limit value of 40 μgm^{-3} (21 ppb).
- 1-hour limit value of 200 μgm^{-3} (104.6 ppb), not to be exceeded more than 18 times a year.

The annual mean objective and limit value are likely to be the most stringent of the targets, particularly at the roadside.

The Government has recently published a consultation document on the Review of the NAQS (DETR et al, 1999). This report sets out proposals for amending the NAQS following a review carried out during 1998.

The national modelling of roadside NO_2 concentrations (Stedman et al, 1998), carried out as part of this review, indicated that policies currently in place or to take effect before 2005 will lead to the annual average objective being achieved at all background locations, except inner London, and at most roadside locations by 2005. However, the national modelling identified a number of major urban road links where concentrations at the roadside may exceed the objective.

One of the key uncertainties within the national modelling of NO_2 is the question of public exposure. The approach adopted in the Strategy is to apply the objectives where members of the public are likely to be exposed over the averaging time of the objective. This includes roadsides in the case of annual averages, but only where there are houses, schools, hospitals etc. along the road, and then only when the building facade is close to the kerb - the location thought to best represent long term exposure. The national models used for the review of the NAQS simply predicted NO_2 at the roadside and did not consider the location of housing. NO_2 concentrations also decrease significantly with distance away from the immediate vicinity of the road. If housing is located more than about 10 m from the edge of the road, then NO_2 levels there are likely to be lower than the roadside levels predicted by the model. A preliminary assessment of a sample of road links outside London predicted to exceed the annual average NO_2 objective indicated that a significant proportion have no people living close to the road.

1.2 STUDY OBJECTIVE

The main objective of this pilot study was to provide a semi-quantitative estimate of the population likely to be exposed to roadside NO_2 concentrations greater than 21 ppb annual mean in 2005 as a result of housing adjacent to major roads (within 10 m of the edge of the road) in UK cities outside London. Additional work has been carried out within London, consisting of a case study area along the North Circular Road (A406).

A secondary objective of the study was to consider if the national scale traffic flow data are consistent with local inventories and whether those road links identified in the national modelling are consistent with those considered to be an issue by local authorities.

1.3 REPORT STRUCTURE

This report describes the methodology used in the field survey and in the analysis of the survey data and additional GIS data (in section 2). The results are presented in section 3. Conclusions are provided in section 4.

2 Methodology

2.1 SELECTION OF ROAD LINKS IN THE SURVEY

Estimates of roadside NO_2 concentrations in 2005 have been taken from the national modelling work which was conducted for the review of the National Air Quality Strategy (DETR et al, 1999). National modelling results indicated that a total of 761 major urban road links would be at risk of exceeding the annual mean objective of 21 ppb in 2005. 395 of these links are in inner London, 100 in outer London and 266 in other cities (Stedman et al, 1998). This pilot study has focused on approximately 100 links with the highest estimated concentrations outside London and also on the North Circular Road (A406) in London. Details of these links are shown in Appendix 1, for outside London, and in Appendix 2 for the A406. The survey in each city did not include all the road links with estimated concentrations of over 21 ppb, because of time constraints. For those locations outside London, a core set of the top 60 road links were surveyed and road links from a secondary set of the next 40 were covered in similar locations, where possible. Those road links not included in the survey, but in the top 100, were in Coventry, Derby, Bradford, Frimley and Nottingham. The road links that have been surveyed are marked in the tables in Appendices 1 and 2.

Detailed information on the split between built-up and non-built-up road links was not available for the major roads in Northern Ireland at the time of the national modelling used in this report . The only non-motorway in Northern Ireland links with estimated concentration greater than 21 ppb in 2005 are the A12 West Long and A55 University Road/Malone Road in Belfast. The likelihood of housing close to these roads has not been assessed. However, further GIS analysis is being undertaken as part of the European Union Daughter Directive Article Five Assessment. This provides an approximate split of built-up and non-built-up roads based on land cover information and will be used to improve future air quality modelling in Northern Ireland.

2.2 FIELD SURVEY

For each road link visited, various information was recorded using the questionnaire shown in Table 1. This included noting the presence of houses, number of houses and distances of the building facade from the kerb, along with other descriptive information about the road link such as number of lanes of traffic and the nature of other buildings. Video and digital photographs were also taken to provide further contextual information.

2.3 GIS ANALYSIS

For those road links where houses were found within 10 m of the kerb, GIS analysis has been used to combine road link and postcode delivery point data to derive additional estimates of numbers of dwellings along these links. A combination of field results and GIS analysis was required because the national road network, postcode and population GIS data sets are generally only accurate to within several hundred metres.

Postcode information has been obtained for each of the road links where houses were reported in the field survey. These various postcode points were then located in the Unit Postcode database. This database contains details of the numbers of delivery addresses within each unit postcode area. For example, part of York Road in Leeds has the postcode LS9 9DN. Within this unit there are 31 residential delivery points and 14 business or other non-residential delivery points. The database also contains grid references for the centre of each unit postcode area, although the level of positional accuracy of these points is on average within 100 metres. It has therefore not been possible to rely on the GIS alone to make an assessment of the numbers of residences close to the roads of concern.

Table 1 Questionnaire used in survey of road links

Road link ID from GIS database
City
Name of road
Road No. e.g. A40
Length (m)
Identified correctly? Give any corrections here
Any houses within 10 m? Y / N Description of aspect. Buildings both sides?
Continue survey? Y / N
Number of houses along road or block
Distance of building facade from kerb (m)
Hospital or School on road? Y / N (details)
Number of road lanes
Location of photos and videos taken
Date / time
Initials or surveyor.

2.4 TRAFFIC FLOW DATA

The national model of roadside NO_2 concentrations uses national traffic flow information. Locally-derived traffic flow information is also available for some locations, as well as modelled flows generated by other research work. The project team has collected some of these data, for comparison with the national modelling, for Manchester, Salford and Birmingham.

Analysis has been undertaken to compare the concentrations of NO_2 that have been predicted using the national modelling and those using the above additional traffic flow data.

3 Results

3.1 FIELD SURVEY RESULTS

Appendix 3 contains a table of the questionnaire results for the 103 roads surveyed. Table 2 shows the cities in which there are road links predicted to have the highest exceedances of the 21 ppb objective for 2005 and those that have been surveyed. Table 3 contains the survey results for those 23 road links where houses were found within 10 m of the kerb.

Where a range of distances from the kerb has been noted in the survey, all houses have been included in the results even though some are slightly over 10m. There is some uncertainty over this distance and therefore these houses have been included in order to prevent an underestimate of exposure.

Table 2 Summary of Survey Results

City / Town	Number of road links exceeding objective for 2005	Number of road links surveyed	Number of road links found with houses at < 10 m
Birmingham	18	16	4
Bradford	1	0	
Bristol	8	7	0
Coventry	1	0	
Derby	1	0	
Doncaster	2	2	0
Fareham	1	1	0
Frimley	1	0	
Glasgow	3	3	0
Hull	3	3	1
Leeds	12	10	1
Leicester	6	6	1
Liverpool	16	16	6
London (A406 case study area)	36	18	5
Manchester	14	12	4
Newcastle	4	4	0
Nottingham	2	0	
Portsmouth	2	2	1
Runcorn	1	0	
Sheffield	4	3	0
Totals	136	103	23

In general, the road links that have been surveyed are inner ring-roads in cities or major radial routes into the city centres. Many are dual-carriageways alongside commercial areas. Video images have been taken on the majority of the roads surveyed (not including those in London or Manchester). Three videos are supplied with this report and details of the sequence of cities are given in Appendix 4.

It is important to note that some of the road links have been found to be open in aspect. These do not conform to the assumption that urban roads are in canyons which results in less efficient pollution dispersion and higher exposure. This may mean that the NO_2 concentrations predicted for these road links are over-estimates, but this error is difficult to quantify from the phtograph and video evidence.

Table 3 shows that Birmingham, Liverpool, Manchester and London have four or more road links where residential buildings are close to road links expected to have roadside concentrations of NO_2 greater than 21 ppb in 2005. These cities will therefore be considered in more detail below. In most of the other cities included in the survey, none of the road links had houses close to the kerb or there were very few, as in Hull, Leicester and Portsmouth. Leeds is an exception, where over 50 houses were found on one road (York Road). This particular road will therefore also be considered in more detail in this report.

Table 3 Details of road links where houses were found close to the kerb

Census ID	City	Name of road	Road no. e.g. A40	Length (m)	Aspect? Buildings both sides?	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes
6390	Birmingham	Kingsbury Road	A38	1273	wide road, housing and commercial both sides	20	5	1 school	2
16365	Birmingham	Tyburn Road	A38	1742	houses one side, commercial on the other	15	7	n	2
56399	Birmingham	Tyburn Road	A38	1201	wide open road, housing one side, commercial on the other	15	<10	n	2
57194	Birmingham	Belgrave Middleway	A4540	812	open wide road, housing	6	10	1 school	2
27932	Hull	Castle Street	A63	658	wide road	6 flats	4-5	n	3
16593	Leeds	York Road	A64	2800	housing and shops both sides	50+	3-4	1 school	2/3
56435	Leicester	King Richards Road	A47	430	wide split road	6 flats	8	n	2
7274	Liverpool	Breaze Hill	A5058	690	few houses 1 side	10	5	n	2/3
17661	Liverpool	Rocky Lane	A5049	1347	half domestic, half commercial	300+	5	n	2/3
18508	Liverpool	Bowring Park Road	A580	372	open road	20	10-12	n	3
37334	Liverpool	Queens Drive	A5058	751	wide road, housing both sides	300+	5	n	2
47917	Liverpool	Edge Lane	A5047	2085	mainly commercial, wide road	30	5	n	3
47919	Liverpool	Edge Lane	A5080	1105	wide road	200+	8-12	n	2/3
7055	London	North Circular Road	A406	2100	some housing at one end of link, rest is wide dual carriageway	20	5-10	n	3
17019	London	North Circular Road	A406	1939	commercial and residential, dual carriageway	50	5-10	n	3 each way
37112	London	Gunnersbury Avenue	A406	1100	some houses set back, some close; open road with wode central area	35	8	n	2/3
37113	London	North Circular Road	A406	2400	houses close to road, often both sides	100+	5	n	3
57056	London	North Circular Road	A406	721	2 storey houses both sides	10	10	n	
17675	Manchester	Princess Road	A5103	2169	some houses close according the photos, not quantified in survey	not quantified	<10	n	2

Census ID	City	Name of road	Road no. e.g. A40	Length (m)	Aspect? Buildings both sides?	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes
26352	Manchester	Kingsway	A56	792	wide road, some with open aspect, some houses close	20	5	n	3
28684	Manchester	Chester Rd in Stretford,	A56	137	residential type buildings, not quantified	25+	~7	n	
48023	Manchester	Regent Road	A57	495	commercial and residential, some blocks of flats very close	50+ flats	<10	n	2
28437	Portsmouth	A228 in Hilsen	A228	2158	wide road some commercial	6	8	n	3/2

3.2 ANALYSIS OF POSTCODE DATA

Table 4 below shows the estimated numbers of houses found in the field survey compared with the numbers of residential delivery points in the Unit Postcode database. The Unit Postcodes database includes all residential delivery points and not just those within 10 m of the kerb. These numbers will tend to over estimate the total population exposed to high NO_2 concentrations. However, there are also further uncertainties relating to the positions of these houses. The field data collected may correspond, in some cases, to a longer stretch of road than that defined as the road link in the model. This could be as a result of a misinterpretation of maps of the road links in the road network database, which do not all correspond to individually named roads. Hence, there may be some errors the field data. Additionally, houses adjacent to the road may have addresses, and therefore postcodes, that are in fact on other roads, such as at corner locations, in blocks of flats or where houses or gardens back on to the main road. The latter point is exemplified on road link 7055 on the North Circular Road in London. In this case, houses were found but they did not occur in the postcode database. With further analysis it was found that the address at that point is Waverley Gardens and this address has been used to find the residences by postcode.

The above factors explain some of the differences in the two estimated total numbers of houses shown in Table 4. Having considered these caveats, it can be seen that these roads have been correctly identified as having housing on them, and the estimated total numbers of houses on individual road links are broadly similar with only a few exceptions.

Figures 1 - 20 show the locations and photographs of the road links surveyed in Birmingham, Liverpool, Leeds, London and Manchester. The maps also include the locations of the postcode points in relation to the road links that have been found to have houses on. These are the postcode points that have been used to calculate the totals in Table 4. The points on the maps are not always adjacent to the road links because the positional accuracy of both of these data sets is only to about 100 m. Photographs of the road links where houses are present within 10 m of the kerb are presented in this section, where available. A full set of photographs are provided in Appendix 5. No photographs are available for Liverpool, Hull, Doncaster, Newcastle, or Portsmouth.

Table 4 Comparison of field survey and postcode data estimates of numbers of residential dwellings along road links with predicted annual mean NO_2 concentrations of >21 ppb in 2005 and houses within 10 m of the kerb

Link ID	City	Name of road	Road no.	Survey data	Data from Postcode Database		
				Count of houses within 10m of kerb	Number of residential postcode units	Example postcodes on this road	Number of residential delivery points
6390	Birmingham	Kingsbury Road	A38	20	2	B24 9PP B35 6AG	10
16365 and 56399	Birmingham	Tyburn Road	A38	30	20	B24 9RX B24 8LY B24 8DY	328 *
46398	Birmingham	Lichfield Road	A5127	3	8	B6 5RW B6 7SP	88
57194	Birmingham	Belgrave Middleway	A4540	6	1	B5 7LH	72
27932	Hull	Castle Street	A63	6 flats	1	HU1 2LY	8
16593	Leeds	York Road	A64	50+	27	LS9 6NW LS14 5AF	566
56435	Leicester	King Richards Road	A47	6 flats	1	LE3 5QG	12
7274	Liverpool	Breaze Hill	A5058	10	2	L9 1DY L9 1DZ	53
17661	Liverpool	Rocky Lane and part of West Derby Road	A5049	300+	11	L6 4BA L13 0BH	144
18508	Liverpool	Bowring Park Road (M62 link)	A580	20	4	L14 3ND L14 3NR	96
37334	Liverpool	Queens Drive	A5058	300+	6	L4 6SJ L4 6SF	172
47917 and 47919	Liverpool	Edge Lane	A5047 / A5080	230+	17	L7 0LQ L7 1QX	189 *
7055	London	North Circular Road (Waverly Gdns)	A406	20	1	NW10 7EE	40
17019	London	North Circular Road	A406	50	18	NW2 7AX NW10 1QR	251
37112	London	Gunnersbury Avenue	A406	35	6	W3 8LA W4 5QG	84
37113	London	North Circular Road	A406	100+	18	NW10 0HP NW10 1SR	357
57056	London	North Circular Road	A406	10	2	NW11 9LE NW11 9LG	41
17675	Manchester	Princess Road	A5103	not quantified	7	M14 7FG M20 1HA	65
26352	Manchester	Kingsway	A56	20	2	SK8 4PA SK8 4PB	27
28684	Manchester	Chester Rd in Stretford,	A56	25+	7	M16 0QW M16 9YD	25
48023	Manchester	Regent Road	A57	50+ flats	1	M5 4SX	1
28437	Portsmouth	A228 in Hilsen	A228	6	unknown	postcode	
TOTAL NUMBER OF HOUSES:				**1297+**			**2629**

* This is the total number of residential addresses for the total length of the road of this name, which is split into two road links in the model

Figure 1 Birmingham: Locations of road links with modelled annual mean NO_2 concentrations >21 ppb in 2005 (using the national scale model) and building facades within 10 m of the kerb, showing residential postcodes on these road links

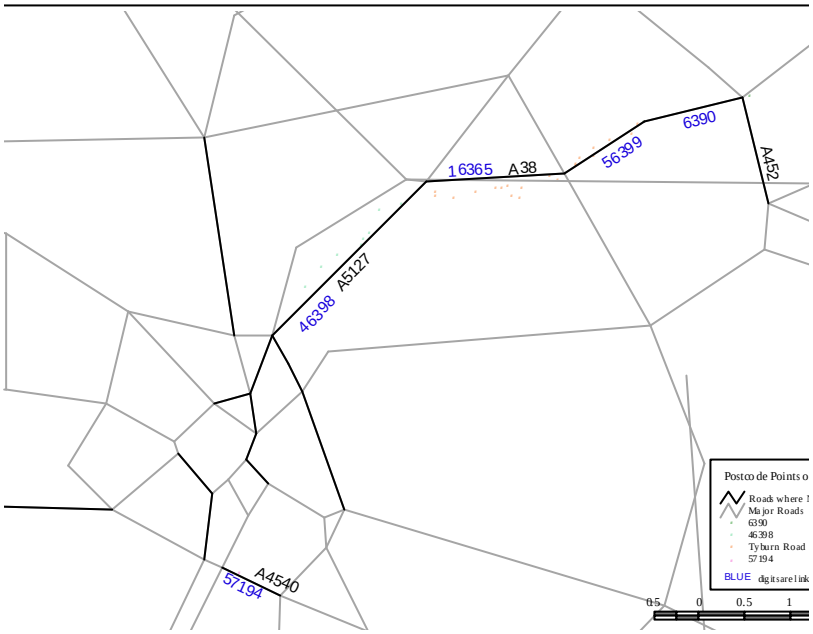


Figure 2 Kingsbury Road in Birmingham (link 6390)

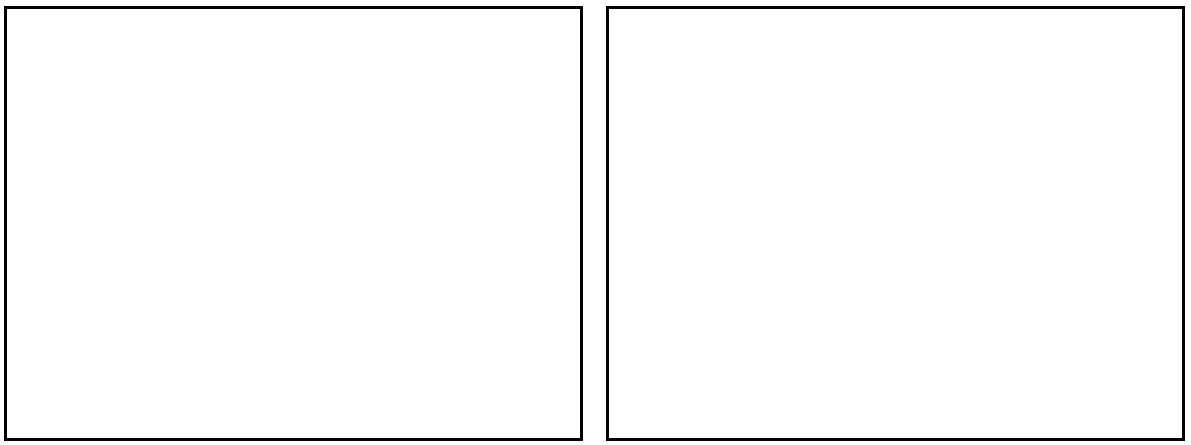


Figure 3 Tyburn Road in Birmingham (link 16365)

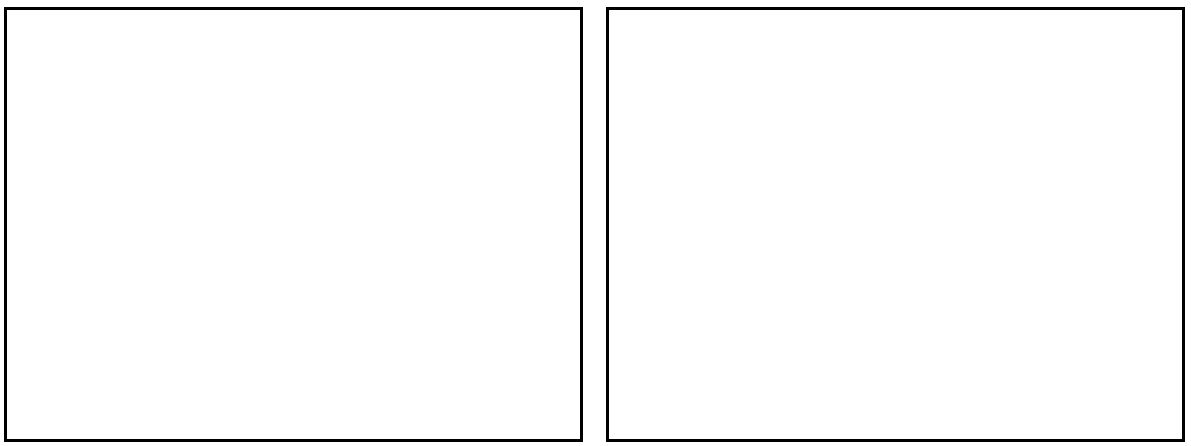


Figure 4 Tyburn Road in Birmingham (link 56399)

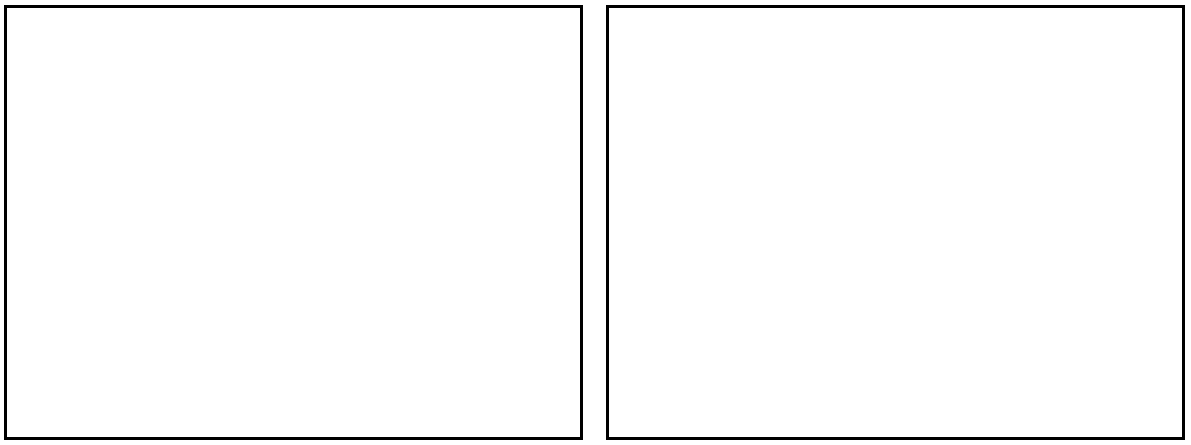


Figure 5 Lichfield Road in Birmingham (link 46398)

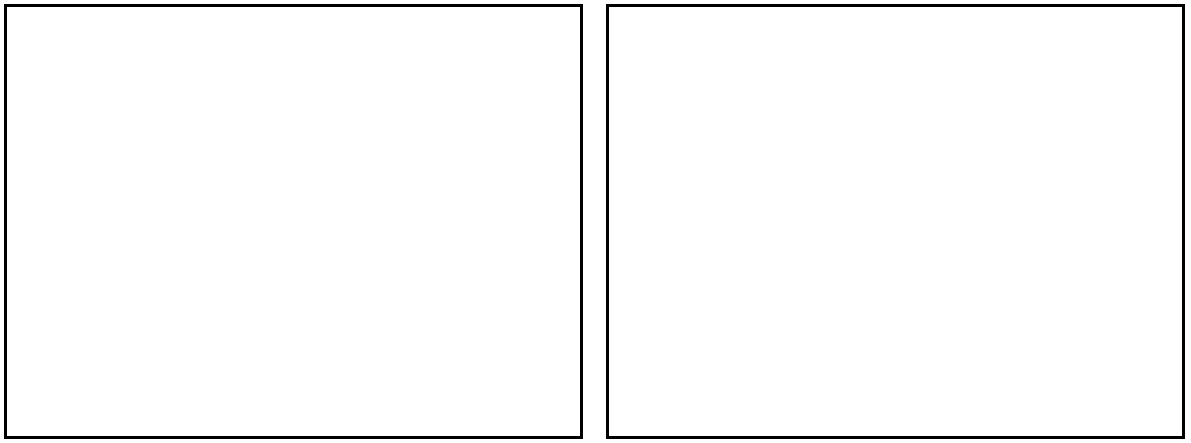


Figure 6 Belgrave Middleway in Birmingham (link 57194)

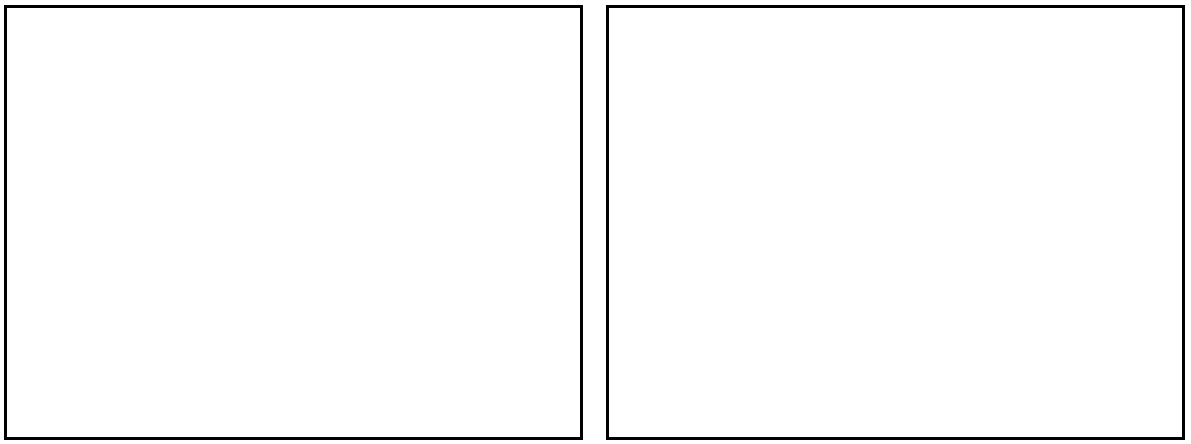


Figure 7 Leeds: Locations of road links with modelled annual mean NO_2 concentrations >21 ppb in 2005 (using the national scale model) and building facades within 10 m of the kerb, showing residential postcodes on these road links

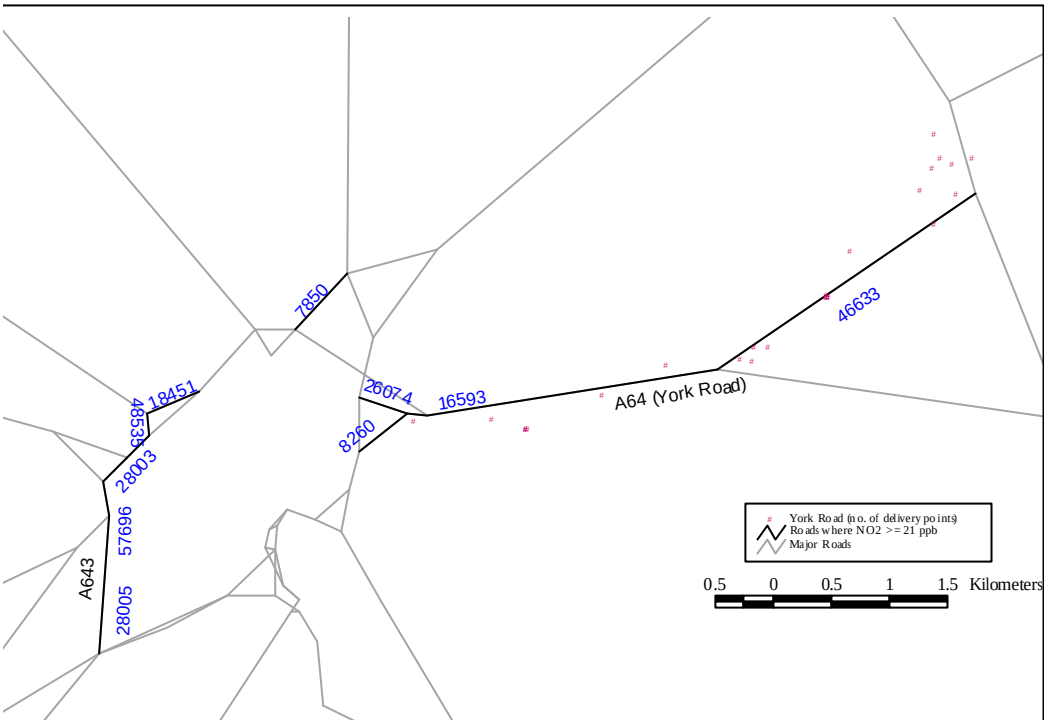


Figure 8 York Road in Leeds (link 16593)

Figure 9 London A406: London A406: Locations of road links with modelled annual mean NO2 concentrations >21 ppb in 2005 (using the national scale model) and building facades within 10 m of the kerb, showing residential postcodes on these road links

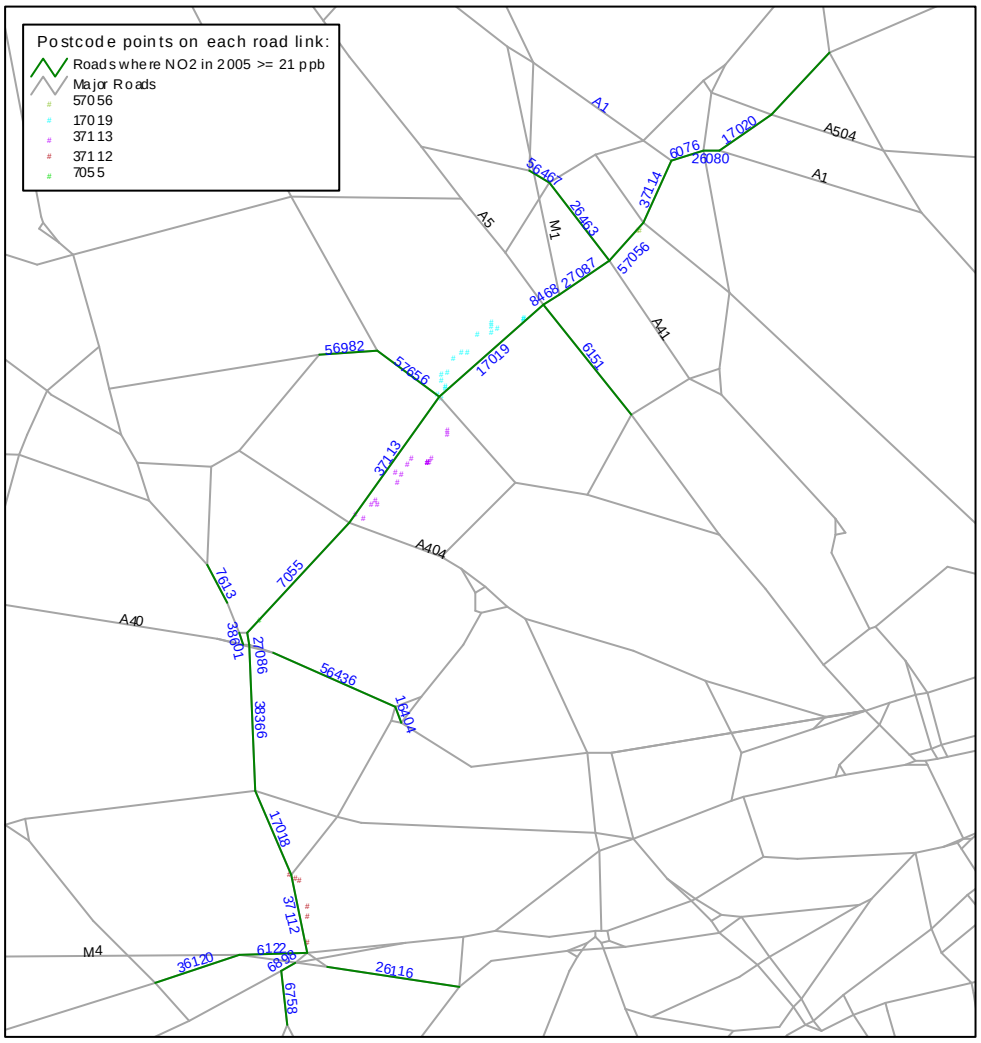


Figure 10 North Circular Road in London (link 7055)

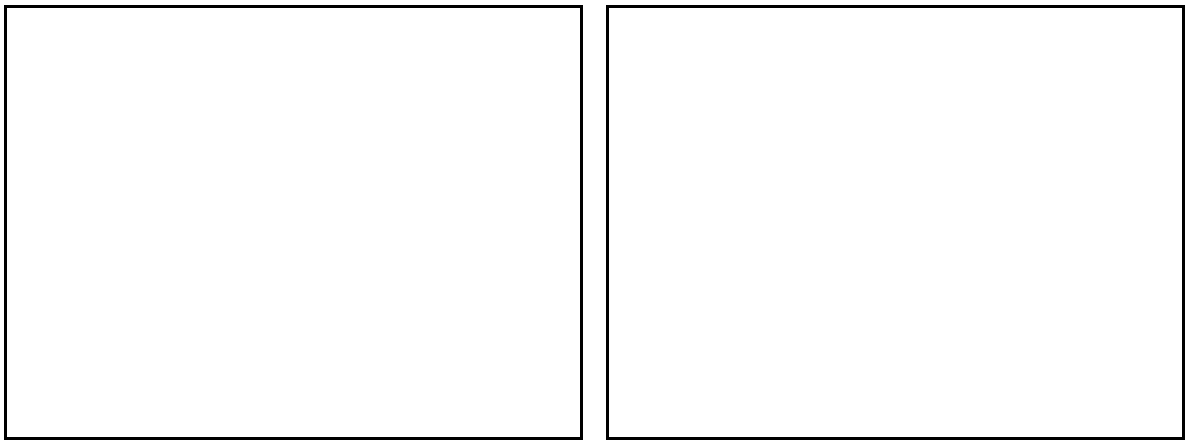


Figure 11 North Circular Road in London (link 17019)

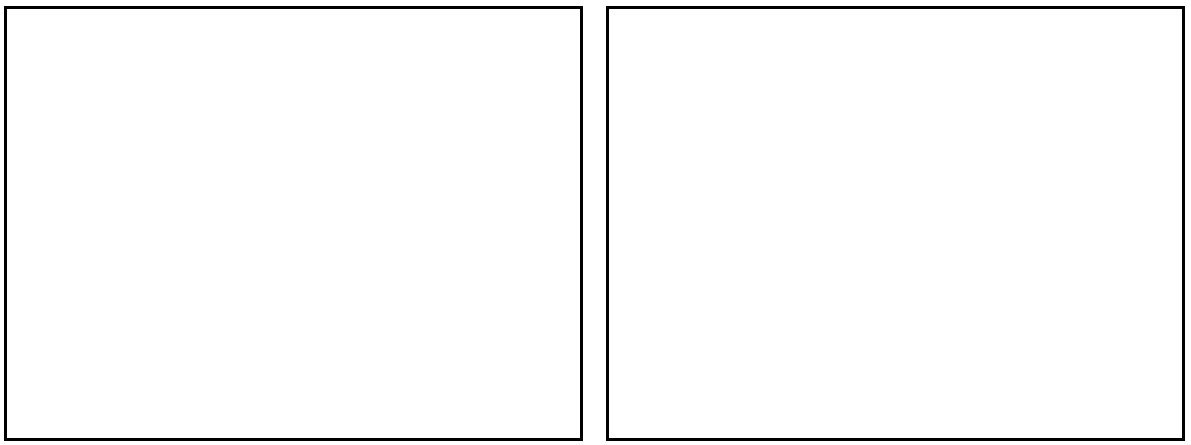


Figure 12 Gunnersbury Avenue in London (link 37112)

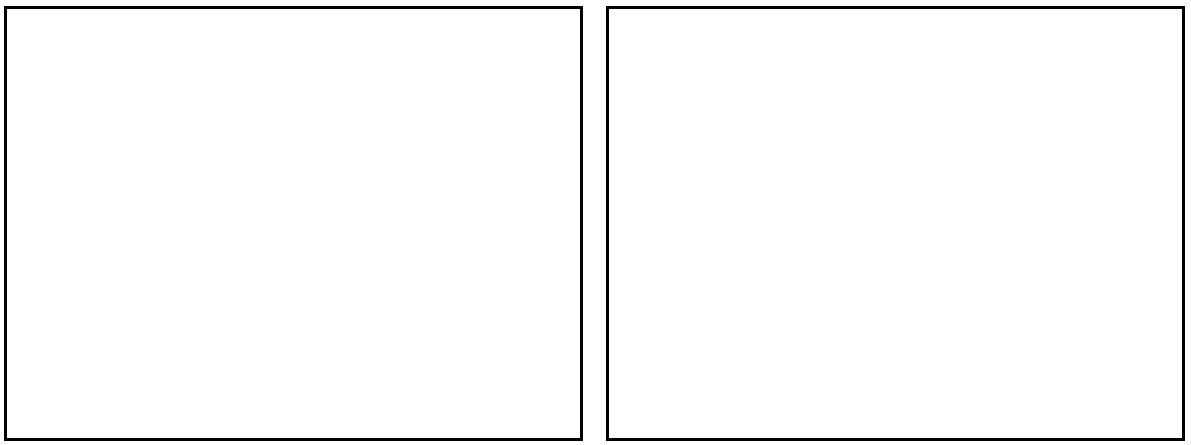


Figure 13 North Circular Road in London (link 37113)

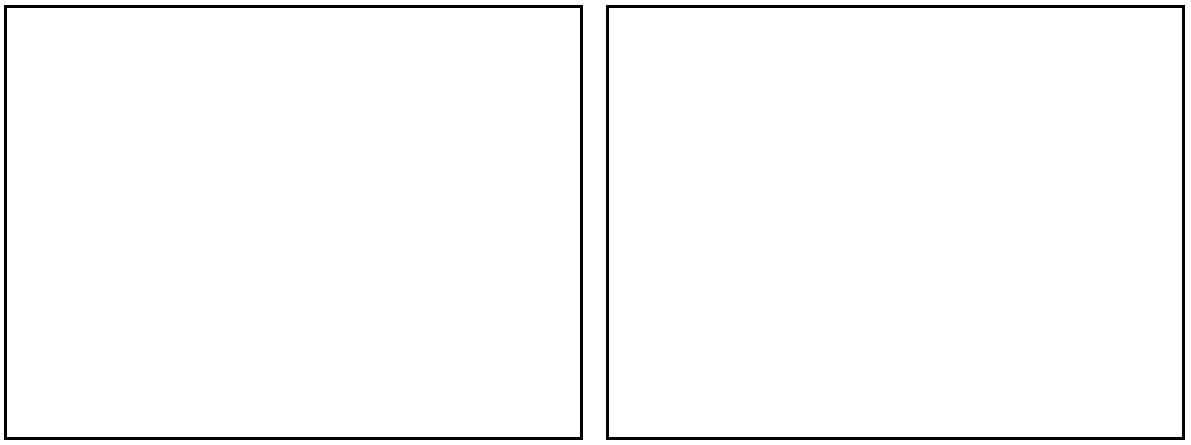


Figure 14 North Circular Road in London (link 57056)

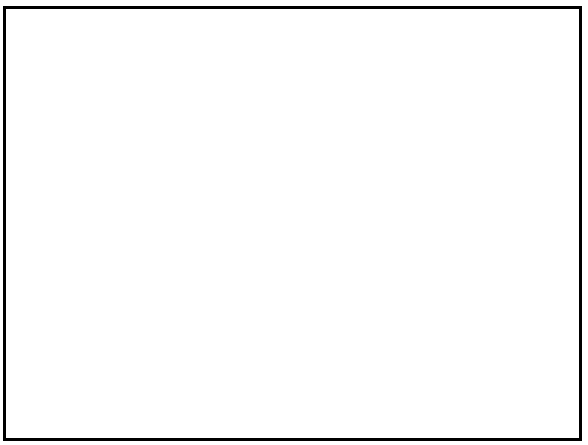


Figure 15 Liverpool: Locations of road links with modelled annual mean NO_2 concentrations >21 ppb in 2005 (using the national scale model) and building facades within 10 m of the kerb, showing residential postcodes on these road links

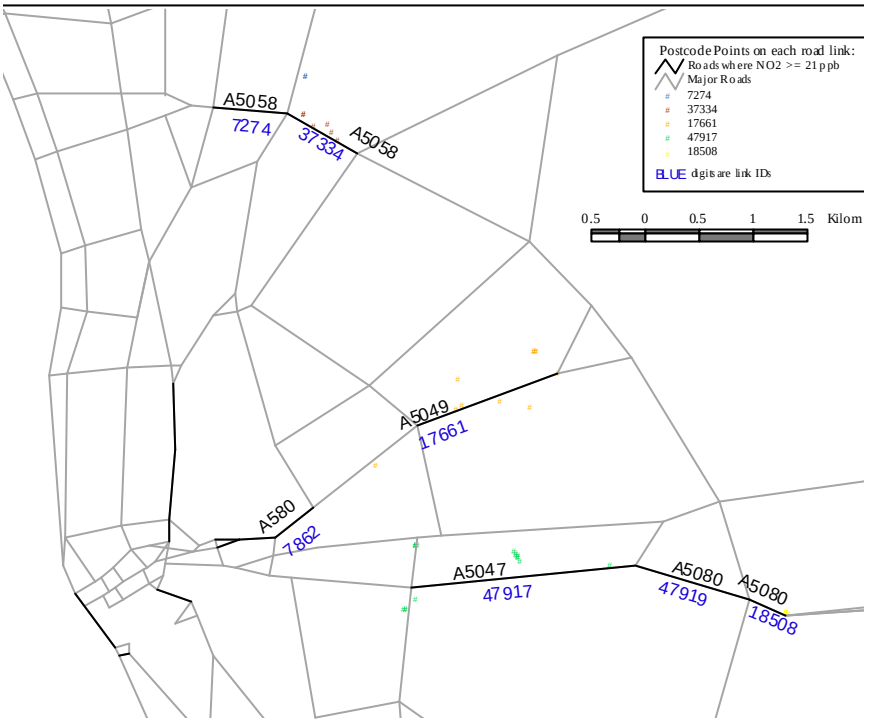


Figure 16 Manchester: Locations of road links with modelled annual mean NO2 concentrations >21 ppb in 2005 (using the national scale model) and building facades within 10 m of the kerb, showing residential postcodes on these road links

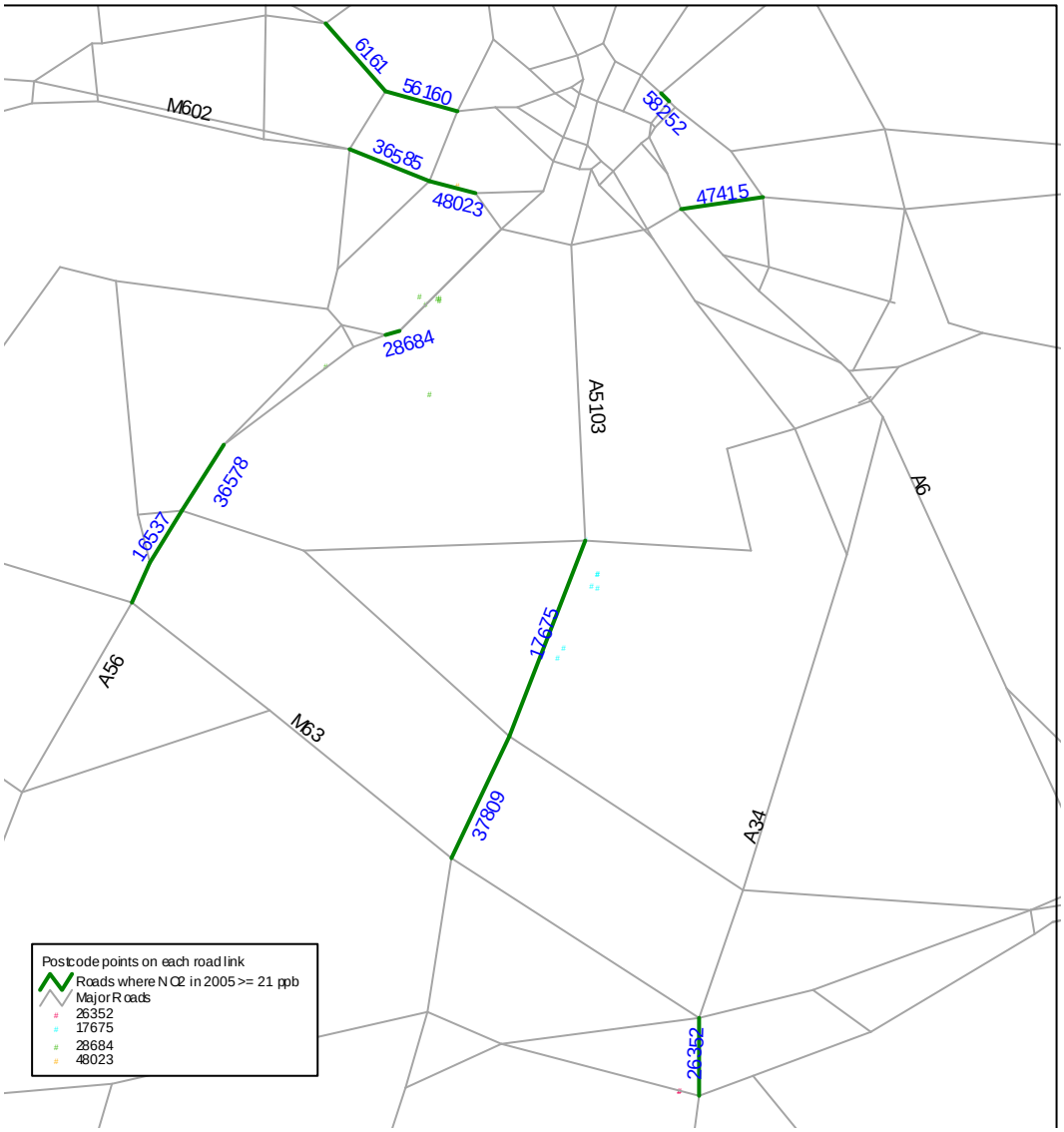


Figure 17 Princess Road in Manchester (link 17675)

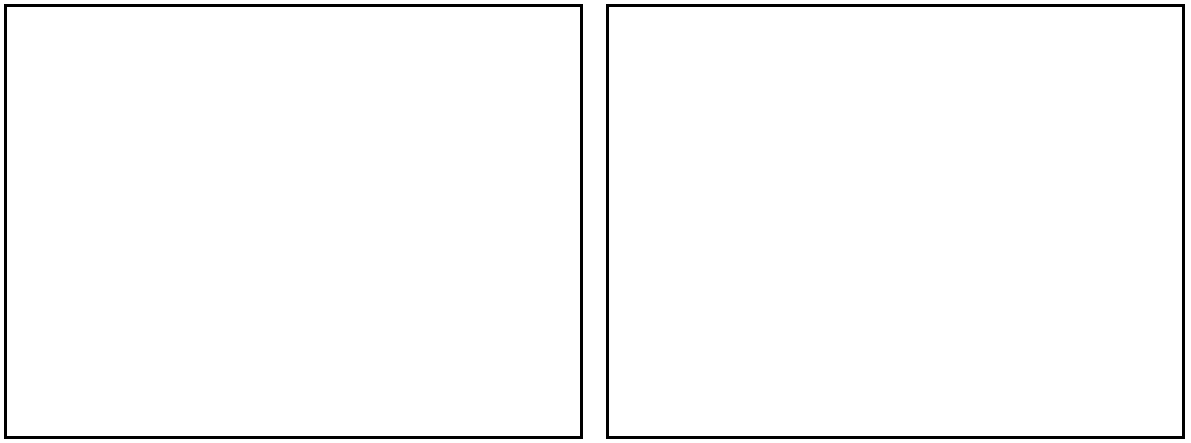


Figure 18 Kingsway in Manchester (link 26352)

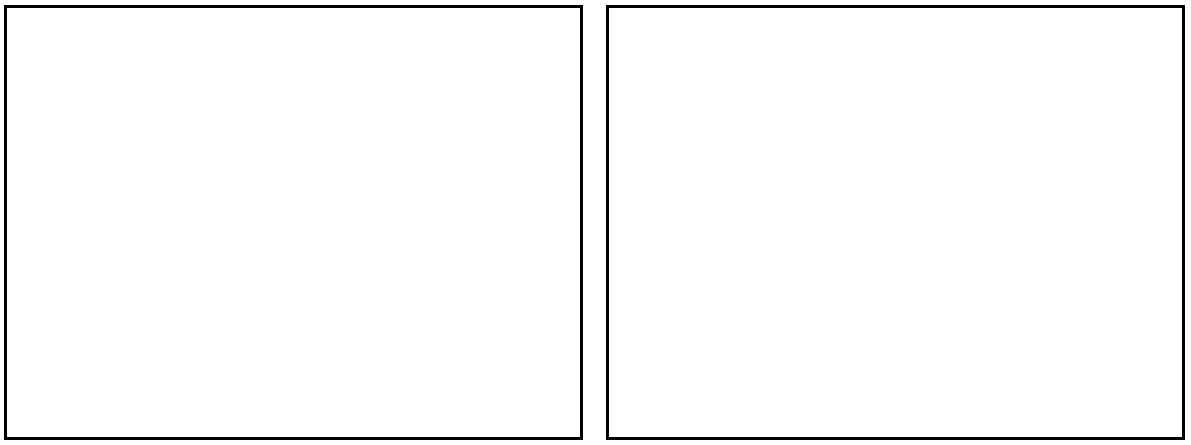


Figure 19 Chester Road, Streford in Manchester (link 28684)

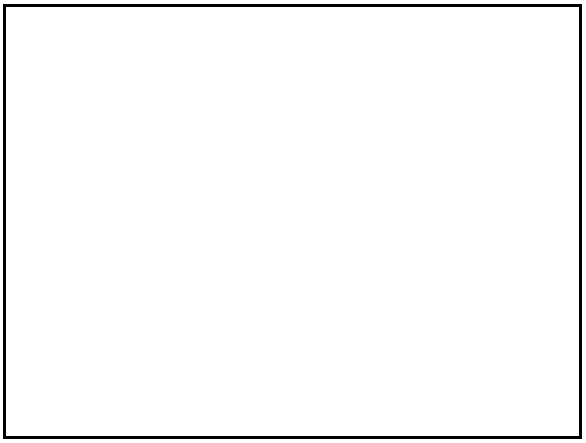
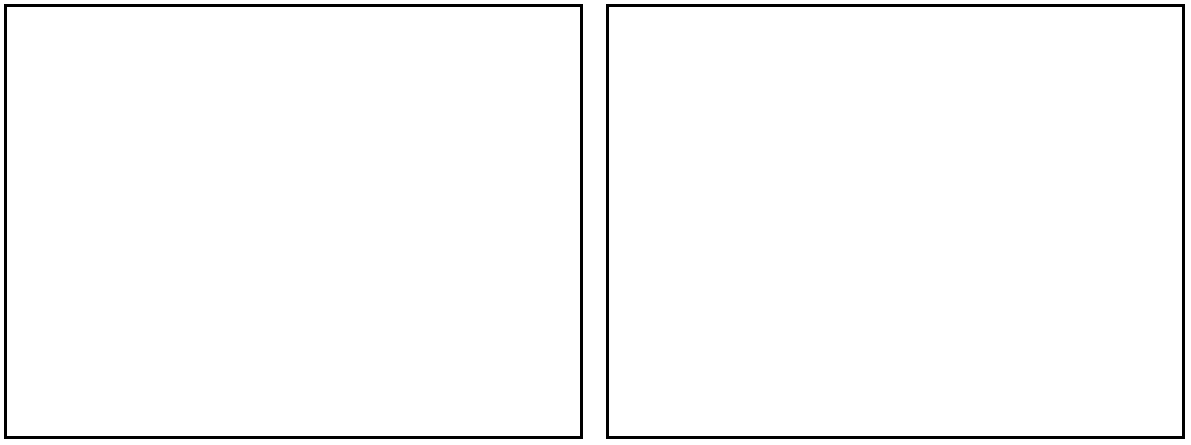


Figure 20 Regent Road in Manchester (link 48023)



3.3 ESTIMATE OF EXPOSED POPULATION

From the data that have been collected in this study, it is possible to make an estimate of the total number of people exposed to exceedances of the NO_2 annual average objective along those roads surveyed. In this survey, 23 of the 103 road links have been found to include housing within 10 m of the kerb. Estimates of about 1300 and 2600 households on these road links have been derived from the field survey and postcode database respectively. The average size of a UK household is 2.7 people, giving a total of about 3510 to 7020 people exposed along these road links (assuming that the population in 2005 will be the same as in 1999).

3.4 TRAFFIC FLOW DATA

Air quality modelling is being undertaken by a number of institutions in the UK, using a variety of different methods and data sources. A secondary aim of this study was to analyse the effects on the results of the national modelling of annual mean NO_2 for 2005 of changing the traffic flow data for a small sample of road links.

There are two primary sources of road traffic data currently in use for preparing urban traffic emission inventories: traffic surveys and transportation models. Information from traffic surveys is attractive because it relates to real traffic on real roads whereas transportation models are a computerised reflection of the actual conditions. However, traffic surveys have the disadvantage that they only provide information relating to the specific survey points, rather than area wide information. On the other hand, transportation models are available for most of the urban area and are comprehensive (Hutchinson and Clewley 1996).

Local measured traffic flow data has been obtained for Manchester and Salford and modelled traffic flows are available for Birmingham. On those links where the national modelling predicted NO_2 concentrations in 2005 to be 21 ppb or greater, NO_2 concentrations have been calculated again using the local data.

Comparisons of the Manchester and Salford data with those used in the national modelling are shown in Table 5 and Table 6. Those links where NO_2 concentrations in 2005 have been previously predicted to be 21 ppb or greater are shown in bold. In most cases the local data are higher than the national data, with the total flows being closer than those for LGV and HGV. These differences are consistent with the expected variations in measurements of this sort.

Modelled flows for roads in Birmingham have been obtained from Cambridge Environmental Research Consultants (CERC). These data were produced by the London Research Centre and represent flows in 1990/1991 (Hutchinson and Clewley 1996). A comparison with the national traffic flow data is shown in Table 7.

A few caveats should however be considered in relation to the comparison for Birmingham. First, the CERC data have been compiled using a different road link network and therefore a direct comparison between road links is not possible in some cases. The CERC network is more detailed, therefore average flows have been calculated where multiple CERC links that make up a national dataset link (those marked with * in the table have been calculated in this way). Second, the national dataset consists of measured flows and the CERC data are modelled flows. This difference in methods results in considerable differences in the flows on the

individual links and the total for all links. Third, the base year of the two datasets is different - 1990/1991 for the CERC data and 1996 for the national data. The differences between the CERC and national data are greater on individual links than those for Manchester and Salford, but differences between the total flows are similar across these three examples.

Table 5 Comparison of traffic flow data for road links in Manchester

Road link	**Mancester dataset**			**National dataset**			**Comparison** (national / local data**)**		
ID	Total	LGV	OGV*	Total	LGV	HGV	Total	LGV	HGV
58252	**47100**	**5200**	**2500**	**46081**	**4366**	**2346**	**1.0**	**1.2**	**1.1**
47415	**38600**	**5300**	**4300**	**31622**	**3639**	**3400**	**1.2**	**1.5**	**1.3**
17675	**54600**	**3800**	**2300**	**49775**	**3484**	**2030**	**1.1**	**1.1**	**1.1**
37809	**47400**	**5300**	**2900**	**68606**	**4552**	**2145**	**0.7**	**1.2**	**1.4**
Totals:	187700			196084		Averages:	1.0	1.2	1.2

* OGV is assumed to be 'Other Goods Vehicles' and equivalent to HGV

Table 6 Comparison of traffic flow data for road links in Salford

Road	**Salford dataset**			**National dataset**			**Comparison** (national / local data**)**		
link ID	All motors	LGV	OGV*	total	LGV	HGV	Totals	LGV	HGV
16543	29300	3100	2800	26665	2741	2195	1.1	1.1	1.3
8565	29000	2500	1600	27109	2437	1414	1.1	1.0	1.1
7691	34400	3400	1900	31816	3272	1660	1.1	1.0	1.1
17926	35200	2900	1600	31969	2351	1157	1.1	1.2	1.4
48023	**43900**	**4800**	**3500**	**34178**	**3468**	**2873**	**1.3**	**1.4**	**1.2**
38050	39500	4300	2700	35040	3520	2181	1.1	1.2	1.2
36585	**44100**	**6200**	**4000**	**38712**	**4283**	**3466**	**1.1**	**1.4**	**1.2**
56160	**45700**	**3800**	**2100**	**43864**	**3599**	**1551**	**1.0**	**1.1**	**1.4**
6161	**57200**	**4800**	**2800**	**49889**	**4301**	**1938**	**1.1**	**1.1**	**1.4**
37363	48100	4500	1900	45153	3869	1584	1.1	1.2	1.2
17254	49100	4200	2100	45944	3645	1763	1.1	1.2	1.2
7301	52000	4700	2600	47918	4451	2271	1.1	1.1	1.1
56133	52400	4400	2200	51131	3976	1992	1.0	1.1	1.1
46164	57200	4800	2700	56439	4616	2272	1.0	1.0	1.2
27321	39400	4300	3600	34915	3593	2841	1.1	1.2	1.3
Totals:	656500			600742		Averages:	1.1	1.2	1.2

* OGV is assumed to be 'Other Goods Vehicles' and equivalent to HGV

Table 7 Comparison of modelled traffic flow data and national measured data for road links in Birmingham (total numbers of vehicles)

Road Link ID	National measured traffic flow data	Local Modelled traffic flow data	Comparison (local/national data)
6358	34226	47524*	1.4
6391	**41868**	**46255***	**1.1**
6392	37624	35369	0.9
7676	**34108**	**34589**	**1**
7677	28046	32904	1.2
7928	**79435**	**30052**	**0.4**
16366	35409	48062	1.4
16423	21008	21682*	1
16487	17283	30363*	1.8
17143	19905	27034*	1.4
17644	25872	17448*	0.7
17996	28845	50515*	1.8
18449	36447	31932	0.9
26395	38923	47204*	1.2
27159	16594	11124	0.7
27736	**39978**	**34282***	**0.9**
27737	30014	25668	0.9
27952	38287	44089*	1.2
28042	31573	22872	0.7
36070	99866	150790	1.5
36400	**45883**	**61522**	**1.3**
37238	22916	18424*	0.8
37780	43652	57254*	1.3
46398	**29322**	**19299***	**0.7**
46399	**67240**	**51060***	**0.8**
46456	19899	22609*	1.1
47166	34175	23565*	0.7
47176	29480	26070*	0.9
47731	35801	29069	0.8
47999	**78607**	**25622**	**0.3**
48344	6699	11472	1.7
56330	**40523**	**71837***	**1.8**
56394	**81002**	**23232***	**0.3**
56459	15360	22450*	1.5
57191	**41894**	**45345***	**1.1**
57193	**33425**	**29278**	**0.9**
57194	**62393**	**33072***	**0.5**
Totals	1457690	1395525	0.96

* CERC data an average of flows on more than one link equivalent to AEAT link

The above data sets have been used to make a comparison of the NO_2 concentrations predicted for those links where there are houses at less than 10m from the kerb, using the national data and newly obtained measured and modelled data. This comparison is shown in Table 8.

Table 8 Comparison of predicted roadside NO_2 concentrations for 2005 using different traffic flow data

Link ID	National modelled NO_2 concentration	NO_2 concentration based on local data	Comparison (local / national)
Birmingham			
6391	23.91	24.68	1.03
7676	24.00	24.09	1.00
7928	28.06	20.84	0.74
27736	23.08	22.09	0.96
36400	25.32	28.10	1.11
46398	23.10	20.99	0.91
46399	25.53	23.30	0.91
47999	27.32	19.50	0.71
56330	23.29	27.82	1.19
56394	27.45	19.40	0.71
57191	24.05	24.68	1.03
57193	23.33	22.45	0.96
57194	24.83	20.48	0.82
Manchester			
17675	22.91	23.72	1.04
37809	25.84	23.84	0.92
47415	22.80	24.24	1.06
58252	23.60	23.83	1.01
Salford			
6161	24.12	25.52	1.06
36585	23.80	24.77	1.04
48023	22.83	24.39	1.07
56160	23.56	24.17	1.03

This comparison shows a broadly similar pattern to the previous comparison of traffic flows, with more variation on the Birmingham links than in Manchester and Salford. 15 (71%) of the links have concentrations within a 10% range of the national modelled NO_2 concentration.

There are three key factors that have influenced the recalculated concentrations:

- the total number of vehicles,
- the relative numbers of the various types of vehicles and
- the background NO_x concentration on each link.

The relative numbers of vehicles has been kept constant for the links in Birmingham, where only modelled total flows were available, but in Manchester and Salford data were available for LGVs and HGVs. A comparison of these numbers is given in Tables 5 and 6.

The background NO_x concentration used in the modelling has been kept constant for the calculation of roadside NO_2 concentration using local traffic flow data. This background portion of NO_x contributes roughly 30 - 50% to total roadside NO_x. Therefore, on links where the differences are large for the traffic flows, smaller diferences are found in NO_2 concentrations. Furthermore, the relationship between roadside NO_x and roadside NO_2 is non-linear, and therefore this accounts for some of the further differences between the two sets of results.

4 Conclusions and Further Work

4.1 CONCLUSIONS

The conclusions from this study are as follows:

1. 103 road links have been surveyed. On 23 of these, houses have been found less than 10m from the kerb. Over 1,300 houses were found in the field survey on these 23 road links.
2. Most of the road links surveyed were within the commercial districts of the cities, were dual-carriageways and were ring roads or major radial routes.
3. Where houses have been found, further analysis has been undertaken using postcode data. It has been estimated that the road links examined have a total of 2,600 residential delivery points on them.
4. A range of 1,300 to 2,600 households has therefore been estimated for those links surveyed. The average size of a UK household is 2.7 people, giving a total of about 3510 to 7020 people exposed along these road links. This does however represent an over estimate of the exposed population because they are not all within 10 m of the kerb. The postcode data does not provide this level of accuracy.
5. A comparison of local and national traffic flow data for Manchester, Salford and Birmingham has been undertaken. This has shown that the datasets of actual flow measurements in Manchester and Salford correspond reasonably well with the national data, whereas modelled traffic flows on road links in Birmingham show considerable differences from the national dataset.
6. A comparison has been made between predicted roadside NO_2 concentrations for 2005 using the local traffic flow data and that using the original national figures. 71% of the links analysed in this way have been estimated to have concentrations based on the local trafic flow data within a 10% range of the national modelled NO_2 concentration.

4.2 SUGGESTIONS FOR FURTHER WORK

Further work could be carried out to provide a more complete analysis of potential population exposure to roadside concentrations of NO_2 or other air pollutants. Additional detailed GIS data should be available from the Ordnance Survey on:

- postcode address points,
- road centre line locations and
- 'Landline' data showing locations of buildings.

The detailed ground truth survey data obtained during the current study could provide an excellent comparison with detailed GIS or aerial photography analysis.

It is recommended that additional work be carried out to compare these methods of analysis with the results of this study so that a robust and systematic technique can be developed for use on subsequent reviews of the NAQS.

5 References

DETR et al (1999) *Review of the National Air Quality Strategy* Department of the Environment, Transport and the Regions, The Scottish Office, The Welsh Office, Department of the Environment Northern Ireland. The Stationary Office, January 1999.

Hutchinson, D. and Clewley, L. (1996) *West Midlands Atmospheric Emissions Inventory*, London Research Centre.

Stedman JR, Bush T and King K (1998). *An empirical model for estimating roadside nitrogen dioxide concentrations in the UK.* AEA Technology Environment, National Environmental Technology Centre. Report AEAT-4291.

Appendices

CONTENTS

Appendix 1: 100 road links outside London with the highest estimated annual mean NO_2 concentration in 2005

City	Road Number	Road name	Length (m)	Predicted NO_2 concentration in 2005	Predicted NO_2 concentration in 2009	Road Link ID	Surveyed ?	Houses at < 10 m
Birmingham	A38	Kingsbury Rd, Walmley	1273	23.36	20.29	6390	✓	✓
Birmingham	A4400	Moor Street Queensway	800	23.91	20.77	6391	✓	
Birmingham	A456	Hagley Road	3232	23.20	20.15	7179		
Birmingham	A4540	Dartmouth Middleway	419	24.00	20.88	7676	✓	
Birmingham	A4400	St Chads Queensway	800	28.06	24.30	7928	✓	
Birmingham	A38	Tyburn Road	1742	26.16	22.73	16365	✓	✓
Birmingham	A4540	Watery Lane Middleway	1559	23.08	20.07	27736	✓	
Birmingham	A4400	James Watt Queensway	500	25.32	21.96	36400	✓	
Birmingham	A5127	Lichfield Road	2732	23.10	20.13	46398	✓	
Birmingham	A38	Bristol Road	847	25.53	22.14	46399	✓	
Birmingham	A452	Chester Road	1400	23.87	20.73	47202	✓	
Birmingham	A4400	Bristol Road	650	27.32	23.65	47999	✓	
Birmingham	A34	Perry Barr Expressway and New Town Row	2540	23.29	20.27	56330		
Birmingham	A38	St Chads Queensway, Corporation Street	782	27.45	23.81	56394	✓	
Birmingham	A38	Tyburn Road at Junction of Bromford Lane	1211	23.28	20.24	56399	✓	✓
Birmingham	A41	Bull Ring, Digbeth	405	24.05	20.89	57191	✓	
Birmingham	A4540	Dartmouth Middleway	393	23.33	20.28	57193	✓	
Birmingham	A4540	Belgrave Middleway	812	24.83	21.53	57194	✓	✓
Bradford	A6177	Rooley Lane	1654	22.84	19.79	17705		
Bristol	A4044	Bond Street	500	24.31	21.07	36409	✓	
Bristol	A4044	Western inner ring road (Colston Ave, Lewins Mead etc)	1100	26.10	22.59	37053	✓	
Bristol	A370	Brunel Way	500	24.88	21.49	48003	✓	
Bristol	A4	Temple Gate / Bath Bridge	347	25.19	21.82	48459	✓	
Bristol	A4044	Temple Way	700	25.69	22.25	56375	✓	
Bristol	A4044	Bond Street	347	23.95	20.76	56400	✓	
Bristol	A4032	Newfoundland Street	1100	25.29	21.90	57291	✓	
Bristol	A3029	Brunel Way, Avon Bridge	195	23.11	19.99	58285		
Coventry	A4053	Ringway Hill Cross	332	22.94	19.88	47690		
Derby	A38	A38 between A52 and A6	2833	22.79	19.72	16361		
Doncaster	A638	A638 across the River Don	685	23.67	20.47	7397	✓	
Doncaster	A638	A638 in City Centre	853	24.34	21.04	8747	✓	
Fareham	A27	Section of A27 shared with A32	779	23.03	19.93	16270	✓	
Frimley, Surrey	A325	A325 near M3 junct 4	425	22.93	19.86	46946		
Glasgow	A814	Stobcross Street	700	25.51	22.13	20922	✓	
Glasgow	A814	Clydeside Expressway	3500	24.44	21.23	40924	✓	
Glasgow	A739	A739 Clyde Tunnel	2009	23.46	20.35	50974	✓	
Hull	A63T	Garrison Road	805	23.07	19.98	7913	✓	
Hull	A63	Castle St	658	25.19	21.81	27932	✓	✓
Hull	A63	Hessle Road	965	25.86	22.39	48331	✓	
Leeds	A58	Clay Pit Lane	656	22.79	19.80	7850		
Leeds	A61	Marsh Lane / York Street	523	22.89	19.91	8260		
Leeds	A64	York Road	500	27.51	23.82	8554	✓	
Leeds	A64	A64 in Burmantofts	2800	26.88	23.28	16593	✓	✓
Leeds	A58	West Street	476	27.59	23.90	18451	✓	
Leeds	A64	York Road	500	24.51	21.27	26074	✓	
Leeds	A58	Wellington Road	600	30.24	26.14	28003	✓	
Leeds	A643	A643 in Holbeck	1200	25.01	21.69	28005	✓	
Leeds	A64	A64 in Harehills	2800	24.11	20.87	46633	✓	
Leeds	A58	Wellington Road	500	28.23	24.43	48049	✓	

City	Road Number	Road name	Length (m)	Predicted NO_2 concentration in 2005	Predicted NO_2 concentration in 2009	Road Link ID	Surveyed ?	Houses at < 10 m
Leeds	A58	West Street	300	27.77	23.84	48535	✓	
Leeds	A58	Gelderd Street	300	27.17	23.53	57696	✓	
Leicester	A46	Burleys Way	500	24.04	20.90	36502	✓	
Leicester	A47	St Mathews Way	586	23.49	20.44	36524	✓	
Leicester	A46	Burleys Way	400	28.08	24.33	48489	✓	
Leicester	A47	Humberstone Road	473	22.91	19.94	48677	✓	
Leicester	A46	King Richards Road	430	23.33	20.30	56435	✓	
Leicester	A46	Burleys Way	600	26.30	22.82	56464	✓	✓
Liverpool	A5058	Breeze Hill	690	22.98	20.01	7274	✓	✓
Liverpool	A580	Brunswick Road	500	24.70	21.50	7862	✓	
Liverpool	A5036	Strand Street	621	23.84	20.70	17657	✓	
Liverpool	A5049	Rocky Lane and West Derby Lane	1374	23.04	20.10	17661	✓	✓
Liverpool	A580	Link prior to M62	372	24.85	21.54	18508	✓	✓
Liverpool	A580	Islington	215	22.86	19.93	28563	✓	
Liverpool	A5058	Queens Drive Walton, between A580 and A59	752	23.25	20.25	37334	✓	✓
Liverpool	A580	Erskine Street	800	24.33	21.17	37794	✓	
Liverpool	A5038	Lime Street	341	25.47	22.09	38350	✓	
Liverpool	A59	A59 near University	1300	25.29	21.95	47911	✓	
Liverpool	A5047	Edge Lane	2085	23.32	20.32	47917	✓	✓
Liverpool	A5080	Edge Lane	1105	23.44	20.37	47919	✓	✓
Liverpool	A59	A59 near University	300	23.75	20.62	48332	✓	
Liverpool	A59	A59 near University	638	24.63	21.38	56612	✓	
Liverpool	A5041	Liver Street	110	23.40	20.33	57715	✓	
Liverpool	A5080	New Islington	227	24.97	21.71	58222	✓	
Manchester	A6	Broad Street, Pendleton	1000	24.12	20.96	6161	✓	
Manchester	A6	Buxton Road	1501	22.90	19.89	6163		
Manchester	A34	Old Trafford	700	24.10	20.96	16537	✓	
Manchester	A5103	Princess Road	2169	22.91	19.87	17675	✓	✓
Manchester	A56	Kingsway Gatley	792	23.99	20.81	26352	✓	✓
Manchester	A56	Chester Rd in Stretford, at junc with Stretford Rd	137	23.12	20.12	28684	✓	✓
Manchester	A56	Chester Rd in Stretford	822	23.44	20.40	36578	✓	
Manchester	A57	Regent Road	895	23.80	20.70	36585	✓	
Manchester	A5103	Junction of M63	1400	25.84	22.40	37809	✓	
Manchester	A635	Dual carriage way at end A57(M)	845	22.80	19.86	47415		
Manchester	A57	Regent Road, between A57(M) and A5066	495	22.83	19.88	48023	✓	✓
Manchester	A6	Crescent Chapel	748	23.56	20.49	56160	✓	
Manchester	A56	Old Trafford	600	26.10	22.66	58022	✓	
Manchester	A665	Great Ancoats St	127	23.60	20.52	58252	✓	
Newcastle	A184	Gateshead Highway off A184 Park Road	453	23.26	20.18	6090	✓	
Newcastle	A1	A1 in Lemington	1500	27.52	23.77	18626	✓	
Newcastle	A184	Park Road, Gateshead	3070	23.23	20.16	47829	✓	
Newcastle	A167	A167 Tyne Bridge	800	25.96	22.48	58151	✓	
Nottingham	A60	London Road near football ground	793	22.80	19.76	17853		
Nottingham	A52	Clifton Boulevard	808	23.68	20.51	37416		
Portsmouth	A288	A228 near M27 junc in Hilsea	212	23.06	20.11	28437	✓	✓
Portsmouth	A3	A3 junction with M27	447	25.75	22.39	47078	✓	
Runcorn	A533	Bridge across River Mersey	2158	29.32	25.30	27275		
Sheffield	A61	NW Sheffield A61 between A6101 and A6102	609	22.92	19.85	16580		
Sheffield	A61	Sheaf Street	800	24.08	20.90	18722	✓	
Sheffield	A6135	Wicker	304	22.87	19.88	47839	✓	
Sheffield	A61	Sheaf Street north of Park Sq	380	23.53	20.44	48076	✓	

Appendix 2: Road links along North Circular Road (London) with the highest estimated annual mean NO_2 concentration in 2005

City	Road Number	Road name	Length (m)	Predicted NO_2 concentration in 2005	Predicted NO_2 concentration in 2009	Road Link ID	Surveyed ?	Houses at < 10m?
London	A1	North Circular Road	500	24.74	21.46	6076	✓	
London	A4	Great West Road	1100	22.78	19.80	6122		
London	A5	Edgware Road	1948	22.49	19.60	6151		
London	A10	Great Cambridge Road	1500	22.95	20.00	6188		
London	A205	Kew Road	800	21.34	18.57	6758		
London	A205	Chiswick High Road	206	21.09	18.36	6898		
London	A406	North Circular Road	2100	29.16	25.23	7055	✓	✓
London	A406	North Circular Road	722	21.03	18.29	7057		
London	A4005	Ealing Road	604	21.42	18.64	7613		
London	A406	North Circular Road	300	24.47	21.25	8468	✓	
London	A40	Western Avenue	229	21.85	18.76	16404		
London	A406	Gunnersbury Avenue	1300	21.43	18.69	17018	✓	
London	A406	North Circular Road	1939	31.81	27.51	17019	✓	✓
London	A406	North Circular Road	900	22.74	19.72	17020	✓	
London	A406	North Circular Road	1700	22.99	20.00	17021		
London	A1	North Circular Road	206	26.94	23.33	26080	✓	
London	A4	Great West Road	1849	28.48	24.66	26116		
London	A10	Great Cambridge Road	4300	22.47	19.56	26180		
London	A41	Hendon Way	1400	24.39	21.19	26463		
London	A406	Hanger Lane Roundabout	200	24.07	20.89	27086	✓	
London	A406	North Circular Road	900	30.72	26.58	27087	✓	
London	A1080	The Roundway	700	21.70	18.96	27918		
London	A4	Great West Road	1300	21.47	18.69	36120		
London	A105	Wood Greed High Road	216	21.07	18.36	36670		
London	A406	Gunnersbury Avenue	1100	21.94	19.10	37112	✓	✓
London	A406	North Circular Road	2400	27.69	23.98	37113	✓	✓
London	A406	North Circular Road	940	24.24	21.05	37114	✓	
London	A406	Hanger Lane	1992	21.33	18.61	38366	✓	
London	A406	Hanger Lane Roundabout	200	23.69	20.57	38601	✓	
London	A40	Western Avenue	1867	25.68	22.27	56436		
London	A41	Watford Way	321	23.18	20.14	56467		
London	A406	North Circular Road	1200	21.03	18.27	56758	✓	
London	A4088	Forty Lane	822	21.36	18.59	56982	✓	
London	A406	North Circular Road	721	25.20	21.87	57056	✓	✓
London	A406	North Circular Road	1300	22.11	19.21	57115		
London	A4088	Neasdon Lane North	1100	22.66	19.71	57656	✓	

Appendix 3: Completed Survey Questionnaires

Census ID	City	Name of road	Road No. e.g. A40	Length (m)	Identified correctly? Give any corrections here	Any houses within 10 m? Y/N	Aspect? Buildings both sides?	Continue survey? Y/N	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes each direction	Location of photos and videos taken	Date / time	Initials of surveyor
6390	Birmingham	Kingsbury Road	A38	1273	y	y	wide road, housing and commercial both sides	y	20	5	1 school	2	2 photos; video 1	17/03/99	RCG
6391	Birmingham	James Watt Queensway	A4400	800	No, not Moor St Queensway	n	commercial offices, open road	n				2	1 photo; video 1	17/03/99	RCG
7676	Birmingham	Dartmouth Middleway	A4540	419	y	n	all commercial, open road	n				2	2 photos; video 1	17/03/99	RCG
7928	Birmingham	St Chads Queensway	A4400	800	y	n	mainly commercial, 1 block flats at ~25m	n				2	3 photos; video 1	17/03/99	RCG
16365	Birmingham	Tyburn Road	A38	1742	y	y	houses one side, commercial on the other	y	15	7	n	2	2 photos; video 1	17/03/99	RCG
27736	Birmingham	Watery Lane Middleway	A4540	1558	y	n	no housing within 30m	n				2	2 photos; video 1	17/03/99	RCG
36400	Birmingham	Moor Street Queensway	A4400	500	y	n	high office blocks	n				2	2 photos; video 1	17/03/99	RCG
46398	Birmingham	Lichfield Road	A5127	2731	y	n	wide road, mixed low commercial	n				2/3	3 photos; video 1	17/03/99	RCG
46399	Birmingham	Bristol Road	A38	847	y	n	wide road, mixed commercial	n				3	2 photos; video 1	17/03/99	RCG
47202	Birmingham	Chester Road	A452	1400	y	n	wide road, some commercial	n				2	3 photos; video 1	17/03/99	RCG
47999	Birmingham	Bristol Road	A4400	650	y	n	wide road, small shops, offices above	n				2	2 photos; video 1	17/03/99	RCG
56394	Birmingham	St Chads Queensway	A38	782	y	n	wide road, some shops	n				2	2 photos; video 1	17/03/99	RCG
56399	Birmingham	Tyburn Road	A38	1201	y	y	wide open road, housing one side, commercial on the other	y	10-15	<10 m	n	2	2 photos; video 1	17/03/99	RCG
57191	Birmingham	Bull Ring Digbeth	A41	405	y	n	built up high shops / offices	n					2 photos; video 1	17/03/99	RCG
57193	Birmingham	Dartmouth Middleway	A4540	393	y	n	open area, mainly large commercial	n					1 photo; video 1	17/03/99	RCG
57194	Birmingham	Belgrave Middleway	A4540	812	y	y	open wide road, housing	y	6	10 m	1 school	2	2 photos; video 1	17/03/99	RCG
36409	Bristol	Bond Street	A4044	500	y	n	Offices 1 side	n				3	2 photos; Video 1	11/03/99	RCG
37053	Bristol	Western Inner Ring Road	A4044	1100	y	n	offices and shops both sides	n				3/2	3 photos; Video 1	11/03/99	RCG

Census ID	City	Name of road	Road No. e.g. A40	Length (m)	Identified correctly? Give any corrections here	Any houses within 10 m? Y/N	Aspect? Buildings both sides?	Continue survey? Y/N	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes each direction	Location of photos and videos taken	Date / time	Initials of surveyor
48003	Bristol	Brunel Way	A370	500	y	n	no buildings close	n				2	2 photos; video 1	11/03/99	RCG
48459	Bristol	Temple Gate Bath Bridge	A4	347	y	n	station / hotel	n				3	2 photos; video 1	11/03/99	RCG
56375	Bristol	Temple Way	A4044	706	y	n	wide road with offices both sides	n				2/3	2 photos; video 1	11/03/99	RCG
56400	Bristol	Bond Street	A4044	347	y	n	high office blocks both sides	n				3	3 photos; video 1	11/03/99	RCG
57291	Bristol	Newfoundland Street	A4032	1100	y	n	wide open road, shops at one end	n				2	3 photos; video 1	11/03/99	RCG
7397	Doncaster	?	A638	685	y	n	commercial	n					2 photos; video 3	31/03/99	RCG
8747	Doncaster	?	A638	853	y	n	offices and commercial	n					2 photos; video 3	31/03/99	RCG
20922	Glasgow	Stobcross Street	A814	700	? yes	n	underneath flyover and high hotels	n				3	2 photos; video 2	22/03/99	RCG
40924	Glasgow	Clydeside Expressway	A814	3500	y	n	open area, commercial both sides	n				3	4 photos; video 2	22/03/99	RCG
50974	Glasgow	Clyde Tunnel	A739	2009	y	n	it's a tunnel!	n				2	2 photos; video 2	22/03/99	RCG
7913	Hull	Garrison Road	A63	805	y	n	wide open road, some commercial	n					2 photos; video 3	31/03/99	RCG
27932	Hull	Castle Street	A63	658	not Hedon Rd	y	wide road	y	6 in 1 block	4-5m	n	3	2 photos; video 3	31/03/99	RCG
48331	Hull	Hessle Road	A63	965	not Hedon Rd	n	wide road and commercial offices	no					2 photos; video 3	31/03/99	RCG
8554	Leeds	York Road	A64	500	y	n	open, offices both sides	n				3	1 photo; video 1	18/03/99	RCG
16593	Leeds	York Road	A64	2800	y	y	housing and shops both sides	y	50+	3-4m	1 school	2/3	4 photos; video 1	18/03/99	RCG
18451	Leeds	West Street	A58	476	y	n	all offices	n				3/2	2 photos; video 1	18/03/99	RCG
28003	Leeds	Wellington Road	A58	600	y	n	open area	n					1 photo; video 1	18/03/99	RCG
28005	Leeds	A643 in Holbeck	A643	1200	y	n	open area, some commercial	n					2 photos; video 1	18/03/99	RCG
46633	Leeds	York Road	A64	2800	y	n	wide open road, some houses at 20-25m	n				2	2 photos; video 1	18/03/99	RCG
48049	Leeds	Wellington Road	A58	500	y	n	no buildings	n				3	1 photo; video 1	18/03/99	RCG
48535	Leeds	West Street	A58	300	y	n	open road, elevated	n				3	2 photos; video 1	18/03/99	RCG

Census ID	City	Name of road	Road No. e.g. A40	Length (m)	Identified correctly? Give any corrections here	Any houses within 10 m? Y/N	Aspect? Buildings both sides?	Continue survey? Y/N	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes each direction	Location of photos and videos taken	Date / time	Initials of surveyor
57696	Leeds	Geldard Street	A58	300	?	n	open road, commercial both sides	n				2	2 photos; video 1	18/03/99	RCG
36502	Leicester	Burleys Way	A46	500	y	no	commercial area	n					2 photos; no video	25/03/99	RCG
36524	Leicester	St Mathews Way	A47	585	y	n	open, some commercial	no					2 photos; no video	25/03/99	RCG
48489	Leicester	Vaughn Way	A46	400	not Burleys Way	no	commercial area	n					2 photos; video 2	25/03/99	RCG
48677	Leicester	Humberstone Rd	A47	472	y	n	all commercial	no					2 photos; no video	25/03/99	RCG
56435	Leicester	A47 west of ring road	A47	430	y	y	wide split road	y	6 flats	8m	n	2	2 photos; video 2	25/03/99	RCG
56464	Leicester	Vaughn Way	A46	600	not Burleys Way	no	commercial area	n					2 photos; video 2	25/03/99	RCG
7274	Liverpool	Breaze Hill	A5058	690	not Balliol Rd	y	few houses 1 side	y	10	5m	n	2/3	2 photos; video 2	30/03/99	RCG
7862	Liverpool	Brunswick Street	A580	500	y	n	wide road	n					2 photos; video 2	30/03/99	RCG
17657	Liverpool	Strand Street	A5036	621	y	n	wide road, commercial	n					2 photos; video 2	30/03/99	RCG
17661	Liverpool	Rocky Lane	A5049	1347	y	y	half domestic, half commercial	y	300+	5m	n	2/3	2 photos; video 2	30/03/99	RCG
18508	Liverpool	M62 link	A580	372	y	y	open road	y	20	10-12m	n	3	2 photos; video 2	30/03/99	RCG
28563	Liverpool	Islington	A580	214	Y	N	commercial	n					2 photos; video 2	30/03/99	RCG
37334	Liverpool	Queens Drive	A5058	751	y	y	wide road, housing both sides	y	300+	5m	n	2	2 photos; video 2	30/03/99	RCG
37794	Liverpool	Erskine Street	A580	800	y	n	wide open road	n					2 photos; video 2	30/03/99	RCG
38350	Liverpool	Lime Street	A5038	341	y	n	all commercial	n					2 photos; video 2	30/03/99	RCG
47911	Liverpool	Near University	A59	1300	y	n	open road	n				3	2 photos; video 2	30/03/99	RCG
47917	Liverpool	Edge Lane	A5047	2085	y	y	mainly commercial, wide road	y	30	5m	n	3	2 photos; video 2	30/03/99	RCG
47919	Liverpool	Edge Lane	A5080	1105	y	y	wide road	y	200+	8-12m	n	2/3	2 photos; video 2	30/03/99	RCG
48332	Liverpool	Near University	A59	300	y	n	open road	n					2 photos; video 2	30/03/99	RCG
56612	Liverpool	Near University	A59	638	y	n	wide open road	n					2 photos; video 2	30/03/99	RCG

Census ID	City	Name of road	Road No. e.g. A40	Length (m)	Identified correctly? Give any corrections here	Any houses within 10 m? Y/N	Aspect? Buildings both sides?	Continue survey? Y/N	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes each direction	Location of photos and videos taken	Date / time	Initials of surveyor
57715	Liverpool	Liver Street	A5041	109	n ?	n	empty road	n					1 photo; video 2	30/03/99	RCG
58222	Liverpool	New Islington	A5080	227	y	n	open road	n					2 photos; video 2	30/03/99	RCG
6076	London	North Circular Road	A1	500	y	n	wide road, some buildings set back	n					1 photo, no video	23/04/99	RCG
7055	London	North Circular Road	A406	2100	y	y	housing at one end of link, rest is wide dual carriageway	y	20	5-10m	n	3	2 photos, no video	23/04/99	RCG
8468	London	North Circular Road	A406	300	y	n	flyover, commercial nearby	n					1 photo, no video	23/04/99	RCG
17018	London	Gunnersbury Avenue	A406	1300	y	n	residential, set back from road	n					2 photos, no video	23/04/99	RCG
17019	London	North Circular Road	A406	1939	y	y	commercial and residential, dual carriageway	y	50	5-10m	n	3 each way	2 photos, no video	23/04/99	RCG
17020	London	North Circular Road	A406	900	y	n	some residential set back from road, then underpass	n					2 photos, no video	23/04/99	RCG
26080	London	North Circular Road	A1	206	y	n	open road, one apartment block	n					1 photo, no video	23/04/99	RCG
27086	London	Hanger Lane	A406	200	y	n	no houses noted in survey, picture shows some close to road	n					2 photos, no video	23/04/99	RCG
27087	London	North Circular Road	A406	900	y	n	commercial buildings and flyover	n					1 photo, no video	23/04/99	RCG
37112	London	Gunnersbury Avenue	A406	1100	y	y	some houses set back, some close; open road with wide central area	y	35	8	n	2/3	2 photos, no video	23/04/99	RCG
37113	London	North Circular Road	A406	2400	y	y	houses close to road, often both sides	y	100+	5m	n	3	2 photos, no video	23/04/99	RCG
37114	London	North Circular Road	A406	940	y	n	open road, few buildings	n					1 photo, no video	23/04/99	RCG
38366	London	Hanger Lane	A406	1992	y	n	some commercial, some open	n					2 photos, no video	23/04/99	RCG
38601	London	Hanger Lane	A406	200	y	n	shops set back from large	n					1 photo,	23/04/99	RCG

Census ID	City	Name of road	Road No. e.g. A40	Length (m)	Identified correctly? Give any corrections here	Any houses within 10 m? Y/N	Aspect? Buildings both sides?	Continue survey? Y/N	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes each direction	Location of photos and videos taken	Date / time	Initials of surveyor
		Roundabout					roundabout,						no video		
56758	London	North Circular Road	A406	1200	y	n	no buildings, underpass	n					2 photos, no video	23/04/99	RCG
56982	London	Forty Lane	A4088	822	y	n	residential, houses set back from road	n					2 photos, no video	23/04/99	RCG
57056	London	North Circular Road	A406	721	y	y	2 storey houses both sides	y	10	10m	n		1 photo, no video	23/04/99	RCG
57656	London	Blackbird Hill / Neasdon Lane	A4088	1100	y	n	commercial and residential, houses at > 10m	n					2 photos, no video	23/04/99	RCG
6161	Manchester	Broad Street, Pendleton	A6	1000	y	n	mostly commercial, houses used as offices	n					2 photos, no video	26/02/99	ST
16537	Manchester	Old Trafford	A34	700	y	n	mainly low commercial, some houses on side roads close but not <10m						2 photos, no video	26/02/99	ST
17675	Manchester	Princess Road	A5103	2169	y	n	some houses close according the photos, not quantified in survey	y	?	<10m		2	4 photos, no video	26/02/99	ST
26352	Manchester	Kingsway	A56	792	y	y	wide road, some with open aspect, some houses close	y	20	5m	n	3	4 photos, no video	26/02/99	ST
28684	Manchester	Chester Rd in Stretford,	A56	137	y	n	residential type buildings, not quantified	y	>25	~7m			1 photo, no video	26/02/99	ST
36578	Manchester	Chester Rd in Stretford	A56	822	y	n	wide aspect, low buildings	n					3 photos, no video	26/02/99	ST
36585	Manchester	Regent Road	A57	895	y	n	housing set back from road on one side, mostly open aspect on other	n				2	3 photos, no video	26/02/99	ST
37809	Manchester	junction of M63	A5103	1400	y	n	housing set back from road					3	4 photos, no video	26/02/99	ST
48023	Manchester	Regent Road,	A57	495	y	n	commercial and residential, some blocks of flats very close	y	possibly >50 flats	<10		2	2 photos, no video	26/02/99	ST
56160	Manchester	Crescent Chapel	A6	748	y	n	commercial	n					1 photo, no video	26/02/99	ST
58022	Manchester	Old Trafford	A56	600	y	n	open aspect, block of flats set way back, commercial close to road						2 photos, no video	26/02/99	ST
58252	Manchester	Great Ancoats St	A665	127	y	n	commercial	n					2 photos, no video	26/02/99	ST

Census ID	City	Name of road	Road No. e.g. A40	Length (m)	Identified correctly? Give any corrections here	Any houses within 10 m? Y/N	Aspect? Buildings both sides?	Continue survey? Y/N	No. of houses along road	Distance from kerb(m)	Hospital or School on road?	No. of road lanes each direction	Location of photos and videos taken	Date / time	Initials of surveyor
6090	Newcastle	Gateshead Highway	A184	450	y	n	wide road, offices	no					2 photos; video 3	31/03/99	RCG
18626	Newcastle	A1 in Lemmington	A1	1500	y	n	wide road, no buildings	n					2 photos; video 3	31/03/99	RCG
47829	Newcastle	Park Road	A184	3069	y	n	wide open, some commercial	n					4 photos; video 2	31/03/99	RCG
58151	Newcastle	A167	Tyne Bridge	800	y	n	river	n					1 photo; no video	31/03/99	RCG
16270	Portsmouth	A27/A32	A27/A32	780	y	n	open	n					2 photos; video 3	01/04/99	RCG
28437	Portsmouth	A228 in Hilsen	A228	2158	y	y	wide road some commercial	y	6	8m	n	3/2	2 photos; video 3	01/04/99	RCG
47078	Portsmouth	A3/M27 junction	A3	450	y	n	open junction	n					2 photos; video 3	01/04/99	RCG
18722	Sheffield	Sheaf Street	A61	800	y	n	open area, some commercial	n				3	2 photos; video 2	18/03/99	RCG
47839	Sheffield	Wicker	A6135	304	y	n	shops and offices built up	n				2	2 photos; video 1	18/03/99	RCG
48076	Sheffield	Sheaft Street (north of Park Sq)	A61	379	y	n	built up area, commercial	n				3	2 photos; video 2	18/03/99	RCG

Appendix 4: Sequence of information supplied on video

Tape 1

Bristol	0:00:00 - 0:09:25
Birmingham	0:09:25 - 0:28:25
Leeds	0:28:25 - 0:41:31
Sheffield (first half)	0:41:31 - end

Tape 2

Sheffield (second half)	0:00:00 - 0:02:31
Glasgow	0:02:31 - 0:09:55
Leicester	0:09:55 - 0:22:50
Liverpool	0:22:50 - 0:45:00
Newcastle (first half)	0:45:00 - 0:45:51

Tape 3

Newcastle (second half)	0:00:00 - 0:06:17
Hull	0:06:17 - 0:10:36
Doncaster	0:10:36 - 0:14:30
Fareham	0:14:30 - 0:16:15
Portsmouth	0:16:15 - 0:17:50

Appendix 5: Photographs of Road Links Surveyed

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