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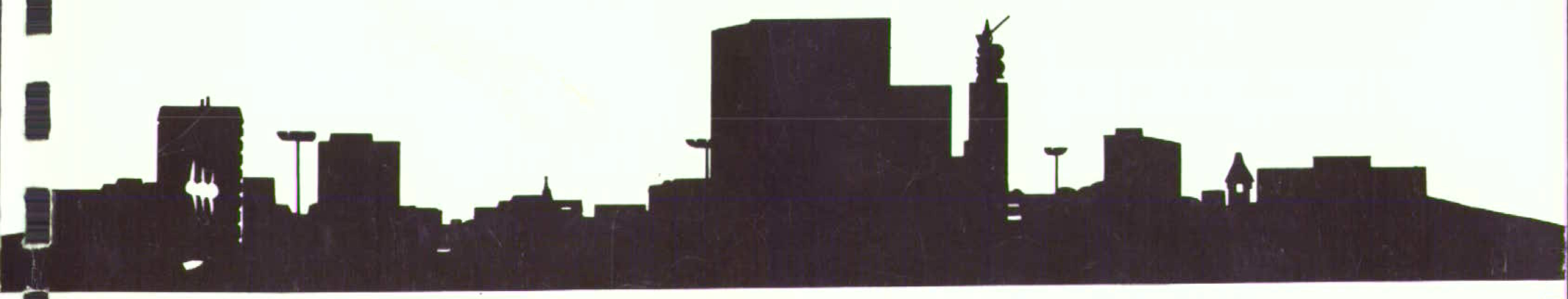

Birmingham City Council

TRAFFIC COLLISIONS IN AN URBAN AREA OF GREAT BRITAIN

a demographic and hierarchic
review of road accidents in Birmingham
and the West Midlands metropolitan districts

DOCUMENT RETRIEVAL INFORMATION

Report No.	Date	ISBN	Pages
AA/BCC 1	1989	0 7093 0161 8	70 +(iv)

Author(s): Stephen D. Lawson

Title and Subtitle:
Traffic collisions in an urban area of Great Britain: a demographic and hierarchic review of road accidents in Birmingham and the West Midlands metropolitan districts.

Performing Organisation (Name, address and telephone):
City Engineer's Department, Birmingham City Council, 1 Lancaster Circus, Birmingham B4 7DQ. Telephone 021-300 7429.

Sponsoring Organisation (Name, address and telephone):
Automobile Association Foundation for Road Safety Research, The Automobile Association, Fanum House, Basingstoke, RG21 2EA. Telephone 0256 492196

Keywords:
Road accidents, metropolitan districts, urban areas, collision types, long-term trends, casualty rates, accident rates, links and junctions, hierarchic classification, spatial distributions, land-use, countermeasures.

Abstract:
Road accidents in Birmingham and the West Midlands metropolitan districts are analysed in terms of their absolute numbers, long-term trends and in relation to other parts of Great Britain.

The casualty rate per head of population for selected road-users is examined.

Accident proportions are given for the number of different collision types at various styles of junction and links of varying standard. Accident rates (per vehicle throughput) for several types of junction are also provided.

A hierarchic classification of road standard is used to illustrate the number and proportion of different accidents on these roads, and graph plots to show the spatial distribution of accidents on the network.

Information about accidents on Birmingham radial routes is reviewed and accident rates on these roads compared with those on others. 'Land-use' adjacent to the highway is used as a measure to provide improved descriptions of accidents on these routes.

The number and type of vehicles involved in accidents is analysed and the protection afforded by different vehicles assessed by examining the severity of the injuries sustained by their occupants.

The review concludes with reference to accident reduction priorities for Birmingham and contains a list of recommendations to either facilitate research in this area or for action based upon the results of the study.

PREFACE

Many highway authorities produce a report each year of the road accidents which have occurred within their jurisdiction. In recent years the quality of these analyses has been improving and they are distributed more widely than was previously the case. Comparison of accident patterns across authorities is now possible; local issues and concerns are more widely known.

In starting the research programme conducted by the City Engineer's Department at Birmingham City Council, the Automobile Association Foundation for Road Safety Research asked, in summer 1988, for a detailed report of accidents within Birmingham and the West Midlands which would develop the type of analysis described above.

Efforts have therefore been made in conducting this work to set the problem of accidents in Birmingham and the West Midlands within context - comparisons have been made with other metropolitan areas of Great Britain and, where possible, accidents and casualties have been related to traffic and people at risk. The use of the terms 'demographic' and 'hierarchic' in the title reflects the fact that the research is related to populations and is structured at various levels of investigation. By incorporating data from related planning bases and making analyses of accidents at common location types or at various points on hierarchies of road standard and purpose, it is intended to facilitate exchange of information and make the data more meaningful to a reader wishing to make comparisons.

Although some of the data presented here have been available to investigators in the past, the information has not been gathered together in one place before. The document is in a sense a more 'local' version of parts of the regional and national statistical analysis of national government, combined with investigations prompted by ideas contained in recent research studies in this country.

It is hoped that this work will be of use and interest not only to local authority engineers and road safety officers, researchers in this field and in those related to road accidents, but also to students of traffic and transportation, some who work in public policy and health, and to others whose concern is Birmingham and the West Midlands metropolitan districts.

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EXECUTIVE SUMMARY

Birmingham, with a population of about one million, is the largest of the seven metropolitan districts which comprise the metropolitan county known as the West Midlands. Together these districts form one of the largest conurbations in Great Britain outside Greater London. Birmingham is the largest metropolitan highway authority in the U.K.

Transportation and mobility are important issues in the West Midlands. For example, car ownership is high in the West Midlands, higher than in any of the metropolitan areas outside London. Related to travel and passage, traffic safety is a major concern – each year there are between 8 and 10 thousand injury-producing road accidents recorded in the metropolitan districts of the West Midlands. Indeed, almost entirely as a result of its size and amount of traffic, Birmingham has the largest number of road accidents each year of any metropolitan authority in Great Britain.

In summer 1988, the Automobile Association Foundation for Road Safety Research came together with Birmingham City Council, and with some assistance from the University of Birmingham, to establish a programme of traffic safety research within the City Engineer's Department. This was the first time that a local highway authority in the U.K. had been awarded private sector funds for a major research programme in traffic safety. It was intended that the research concentrate on road accidents in urban areas and be designed and conducted so as to be of potential benefit not only to Birmingham but also to other authorities in major metropolitan areas.

The emphasis of the research has been on doing work which has direct practical applications, the idea being that it be used to guide practice and that the results be fed quickly through to policy-makers. The first completed part of the research programme is a review of road accidents in Birmingham and the West Midlands, and the major results from this study are presented below. Another module in the programme has been a study of accidents to young pedestrians. Illustrating the action-based nature of the work, the preliminary results from that study have already been used in formulating a course of education for young road-users and in deciding traffic management priorities. The results of that piece of work will be reported on formally in a later publication.

MAIN FEATURES OF ACCIDENT PATTERNS

The review of road accidents in Birmingham and the West Midlands metropolitan districts has shown:

* The very high degree of urbanisation in the West Midlands means that the number of pedestrian accidents is high. Each year about 12% of all accidents involve child pedestrians and 17% involve adult pedestrians.

* The number of road accident casualties in the metropolitan districts of the West Midlands has reduced by about 16% in the eleven years 1978 to 1988, much of this reduction having occurred in Birmingham. In the same period there has been an increase of about 22% in traffic in the West Midlands.

* In the West Midlands metropolitan districts the number of two-wheeled motor vehicle (T.W.M.V.) users injured per head of population almost halved between 1980 and 1988. Casualty rates for selected other road-users have changed relatively little over this time.

* Among results of interest, analysis of accidents at different types of location in the West Midlands showed:

    – 22% of those accidents at roundabouts involved a cyclist compared with only 8% of those accidents at junctions controlled by traffic signal.

    – on the single-carriageway links between junctions, 48% of all accidents involved a pedestrian, the corresponding figure for dual-carriageway being 34%.

* In Birmingham, largely as a result of the high traffic volume experienced, accident rates per vehicle travelling through any given junction are generally lower than the average figures for Great Britain. Similar results are likely to be found in other large cities.

* Detailed analysis of accident rates in Birmingham showed junctions controlled by traffic signals generally had more accidents per vehicle throughput than those which were priority-controlled, the latter having about the same number as mini and small roundabouts, conventional roundabouts experiencing slightly less than those controlled by traffic signals.

* Accident rates (per million vehicle kilometre) on 'A' class roads in Birmingham and the West Midlands were found to be generally lower than those on 'B' roads and both generally lower than their respective national equivalents.

* In a three year period just under one-third of all Birmingham accidents were found to occur on the City's radial routes, approximately another third on all other 'A','B' and 'C' category classified roads and another on all non-network roads in between. Only 4% of accidents occurred within the City Centre.

* In 1988 there was an increase in accidents in Birmingham of just under 1% compared with 1987. This increase occurred almost entirely on non-network roads, as opposed to the classifed network.

* Further study of accidents in Birmingham during a one year period (1986) showed:

  - 25% of all accidents on non-network (unclassified) roads involved child pedestrians, only 8% of those on 'A' class roads involving this road-user.

  - nearly four times as many adult pedal cyclists were injured compared with child pedal cyclists, almost half of the former group being injured in accidents on 'A' class roads.

  - single-vehicle non-pedestrian accidents were most common on 'A' class roads.

  - almost half the accidents studied which had occurred on non-network roads in Inner Areas involved child pedestrians.

  - there were about 10 times the number of cars involved in accidents in Birmingham in 1986 as any other single type of vehicle.

  - 'threat to life' to non-occupants was greater from large, heavy vehicles than from small, light ones; larger vehicles in turn generally, but not always, offering greater protection to their occupants or being involved in less severe types of accidents. As an example of the effect of vehicle mass, 70% of all pedestrians struck by Heavy Goods Vehicles were either killed or seriously injured, compared with 42% of those struck by Public Service Vehicles and 30% by cars.

* Reviewing previous studies of accidents on Birmingham radial routes, it was shown that accident rates per kilometre on these routes were higher than those on similar roads in Wolverhampton and Coventry but about the same as those in four southern towns in England.

* Some methodological difficulties in the use of 'Land-use' as a proxy for accident occurrence have been identified and this measure used to show differences in accident patterns on Birmingham radial routes, some of these results derived from earlier published and unpublished studies. Results from this part of the review include:

  - the very high numbers of accidents occurring on parts of the radial routes adjacent to shops.

  - the similarity of accident rates on Birmingham radial routes according to adjacent land use (when accident rates ranked by order) compared with data from other parts of Great Britain.

RECOMMENDATIONS FOR ACTION

* The major recommendations for action from this research are:

  - that local authority researchers and others should continue to seek improved descriptions of the road accidents that occur, but that they should increasingly look beyond the Stats 19 form to gain such information.

  - that local authorities should inventory and hold together on computer files (which may be related to specific highway locations) more details of accident and injury-producing features on their roads, the most obvious of which being

  - that, in view of the large proportions (almost half of all accidents on non-network roads in Inner Areas) of child pedestrians being injured, greater efforts are made in urban safety management and in education of the young road user. (There is at present a paucity of information on good practice in the role of such techniques as 'traffic calming' and other methods of speed reduction).

  - that the theme of analyses of accidents by adjacent land-use be developed in view of its potential use as a tool in development control.

  - that local authorities look more closely at the topic of 'safety audit', viewing the subject in as broad a sense as practicable and seeking to gain from it as an approach, not only to procedures, but also by using it as a focus for a knowledge-base of practice and research.

  - that there be greater requirement on local authorities, not only to know about the accidents on their roads, but to have a structured course of action for implementation of policy and appropriate measures.

FUTURE STUDIES

* The work on young pedestrians referred to above will focus on the characteristics of accidents to this road-user within four distinct age groups - 0-4 years, 5-9 years, 10-14 years and 15-19 years. The study has been designed so as to draw upon several data sources and to concentrate on the characteristics of those at risk, the environmental and behavioural circumstances surrounding the accident and the selection of appropriate countermeasures. Early indications from this research are that some of the important issues which will arise are the threat to very young members of the ethnic minority communities in Inner Areas, alcohol-induced risk-taking among those aged 15-19 years and the high numbers of these accidents occurring on dual-carriageways of between 6 and 10 lanes width.

* Another project already underway is to analyse violation of automatic traffic signals ('red light running'). It is intended that the study should analyse the pattern of violation in Birmingham, assess why some sites experience more violation than others and consider opportunities for countermeasures and potential for accident reduction. One strand of this work may be to formulate guidelines on the econometrics of providing cameras to photograph vehicles whose drivers transgress, thereby providing an opportunity to follow-up and prosecute offenders.

NOTES AND DEFINITIONS

Except where otherwise stated, to enable comparison with national and regional data, accident statistics from a 'base year' of 1986 have been used throughout this report. In some time-series analyses 1987 and 1988 data have been included. Data in the individual studies referred to are, of course, from a variety of time periods, dependent upon when the research was conducted. Most data have been drawn from the data bases held by Birmingham City Council and the West Midlands Joint Data Team. A small amount of information has also been taken from work of the latter group and from other local studies. Sources are acknowlegded where appropriate.

The results quoted for accident patterns in large areas are, with exceptions, generally very stable over time and much of the 1986 data will be relevant for many years to come.

Except for the reference to West Midlands region in Figure 4, the term 'West Midlands' refers to the county area of that name and also to the seven metropolitan district authorities lying within that area.

Throughout this document the term 'accident' is used to refer to those injury-producing road accidents reported to the Police. 'Urban' road accidents are those occurring on a road with speed limit 40 m.p.h. or less.

'Network' roads are all the 'M', 'A', 'B' and 'C' class roads. Non-network roads are those minor roads, such as in residential and industrial areas, lying between the major routes. There are approximately 430 kilometres of classified road and 1680 kilometres of unclassified road in Birmingham for which the City Council has responsibility. The Department of Transport is highway authority for motorways lying within Birmingham.

Children are defined as those aged 0-14 years except in Table 5a and Figure 5 where 15 year olds are included.

Population figures or rates refer to the particular age groups and/or geographic areas and are mid-year estimates.

This study is part of the work of the City Engineers Accident Research and Remedial Measures Team who are:

S Proctor	Senior Engineer (Team Leader)
S D Lawson	Senior Research Officer
D Greaves	Engineer
G V Stanley	Engineer
G Rolph	Technician

The Accident Research and Remedial Measures Team works within the Traffic Management Division, primarily on the identification and 'treatment' of hazardous locations (changing about 30 sites each year), but also conducting research and providing data on local aspects of road traffic accidents.

TRAFFIC COLLISIONS IN AN URBAN AREA OF GREAT BRITAIN

a demographic and hierarchic review of road accidents in Birmingham and the West Midlands metropolitan districts.

1.0 INTRODUCTION

The County of West Midlands is a predominantly urban area comprised of the metropolitan districts of Birmingham, Coventry, Dudley, Sandwell, Solihull, Walsall and Wolverhampton. It covers an area of about 93.9 thousand hectares and is occupied by some 2.6 million people. Birmingham is the largest of the seven districts, occupying 26.3 thousand hectares and having a population of about 1.0 million. Over 95% of the roads in the West Midlands and 96% of the roads in Birmingham are urban in nature.

This study is intended as an interpretative review to be used in conjunction with data such as those presented in the annual and occasional reports of the local authorities in the West Midlands. The material is presented at a relatively non-technical level in order that the lay reader may gain a 'feel' for accidents and casualties in the study area and make comparisons with other parts of Great Britain.

2.0 ACCIDENT AND CASUALTY TOTALS

In 1986 a total of 5030 people were reported to have been involved in 3950 injury-producing accidents in Birmingham. The equivalent figures for the West Midlands districts are 9394 accidents and 11892 casualties. Accidents and casualties in Birmingham each year form about two-fifths of the West Midlands districts totals. In 1986 casualty totals for Birmingham and for all West Midlands districts formed 1.5% and 3.3% (respectively) of the total number of casualties in Great Britain.

In addition to those accidents described above which have been reported to the Police, it is estimated that approximately 30% of injury producing accidents are not reported to the Police. There are also a large number (estimates put this at more than ten times the number of injury accidents) of accidents involving only damage to vehicles and/or property.

3.0 TRENDS IN TIME

The number of people injured in road accidents in the West Midlands districts has declined, overall, since records began to be stored and analysed by local authorities in the West Midlands in the mid-1970s. Much of the reduction (a 16% decrease in accidents in the last eleven years compared with an increase in traffic of about 22% - Figure Ia) in the West Midlands in recent years has occurred in Birmingham. This trend is reflected in Figure Ib in which the number of casualties per district from 1980 to 1988 is presented.

The number of accidents, by selected road class, in Birmingham between 1980 and 1988 is presented in Figure Ic. For the five groups of road examined there is little difference between categories in the overall downward trend, although the number of accidents on 'A' roads shows greater deviation from the 'norm' than the others.

In 1988 there was an increase in accidents in Birmingham of just under 1% compared with 1987. It can be seen from Figure Ic that this increase was almost entirely a feature of the non-network roads.

It would be worthwhile to provide regular monitoring of the number of accidents in future years, and especially of those occurring on non-network roads: there is local concern that recently traffic may have been diverting from the main highway network onto minor roads, with a resultant rise in accidents on these roads.

Some year-to-year variation in these patterns is to be expected because of the multi-factorial nature of road accidents and it would be misleading to attempt to attribute any single 'cause' to any of the year-to-year changes within this pattern.

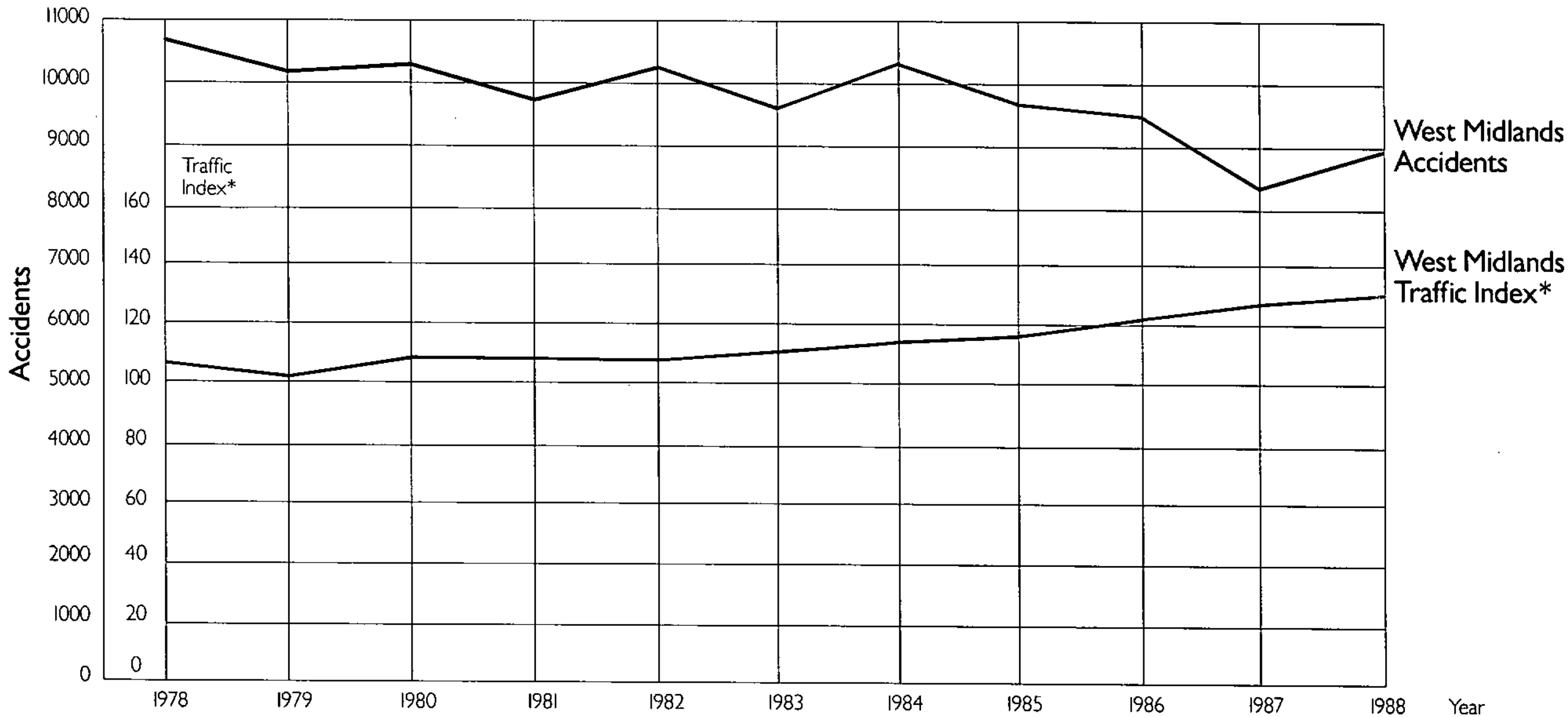
West Midlands districts casualty totals per head of population, for four common road-user types over the last 9 years, are presented in Figures 2a and 2b, with the pedestrian category divided into selected age groups. Figure 2a shows that, other than the 'dip' in 1983, the car occupant casualty rate has remained remarkably constant, as has that for pedal cyclists and also for pedestrians aged 20 years and above. The number of two-wheeled motor vehicle (T.W.M.V.) users injured per head of population has almost halved between 1980 and 1988. (Details of the absolute numbers of casualties in 1986 are included in Table 1).

Figure 2b indicates that the pedestrian casualty rate per head of population has fluctuated slightly in the period 1980 to 1988 but remained relatively constant. In 1988 there were more pedestrian casualties per head of population aged 10-14 years than in 1980, fewer 0-4 years and 5-9 years and about the same number of those aged 15-19 years. The 'young pedestrians' described in Figure 2b are the subject of a separate study (see, for example, Lawson and Proctor (1989)).

At a national level, accidents have been declining (Figure 3) despite an increase in traffic. The picture is also similar for some of the other regions (Figure 4), including large urban areas, but appears less true for those more rural regions and those in the south of Great Britain.

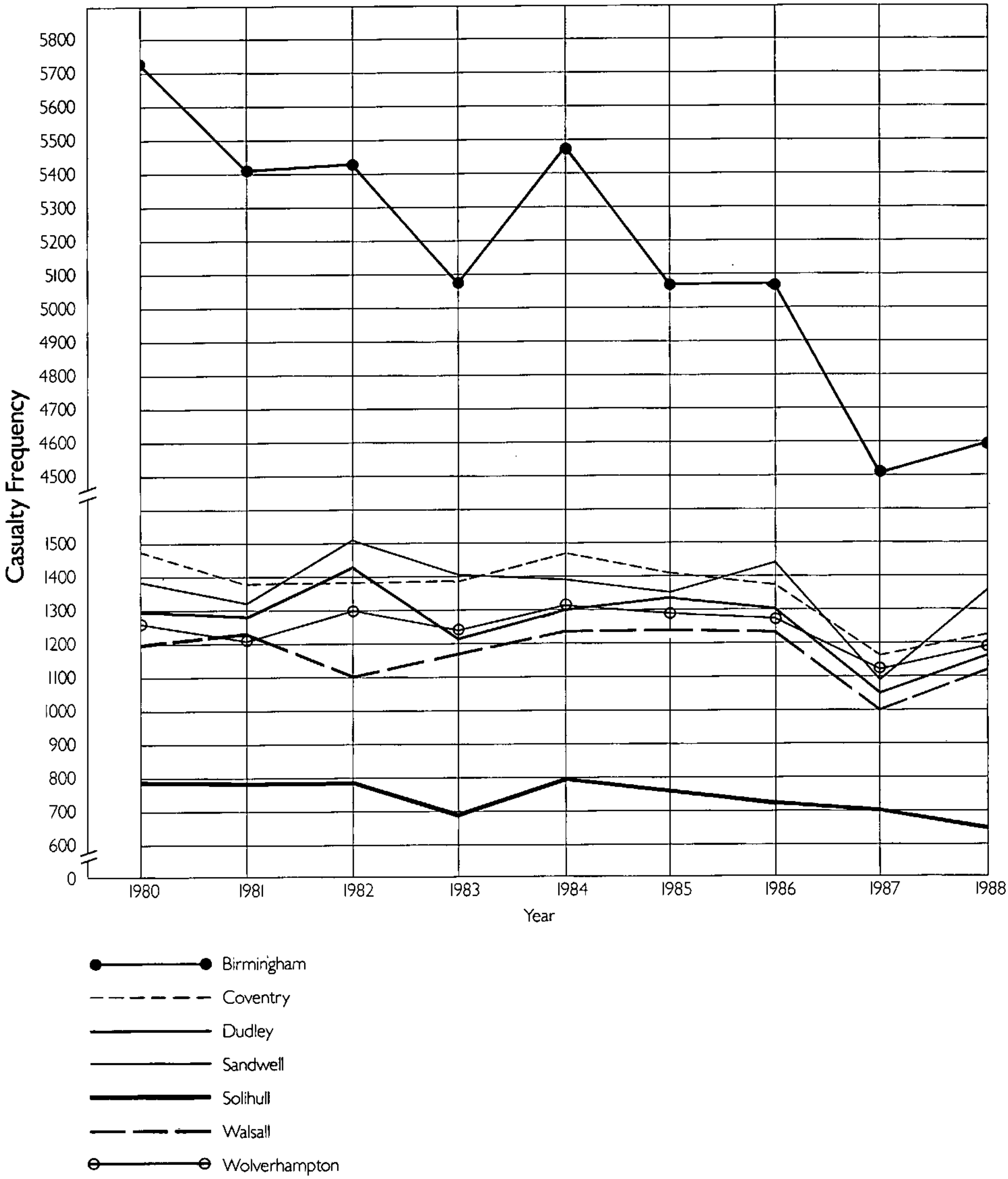
The data contained in Table 2a may be used to interpret Figure 4. The table illustrates the split of accidents by road type in the U.K. Department of Transport regions and the severity index (measured as the quotient of those 'fatal' and 'serious' accidents and the total number of accidents).

Figure 1a West Midlands Accidents and Traffic — Recent Trends



* Traffic data are non-motorway traffic expressed as an index where 1977 = 100

Figure 1b West Midlands Casualties by District 1980–88



Source: After 'Road Accident Data Review 1986'
West Midlands Joint Data Team

Figure 1c Accidents in Birmingham by selected categories of Road, 1980–88

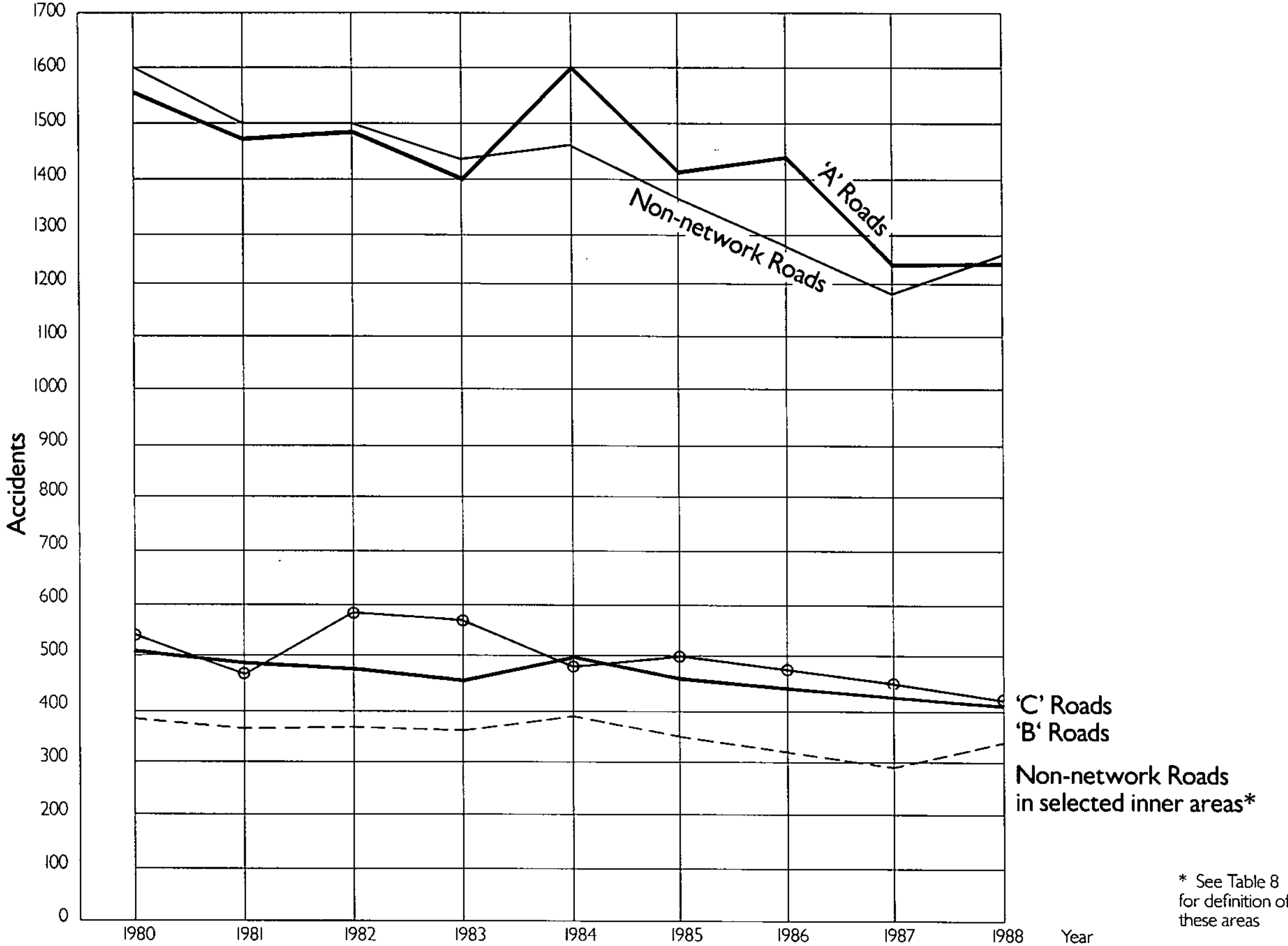


Figure 2a Selected West Midlands casualties per thousand of Population 1980–1988

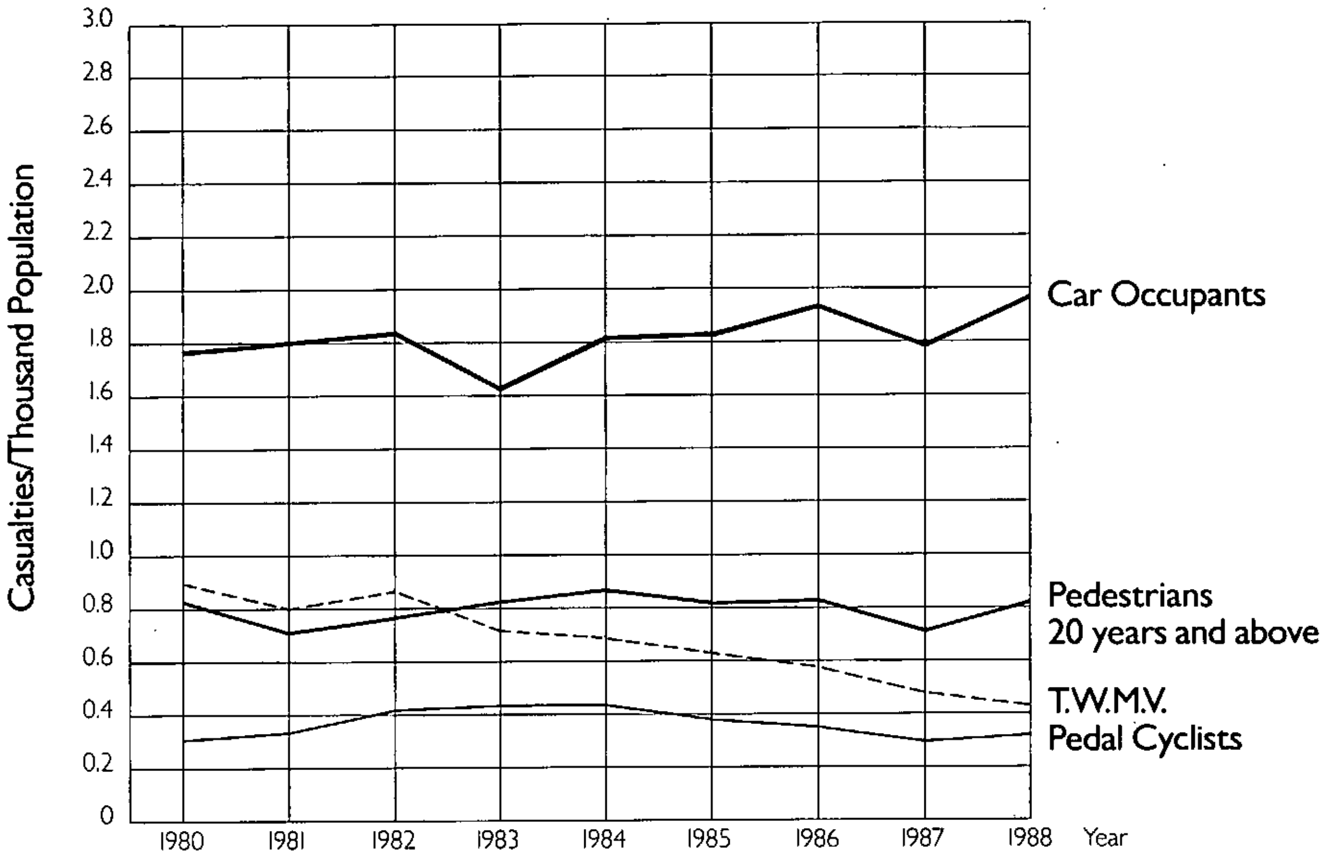


Figure 2b West Midlands Young Pedestrian casualties per thousand of Population 1980–1988

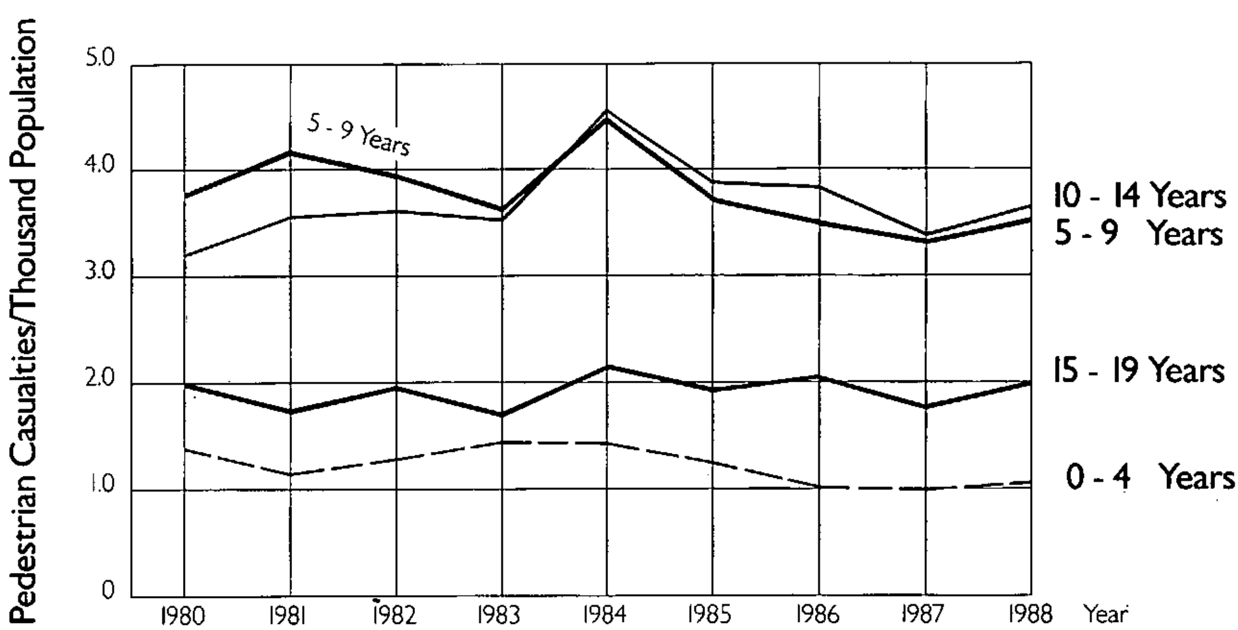
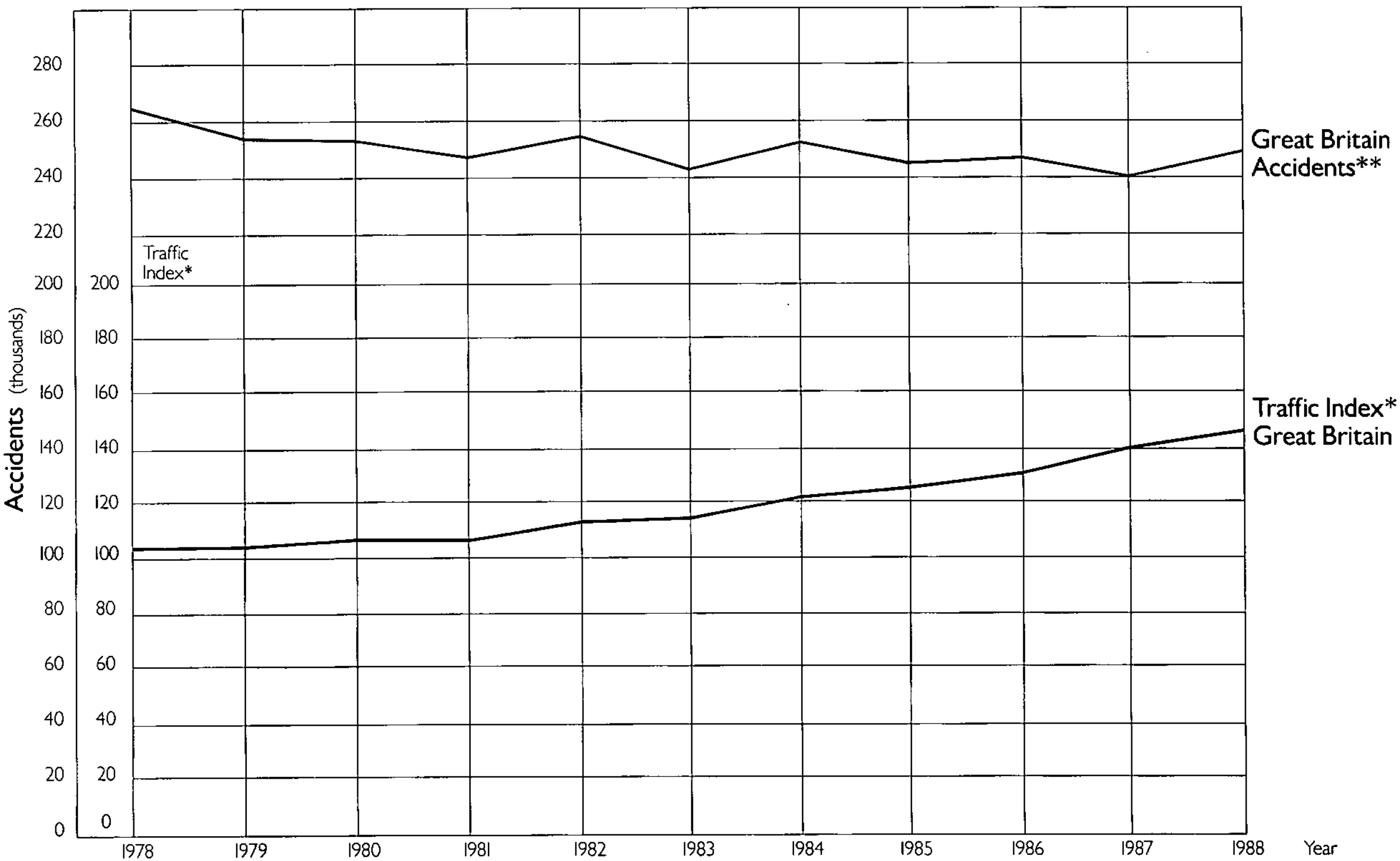


Table 1 West Midlands casualties by casualty class and age group, 1986.

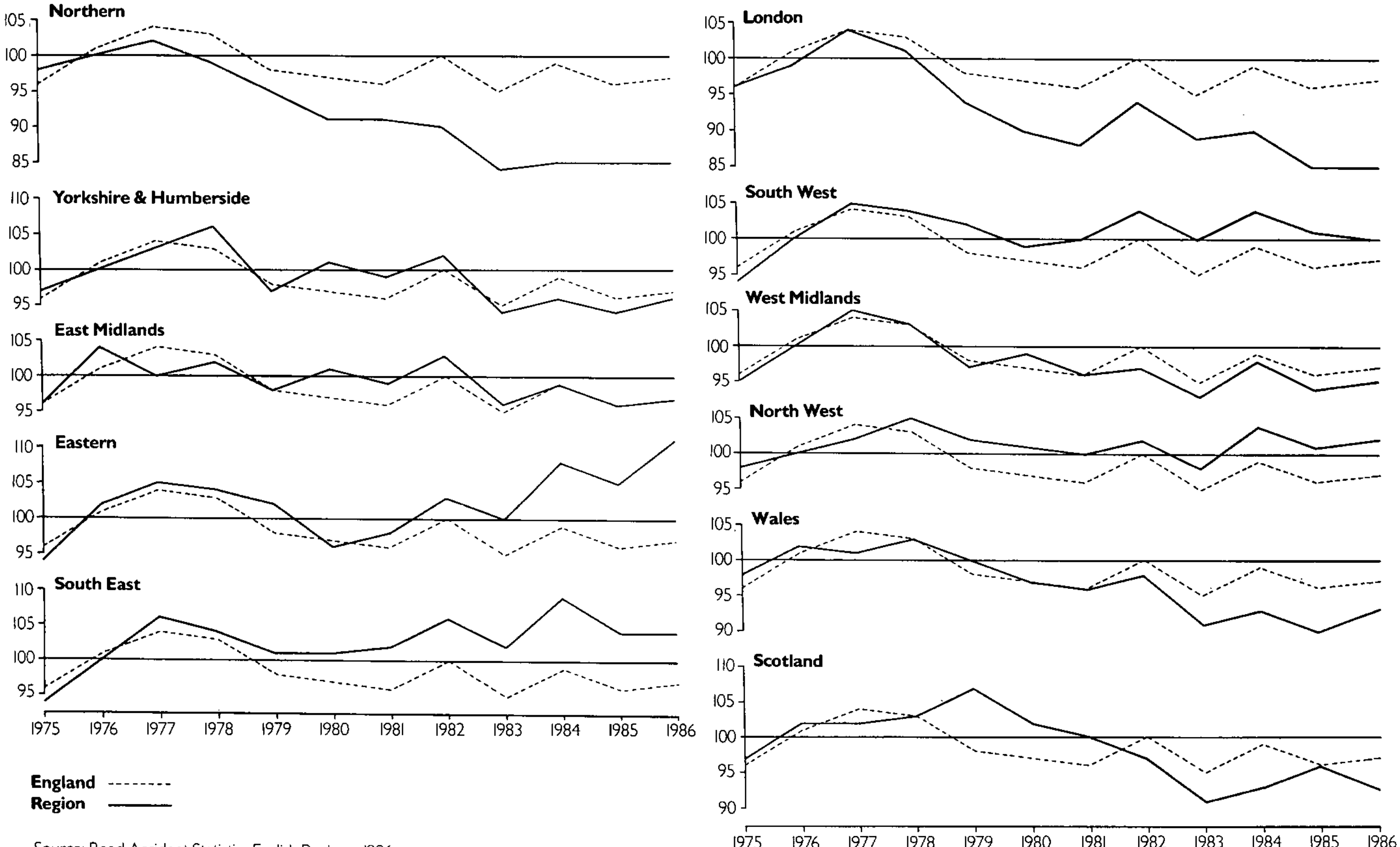
Casualty Class		0-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	70+	Total
Pedestrians		177	567	657	468	392	221	185	150	236	379	3432
Pedal Cyclist		6	52	198	230	193	95	57	39	28	13	911
T.W.M.V.:	Riders	0	0	3	505	553	139	78	67	27	3	1375
	Passengers	0	2	0	67	69	5	3	2	0	0	148
Car and Taxi:	Drivers	0	0	2	355	1118	582	380	251	136	85	2909
	Passengers	127	112	112	484	677	227	204	141	114	76	2274
PSV:	Drivers	0	0	0	1	1	4	12	0	1	0	19
	Passengers	16	7	8	13	17	19	34	50	77	75	316
Goods Vehicle:	Drivers	0	0	0	13	109	69	53	24	9	0	277
	Passengers	5	7	7	40	53	12	9	8	4	1	146
Other Road-users		2	4	2	6	16	20	9	12	9	5	85
All Road-users		333	751	989	2182	3198	1393	1024	744	641	637	11892

Figure 3 Great Britain Accidents and Traffic — Recent Trends



* Source: Transport Statistics Great Britain 1978–1988 (Index 1977 = 100)
** 1988 Accident total is provisional

Figure 4 Accident Indices by Region 1975–1986



Source: Road Accident Statistics English Regions, 1986

Table 2a Accident indices : by region, 1986.

Region	Total No. Accidents	No. Urban Accidents /(severity index)	% Urban Accidents form of Total	No. Rural Accidents /(severity index)	No. Motorway Accidents /(severity index)
Northern	8387	6453 (0.23)	77.0	1865 (0.31)	69 (0.36)
Yorkshire/ Humberside	19885	15858 (0.25)	79.0	3686 (0.41)	341 (0.25)
East Midlands	17100	11533 (0.24)	67.5	5164 (0.33)	403(0.27)
Eastern	27294	16990 (0.24)	62.3	9430 (0.33)	874 (0.21)
South East	32145	21480 (0.24)	66.9	9645 (0.33)	1020 (0.25)
Greater London	43222	41873 (0.19)	96.9	1104 (0.21)	245 (0.13)
South West	19580	12227 (0.28)	62.5	6954 (0.36)	399 (0.33)
West Midlands	20808	15886 (0.26)	76.4	4352 (0.33)	570 (0.27)
North West	29044	24414 (0.17)	84.0	3838 (0.27)	842 (0.22)
Wales	10525	7238 (0.23)	68.8	3165 (0.34)	122 (0.26)
Scotland	19814	13871 (0.30)	70.0	5666 (0.43)	277 (0.35)
Total	247804	187823 (0.23)	75.9	54869 (0.34)	5162 (0.25)

Source: T.R.R.L.

4.0 QUALITATIVE DESCRIPTIONS

As with all cities and large towns, accidents in Birmingham and the other towns and city in the West Midlands county area tend to cluster at locations either in the city/town centre or on the arterial routes leading to or from them, with the remainder being scattered throughout the minor roads in-between.

Birmingham City Centre may be viewed as the hub of a wheel with the radial routes extending from this centre. The roads pass through built-up areas stretching between 10 and 12 kilometres from the City Centre to the south-west, south and east, towards Dudley in the West, the districts of Sandwell and Wolverhampton in the north-west and Walsall in the north. Solihull is situated some 15 kilometres to the south-east of Birmingham and Coventry City Centre about another 20 kilometres beyond.

The nature and sizes of the individual West Midlands districts is reflected in the type of casualties described here. As mentioned above, all the districts are predominantly urban in nature and there are therefore a relatively high number of accidents involving pedestrians in the West Midlands compared with Great Britain as a whole. This is discussed in detail below.

Birmingham, the largest district, has about four times the number of casualties of each of Coventry, Dudley, Sandwell, Walsall and Wolverhampton, these five districts having broadly similar characteristics, areas, population and road lengths. Solihull is more rural than the other districts, has fewest accidents, but relatively more involving drivers and passengers of cars and fewer involving pedestrians. A summary of casualties in the West Midlands by road-user type is provided in Table 1.

5.0 WEST MIDLANDS COMPARED WITH OTHER METROPOLITAN AREAS

Of the metropolitan areas of Great Britain, the West Midlands is second only to Greater London in terms of the number of vehicles licensed, cars licensed and number of cars per thousand of population (Table 2b). The number of cars per thousand of population in the West Midlands (321) is markedly greater than in the other metropolitan areas outside London, all of which have below the average for Great Britain (315).

It is useful to compare the West Midlands metropolitan district councils with other conurbations in England in terms of accidents and casualties in these areas. Table 3a shows that, apart from Greater London, the West Midlands was second only to Greater Manchester in terms of the number of casualties injured in 1986. The West Midlands districts are relatively more urban than the other metropolitan counties (excluding London) and this is reflected in the percentage that adult pedestrian casualties form of the total (Table 3b). It is worth noting from Table 3b that in Tyne and Wear the percentage that pedestrian casualties form of the total is particularly high and this may be worthy of study by road safety agencies in that area. There is also a relatively high percentage of child pedestrian casualties (11.7% of all casualties) in the West Midlands; in relative terms only Tyne and Wear exhibits a higher percentage (14.6% of all casualties).

The relative numbers of pedal cyclists injured in each of the urban areas listed in Table 3b is similar, varying only between about 5.4 and 8.9% of the total number of casualties in each area. Many of these differences are likely to be explained by differences in topography and therefore the use of cycles. For example, West Yorkshire, one of the more hilly areas, has relatively few cyclist casualties. The West Midlands falls within the middle of this range with 7.7% of all casualties being cyclists.

The percentage that T.W.M.V. users form of all casualties in each of the conurbations varies between 8.4 and 15.8% (Table 3b) with the West Midlands towards the higher end of this spectrum with 12.8%.

Car occupant casualties form between 43.1 and 48.6% of all casualties in each of the seven areas (Table 3b) with the exception of Tyne and Wear (39.9%). The number of car occupant casualties per thousand licensed cars varied between 6.2 and 11.2 (Table 2b), the West Midlands at the lowest extreme of this range.

In Table 3c the number of casualties per head of population for selected road-users is presented.

The measure of risk presented in Table 3c is not a measure of an individual's likelihood of having an accident based upon distance travelled or time spent travelling. It is, however, a measure of the overall risk to the population and as such has use in resource-planning. For example, injuries to road accident casualties are often road-user or accident-type specific – hospitals in London would probably need to adopt different strategies for dealing with T.W.M.V. casualties compared with Tyne and Wear where the numbers of casualties per ten thousand of population are 11.7 and 3.1 respectively.

Almost certainly as a result of the exposure experienced by these road-users, car-users are the most frequently injured per head of population; child pedestrians have a higher risk of injury than older pedestrians both of whom experience higher risk than T.W.M.V. users who in turn have a risk per head of population of the order of double that of pedal cyclists.

There is some variation by area indicated in Table 3c. The figures for West Midlands do not lie at the extreme of any of the ranges. The casualty rate per head of population in the West Midlands is generally low compared with elsewhere. London accident rates are consistently high. Compared with the total figures for Great Britain, as would be expected of counties comprised of or including large urban areas, the casualty rate per head of population for pedestrians is relatively high in the metropolitan areas, and that for car-users relatively low.

Just how many of the accidents do occur on urban roads is shown in Table 3d. In all of the metropolitan areas over 85% of the accidents occur on urban roads, and in four of the eight areas the figure is over 90%.

Table 2b Motor vehicles currently licensed in metropolitan areas and Great Britain, 1986.

	All vehicles (thousands)	Cars (thousands)	Cars per thousand population	Car occupant casualties per thousand licensed cars
Greater London	2628	2196	324	10.1
Greater Manchester	848	700	271	8.9
Merseyside	403	338	230	11.2
South Yorkshire	423	338	260	7.3
Tyne and Wear	295	243	214	7.0
West Midlands	1020	844	321	6.2
West Yorkshire	682	554	270	8.7
All (English) metropolitan areas	6299	5213	291	8.9
All (English) non-metropolitan areas	12774	10081	345	8.2
Great Britain	21669	17389	315	9.2

Source: derived from Transport Statistics (Great Britain) 1976-1986, H.M. S.O.

Table 3a Casualties: by selected road-user type, severity and Metropolitan areas and Great Britain (Urban), 1986.

	Pedestrians				Pedal Cyclists		T.W.M.V.		All car-users		All road-users	
	Children		Adults									
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Greater London	19	3280	273	8097	18	4055	74	7886	116	22122	520	51090
Greater Manchester	19	1596	85	2321	11	1256	20	1761	47	6159	188	14003
Merseyside	9	877	50	1159	5	528	8	705	29	3748	102	7663
South Yorkshire	7	491	40	769	5	381	13	881	27	2455	96	5580
Tyne & Wear	8	614	38	808	2	297	3	353	17	1681	73	4178
West Midlands	13	1387	87	1936	4	907	19	1503	60	5194	194	11698
West Yorkshire	16	1051	101	1488	2	555	19	1516	67	4765	216	10110
Gt. Brit. (Urban)	215	20828	1261	34672	151	23117	399	40633	561	90081	2663	225340

Source: Road Accidents Great Britain, 1986.

Table 3b Percentages of five road-user casualty types as a fraction of all roadusers injured in metropolitan areas and Great Britain (Urban), 1986.

	Child Pedestrian	Adult Pedestrian	Pedal Cyclists	T.W.M.V.	Car-user	%	(No.)
Greater London	6.4	16.2	7.9	15.4	43.1	100	(51610)
Greater Manchester	11.4	17.0	8.9	12.6	43.7	100	(14191)
Merseyside	11.4	15.6	6.9	9.2	48.6	100	(7765)
South Yorkshire	8.8	14.3	6.8	15.8	43.7	100	(5676)
Tyne & Wear	14.6	19.9	7.0	8.4	39.9	100	(4251)
West Midlands	11.7	17.0	7.7	12.8	44.2	100	(11892)
West Yorkshire	10.3	15.4	5.4	14.8	46.8	100	(10326)
Gt. Brit. (Urban)	9.2	15.8	10.2	18.0	39.8	100	(22,3003)

Note: For example, of all casualties injured in Greater London, 6.4% were child pedestrians.

Source: derived from Road Accidents Great Britain, 1986.

Table 3c Population and casualties per head of population by selected road-user type for metropolitan areas and Great Britain, 1986.

Area	Population Total (Thousands)	Child Population* (Thousands)	Other Population* (Thousands)	Casualties per ten thousand of population					
				Pedestrian Child	Pedestrian Other	Pedal Cyclist	T.W.M.V.	Car-user	All road-users
Greater London	6775.2	1287.3	5487.9	25.6	15.3	6.0	11.7	32.8	76.2
Greater Manchester	2579.5	490.1	2089.4	33.0	11.5	4.9	6.9	24.1	55.0
Merseyside	1467.8	278.9	1188.9	31.8	10.2	3.6	4.9	25.7	52.9
South Yorkshire	1297.9	246.6	1051.3	20.2	7.7	3.4	6.9	19.1	43.7
Tyne & Wear	1135.5	215.7	919.8	28.8	9.2	2.6	3.1	15.0	37.4
West Midlands	2632.3	500.1	2132.2	28.0	9.5	3.5	5.7	20.0	45.2
West Yorkshire	2053.1	390.1	1663.0	27.4	9.6	2.7	7.5	23.5	50.3
Great Britain	55196.5	10487.3	44709.2	20.6	8.5	4.7	9.5	28.8	58.2

* Assumed to be 19% of the population in each metropolitan area, this being the fraction of estimated resident population of those aged under 15 years in England in mid 1986

Source: derived from Road Accidents Great Britain, 1986.

6.0 ACCIDENT TOTALS IN INDIVIDUAL METROPOLITAN DISTRICTS

All the metropolitan counties listed in Tables 3a and 3b are comprised of one or sometimes two major cities with between three and nine adjacent metropolitan districts. The number of accidents in these areas is dependent upon numerous factors, not least the size of the area. From Table 4a it can be seen that the number of accidents in the major provincial cities in 1986 had a range of between 1038 (Newcastle) and 3950 (Birmingham). (In each major city over 85% of these accidents occurred on urban roads (Table 4b)). The number of accidents per thousand of population had a range of between 3.3 (Sheffield) and 6.0 (Manchester) with Birmingham (3.9) lying towards the lower end of this span. In 1986 the number of accidents in the other metropolitan districts had a range of between 410 (South Tyneside M.D.C.) and 1430 (Kirklees M.D.C.) (Department of Transport, (1988)).

7.0 ACCIDENTS IN WEST MIDLANDS COMPARED WITH GREAT BRITAIN

As stated above, the almost exclusively urban nature of the West Midlands districts means that there are relatively high numbers of pedestrian casualties in the West Midlands. Compared with other metropolitan areas and with those accidents which occur on all urban roads in Great Britain (Table 3b), the proportions of accidents in the West Midlands involving pedestrians and child pedestrians are amongst the highest detailed in the table.

Compared with 'urban road accidents in Great Britain' the West Midlands districts have relatively fewer road-user casualties who are cyclists (10.2% in Great Britain compared with 7.7% in the West Midlands) and T.W.M.V. users (18.0% compared with 12.8%) and more car occupants (39.8% compared with 44.2%).

8.0 ACCIDENTS IN THE WEST MIDLANDS IN DETAIL

The nature and extent of road accidents in any area is determined to a large degree by the characteristics of that area, by its topography, population density, type and style of roads and by some of the additional features and standards of those roads. It is helpful to disaggregate the roads of the West Midlands into two broad categories – network (all the 'M', 'A', 'B' and 'C' class roads) and non-network (those minor roads such as in residential and industrial areas) roads lying between the major routes.

Since the characteristics and features of the many sites, junctions and lengths of road which comprise the road system have such a strong influence on who is involved and how accidents occur, it is necessary to disaggregate the data within several categories. Tables 5a and 5b show one such grouping of a set of recent accident data.

Tables 5a and 5b are useful since they allow statements to be made not only about the absolute numbers of accidents occurring at various locations, but also because comments along the lines of, "of all accidents occurring at roundabouts, 16% involve pedestrians" may be made. These tables are discussed in sections 8.1 to 8.5. Part of the content of the tables is presented graphically in Figure 5.

Table 3d Number (and percentage) of accidents on urban roads in metropolitan areas, 1986.

Area	All Roads	Urban Roads	(% Urban)
Greater London	43222	41876	96.9
Greater Manchester	11373	10726	94.3
Merseyside	6035	5603	92.8
South Yorkshire	4469	3838	85.9
Tyne & Wear	3388	2960	87.4
West Midlands	9394	8918	94.9
West Yorkshire	8067	7029	87.1
Total	85948	80950	94.2

Source: T.R.R.L.

Table 4a Accidents in major provincial cities in England by selected road class, 1986.

	Motorway	Trunk	Principal 'A' Roads	All Roads	Accidents/ pop'n x 10^3
Birmingham	69	42	1659	3950	3.9
Bradford	9	152	731	1949	4.2
Leeds	66	199	912	2820	4.0
Liverpool	3	18	1026	2428	5.0
Manchester	30	21	1310	2724	6.0
Newcastle	19	26	405	1038	3.7
Sheffield	2	47	696	1746	3.3

Source: *Road Accident Statistics English Regions 1986, with population figures supplied by the West Midlands Joint Data Team.*

Table 4b Number (and percentage) of accidents on urban roads in major provincial cities in England, 1986.

	All Roads	Urban Roads	(% Urban)
Birmingham	3950	3861	(97.7)
Bradford	1949	1832	(94.0)
Leeds	2820	2427	(86.1)
Liverpool	2428	2420	(99.7)
Manchester	2724	2669	(98.0)
Newcastle	1038	941	(90.7)
Sheffield	1746	1664	(95.3)
Total	16655	15814	(95.0)

Source: T.R.R.L.

Table 5a Some different types of West Midlands injury accidents expressed as a fraction of all accidents (totals in brackets) at each type of location (31 January 1983 - 30 January 1985).

Location	Severity Index*	West Midlands Districts Accident Total	Pedestrian Accidents		Child Pedestrian Accidents		Pedal Cycle Accidents		Child Accidents	
		No.	%	No.	%	No.	%	No.	%	No.
Strategic Network Roads***										
Traffic signal-controlled junctions	0.28	1617	33**	(537)	11	(176)	8	(129)	18	(293)
Roundabouts	0.23	807	16	(131)	4	(33)	22	(178)	11	(85)
Uncontrolled Junctions – single-carriageway	0.29	5336	30	(1578)	13	(712)	13	(718)	21	(1142)
Uncontrolled Junctions – dual-carriageway	0.35	963	29	(283)	10	(95)	12	(119)	16	(156)
Single-carriageway links	0.34	3016	48	(1434)	22	(667)	7	(220)	29	(880)
Dual-carriageway links	0.37	1008	34	(341)	10	(97)	7	(73)	14	(146)
Non-network Roads										
Junctions	0.27	3496	37	(1279)	20	(683)	17	(577)	33	(1142)
Links	0.29	2835	51	(1435)	36	(1009)	11	(316)	46	(1308)

$$\text{* Severity-Index} = \frac{\text{Fatal Accidents + Serious Accidents}}{\text{All Injury Accidents}}$$

** Row percentages do not total to 100% since the list of accident types is neither exhaustive nor mutually exclusive.
*** 'Network' refers to the strategic accident road network which includes all 'M', 'A', 'B' and 'C' class roads.
Source: West Midlands Joint Data Team

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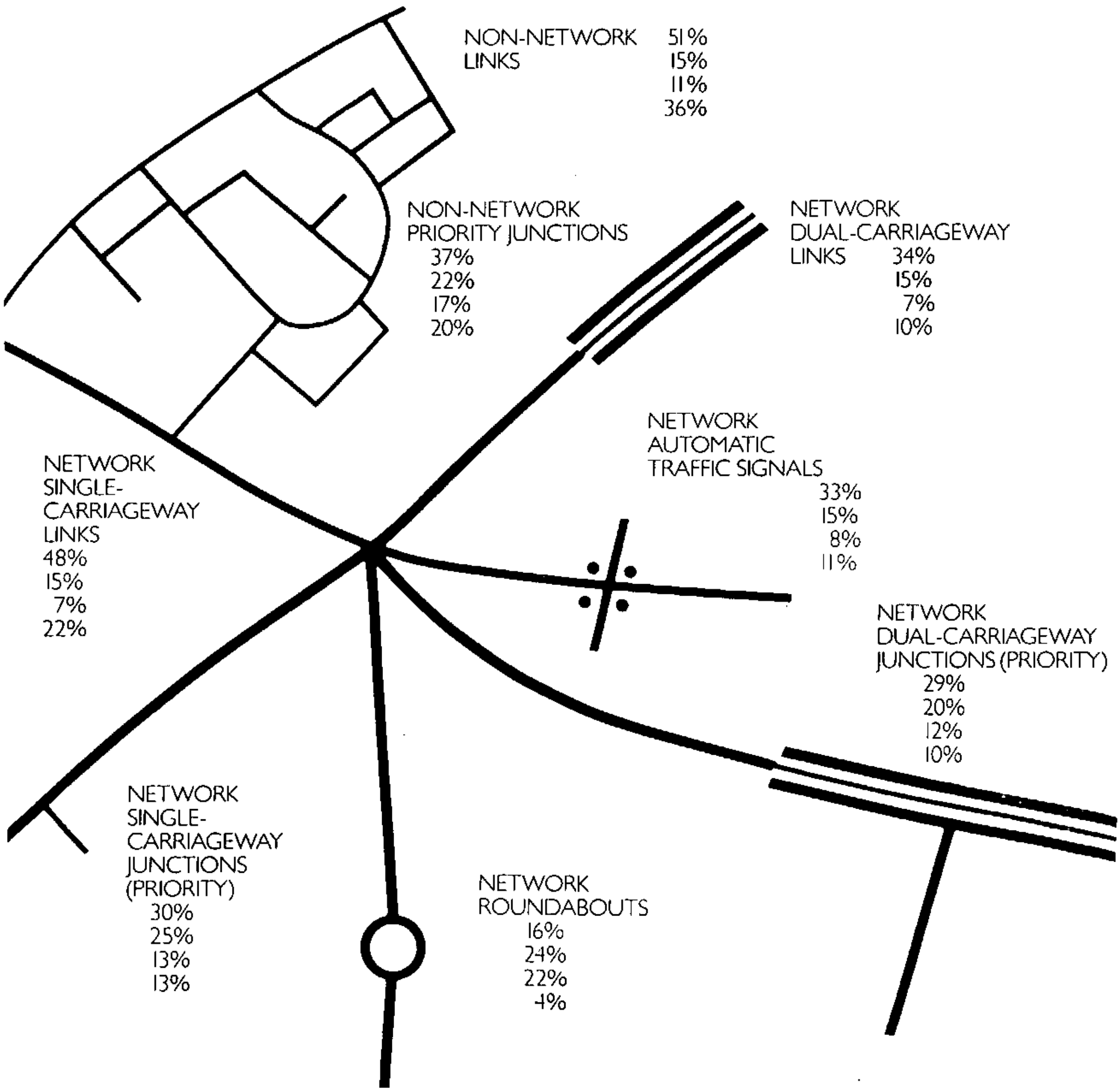
Table 5b Some different types of West Midlands injury accidents expressed as a fraction of all accidents (totals in brackets) at each type of location (31 January 1983 - 30 January 1985).

Location		Powered Two-wheeler %	Powered Two-wheeler No.	Single-Vehicle Non-Pedestrian %	Single-Vehicle Non-Pedestrian No.	Dark Accidents %	Dark Accidents No.	Wet Accidents %	Wet Accidents No.
Strategic Network Roads									
Traffic signal-controlled junctions		15	(246)	5	(78)	34	(555)	37	(595)
Roundabouts		24	(193)	21	(169)	38	(307)	37	(296)
Uncontrolled Junctions	single-carriageway	25	(1388)	7	(369)	29	(1553)	38	(2037)
	dual-carriageway	20	(192)	10	(95)	34	(324)	40	(383)
Single-carriageway links		15	(442)	16	(468)	33	(985)	35	(1045)
Dual-carriageway links		15	(147)	27	(275)	36	(361)	39	(393)
Non-network Roads									
Junctions		22	(774)	8	(291)	27	(942)	31	(1082)
Links		15	(418)	14	(399)	26	(751)	27	(764)

Figure 5 The Distribution of Accidents by Location Type West Midlands January 1980–January 1983



KEY:
% PEDESTRIAN ACCIDENTS
% T.W.M.V. ACCIDENTS
% PEDAL CYCLIST ACCIDENTS
% CHILD PEDESTRIAN ACCIDENTS

e.g. of all accidents happening at roundabouts, 22% inolve pedal cyclists.

8.1 LOCATION AND TYPE OF ACCIDENTS

Examining Table 5a it should be noted firstly that accidents are relatively common at junctions (column 2). Junctions occupy substantially less road space than the links in-between but experience more accidents because of the conflicting vehicle movements at these intersections. Accidents are most common at the category of junction, 'priority single-carriageway junction' probably because these types of site are more common that any other.

A few additional comments about the overall pattern of accidents may be helpful. From column 2 of Table 5a, it can be seen that accidents are common at junctions. They are also more common on single than on dual-carriageway links and at automatic traffic signal (A.T.S.) junctions than at roundabouts (largely because there are more A.T.S. junctions than roundabouts). Similarly, in absolute terms, pedestrian accidents are common on single-carriageway routes both on links and at junctions (although less so on non-network roads for the latter). Child pedestrians tend to be injured on non-network roads rather than on the network, and pedal cyclists and riders of T.W.M.V. at junctions, particularly on the network (more so for T.W.M.V. riders). Single-vehicle non-pedestrian accidents are predominantly a feature of network rather than non-network roads.

The severity index (column I, Table 5a) is often related to the mass ratios of the vehicles involved, the vulnerability of particular road users commonly injured, and also to the speed of vehicles travelling along particular routes or through various types of site. For example, the severity of accidents involving pedestrians is often higher than that in non-pedestrian accidents and therefore the severity index is high on the links between junctions where pedestrian accidents tend to occur. Similarly, accidents on dual carriageways, both on links and at junctions, tend to have a higher severity than those on single-carriageways. Generally, those accidents on non-network roads are of a slightly lower severity than those on network roads.

8.2 ROUNDABOUTS AND TRAFFIC SIGNALS

In recent years there has been some debate about the relative safety of roundabouts and those junctions controlled by A.T.S. This discussion has particular relevance at locations which have previously been without control of any form but for which a choice of control is to be made. The data in Tables 5a and 5b do not permit comment on the average number of accidents for each type of site (this issue is discussed in 8.6) but do allow analysis of the types of accident which generally occur at these two locations. It can be seen that, of all accidents happening at the two types of site, 22% of those at roundabouts involved cyclists whereas only 8% of those at A.T.S. junctions involved this road user. Similarly the relevant percentages for some other types of accident at A.T.S. junctions and roundabouts are: 33% of all accidents at A.T.S. involve pedestrians compared with 16% at roundabouts; child pedestrian accidents – 11% of all accidents at A.T.S. versus 4% of those at roundabouts; single-vehicle non-pedestrian - 5% at A.T.S. and 21% at roundabouts; T.W.M.V. – 15% at A.T.S. and 24% of those at roundabouts. Accidents occurring in the wet and the dark are represented by similar percentages at the two types of site.

It is important to emphasise that although, for example, a relatively high percentage of those accidents at A.T.S. junctions involve pedestrians it is not necessarily true to say that these sites are 'dangerous for pedestrians'. Rather, it may simply be that A.T.S. are installed at those types of urban, congested sites where pedestrians are abundant (there being insufficient land to accommodate a roundabout).

8.3 UNCONTROLLED JUNCTIONS

Comparing accidents at uncontrolled junctions on single and dual-carriageway roads, the greater speed of vehicles on dual carriageway routes is reflected not only in the higher severity of impacts but in the number of single-vehicle non-pedestrian accidents (10% of those accidents at dual-carriageway uncontrolled junctions compared with 7% of all accidents at the single carriageway equivalent). The slightly greater percentages of accidents in the dark and wet on dual-carriageways, both at junctions and on links, almost certainly reflects the combined effects of speed and accidents involving skidding. The greater percentage of accidents in the dark may be related in part to the role of speed, single-vehicle accidents and, in turn, to the role of alcohol in accidents at certain times of the day.

The part that pedestrian accidents play in accidents at junctions, compared with other types of accident, is relatively small and this is reflected in the figures - pedestrians are involved in 30% of all accidents at single-carriageway and 29% of dual-carriageway uncontrolled junctions. Only roundabouts exhibited a lower percentage (16% of all accidents at this type of site).

T.W.M.V. riders are particularly vulnerable at uncontrolled junctions and this is reflected in the fact that 25% of all accidents at uncontrolled single-carriageway junctions involved these roadusers (the highest percentage of any of the locations considered) and 20% at dual-carriageway uncontrolled junctions.

8.4 LINKS

When accidents on links are compared with those at junctions it can be seen that relatively high percentages of accidents on links involve pedestrians (particularly on single-carriageways) and single-vehicle non-pedestrian accidents. Of all accidents on single-carriageway links, 48% involve a pedestrian; 34% of those on dual-carriageways involve a pedestrian. Similar figures for single-vehicle non-pedestrian accidents are 16% and 27% respectively.

The percentage of pedestrian accidents on single-carriageway links (48%) is greater than the figure for dual-carriageway (34%) but it is worth noting that the ratio of the two percentages is greater for child pedestrians (for which the percentages of accidents on single and dual-carriageways are 22% and 10% respectively), possibly reflecting the lower likelihood of children to cross dual-carriageway links compared with single-carriageways. Pedal cyclists and T.W.M.V. riders account for 7% and 15% respectively of all accidents at both types of site.

8.5 NON-NETWORK

Non-network roads (defined in 8.0) have several characteristics which lead to the accidents on them differing from those on network roads. Fewer H.G.V.s (and therefore smaller vehicle mass ratios for vehicles involved in accidents) and lower vehicle speeds on these roads tend to lead to a low severity index for accidents (column 1, Table 5a) but this is countered to some degree by the high involvement of pedestrians (51% of all accidents on non-network links and 37% of all accidents at non-network junctions). Accidents in the dark and wet are relatively less common, the former possibly reduced by the high numbers of children involved in accidents (these accidents being common in daylight) and both influenced by lower speeds and smaller numbers of single-vehicle non-pedestrian accidents. Comparing the percentage that T.W.M.V. riders and pedal cyclists form of all accidents on network and non-network roads, it can be seen that T.W.M.V. riders form a larger proportion of those accidents on network roads than cyclists, whereas the reverse is true for non-network roads.

8.6 ACCIDENTS PER JUNCTION IN BIRMINGHAM

Almost all the data presented thus far have been concerned with the proportions of different accident types at specific locations. Section 8.6 and 8.7 are concerned with the number of accidents *per* junction or *per* length of road.

Some data collected by Storey (1984) are presented in Table 6. These show the number of accidents per junction for various types of junction in Birmingham averaged over a 3 year period between 3lst January 1980 and 30th January 1983. A regression equation has been used to link the total number of injury accidents to the total traffic flowing into a junction ("Inflow") during a 12 hour period between 7am and 7pm. Briefly, the data show:

i) the number of accidents in the three year period was generally greater at 4-arm junctions than 3-arm junctions but there was little difference in accident rates between 4 and 5-arm junctions.

ii) A.T.S. junctions generally experience more accidents than priority-controlled junctions, more than mini, small and conventional roundabouts (the number of accidents at these roundabouts increasing with size) but less than grade-separated roundabouts.

iii) grade-separated roundabouts experience the largest number of accidents of any type of junction but it should be noted that this may be due in part to the way in which accidents are coded to this type of location, it being common to find accidents occurring either on the approaches, or on the road passing over or under the junction, being coded to the roundabout.

iv) the regression lines for the more reliable (larger) samples show that typically no more than between one-third and one-half of the variance in accident rate is statistically explained by 'Inflow'. (It should be noted also that the method used has not 'forced' the line through the origin so that whilst the relationships may be at their 'best' for values of traffic inflow around the mean, extrapolation, particularly towards the lower limits, is less reliable).

v) the accident rates generated by these equations are generally lower than for those provided for in comparable junctions in the Department of Transport's COBA program. This is likely to be the case in other metropolitan areas and is possibly due to the sampling procedures used in collecting sites for the COBA relationships, there not being sufficient representation of sites taking the very high volumes of traffic in a metropolitan area. Accident rates (per vehicle throughout) are generally lower at sites with high volumes than those at sites with low volumes - Department of Transport COBA equations therefore over-estimate likely accident frequencies. This point is illustrated in Figure 6 in which some of Storey's original data for the West Midlands, as opposed to only Birmingham, (for 3-arm, signal-controlled junctions with dual-carriageway approaches - on at least one arm) are compared with the COBA curve for that type of junction. It can be seen that all but three of the West Midlands data points fall beneath the curve and that, even allowing for the fact that the best (straight) line of fit has not been forced through the origin, this line falls well below the COBA line for all points for which there are local data. Storey (1989) reports that other types of site also tended to show COBA curves over-estimating when compared with West Midlands data.

vi) it must be stressed again that although, for example, the A.T.S. junctions generally have more accidents than small roundabouts, it is not automatically true to say that the A.T.S. form of control is 'less safe'. Rather, it may often be more accurate to say that the constraints imposed by the site (for example, the proportion of competing flows, land-use, space) dictate that one form of control is more suitable than another and that the nature of the use of the site (for example, the presence of pedestrians) leads to more accidents at one type of control than another.

8.7 ACCIDENTS PER KILOMETRE

Tables 7a and 7b illustrate the number of accidents per unit length and per million vehicle kilometre for 'A' and 'B' class roads in each of the West Midlands metropolitan districts and for Great Britain. Data are provided for 'link-only' and for links and junctions combined.

Table 7a shows that in the West Midlands districts accident rates per million vehicle kilometre are generally lower on 'A' roads than on 'B' roads. The range of values of accident rates is high - for example, for link-only 'A' class roads the accident rate per million vehicle kilometres varies between 0.44 in Solihull and 0.99 in Wolverhampton, probably due to a large extent to the rural nature of many Solihull 'A' roads.

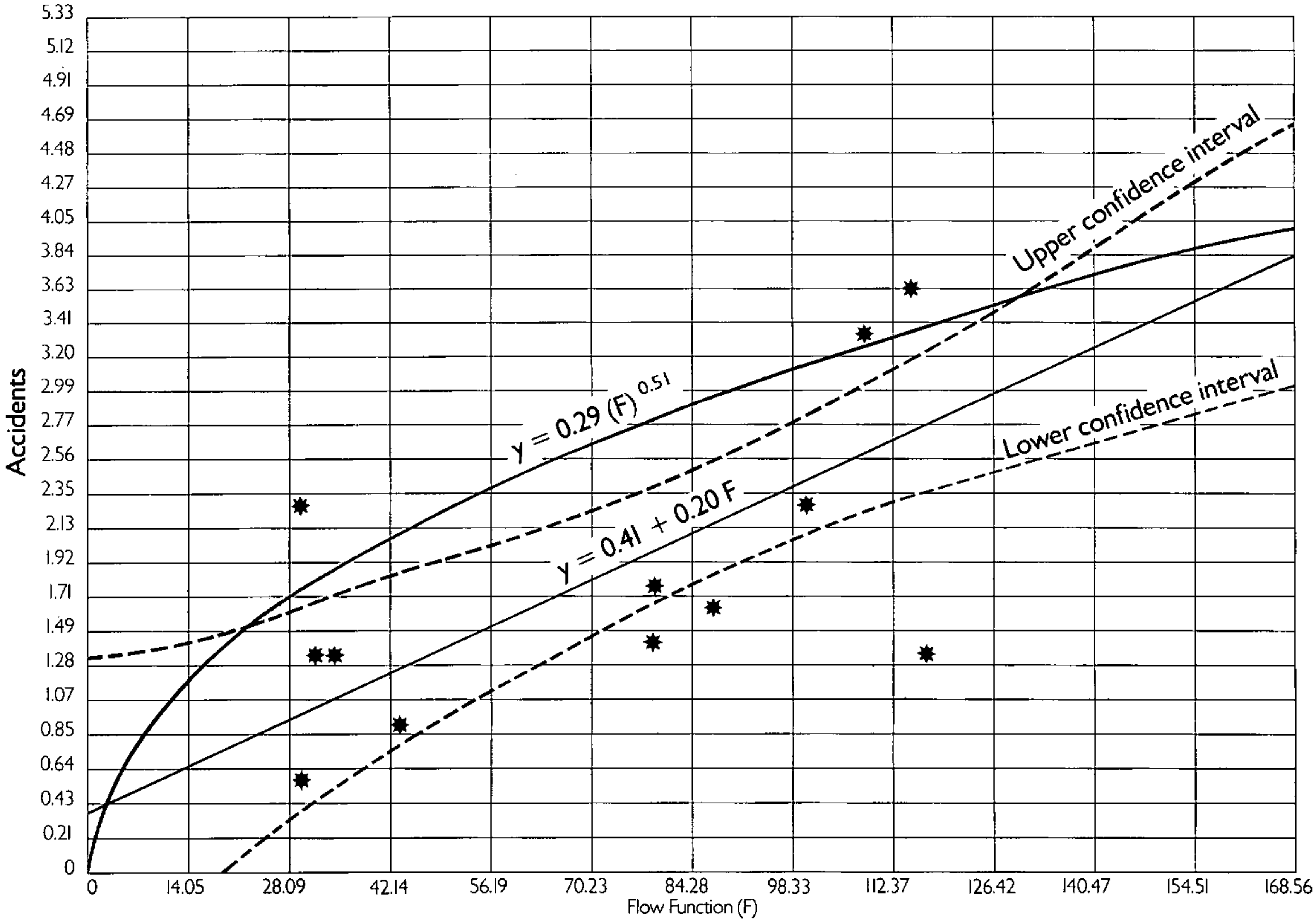
West Midlands data from the next-to-bottom row of Table 7a may be compared with those in Table 7b, taken from Road Accidents Great Britain (Department of Transport, 1985). It can be seen that, probably because of the very high traffic volume involved, the accident rates per million vehicle kilometres on the predominantly urban roads of the West Midlands districts are generally lower than for Great Britain as a whole.

Table 6 Accidents per junction in Birmingham 31st Jan. 1980 - 30th Jan. 1983 (Storey, 1984).

Junction Type	Arms	Average annual accident total	Average 12 hour inflow (Vehicles x 10^3)	Sample size	Regression equation	Coeff. Determ.
Priority	3	1.38	19.46	87	y = 0.78 + 0.03 x	0.07
	4	1.83	15.86	79	y = 1.24 + 0.04 x	0.04
	5	2.31	14.25	8	y = 0.89 + 0.10 x	0.09
	All	1.63	17.59	174	y = 1.18 + 0.03 x	0.03
Signal	3	1.92	21.73	18	y = – 0.05 + 0.09 x	0.18
	4	3.02	24.77	89	y = – 0.52 + 0.14 x	0.51
	5	3.19	23.97	9	y = 3.00 + 0.01 x	0.01
	All	2.86	24.24	116	y = – 0.34 + 0.13 x	0.43
Mini-Roundabout	3	1.08	25.22	3	y = – 0.98 + 0.08 x	0.99
	4	1.54	16.64	7	y = – 0.67 + 0.13 x	0.68
	5	1.42	15.90	3	y = – 2.98 + 0.28 x	0.52
	All	1.40	18.45	13	y = 0.21 + 0.06 x	0.16
Small Roundabout	3	1.85	20.85	5	y = – 1.99 + 0.18 x	0.86
	4	1.38	20.16	24	y = 0.38 + 0.05 x	0.07
	5	1.54	17.07	6	y = – 0.07 + 0.15 x	0.73
	All	1.47	19.73	35	y = 0.05 + 0.07 x	0.15
Conventional Roundabout	3	1.25	30.01	1	–	–
	4	2.35	25.94	10	y = 0.58 + 0.07 x	0.06
	5	2.45	16.56	5	y = 0.94 + 0.09 x	0.18
	All	2.31	23.26	16	y = 1.37 + 0.04 x	0.03
Grade - Separated Roundabout	3	–	–	–	–	–
	4	5.50	31.86	8	y = 2.96 + 0.08 x	0.09
	5	5.65	34.15	5	y = – 2.19 + 0.23 x	0.53
	All	5.56	32.74	13	y = 1.42 + 0.13 x	0.20
All Sites*	3	1.54	20.30	125	y = 0.68 + 0.04 x	0.08
	4	2.40	20.91	226	y = – 0.05 + 0.12 x	0.34
	5	2.80	20.48	37	y = – 0.04 + 0.14 x	0.38
	All	2.16	20.68	388	y = 0.13 + 0.10 x	0.25

** Includes other, miscellaneous types of sites not included in the categories specified.*

Figure 6 Accidents at 3–arm Junctions (highest link standard–dual) controlled by Automatic Traffic Signal: Local Values compared with COBA Curve



Coefficient of correlation 'R' = 0.75
Confidence intervals at 90% level

Source: Storey, 1984

Table 7a Accidents and traffic on 'A' and 'B' class roads of West Midlands districts, 1983-1985.

District	Birmingham		Coventry		Dudley		Sandwell		Solihull		Walsall		Wolverhampton		All Districts	
Road Class	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Link Only Total No. Links	259	109	80	26	111	45	94	36	48	29	90	37	81	11	781	299
Total Link Length (Km)	158.47	78.67	51.53	13.90	61.28	24.01	61.84	22.25	48.16	28.81	57.82	32.85	49.27	7.03	506.55	216.98
Total No Accident /3 Years	2097	997	634	199	732	180	676	216	288	191	584	232	837	71	6799	2133
Total Vehicle Travel (Hundred MVKm/Yr)	11.02	3.18	3.04	0.52	3.27	0.66	3.36	0.58	2.18	0.96	2.74	1.10	2.82	0.20	29.13	7.38
Average 07.00-19.00 Link Flow (Thousand)	16.55	9.63	14.04	8.97	12.70	6.59	12.95	6.22	10.80	7.92	11.26	7.97	13.61	6.73	13.69	8.10
Accidents/ MVKm/Yr	0.88	1.04	0.70	1.27	0.75	0.90	0.67	1.24	0.44	0.66	0.71	0.70	0.99	1.19	0.78	0.96
Accidents/Km/Yr	6.11	4.22	4.10	4.77	3.98	2.50	3.64	3.24	1.99	2.21	3.37	2.35	5.66	3.37	4.47	3.28
Combined Link & Junction Total No. Lengths of Link & Junc.	259	109	80	26	111	45	94	36	48	29	90	37	81	11	781	299
Total Length of Link & Junc.(Km)	171.4	84.13	55.53	15.20	66.83	26.26	66.54	24.05	50.56	20.26	62.32	34.70	53.32	7.58	545.60	231.93
Total No. Accidents/ 3 Years	4522	1362	1009	287	1092	236	1047	287	406	255	902	333	1199	98	10332	2909
Total Vehicle Travel (Hundred MVKm/Yr)	11.90	3.40	3.28	0.58	3.57	0.72	3.62	0.63	2.30	1.02	2.96	1.16	3.05	0.21	31.48	7.91
Accidents/ MVKm/Yr	1.26	1.33	1.02	1.66	1.02	1.09	0.96	1.52	0.59	0.83	1.02	0.95	1.31	1.53	1.09	1.23
Accidents/Km/Yr	8.79	5.40	6.05	6.29	5.45	3.00	5.24	3.98	2.68	4.20	4.82	3.20	7.50	4.31	6.31	4.18

Table 7b Accidents per million vehicle kilometre on roads in Great Britain, 1984

Urban roads	Accidents/MVKm
A	1.32
B	1.58
Other	1.75
Non-built up roads	
A	0.39
B	0.63
Other	0.68
All speed limits	
Motorways	0.13
A	0.81
B	1.15
Other	1.43
Total	0.91

Source : Road Accidents Great Britain, 1984

In 8.5 the proportion of various types of accident on non-network roads in the West Midlands was examined. This type of analysis is extended and developed in Table 8, in which the proportions of different accidents on several types of road in Birmingham during 1986 are considered. These road types are 'All roads', 'A' roads, 'B' roads 'C' roads, non-network roads and non-network roads in selected Inner Areas.

Table 8 confirms the earlier comments (8.5 above) about the greater proportion of child pedestrian accidents occurring on minor roads, these accidents correspondingly accounting for 25% of accidents on non-network roads, 8.1% on 'A' class roads and 17.3% and 16.2% on 'B' and 'C' category roads respectively.

Although more adult pedestrian accidents occurred on 'A' class road than on any of the other three individual road classes, it can be seen that the fraction which these accidents form of all accidents of a given road type varies comparatively little, having a range between 20.7 and 25.4%.

There were very few pedal cycle accidents involving children on all road types considered and their relative proportions by road type varies very little (from just less than 0.1% all accidents on 'C' category roads to 3.3% on non-network roads).

There were nearly four times as many pedal cycle accidents with adult casualties (221) as accidents with child casualties (66). 'A' roads were the most common site for adult cyclist accidents, 97 occurring on this category of highway. The proportion that adult cyclist accidents formed of all accidents occurring on the various road differed little between road class. The same is true of accidents involving powered two-wheelers (a range of 12.0 - 14.0%) with most of the 503 accidents involving this road user occurring on 'A' and non-network roads (201 and 151 respectively).

As would be expected, because of the greater opportunities for executing this manoeuvre afforded by the greater road length, the number of accidents involving right turns is greater on 'A' class roads but, again, the respective proportions differs little by road class.

Single-vehicle non-pedestrian collisions are most common on 'A' roads and the respective proportions of all accidents on the various categories of road are only very slightly greater on 'A' and 'B' class roads than on the others.

Accidents in darkness accounted for between 28.3% and 31.8% of all accidents in the four categories of road, those occurring on wet surfaces between 33.3 and 39.5%. The percentage of accidents occurring on wet roads is often a proxy for the speed possible on the road and it is noteworthy that 'A' 'B' and 'C' class roads have higher values than that for non-network roads (39.5, 37.4, 38.0 and 33.3% respectively).

Examination of those accidents occurring on non-network roads in the selected Inner Areas shows a number of interesting results. Almost half (156) of the 323 accidents involve child pedestrians and a further 50 adult pedestrians. There were relatively fewer accidents of all other accident types considered on the selected non-network roads in inner areas, compared with accidents on all non-network and 'All' roads.

Table 8 Selected road accidents in Birmingham by type of road, 1986

		%	No.
All Roads – 3950 accidents			
Pedestrians –	child	16.3	632
–	adult	22.2	877
Pedal cycle –	child	1.7	66
–	adult	5.6	221
T.W.M.V.		12.7	503
Right turners		18.7	738
Single-vehicle non-pedestrian		10.4	410
In darkness		30.0	1186
Wet surface		37.1	1464
'A' Roads – 1439 accidents			
Pedestrians –	child	8.1	116
–	adult	25.4	365
Pedal cycle –	child	0.6	10
–	adult	6.7	97
T.W.M.V.		14.0	201
Right turners		20.7	298
Single-vehicle non-pedestrian		11.5	165
In darkness		31.8	458
Wet surface		39.5	568
'B' Roads – 439 accidents			
Pedestrians –	child	17.3	76
–	adult	22.1	97
Pedal cycle –	child	1.3	6
–	adult	7.1	31
T.W.M.V.		11.4	50
Right turners		20.5	90
Single-vehicle non-pedestrian		11.8	52
In darkness		31.0	136
Wet surface		37.4	164
'C' Roads – 479 accidents			
Pedestrians –	child	16.2	78
–	adult	22.3	107
Pedal cycle –	child	<0.1	3
–	adult	3.8	18
T.W.M.V.		13.6	65
Right turners		18.4	88
Single-vehicle non-pedestrian		9.4	45
In darkness		29.0	139
Wet surface		38.0	182

Accident types listed in Table 8 are not necessarily mutually exclusive and therefore column percentages do not sum to 100%

Table 8 continued

Non-network Roads-1263 accidents		%	No.
Pedestrians –	child	25.2	318
–	adult	20.7	262
Pedal cycle –	child	3.3	42
–	adult	5.1	64
T.W.M.V.		12.0	151
Right turners		17.4	220
Single-vehicle non-pedestrian		7.2	91
In darkness		28.3	357
Wet surface		33.3	420

Selected Inner Areas*323 accidents		%	No.
Pedestrians –	child	48.3	156
–	adult	15.5	50
Pedal cycle –	child	1.2	4
–	adult	1.9	6
T.W.M.V.		8.0	26
Right turners		12.4	40
Single-vehicle non-pedestrian		6.2	20
In darkness		22.6	73
Wet surface		31.3	101

**Only non-network roads in the areas defined by rectangles having co-ordinates in the bottom left hand corner and top right (respectively) of: 028887 and 090913 (Handsworth), 064826 and 102851 (Balsall Heath), 090852 and 122872 (Small Heath/Bordesley Green) and 092875 and 129893 (Saltley/Washwood Heath/Ward End).*

Another aspect of the analysis of accidents by road hierarchy involves the very important role of radial routes leading to and from town and city centres. It was noted in 4.0 that, as would be expected, accidents on these routes are common. Earlier work by Faulkner (1975), suggested that in medium-sized towns in England the split appeared to be about a quarter of all accidents occurring in town centres with about three-eighths on arterial routes and three-eighths on minor roads in-between. These proportions will of course vary from town to town or city to city dependent the size of the urban area, the proportion of major to minor routes and the amounts of traffic involved.

The radial routes in Birmingham and the West Midlands have been the subject of a series of studies (Lawson, 1985a, 1985b, 1986). In Birmingham it was shown that in the three year period 1980-82, 29% (3818) of all injury accidents occurred on just 120 kilometres of Birmingham radial routes, this being about 6% of the total of all network and non-network roads in Birmingham. This compares with only 4% (511) of all accidents which occurred in the same time period in a 0.9 x 1.4 km rectangle enclosing Birmingham City Centre, 32% (4231) on all other 'A','B' and 'C' category classified roads and 35% (4587) on all non-network roads. This break-down is illustrated in Figure 7.

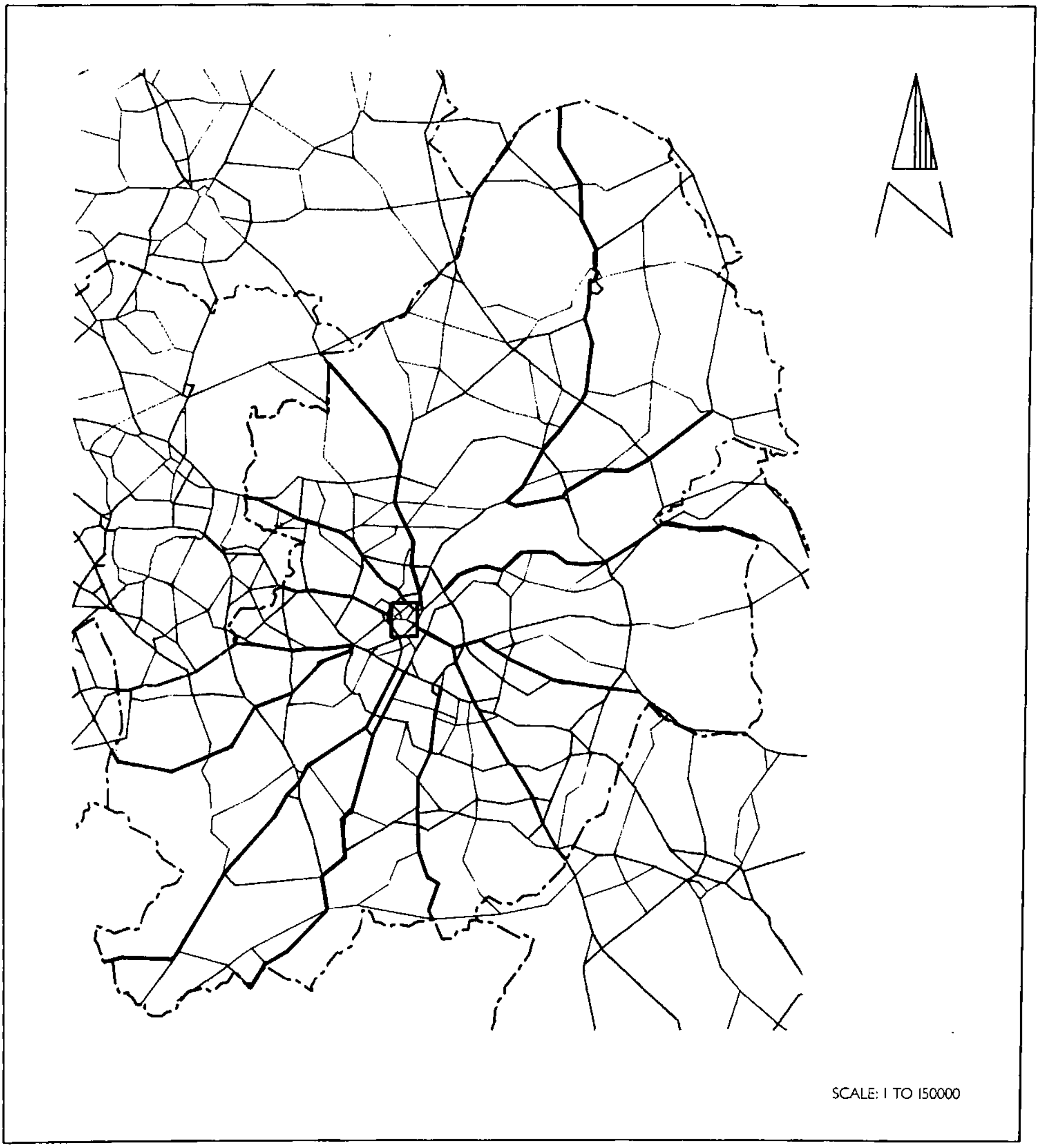
In Table 9a some data taken from one of these studies (Lawson, 1985a) are used to compare the accident rates on radial routes in Birmingham, with Coventry and Wolverhampton and with those on the arterial routes of four southern towns in England studied by Chapman (1978).

It can be seen from Table 9a that accidents per kilometre are noticeably higher in Birmingham and the four southern towns compared with Coventry and Wolverhampton.

Note also that the accident rate per kilometre per year for the three sets of West Midland radial routes may be compared with data from the bottom row of Table 7a. Although the two data sets are for slightly different time periods, it can be seen that, as would be expected, the radial routes have a higher rate of accidents per kilometre than that for 'A' class roads overall in the same area - Birmingham radial routes exhibited a 17% higher accident rate than all 'A' class roads in Birmingham, Coventry's radial routes are about 17% higher and Wolverhampton's 3% higher, the latter showing only a small difference probably because of the greater proportion radial routes form of all 'A' class routes in Wolverhampton (87%, as opposed to 70% in Birmingham and 62% in Coventry).

Figure 7 Accidents in Birmingham 1980–82

	Accidents
City Centre	511
Radial Routes	3818
Other 'A', 'B' and 'C' roads	4231
Non-network roads	4587
	13147



Birmingham classified road network with radial routes in bold and area of City Centre boxed.

Table 9a The frequency of all accidents per kilometre on four samples of routes.

	Radial routes			Arterial roads
	Birmingham 1980-82	Coventry 1980-82	Wolverhampton 1980-82	Four Southern Towns 1972
Accidents	3818	756	1071	1015
Road Length (Km)	120.47	34.60	46.30	101.80
Accidents/Kilometre/Year	10.56	7.28	7.71	9.97

8.9 LAND-USE

Throughout this document emphasis has been placed on showing how the style of road and amount of traffic influences the incidence of accidents. These features, and finer aspects of road geometry and layout, certainly influence accident rates, as does the type of road-user present and the nature of vehicle and pedestrian activity. The latter aspects are governed to a very great extent by the nature of the land-use adjacent to any road.

The relationship between land-use (as a proxy for activity) adjacent to a road and accidents thereon has received surprisingly little attention, probably because data on land-use are not collected on the Stats 19 form and therefore need to be gained in specially-conducted research studies. Generally the only reference to land-use and road accidents in 'global' data such as those presented in 'Road Accidents Great Britain' refer to the urban/rural split of less than and equal to 40 m.p.h. and greater than 40 m.p.h.

Several researchers (see Table 9b) have used a classification of land-use to show differences in the incidence of accidents at different locations. In Table 9b it has been necessary to present the data in rank order since each author's data relate to different types of road, categories of accident and indeces of occurrence. However, from Table 9b one may see that accidents on roads adjacent to shops are consistently more common than on roads which pass other types of land-use. Roads adjacent to housing generally appear in the middle of any ranking and those adjacent to industrial land use at the bottom. Motorways, although not an 'adjacent land use' as such, were examined by Silcock and Worsey and are included in this table for purposes of comparison.

Earlier studies (Lawson, 1985a) in Birmingham indicated that it was very difficult to show differences in road accident patterns according to large areas such as the comparison that may be made between, for example, an industrial area and a predominantly 'recreational' area including several large parks and similar attractions. The rarity of the road accident as an event, the confounding causal effect of factors related to the layout and geometry of the road system and the incidence of traffic merely travelling through an area are only three of many problems associated with this type of assessment. Occasionally it has been possible to identify particular accident characteristics associated with larger areas – child pedestrian accidents in residential areas being a good example – but often, for example, even the anticipation that there may be a 'higher than expected' level of H.G.V. accidents in an industrial area has not been shown to be the case. The researcher needs to tune his strategy to a finer degree and attempt to separate statistical 'noise' from the role of causal or proxy variables.

These problems may be illustrated in the example of the study of road accidents at or near five different styles of shopping centre (Figure 8). In this work it was found (Lawson, 1985a) that only on the roads passing through the shopping centres built in the linear style or at the crossroads was there an accident pattern which when compared with stretches of road away from these centres could in any way be said to reflect the activity of the adjacent land-use. The influence of the land-use as an 'accident generator' or, more correctly, the role of activity at the shopping centres, was sufficiently remote at the other types of shopping centre for it not to be reflected in the accident statistics.

Some examples of the type of characteristics associated with accidents adjacent to shops would be greater involvement of accidents involving pedestrians and pedal cyclists (see, for example, Chapman, 1978) and accidents at times of day when shopping activity is high. In the work on Birmingham radial routes it was found (Lawson, 1985a, 1986) that on links between junctions:

(i) overall, there were significantly more accidents on roads with shops adjacent to at least one side of the road compared with other types of links without shops,

(ii) that two-vehicle non-pedestrian accidents (T.V.N.P.) accidents were significantly more frequent on roads adjacent to shopping development on at least one side of the link compared with links which had neither shops nor housing adjacent and,

(iii) that T.V.N.P. accidents were significantly common on links with housing adjacent to at least one side, compared with links with other forms of land-use (but not shops) adjacent,

(iv) that there were significantly more pedestrian accidents on roads with shops adjacent to at least one side of the link than on roads with other forms of land-use, and,

similarly, that at the minor junctions on links:

(v) there were significantly more accidents adjacent to shops than the other types of land-use.

Some data from the earlier of the two studies cited above are presented in Table 9c. This shows the accident rate per million vehicle kilometres of non-junction accidents and illustrates the high accident rates associated with roads adjacent to shops.

Presented in a slightly different form (Table 9d), the Birmingham radial route data have been compared with those for similar types of link from a study by McGuigan (1982) of all network roads of the Lothian Region of Scotland. The accident rates for the two data sets are similar when ranked, but those for Lothian are higher in absolute terms, again probably because the average traffic volume on the links in that data set are lower than those on Birmingham radial routes.

Similarly, for six categories of land-use for which comparison is possible, Birmingham radial route data and those provided by Chapman show close agreement when ranked according to accidents per kilometre (Table 9e). Note however that, in this instance, the Birmingham radial route data are for both links and minor junctions but exclude accidents at major junctions (essentially all roundabouts and A.T.S.-controlled junctions) whereas the Chapman data are for all accidents on the arterial routes of the towns he studied. Accident rates in his study therefore appear artificially high when compared with those in Birmingham.

Taking the idea of land-use one step further, a very limited amount of work has been done on the relationship between age and style of housing and road accidents. One of the first of these was the work by Preston (1976) in Manchester. Local work in Birmingham (King *et al.*, 1987 and Lawson and Proctor, 1989) has confirmed many of her findings and illustrated the high numbers of accidents to young pedestrians in Inner-City areas where Victorian dwellings are common and there is little or no provision for off-street parking.

A T.R.R.L. review note (Transport and Road Research Laboratory, 1977) provided a useful classification within the housing category - 19th century development, 1919-1939 development and post-1945 development. This categorisation reflects distinct styles of housing, but it is reported that their research found that in many important aspects of accident occurrence there is little difference between the three groups.

As part of the Birmingham study (Lawson, 1985a), housing on the radial routes was categorised according to age (see Table 9f) and accident rates on the roads adjacent were analysed. The relevant data are presented in Table 9f and the accident rates in simplified form in Table 9g. It should be noted that, by restricting the study of the potential influence of housing age on accidents to only the radial routes, many of the confounding variables discussed earlier were either completely or partially eliminated from the study.

Sadly this approach leads to small sample sizes and, almost certainly partly as a result of this, Table 9g indicates that there was great variation in accident rates within the land use category. Although it may be argued from Table 9g that the oldest development (Pre-1919) most often has the highest accident rate associated with roads adjacent to it, from Table 9f it may be seen that those categories with a substantial sample of road length (greater than 5 km) are limited in number to six. The sample is therefore probably not sufficiently large to sustain this argument.

Table 9b Rank order of accident rates according to adjacent land-use (1 - high).

Land-use	Chapman (1978) Four Southern Towns	McGuigan (1982) Lothian Region		Silcock and Worsey (1982) Manchester	Silcock and Worsey (1982) Newcastle
		Single C'way	Dual C'way		
Residential	3	2	1	2	4
Commercial (eg. Shops)	1	1	-	1	1
Services (eg.Schools and Hospitals)	-	-	-	4	3
Industrial	4	4	-	6	5
Open land	2	3	2	3	2
Motorway	-	-	-	5	6

Figure 8 Some sketch plans of typical Shopping Centre layout

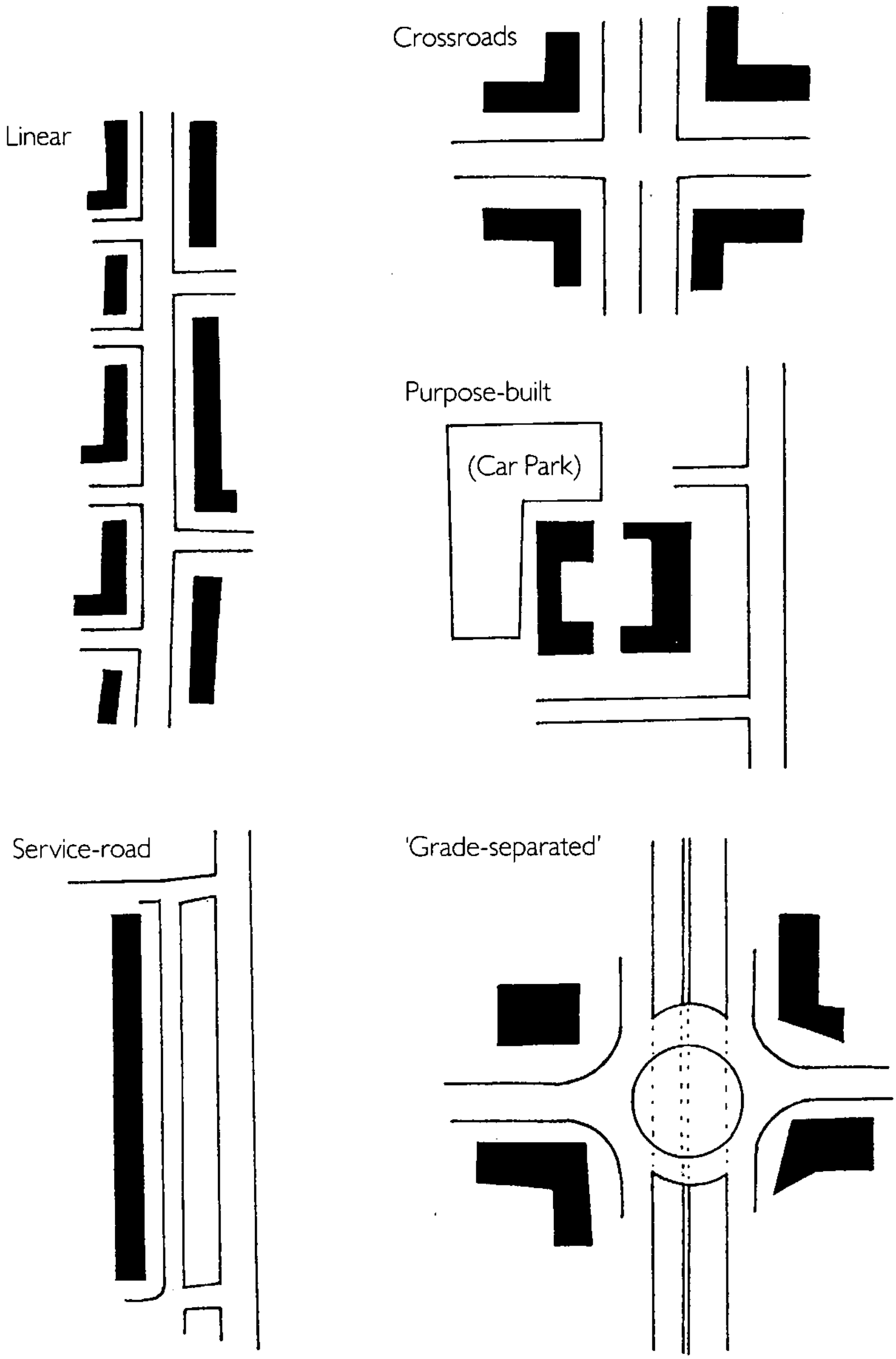


Table 9c Birmingham Radial Routes : link accidents and vehicle throughput by link category.

Land-use	Carriageway Type	Accidents (3 Years)	Vehicle Throughput MVKm (l year)	Accidents /MVKm
Shops/Shops	Single	239	60.25	1.32
Residential/Residential	"	214	159.98	0.45
Industrial/Industrial	"	31	27.56	0.38
Shops/Residential	"	35	16.42	0.71
Shops/Industrial	"	7	4.52	0.52
Residential/Industrial	"	29	13.41	0.72
Commercial/Commercial	"	9	5.13	0.58
Flyover or underpass	"	10	10.67	0.94
Park/Park	"	6	1.94	1.03
Open/Open	"	11	11.52	0.32
Other	"	1	1.95	0.17
Rural/Rural	"	7	43.45	0.16
Shops and other type	"	21	6.62	1.06
Residential and other type	"	64	41.87	0.51
Ind. or Com. and Other	"	9	4.07	0.74
Open and other	"	1	1.95	0.17
Shops/Shops	Dual	65	28.87	0.75
Residential/Residential	"	115	72.00	0.53
Industrial/Industrial	"	19	18.22	0.35
Shops/Residential	"	29	10.06	0.96
Shops/Industrial	"	13	1.58	2.75
Residential/Industrial	"	51	45.26	0.38
Commercial/Commercial	"	9	6.08	0.49
Flyover or underpass	"	33	16.95	1.95
Park/Park	"	3	2.40	0.42
Open/Open	"	-	-	-
Other	"	-	-	-
Rural/Rural	"	-	-	-
Shops and other type	"	-	-	-
Residential and other type	"	57	31.77	0.60
Ind. or Com. and Other	"	2	1.36	0.49
Open and other	"	13	7.07	0.61
		1102	651.00	

Note: combinations in Tables 9c to 9g refer to ground level land-use adjacent to the highway.

Table 9d Link accident rate by vehicle throughput for selected land-use categories, Lawson (1985a) vs McGuigan (1982).

		Lawson				McGuigan			
Land-use	Carriageway	Accidents (3 Years)	MVKm (1 Year)	(Accs/ MVKm)	Rank	Accidents (45 Months)	MVKm (1 Year)	(Accs/ MVKm)	Rank
Shops/ Shops	Single	239	60.25	1.32	1	497	67.61	1.96	1
Residential/ Residential	"	214	159.98	0.45	5	602	221.61	0.72	4
Industrial/ Industrial	"	31	27.56	0.38	6	32	15.58	0.55	6
Shops/ Residential	"	35	16.42	0.71	2	165	28.57	1.54	2
Shops/ Industrial	"	7	4.52	0.52	4	28	7.30	1.02	3
Residential/ Residential	Dual	115	72.00	0.53	3	35	16.73	0.56	5
All single and dual-carriageway links		1102	651.00	0.56		3652	1660.06	0.59	

Table 9e Accidents per kilometre per year by principal land-use types Lawson (1985a) vs Chapman (1978).

Land-use	Lawson (1985a) No. Accidents	Lawson (1985a) Total length	Lawson (1985a) Accidents/ Km/Year	Lawson (1985a) Rank	Chapman (1978) No. Accidents	Chapman (1978) Total length	Chapman (1978) Accidents/ Km/Year	Chapman (1978) Rank
Shops/Shops	850	20.26	13.98	1	259	13.20	19.62	1
Residential/Residential	979	40.87	7.98	4	327	44.70	7.32	6
Industrial/Industrial	143	7.30	6.53	5	63	7.35	8.57	5
Shops/Residential	195	5.31	12.24	2	67	4.20	15.95	2
Residential/Industrial	236	9.24	8.51	3	57	4.97	11.47	3
Other	536	28.41	6.29	6	230	24.68	9.32	4
All	2939	111.39	8.79		1003	99.10	10.12	

Table 9f Data relating to links adjacent to different types of residential land-use.

Land-use	Carriageway Type	Development Date	No. Links	No. Accidents	Length (Km)	Vehicle Throughput (MVKm)	Accidents /MVKm
Resid/Resid	Single	Pre-1919	22	110	11.56	73.75	1.49
" "	"	1919-1939	20	79	11.10	53.78	1.47
" "	"	Post-1945	10	25	6.65	32.45	0.77
Resid/Shops	"	Pre-1919	3	15	0.78	3.72	4.04
" "	"	1919-1939	5	15	1.94	10.83	1.39
" "	"	Post-1945	1	5	0.47	1.88	2.66
Resid/Other	"	Pre-1919	15	72	7.07	38.11	1.89
" "	"	1919-1939	4	6	1.90	10.11	0.59
" "	"	Post-1945	3	15	1.52	7.07	2.12
			83	342	42.99		
Resid/Resid	Dual	Pre-1919	6	19	1.91	10.53	1.80
" "	"	1919-1939	17	75	8.28	53.70	1.40
" "	"	Post-1945	2	21	1.37	7.77	2.70
Resid/Shops	"	Pre-1919	2	14	0.36	1.64	8.53
" "	"	1919-1939	5	13	1.46	7.53	1.73
" "	"	Post-1945	1	2	0.30	0.89	2.25
Resid/Other	"	Pre-1919	4	16	1.29	9.24	1.73
" "	"	1919-1939	11	78	6.73	48.88	1.60
" "	"	Post-1945	3	14	1.98	18.91	0.74
			51	252	23.68		

Table 9g Accidents per million vehicle kilometre on links adjacent to three types of residential land-use.

Land-use	Single-carriageway Pre-1919	Single-carriageway 1919-1939	Single-carriageway Post-1945	Dual-carriageway Pre-1919	Dual-carriageway 1919-1939	Dual-carriageway Post-1945
Residential/ Residential	1.49	1.47	0.77	1.80	1.40	2.70
Residential/ Shops	4.04	1.39	2.66	8.53	1.73	2.25
Residential/ Other	1.89	0.59	2.12	1.73	1.60	0.74
Overall Rate	1.71	1.34	1.09	2.29	1.51	1.34

8.10 SPATIAL DISTRIBUTIONS

Figures 9a to 9j illustrate the spatial distribution of accidents of various types against a background of the 'A' class road network. Motorways and 'B' class roads have been omitted from the figures for fear of causing 'clutter'. As would be expected, many of the accidents, notably those related to traffic volume, follow closely the main radial routes and ring roads of Birmingham; others, such as those involving child pedestrians, are scattered in the areas between these roads.

It is noticeable that accidents to young pedestrians are particularly common in the Inner Areas (Figures 9a to 9d) in a 'distorted horseshoe' shape stretching from the north-west, through the north and east, to the south of the City. Pedestrian accidents involving those 20 years and above (Figure 9e) are common on the radial routes and in the City Centre.

Very few pedal cycle accidents involving either those aged 0-14 years or 15 years and older occur on 'A' class roads (Figures 9f and 9g). Single-vehicle non-pedestrian and T.W.M.V. accidents are common both on and off the 'A' class network (Figures 9h and 9i) whereas surprisingly few of those involving H.G.V.s occur on 'A' class roads (Figure 9j).

8.11 VEHICLES INVOLVED

In 1986 there were 6447 vehicles involved in the 3950 accidents in Birmingham. Table 10 a shows the type of vehicle involved. As would be expected, there are around ten times as many cars involved in these accidents as any other single type of vehicle, with about one thousand motorcycles, goods vehicles and pedal cycles each involved.

Accident severity is affected not only by the road class and type (as described above) but also by vehicle mass. Tables 10b and 10c illustrate this severity, the overall trend being that, the larger and heavier the vehicle, the more likely it is to protect its occupants and to be a hazard to others who are struck by it. This information may be derived by comparing the number, and severity of injuries, of casualties involved (Table 10b and c) with the number of vehicles of a given type involved in accidents (Table 10a). For example, the number of user casualties killed or seriously injured per respective vehicle involved for four common road user types is 0.09 (car occupants), 0.31 (motorcycle riders and pillion passengers), 0.05 (H.G.V. occupants) and 0.03 (P.S.V. occupants).

In this instance the casualty severity index (which takes only the quotient of the severe injuries and the total number of those injured, and does not include information about the number of the relevant road-users *un*injured in accidents involving their vehicle) is a slightly misleading statistic. Simply taking this figure fails to adequately indicate the vulnerability of the motorcyclist or the protection afforded to the H.G.V. occupant, showing only that, for instance, when H.G.V. occupants do become recorded as casualties their injuries tend to be severe. (Note also that the small sample sizes of some of the entries in Tables 10b and 10c mean that the severity ratio shown is occasionally not a reliable indicator). In general, occupants of cars have a severity index (0.19) of just over half that of motorcycle riders and pillion passengers (0.35). In this sample H.G.V occupants experienced a severity index (0.29) of about one-and-a-half times that of car occupants. P.S.V. occupants sustained the lowest injury of all vehicle occupants (0.04). The relevant severity indices for the respective road users in Great Britain in 1986 were 0.19 (car occupants), 0.32 (motorcycle riders and pillion passengers), 0.23 (H.G.V. occupants), and 0.09 (P.S.V. occupants).

Similarly, although the sample sizes are small, it can be seen that pedestrians struck by P.S.V.s and H.G.V.s experienced a high severity of injury (0.42 and 0.70 respectively) and those struck by cars a slightly lower one at 0.31.

Figure 9a Birmingham Pedestrian (0 - 4 yrs) Accidents 1985–87

Figure 9b Birmingham Pedestrian (5 - 9 yrs) Accidents 1985–87

Figure 9c Birmingham Pedestrian (10 - 14 yrs) Accidents 1985–87

Figure 9d Birmingham Pedestrian (15 - 19 yrs) Accidents 1985–87

Figure 9e Birmingham Pedestrian (20+ yrs) Accidents 1985–87

Figure 9g Birmingham Pedal Cycle (15 yrs+) Accidents 1985–87

Figure 9f Birmingham Pedal Cycle (0 - 14 yrs) Accidents 1985–87

Figure 9h Birmingham Single-Vehicle Non-Pedestrian Accidents 1985–87

Figure 9i Birmingham T.W.M.V. Accidents 1985–87

Figure 9j Birmingham Heavy Goods Vehicle Accidents 1985–87

Table 10a Vehicles involved in accidents in Birmingham, by vehicle type and severity of accident, 1986.

Vehicle Type:	Fatal	Serious	Slight	Total
Pedal Cycle	2	42	249	293
Moped	0	24	44	68
Motor Scooter	0	13	39	52
Motor Cycle	13	145	278	436
Combination	0	0	2	2
Invalid Tricycle	0	0	1	1
Other 3-wheeler	1	8	10	19
Taxi	0	3	28	31
Car 4-wheeled	80	991	3474	4545
Mini-bus	0	12	24	36
P.S.V.	3	41	199	243
Goods <1.52T	9	107	337	453
Goods 1.52-3.04T	2	11	42	55
Other Motor-vehicle	0	7	13	20
Other Non-Motor-vehicle	0	0	0	0
Goods >3.04T	6	36	97	139
Unknown vehicle	1	8	45	54
Total	117	1448	4882	6447

Table 10b Severity of injury to pedestrian struck by vehicles involved in accidents in Birmingham, 1986.

Vehicle Type:	Killed	Serious	Slight	Total	Severity Index
Pedal Cycle	0	1	3	4	0.25
Moped	0	4	4	8	0.50
Motor Scooter	0	1	7	8	0.13
Motor Cycle	4	16	41	61	0.33
Combination	0	0	0	0	–
Invalid Tricycle	0	0	0	0	–
Other 3-wheeler	0	5	4	9	0.56
Taxi	0	0	5	5	–
Car 4-wheeled	36	351	876	1263	0.31
Mini-bus	0	3	6	9	0.33
P.S.V.	1	19	27	47	0.43
Goods <1.52T	5	29	67	101	0.34
Goods 1.52-3.04T	2	3	11	16	0.31
Other Motor-vehicle	0	1	2	3	0.33
Other Non-Motor-vehicle	0	0	0	0	–
Goods >3.04T	3	11	6	20	0.70
Unknown vehicle	1	2	10	13	0.23
Total	52	446	1069	1567	0.32

Table 10c Severity of injuries to occupants/riders of vehicles involved in accidents in Birmingham, 1986.

Vehicle Type:	Killed	Serious	Slight	Total	Severity Index
Pedal Cycle	2	41	244	287	0.15
Moped	0	21	39	60	0.35
Motor Scooter	0	13	36	49	0.27
Motor Cycle	9	143	281	433	0.33
Combination	0	0	3	3	–
Invalid Tricycle	0	0	1	1	–
Other 3-wheeler	1	4	8	13	0.39
Taxi	0	2	18	20	0.10
Car 4-wheeled	26	403	1777	2206	0.19
Mini bus/	0	7	17	24	0.29
P.S.V.	0	8	174	182	0.04
Goods <1.52T	2	33	113	148	0.24
Goods 1.52-3.04T	0	0	7	7	–
Other Motor Vehicle	0	1	5	6	0.17
Other Non Motor-vehicle	0	0	0	0	–
Goods>3.04T	0	7	17	24	0.29
Unknown vehicle	0	0	0	0	–
Total	40	683	2740	3463	0.21

9.0 OTHER LOCAL DESCRIPTORS

There are other less-easily quantified aspects of the Birmingham and West Midlands area which are reflected in the accidents experienced. Evidence to support differences between these areas and other parts of the U.K. is at best scanty and often anecdotal. For example, it has been said that pro-car policies of the highway authority in the past has led to the building of many open, fast routes, to a clutter of street furniture and that this may have increased the off-road collision problem. Similarly, there is growing evidence of the threat to child pedestrians in the Inner Areas of Birmingham (see Figures 9a to 9c) and also to children of members of the ethnic minority communities (King *et al.*, 1987, Lawson and Proctor, 1989)

Vehicle mix in parts of the West Midlands very certainly differs from that in other parts of the country with, for example, H.G.V.s being especially common on the roads of Dudley and cycling a more common form of transport in Coventry than in other districts. Vehicles of the Austin Rover Group are also relatively common in most parts of the West Midlands - this in itself may not appear to be of major significance but has, in local studies of vehicle occupant-injury, (see, for example Griffiths *et al.*, 1983) been shown to be relevant to the amount of protection afforded by small vehicles such as the 'Mini' which sell in great numbers. More subtle differences in accident type in the urban area are also to be expected when these are compared with accidents in Great Britain as a whole. Again, to take the example of collisions with off-road objects, because relatively high numbers of these accidents are encountered, the number of roll-over accidents in the area is low.

10.0 ROAD ACCIDENT PRIORITIES FOR BIRMINGHAM CITY COUNCIL

Emphasis in the early accident analysis and remedial measures work in this area was on developing generally-agreed measures of ranking high risk sites, notably at junctions but also at Pelican Crossings and on links. More recently efforts have concentrated on specifying the software to facilitate identification of sites.

This has included work in the following main areas:

(i) interactive programs enabling details of the number and type of accidents at any site or within an area to be retrieved within seconds,

(ii) 'sort' mechanisms enabling accidents of similar types to be sifted, grouped and presented to the investigator,

(iii) basic graphics, enabling accidents such as those involving vehicles moving in similar compass directions to be presented together on screen,

(iv) sophisticated 'blacksite' packages - means of identifying lengths of road or areas with particularly high accident numbers or rates,

(v) data look-up tables enabling the investigator to compare the observed proportion of a type of accident at a site with the 'expected' proportion of accidents at either similar types of site or in the West Midlands districts as a whole.

It would seem likely that as these systems develop it will become easier to identify patterns of accidents on non-network roads, an area of work which has in the past proved difficult. This has implications for the ease with which it will be possible to conduct research on, and counter, the types of accidents which occur on non-network roads. Child pedestrians are an obvious example of a road-user group who may benefit from these developments.

Other accident types which will, or will continue to, be of concern in the West Midlands are those involving 'drink/drive', 'drink/walk', other enforcement issues such as 'red light' violation at A.T.S., any accidents for which local values are sought for a 'warrant' before implementation of hardware is considered (e.g. Pelican Crossings), and accidents involving particular road-user groups such as older teenagers (who, until recently, have seldom been targeted in campaigns) the elderly and ethnic minorities. In addition, any factors which change over time (such as legislation) and are considered likely to have an effect on accidents are likely to be examined.

11.0 RECOMMENDATIONS FOR ACTION

The comments which follow are drawn from the results of this study and from observations made whilst conducting it. The comments are of two general types - those which it is felt would facilitate work in this area and those which arise as results from the study.

One of the stated objectives of this review has been to provide better descriptions than were previously available of road accidents within the West Midlands metropolitan districts. This goal may have been successfully achieved but it is important to stress the continuing need for such development of descriptions, this requirement stemming from the multi-factorial nature of road accidents.

Accident research is a relatively young science and, although many of the boundaries have been put on the discipline and its nature, terms and methodologies have been defined, a statement of the then Institution of Highway Engineers (1980) continues to hold true. There is a need for,'........optimum criteria for classification of levels and types of risk at different locations. This entails determining the most appropriate basis for comparison of accidents - traffic volume or flow, road characteristics, land-usage and population, other types of accident - for different enviromental conditions, in particular for urban and rural areas.'

Steps are being taken towards being able to realise these objectives.

There is a paucity of successful demonstration projects or results from studies to show the benefits of speed reduction measures. It is interesting to note that, although the County Surveyors' Society Special Activity Group on Accident Reduction is able to draw on a dozen or more large studies, many evaluating results of treatment at scores of sites, showing the benefit, or otherwise, for each of pedestrian crossings, roundabouts, road surfacing, road marking and traffic signals, the same is not true of speed reduction measures. Although it is possible that work has been done for reasons other than accident treatment, at the time of writing (summer 1989), U.K. highway authorities are only able to report on less than a dozen individual case studies of speed reduction. More work needs to be done in this area.

Given the high incidence of accidents to young pedestrians (many of whom are from ethnic minority communities) in the Inner City reported upon in this document, it is recommended that the type of work described by King *et al.* is continued in the sense that road safety education, training and publicity be closely matched to the needs of the population at risk. It is also important to have good information about the drivers of vehicles in these areas in order that they may be targeted when necessary.

Continuing on the subject of ways in which local authorities may usefully extend their work in this area and develop understanding among interested parties, there appears to be a need to bridge the gaps in our understanding of the number of accidents to be 'expected' in large areas of the size of a town or part of a city. Such information would be helpful in explaining accident totals to those not directly involved in this work (such as politicians), and in deciding where best resources may be directed. Hakkert (1969) commented that little is known of accident problems in larger areas and this remains true twenty years later.

Essentially, national government, through T.R.R.L., is good at identifying road accident patterns at different types of site which have common features (for example, four-arm roundabouts) and in many other fields where information on generalities is sought about what is happening, or would happen, under specific sets of circumstances which are, or will be, experienced by local highway authorities. On the other hand, local authorities have become skilled in the last fifteen years in the study of accidents at individual sites (usually junctions) and, more recently, in understanding the occurrence of road accidents along lengths of route and in areas the size of part (often between about one-tenth and one-quarter) of a free-standing town.

If accidents *are* to be viewed as an 'epidemic' and epidemiology used to tackle the problem, then two areas of research would help to fill the gaps described above. Road accident-generating features have been studied for more than fifty years but it is disappointing to note that so far no-one has taken a large data base from a large urban area and used measures of traffice flow, road standard and length, land-use and other features to build combined statistical models of accident occurrence. Such a study would require accident data from a large data base such as that maintained by one of the more 'advanced' local authorities and the contribution of personnel familar with the highway network.

The second stage of this exercise would involve taking the models contructed in one area, comparing them with those built elsewhere and using them to 'explain' accident totals in the areas of other towns or cities.

It is also suggested that the framework of 'land-use' be developed further by researchers in their analysis of road accidents. This study has shown that, although a body of knowledge exists for certain types of road (for example, radial routes) and areas (housing estates), only recently has an understanding developed of the way to approach such analyses. Carefully-designed studies may provide useful insights into the relationship between road accidents and activity in, for example, industrial areas or those on highways adjacent to recreational land. Such information is likely to become increasingly important as a growing population puts greater pressure on land resources.

In recent years much attention has been given to the subject of collisions with roadside objects in Birmingham and the West Midlands. The topic has been well documented (see, for example, Lawson 1985b, 1987) and there has been little need to discuss it further in the present review. However, given that the most recent large-scale national data collection exercise in this field (see Starks and Miller, 1966) was conducted some twenty-five years ago, it would be of benefit to reassess the situation and evaluate how policies on the design and placement of roadside objects influence the fequency and severity of collisions.

Much is now possible with the developments in the last ten years of strategies of data collection and manipulation. With this has come recognition of the need to inventory, and update regularly, details of numbers of road accidents, road lengths, traffic volumes, together with other highway features. The days of a local authority being ridiculed by the media for counting the number of lamp posts it has installed are slowly disappearing as awareness grows of the importance of having this type of information.

However, relatively few local authorities (almost certainly less than ten) in the U.K. today have the ability to combine road accident and traffic flow data in the way this has been done in Tables 6 and 7a and in Figure 6. The holding of the two data sets on accidents and traffic volumes in such a way that they may be combined is a useful and elementary stage of accident descriptions and should be a target of more local authorities.

The combination of data sources from what have been traditionally viewed as the two distinct worlds of planning and highway engineering has been used in this report in relating road accident casualties to population. The establishment of joint local authority planning and transportation teams in London, West Yorkshire and West Midlands encourages this exchange at a local level. For example, the work of King *et al.*, (1987) was one of the first U.K. local authority studies to draw upon census, accident, and employment data in their study of child pedestrian casualties.

The search for road accident-related data beyond that contained on the Stats 19 form should be encouraged. Too often local authority publications on accident data simply record, without commentary, that information available from their Stats 19 data set without regard either to exposure data or to information held by other agencies such as the National Health Service, police and Her Majesty's Coroners or (in Scotland) the Procurators Fiscal. As a result there is a certain 'staleness' and predictability about these reports which makes them difficult to read and does little to encourage deeper understanding of the mechanisms surrounding accidents.

The present study has shown that the collection of only a small amount of data beyond that collected on the Stats 19 form may provide useful insights into accident occurrence, the information on the nature of land-use adjacent to a road being a good example.

Specific items highlighted in the present study which either require further study or should be acted upon are listed below.

The number of accidents and casualties in Birmingham and other West Midlands districts has been decreasing over recent years. Indeed it has been shown (West Midlands Joint Planning and Transportation Data Team, 1988) that this is broadly in line with the Government's own reduction of one-third of casualties between 1987 and the year 2000. However, the present study (Figure 4) reports on large differences between Department of Transport regions, and some authorities within these regions will be hard-pressed to attain these goals. It is recommended that individual targets are set for local authorities dependent upon such indices as projected changes in traffic flow and the urban/rural split in these areas. However, such targets would need to be chosen with care if they are not to be viewed as impossibly out-of-reach and as a 'big stick' being used to threaten local authorities.

On the subject to 'local values', the importance of the advice provided by the Department of Transport in their COBA manual, that local accident values should be used where they are available, has been shown in the present study to have validity. It would be interesting and useful to know if there is systematic variation in accident rates, at different types of junction, by region of the country.

Reference has already been made to the fact that accidents to young pedestrians have been, and are being, studied in detail within the West Midlands. This is clearly important and there should be great concern at the fact that almost half of the accidents on non-network roads in Inner Areas were found to involve child pedestrians.

The work of the T.R.R.L. Urban Safety Project and some other developments in 'traffic calming' mean that some new ideas are coming through to alleviate the type of problems described above. However, there is often vigorous opposition to traffic calming (from the residents in areas where measures are proposed) and it is clear that there are few easy solutions available. Design constraints are such that it is difficult to reduce effectively vehicle speeds without severely restricting the amount of on-street parking available to residents or increasing vehicle noise and vibration. It appears that the areas of greatest need are those where the largest obstructions to progress are to be found. It may be that the first demonstration projects should be attempted in suburbs (rather then the Inner City) where there is less pressure on road space for parking and where the ideas may be developed and hopefully gain in social-acceptability before being introduced elsewhere.

Related to many of the above comments is the subject of 'safety audit', a framework for road accident analysis. It is good to see that a phrase has been coined to cover and marshal the efforts of road safety practitioners but slightly disappointing to detect a lack of willingness to define the term, to think of safety audit as a philosophy rather than simply a set of checklists and to expand upon the influence that it could have.

It has been noted (Lawson, 1988) that, 'There seems to be at least three stages or levels of commitment to the subject. One involves those who simply talk about their existing work and use safety audit to describe engineering intuition and the way they have always done things. It is used too by those who have a solid, if detached grounding in accident analysis and also by those who have developed procedures and contextual frameworks to ensure that accident analysis links in with other parts of their work setting. Where we seem to be lacking is in another area - that of developing a scientific generally-agreed basis for safety audit.'

Such agreement depends to a very great extent not only on definition but also upon gathering information and being able to present knowledge to practitioners. There are several ways in which progress may be made here, many of which require detailed quantification and analysis and close collaboration with traffic engineers in local authorities in what has traditionally been a situation in which little workplace-based research has been done.

Lastly, a comment on the implementation of change. There is now general agreement on the need to describe thoroughly the accidents which occur in any given area and to relate these where possible to causal factors and to measures of exposure. There is, however, often a predisposition for engineers and scientists to assume that description preceeds understanding. Although this is likely to be true, there appears to be a gap in how "description" can be turned into guidance to action and formulation of policy. The relevant directing legislation in local authority traffic safety work is Section 39 of the 1988 Road Traffic Act which, although it places a statutory responsibility upon local authorities to conduct work in this field, defines no target or minimum acceptable level of activity. Removing the 'permissive' tone of this part of the Act would appear to be an area worthy of great effort, where 'road safety plans' may be used and where descriptions of road accidents such as those contained in this document may be used as benchmarks to check progress.

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13.0 ACKNOWLEDGEMENTS

The author is grateful to the Automobile Association Foundation for Road Safety Research for the support of the research programme of which this work is part, to Derek Rawson, Birmingham City Engineer, for permission to present the data contained herein, and to other metropolitan authorities in the West Midlands for access to their data.

West Midlands Police are responsible for collecting the Stats 19 data within the area of the study.

Jim Carr, Mike Boyle and Barbara Sabey have been helpful in guiding this work for the Automobile Association Foundation and the other members of the Steering Group, Martin Belcher and Steve Proctor have also provided assistance, as have Howard Tillotson, John Snell and Murray Mackay at Birmingham University. Thanks are also due to Barry Perks, Keith Watkins and many other colleagues at Birmingham City Council.

Data contained in Tables 2a, 3d, and 4b were provided by T.R.R.L. - the help of Bob Stone and Diane Chapman is gratefully acknowledged. Data in Tables 5a and 5b were provided by the West Midlands Joint Planning and Transportation Data Team. Several members of that team supplied information for use in this study.

The views expressed are those of the author and not necessarily those of Birmingham City Council or the Automobile Association Foundation for Road Safety Research.

14.0 APPENDIX – THE A.A. FOUNDATION

The A.A. Foundation for Road Safety Research was formed by the Automobile Association in December 1986 as part of its continuing efforts in the road safety field and as a major contribution to European Road Safety Year.

Registered as a charity, the objectives of the Foundation are:

> To carry out, or procure, research into all factors affecting the safe use of public roads;
>
> To promote and encourage the safe use of public roads by all classes of users through the circulation of advice, information and knowledge gained from research; and
>
> To conceive, develop and implement programmes and courses of action designed to improve road safety, these to include the carrying out of any projects or programmes intended to educate young children or others in the safe use of public roads.

Control of the Foundation is vested in a Council of Management under the Chairmanship of the Chairman of the Automobile Association, Sir Ralph Carr-Ellison.

Support for the Foundation in its sponsorship of research projects is encouraged from companies and other bodies that have a concern for an interest in road safety. At the time this report was prepared, the Foundation was supported by:

British Petroleum, Esso, Godfrey Davis Europcar, The Caravan Club, Private Patients Plan and the following insurance companies: Guardian Royal Exchange, Bishopsgate, Municipal Mutual, AA Motor Policies at Lloyd's, Orion, Cornhill, Minster, Excess, Sphere Drake, Provincial, Sun Alliance, Eagle Star, Sentry, Norwich Union, N.E.M., Royal, and Commercial Union.