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PROBLEMS FOR VULNERABLE ROAD USERS IN GREAT BRITAIN

M.R. Tight, O.M.J. Carsten & D. Sherborne

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An Intelligent Traffic System for Vulnerable Road Users

PROBLEMS FOR VULNERABLE ROAD USERS IN GREAT BRITAIN

M.R. Tight
O.M.J. Carsten
D. Sherborne

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Workpackage Leader: M.R. Tight, ITS, University of Leeds

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1. INTRODUCTION

In Britain pedal cycle and, in particular, pedestrian travel are important transport modes for the population. However, given the vulnerable nature of these modes of transport, the number of accidents involving pedestrians and cyclists is high, and in particular the number of killed and seriously injured victims is high. Technical measures to improve safety and efficiency focus almost exclusively on motorized traffic, disregarding the needs of non-motorized traffic participants. In order to determine how technical measures, such as Road Traffic Informatics (RTI) applications, can be used to increase the safety and mobility of pedestrians and cyclists, more information is needed about the causes of accidents to these groups.

This report aims to look at a number of the attributes of accidents which involve vulnerable road users and at the characteristics of their travel, in order to identify areas where safety and mobility improvements may be obtained. It is intended to serve as a tool in subsequent stages of this project, and thus is not a general survey of safety and mobility problems for vulnerable road users, but rather a review of those issues that are related to the RTI measures envisaged by the project. The project is aimed at improving VRU safety and mobility both directly, through the enhancement of signalized junctions and pedestrian crossings, and indirectly, through the creation of a model of the traffic system incorporating vulnerable road users. It is intended that this model will permit the routing and guidance of motorized vehicles in such a way as to enhance VRU safety and reduce VRU annoyance and delay from traffic. Both the direct and the indirect measures envisaged will only be relevant to VRU safety and mobility on main roads in urban areas; they are unlikely to be applicable to residential streets or minor roads unless these have substantial VRU flows. The report therefore concentrates (in so far as existing information permits) on VRU safety and mobility on main roads and on VRU use of facilities that are intended to be upgraded through the planned RTI measures.

The report is split into two main sections; the first of which will examine safety and mobility problems for vulnerable road users on a national level, and the second will examine safety and mobility problems for vulnerable road users at a more local level, specifically for Bradford in West Yorkshire. Parallel reports are being produced for Sweden and The Netherlands, which will examine the situations regarding the safety and mobility of vulnerable roads users in those countries as a whole, and in one urban area from each (namely the town of Vaxjo in Sweden and the City of Groningen in The Netherlands).

2. DEFINITIONS

BRITAIN: England, Scotland and Wales.

WEST YORKSHIRE: This is a county of just over 2 million people, it is a mixture of rural and urban locations. The urban situation is concentrated around 5 major cities: Bradford, Halifax, Huddersfield, Leeds and Wakefield.

BRADFORD METROPOLITAN DISTRICT: This is a predominantly urban area with a population of 460,000 mainly concentrated around the city of Bradford. Bradford City is a cosmopolitan area with concentrations of people who originated from the Asian sub-continent.

INJURY ACCIDENT: One involving personal injury occurring on the public highway (including footways) in which a road vehicle is involved and which becomes known to the police within 30 days of its occurrence. The vehicle need not be moving and it need not be in collision with anything (it might, for example, explode while stationary). One accident may give rise to several casualties. Damage only accidents are not included.

FATAL INJURY: An injury from which death occurs in less than 30 days as a result of the accident. Deaths from natural causes are not included.

SERIOUS INJURY: An injury for which a person is detained in hospital as an in-patient, or any of the following injuries whether or not he/she is detained in hospital: Fractures, concussion, internal injuries, crushings, severe cuts and lacerations, severe general shock requiring medical treatment, injuries causing death 30 or more days after the accident. An injured casualty is coded as seriously or slightly injured by the police on the basis of information available within a short time of the accident. This generally will not include the results of a medical examination, but may include the fact of being detained in hospital, the reasons for which may vary somewhat from area to area.

SLIGHT INJURY: An injury of minor character such as a sprain, bruise or cut which are not judged to be severe, or slight shock requiring roadside attention.

CASUALTY: Someone receiving a fatal, serious or slight injury.

PEDESTRIAN: Includes persons riding toy cycles on the footway, persons pushing bicycles, pushing or pulling other vehicles or operating pedestrian controlled vehicles, those leading or herding animals, occupants of prams or wheelchairs, and people who alight safely from vehicles and are subsequently injured.

PEDAL CYCLISTS: Riders of pedal cycles, including any passengers.

BUILT-UP ROADS: Accidents on built-up roads are those which occur on roads with speed limits (ignoring temporary limits) of 40 mph or less.

3. SOURCES OF DATA

3.1. ACCIDENT DATA

At a national level the only source of information on pedestrian accidents is that collected by the police and recorded on a form called "Stats 19". This database contains substantial amounts of information about all road accidents reported to the police in Britain. It includes background information on the accident itself (location, time of day, severity and so on), the vehicles involved, and the casualties involved. A limited set of summary tables of the information contained in this data set are published in a yearly publication called Road Accidents Great Britain. Special tabulations of this data can be carried out on request to the Transport and Road Research Laboratory, though there is a charge for this service.

At a local level, the basic accident data is that collected by West Yorkshire Police, this police force covers all of West Yorkshire and therefore includes the Bradford area. Not all road accidents have to be reported to the police and of those that are reported to them, the police only keep detailed records on computer file of those accidents in which someone was injured. These detailed records include all the information laid down in the Great Britain, Department of Transport document "Stats 19" and in addition includes a brief narrative description of where the accident happened and what occurred.

The police force also keeps a detailed file of all injury accidents for their own information. In the main this file is used to provide the basis as to whether there will be any prosecution for a driving offence as a result of the accident (There is no corresponding pedestrian offence). None of this information is recorded automatically on a computer file, but information such as location plans and witness's statements are available for inspection by approved personnel.

3.2. MOBILITY DATA

There is little existing nationally representative information on mobility problems for pedestrians and even less for cyclists. The main source of information on travel patterns in Britain is the National Travel Survey (NTS), conducted every few years by the Department of Transport.

At a local level there is in existence within the Bradford area a database containing the daily volume of traffic on the majority of major routes in the Bradford area. However the information is very much more limited for minor roads and those within housing estates.

Whenever a formalised crossing facility is considered, a weekday pedestrian count is made of those people already crossing in that vicinity. This is done so as to prove the need or otherwise of the facility. No estimate is made of suppressed demand. At the present time these are the only pedestrian crossing movements routinely collected.

4. THE NATIONAL SITUATION

4.1. SAFETY

4.1.1. Pedestrians. In Britain in 1987 there were 1703 pedestrian fatalities accounting for 33.2% of all traffic fatalities, 16057 pedestrians seriously injured accounting for 25.0% of all serious traffic casualties and 57453 pedestrian casualties of all severities accounting for 18.4% of total casualties (Department of Transport, 1988a). Hence, it can be seen that pedestrians account for a substantial proportion of road casualties, and that their involvement rate is particularly high in terms of fatalities and serious casualties. This latter point is no doubt due to the particularly vulnerable nature of this type of road user. National figures show that certain types of pedestrians are more involved in more accidents than others. In comparison with adults in the 20-59 age group children in the age groups 5-9 and 10-14 years have approximately four times the rate of killed and seriously injured per head of population. The elderly (60+ years) also have about twice as many killed and seriously injured per head of population as this group.

It should of course be borne in mind when considering these figures that studies have indicated that not all injury accidents involving pedestrians are reported to the police and hence many do not appear in national statistics. A recent study using hospital based data indicated that the level of reporting is about 85% for seriously injured pedestrians and only about 64% for slightly injured pedestrians (reported on in Sabey, 1989). Applying these figures to the 1987 casualty totals above means that there may have been as many as 18891 serious casualties and 82614 casualties of all severity. It is not known whether any important biases exist between those casualties who are recorded in the police statistics and those who are not.

Most reported pedestrian accidents occur on built-up roads (95.1%). This is particularly so for child pedestrian accidents where 97.5% occur on built-up roads compared to only 93.9% for adult pedestrians. Published annual series of accident statistics in Britain do not give details of the type of road upon which pedestrian accidents occur. However, figures from a special study for four towns in the south of England show that pedestrians were involved in 25.4% of accidents occurring on arterial roads, and that of these 46.1% occurred at a junction and 53.9% were not at a junction (Chapman, 1978). Another study of accidents to child pedestrians in five urban areas (Tight, 1987) has shown that the risk per road crossing is substantially higher when crossing main (arterial and local distributor) roads than when crossing other roads. This is particularly the case when on journeys to and from school when the risk of crossing a main road is approximately ten times higher than crossing other roads.

There are a number of very apparent patterns concerning the time of day of pedestrian accidents. These patterns vary according to the day of week. On weekdays there are a number of peaks of accidents throughout the day, most notably between 8am and 9am, a smaller one at lunchtime between 12am and 1pm, and finally the largest peak of the day between 3pm and 6pm when about one-third of the daily pedestrian accidents occur. Another peak of pedestrian accidents occurs both late on Friday night and early on Saturday morning, and late on Saturday night and early on Sunday morning, no doubt related to some extent to alcohol intake. Finally, on both Saturday and Sunday there is no peak of accidents in the

morning period between 8am and 9am. Accidents on these days seem to peak between about 11am and 8pm, though the peak starts slightly earlier on a Saturday than on a Sunday and finishes slightly later on a Sunday than on a Saturday. It has been shown using data from the National Travel Survey (Goodwin and Hutchinson, 1977) that the pattern of pedestrian accidents throughout the day reflects very much the pattern of pedestrian usage of the road throughout the day (and also the pattern of vehicle usage). The only exceptions to this are the accidents in the late evening occurring about pub closing time when the number of pedestrian accidents is somewhat higher than would be expected based upon pedestrian usage alone.

In 1987 a total of 4909 (8.5%) pedestrian casualties occurred at crossing facilities, though a further 5655 (9.8%) occurred within 50 metres of a pedestrian crossing. Of the casualties actually occurring on crossings, 1837 (37.4%) were on zebra crossings and 2170 (44.2%) were on pelican crossings. A greater proportion of adult pedestrian casualties (9.4%) were injured on pedestrian crossings than child pedestrian casualties (6.2%). It is generally accepted that at-grade pedestrian crossings (zebras and pelicans) are one of the safest places for pedestrians to cross the road. A recent study in West London (Grayson, 1987) showed that the risk of crossing a road using either a zebra or a light controlled crossing was in general lower than the risk involved when crossing more than 50 metres from the crossing and substantially lower than the risk involved when crossing within 50 metres of the crossing. The study by Tight (1987) showed that for child pedestrians in five urban areas the risk of crossing a main road not at a crossing facility was three times as high as crossing a main road at a crossing facility.

Studies have shown that in urban areas about one-quarter of accidents involving child pedestrians occur on journeys to and from school (see for example Tight, 1987 or Sabey, 1989). The risk of such an accident per unit of exposure has been shown to be higher on the journey home from school (Tight, 1987). This study also showed that the risk of being involved in an accident per crossing and per unit of distance walked for child pedestrians on journeys to and from school is higher within the area extending up to half a kilometre around a child's school than at distances greater than half a kilometre from the school.

4.1.2. Pedal Cyclists. In 1987 there were 280 fatalities involving pedal cyclists (5.5% of all traffic fatalities), 4851 pedal cyclists seriously injured (7.5% of all serious casualties), and 26194 pedal cyclist casualties of all severities (8.4% of all casualties). Unlike pedestrians, pedal cyclists have a higher rate of involvement in accidents as slight casualties than as serious casualties or fatalities. National figures show that certain age groups of pedal cyclists have more accidents per head of population than others. The age groups 10-14 years, 15 years and 16 years have substantially higher rates of injury than any other age groups. It is interesting to note that the age groups with the highest involvement rates are slightly older for pedal cyclists than for pedestrians. This no doubt reflects the patterns of use children make of bicycles, in particular the age at which they are first allowed to have bicycles, and secondly the age at which they are allowed to use those bicycles on the road.

As with the pedestrians there have been shown to be serious limitations regarding the completeness of the police accident figures for pedal cyclists. A recent hospital based study (Mills, 1988) has shown that only 28% of the pedal cycle casualties appeared in the police accident statistics, while only 3% of single vehicle pedal cycle accidents were reported to the police. Applying these figures to the 1987 casualty totals means that there may have been as many as 93550 pedal cycle casualties, a figure somewhat higher than the pedestrian casualty total, though it should be

borne in mind that whilst the figures for pedal cycle accidents include accidents where only a pedal cyclist was involved, this is not the case for pedestrian accidents.

Most reported pedal cycle accidents occur on built up roads (89.3%). As was the case with pedestrians, a greater proportion of pedal cycle accidents involving children occur on built up roads (92.3%) than those involving adults (88.1%). Of those pedal cycle casualties which occur in urban areas, 52.5% occurred on A and B class roads (which can be roughly taken to represent the network of arterial and local distributor routes in urban areas), while the remaining 47.5% occurred on Other class roads (for the most part small residential streets). The figures show a casualty rate per 100 million vehicle kilometres of 1170 and 1069 for A and B class roads respectively, compared to only 495 for Other class roads (C roads and unclassified surfaced roads).

The current national manual on urban traffic (Institution of Highways and Transportation, 1987) recognize that cyclists have particular problems at roundabouts and indicate that, "where justified", grade separation can provide a safer alternative. The same manual acknowledges that cyclists may be particularly vulnerable to being hit by exiting or entering traffic on major roads equipped with ramps, but does not make any recommendations for particular solutions.

There is a marked seasonal trend in pedal cycle casualties, with most of them occurring in the summer months. This trend is presumably related strongly to the effect of weather conditions on the number of cyclists using the roads.

4.2. MOBILITY

Because of the lack of general information on pedestrian and cyclist mobility problems, this section will discuss the role of pedestrian and bicycle travel in the nation's mobility, provide information on the standard facilities that are provided for vulnerable road users, and discuss some of the problems for them that have been revealed through various local studies.

4.2.1. The National Travel Picture. The main source of information on travel patterns in Britain is the National Travel Survey (NTS), conducted every few years by the Department of Transport. According to the most recent survey which was conducted in 1985-86, journeys where the main mode of transport was by car accounted for 68.9 percent of all journeys and 72.8 percent of all mileage. By contrast, bicycle travel accounted for 2.3 percent of journeys and 0.8 percent of mileage and foot travel for 10.4 percent of journeys and 2.3 percent of mileage (Department of Transport, 1988b). Including trips of less than one mile for pedestrians and cyclists, but not for cars, average trip length for bicycle journeys was 1.75 miles, compared to 0.66 miles for pedestrian trips and 8.41 miles for car trips (Department of Transport, 1988c).

Unfortunately, the published figures from these surveys exclude all pedestrian journeys of less than one mile in length (the most recent survey has a brief analysis of these trips). This exclusion of all short pedestrian trips appears to stem from an attitude that such journeys do not constitute true travel. The published statistics are therefore of little use in estimating the real share of all British travel that is done on foot.

The raw data from the 1972-73 and 1975-76 surveys were, however, reanalysed for a study by the Policy Studies Institute (Hillman and Whalley, 1979), and this study constitutes the best available data source on the overall pattern of pedestrian travel.

The reanalysis indicated that in 1975-76 journeys on foot accounted for 35.2 percent of all journeys (as compared to 12.4 percent in the published statistics). A *journey* was defined as a one-way trip from origin to destination. A change of *stage* on a journey might occur with a change of mode or a change of vehicle. Walking accounted for 49 per cent of all stages. Naturally journeys on foot were generally shorter than those for other modes of travel: the mean length was about 0.8 miles and 40 percent of them were less than half a mile long. Overall, travel on foot accounted for about 6 percent of all travel distance.

Breaking down travel by journey purpose, walking accounted for 46 percent of all journeys to and from shops, 60 percent of all journeys to and from school, 34 percent of leisure-related journeys (social visits, recreation, eating and drinking, entertainment and sports), and 19 percent of all journeys to, from or on work. In general, women made more journeys on foot than men, and, taking into account their lower number of journeys overall, walking constituted a more important mode of travel for women than it did for men. Children aged 3 to 15 did 51 percent of their journeys on foot. The comparable figure for males aged 16-64 was 21 percent, for females aged 16-59 was 37 percent, and for all pensioners (men over 64 and women over 59) was 46 percent. Thus all but men of working age depended on foot transport for much of their travel.

4.2.2. Facilities. These summary statistics reveal the importance of walking in the national transportation picture. Yet in terms of facilities, the pedestrian is generally treated as a second-class citizen. One perhaps tongue-in-cheek calculation concluded that 77 percent of the nation's carriageways was for the use of vehicles, while only 23 percent was for pedestrians (Roberts, 1980). The same paper concluded that there was one "moderately safe" pedestrian crossing point every 7.4 km of urban road (safe crossings being defined as those where pedestrians have priority at least some of the time). In terms of public policy, perhaps the strongest indication of the status of the pedestrian is the value put on pedestrian delay in calculating the benefit of new road schemes or improvements to existing roads. In Britain, predicted savings in time for vehicle users are a major part of the justification for such schemes, but pedestrian delay is rarely taken into account (Skelton, 1982).

The standard crossing facilities for pedestrains in Britain are:

1. Zebras. These consist of white stripes across the road, together with flasshing beacons at the side and indicate pedestrian priority in the road. Traffic is required to yield to any pedestrian with a foot in the carriageway.

2. Pelicans. These are light-controlled crossings which are activated by the pedestrian pushing a button and have three phases. In the first phase, the lights are green for traffic and red for pedestrians. In the second phase, the lights are red for traffic and green (green man plus audible signal) for pedestrians. In this phase, traffic is required to stop. In the third phase, the lights are flashing orange for traffic and flasing green for pedestrians. In this phase, traffic is required to yield to pedestrians in the crossing and pedestrians may continue to cross though they are advised not to begin to cross. It should be noted that all the rules for pedestrians on pelican crossings are advisory, whereas for motorists they are mandatory.

3. Crossings at lights. At most traffic lights in Britain there is no specific phase for pedestrians in any one arm of the junction, but at

some signalized intersections a pedestrian phase is provided on one or more arms. During this phase, a green light is indicated to pedestrians and relevant traffic (including turning traffic) is held with a red light. This restriction on turning traffic contrasts with the situation on most other European countries. Just as for pelican crossings, the pedestrian lights are advisory.

4. Refuges. Central refuges are commonly provided on wide roads or those with relatively heavy traffic. They permit the crossing of the road to be carried out in two stages and give some shelter from traffic.

It is also important to bear in mind the British rules for turning traffic. While the Highway Code (the book of rules and recommendations for road users) recommends that turning traffic yield to pedestrians, this recommendation has no legal force and is widely flouted. In actual fact, British pedestrians do not have right of way over turning traffic and tend to be extremely cautious in crossing at junctions. This caution is natural since the pedestrian is often obligated to watch out for traffic coming from several directions.

4.2.3. Problems. Mobility problems for pedestrians can be classed into three main groups:

1. Severance
2. Delay
3. Vulnerable road user perception (of danger, of poor environmental quality, etc.)

Severance has not been extensively researched in the UK. A recent report (Grigg and Ford, 1983) that reviewed literature on the subject considered mainly American material. One British study that was cited (Lee and Tagg, 1976) did find that roads with heavy traffic acted as neighbourhood boundaries and that older people were more affected by the severance effect. The conclusion from the literature review was that "the burden of severance falls most heavily on those who are dependent on walking as their principal mode of transport and this implies that it is most likely to be experienced by the young, the retired and women and that it is less likely to be experienced by the employed".

Delay has been much more extensively studied than severance. Among the studies are ones in Coventry (City of Coventry, 1973) and London (JURUE, 1975; Goldschmidt, 1977). The Coventry work modelled pedestrian crossing time by traffic flow and road width where there were no crossing facilities and by traffic flow alone where there were zebras or traffic signals. An increase in flow from 1000 to 2000 vehicle per hour raised crossing time where there were no facilities by about 60 percent.

The Coventry findings were largely confirmed by the London studies, with the important difference that *delay* rather than *crossing time* was modelled. The two London studies used similar methodology. Goldschmidt found that at random crossing points (i.e. those with no pedestrian facilities) and zebras the best model of delay used traffic flow alone, while at traffic signals the best model included traffic flow, road width and length of green phase. The JURUE study was carried out only at random crossing points and again found that delay could be predicted by traffic flow alone. Both the London studies showed that, at a random crossing point, an

increase in traffic flow from 1000 to 2000 vehicles an hour raised average delay from about 6 seconds to about 18 seconds.

As regards pedestrian crossings, the Goldschmidt study found that delays at zebras correlated better with flows of medium and heavy goods vehicles than with total traffic flows. The author theorizes: "This may reflect a reduced willingness on the part of large vehicles to stop, as well as a degree of intimidation of the pedestrian." Another finding was that, on average, the delay at pelican crossings was two or three times as great as the delay at zebras. Pelican crossings are often set to a delay of up to 45 seconds between pressing of the button by a pedestrian and activation of the signal. Many pedestrians, especially men were observed to become impatient and to cross before the lights changed, while others, especially the elderly, were unable to react quickly enough to a change in the lights and so were left stranded for considerable periods. Some critics of pelican crossings have termed them pedestrian-delay devices.

It is important to note one feature of the various delay studies. They cannot observe changes in pedestrian behaviour caused by the delay. This was noted by Goldschmidt:

> [Waiting] cannot be seen in isolation from the individuals affected, nor from the alternative actions available to the pedestrian. A pedestrian trying to cross the road, but unable to do so immediately, may either wait at the kerbside until the road is clear, or he may walk along the kerb, continuously looking for a gap in the traffic, and then cross without stopping. Alternatively, he may decide to walk to a pedestrian crossing before attempting to cross. In extreme cases, he may adjust his route to avoid crossing the road altogether.

Perception of difficulty or environmental hazard can be important in modifying pedestrian behaviour. A survey of pedestrians' attitudes on a shoping street in Liverpool found that eight attributes were the most significant (Hills, 1976). They were (in order of importance):

1. shops
2. noise
3. crowds
4. freedom to cross
5. safety for pedestrians
6. personal safety
7. access by transport
8. overall appearance

We can see that safety and mobility issues ranked high. Among pedestrians interviewed in central Newcastle in 1979, 56 percent agreed that it was difficult to cross roads, although in providing unprompted responses 58 percent did not perceive any major difficulty in walking round the city centre (Bennison, 1980).

Other surveys have confirmed the importance of safety and mobility. The National Environmental Survey of 1972 investigated people's attitudes to the area in which they lived and to road conditions outside their homes (Social and Community Planning Research, 1978). Among problems in the walking environment, difficulty in road crossing ranked highest with 45 percent of respondents counting it as "most bothering" or "second most bothering". The next highest factor, noise and vibration, was similarly ranked by only 30 percent of respondents.

A number of studies have investigated pedestrians' perception of hazard in crossing the road. Thus Crompton (1978) found that at random crossing points 35 percent were worried about their safety, at pelicans 27 percent, and at zebras 35 percent. The flow of heavy goods vehicles was one of the main predictors of worry.

Unfortunately, there has been little effort to study the extent to which perception of hazard or nuisance translates into behavioural change such as change in route or trip suppression. It is, however, generally accepted that pedestrians are unwilling to accept a deviation of more than 30 metres from a straight line path in order to use a crossing facility (e.g., Katz, 1978). It is also generally accepted that changes in grade for street crossing, entailed by footbridges and subways, are disliked by pedestrians (Institution of Highways and Transportation, 1987).

5. THE LOCAL SITUATION

5.1. SAFETY

West Yorkshire has an annual casualty total of about 10,000 injuries, of these approximately 175 result in death. Figure 1 shows a typical yearly distribution of the casualties by the type of road user. As can be seen from this the vulnerable road user is represented by over 30% of the casualty total: 24% are pedestrian casualties and 6% are pedal cyclists. Figure 2 shows that over the past eight years although there has been a slight reduction in the overall number of injuries, it is still remaining at a high consistent level, especially to those killed or seriously injured.

In West Yorkshire 97% of all its pedestrian accidents and 93% of its pedal cycle accidents occur on urban roads. In Bradford 99% of pedestrian accidents and 98% of pedal cycle accidents occur on urban roads. Hence for all practical purposes all pedestrian and pedal cycle accidents occur on urban roads in these areas.

Bradford District has an annual casualty total of just under 2000. Figure 3 shows the distribution of casualties for 1987 by the type of road user. As can be clearly seen, nearly 40% of the casualties fall into the vulnerable road user category. For Bradford over 30% of all its casualties are pedestrians.

An initial analysis of the particular pedestrian problem in Bradford identified three major areas of concern. These identified problems are:

1. A high rate of child pedestrian casualties;
2. Specific routes and areas with a pedestrian problem;
3. Lack of pedestrian facilities at designated crossing points.

As has been demonstrated pedestrians are over-represented in the casualty total for Bradford. In addition to the evidence from Figure 3, the casualty rate per 100,000 children is much higher. For Bradford the child pedestrian casualty is 324, compared with the West Yorkshire figure of 254. This can be further seen for the different age groups in Figure 4, which shows a particular problem in the 5-9 age group.

A previous report (Bradford Council, 1988) has already identified this specific problem in Bradford and has highlighted some of the more specific features of the accidents.

Figure 5 shows that the majority of child pedestrian accidents in different parts of Bradford occur on the minor (or unclassified) roads. In addition an investigation into the location of the scene of the accident and the people involved has shown that 79% of the child pedestrian casualties lived within 500 metres of the scene of their accident. It also showed that 63% of the drivers involved in these accidents lived within 5km of the scene.

Figures 6 and 7 identify various parts of Bradford where the child pedestrian problem is greatest and these areas probably give the greatest scope for improvement.

An already issued report (HETS, 1988d) has highlighted a concentration of pedestrian accidents, mainly involving adult pedestrians on a major radial route from the Bradford City centre. These accidents are slightly different from the existing known pattern of accidents in two ways:

1. Time of day
2. Accidents at Traffic Signals

There has been an identified problem of pedestrian accidents occurring between the hours of 10pm and 3am. In very few of these accidents was there any evidence that the driver of the vehicle had been drinking although the pedestrian had been. Obviously the vehicle flows at this time would be lower and hence there is the scope to place extra controls on the vehicles to give greater safety to the pedestrians.

A recent report (HETS, 1989) which identifies those locations in Bradford which have the greatest number of accidents, has commented upon the number of junctions throughout the city, which have a pedestrian accident problem. The common feature of these junctions is that although they are controlled by traffic signals, no specific consideration has been made for pedestrians.

Over the last 6 years the number of pedal cycle accidents in West Yorkshire and Bradford District have remained fairly constant. There is certainly no sign of any positive trend.

Accidents involving child cyclists are concentrated during the summer months, with 62% occurring between April and August. The accidents are also concentrated during the late afternoon and early evening period, 4pm-8pm. As mentioned previously, nearly all of the accidents, 97%, occur in the urban situation, with only 30% on classified roads.

For accidents involving adult cyclists the situation is somewhat different in that the monthly accident pattern follows that for all accidents, with a peak during the latter half of the year (October and November). Also the accidents occur in urban areas with nearly 70% on classified roads. These figures lead to the conclusion that the majority of the adult cycling accidents occur during commuting journeys to and from work.

For both adults and children approximately 80% of cycling accidents occur at junctions. Very few specific junctions in the Bradford area have a significant number of pedal cycle accidents, but at some roundabouts there are identifiable problems.

For the whole of West Yorkshire there are very few accidents involving interaction between a pedal cyclist and a pedestrian (Less than 10 per year).

5.2. MOBILITY

An unpublished report by West Yorkshire Metropolitan County Council showed that in 1981, 36.5% of all journeys in West Yorkshire were on foot, 1% were made by pedal cycle, and 45% as an occupant of a car. In terms ofjourney purpose; walking accounted for 41% of all shopping trips, 62% of all journeys to and from school and 37% of all leisure related journeys. These figures are similar to the national figures cited in Section 4.2.1. There is no evidence available at present to show that the situation in Bradford varies significantly from these figures.

About 20% of all pedal cycle journeys were to and from school, however this represents only 1% of the total number of journeys to and from school.

6. CONCLUSIONS

6.1. ACCIDENTS, SAFETY AND MOBILITY OF PEDESTRIANS

According to national statistics, 6% of the total distance travelled is on foot, while pedestrians account for 18.4% of casualties. These numbers point to the "vulnerability" of pedestrians: in almost any collision between a vehicle and a pedestrian, the injuries to the pedestrian are likely to be more severe than those to the vehicle occupants. There is no evidence that the situation in Bradford is significantly different from the national figures. The vast majority of pedestrian accidents for both children and adults occur in urban areas.

In general terms, children aged 5-14 and the elderly, aged 60 and over, are most likely to be involved in accidents and cars are the vehicles most likely to be involved. Any effective action taken to reduce these conflicts must prove beneficial to vulnerable road users.

Nearly 20% of all pedestrian accidents occur at or within 50 metres of a pedestrian crossing facility. This points to the need to make these facilities more safe for pedestrians. One way to achieve this might be by reducing the delay to pedestrians at signalised crossings. This might serve both to increase the numbers of pedestrians who use the crossings and to decrease the numbers who are encouraged to take risks by impatience at delay.

6.2. ACCIDENTS, SAFETY AND MOBILITY FOR PEDAL CYCLISTS

On a national level bicycle travel accounts for less than 1% of the total mileage travelled, yet over 8% of all reported road casualties are cyclists. In West Yorkshire, 20% of all cycle journeys are trips to and from school, yet even these only represent 1% of all school journeys. Within West Yorkshire and Bradford in particular, there are very few special facilities to assist pedal cyclists on their routes through urban areas. The accident statistics show that nearly all of the cycle accidents occur in urban areas. It is also notable that in West Yorkshire 80% of all cycle accidents occur at road junctions with roundabouts presenting a particular problem.

Within West Yorkshire there is very little evidence of the interaction between pedestrians and cyclists causing a problem.

6.3. SITUATIONS SUITABLE FOR RTI MEASURES

There are three types of situations where the implementation of RTI measures of the type envisaged by this project could prove to have a beneficial effect upon the safety and/or mobility of vulnerable road users. These are:

1. Situations where pedestrian or bicycle flows are high and many accidents occur;

2. Situations where pedestrian or bicycle flows are high and the risk of an accident is high;

3. Situations where pedestrian or bicycle flows are not high because of trip suppression caused by real or apparent high vehicular flow.

More information is required to determine why certain journeys are not made either by foot or pedal cycle when these modes appear to be the more natural forms of transport. There is major scope, both on a national and local level, for providing improved facilities for pedal cyclists whose needs have not been addressed seriously.

Within Bradford many pedestrian accidents occur at junctions on the city's main ring road. Many of these junctions have inadequate provision for pedestrians, either adult or child. More detailed information on pedestrian route choice is needed to provide an integrated system of pedestrian facilities that will not make the situation more dangerous.

In Bradford there is also a particular problem on corridors where there are large flows of pedestrians and comparatively small vehicular flows. In these situations RTI measures should be appropriate for giving higher priority to pedestrians without any significant delay to vehicular traffic.

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WEST YORKSHIRE
Casualty Distribution by Road User

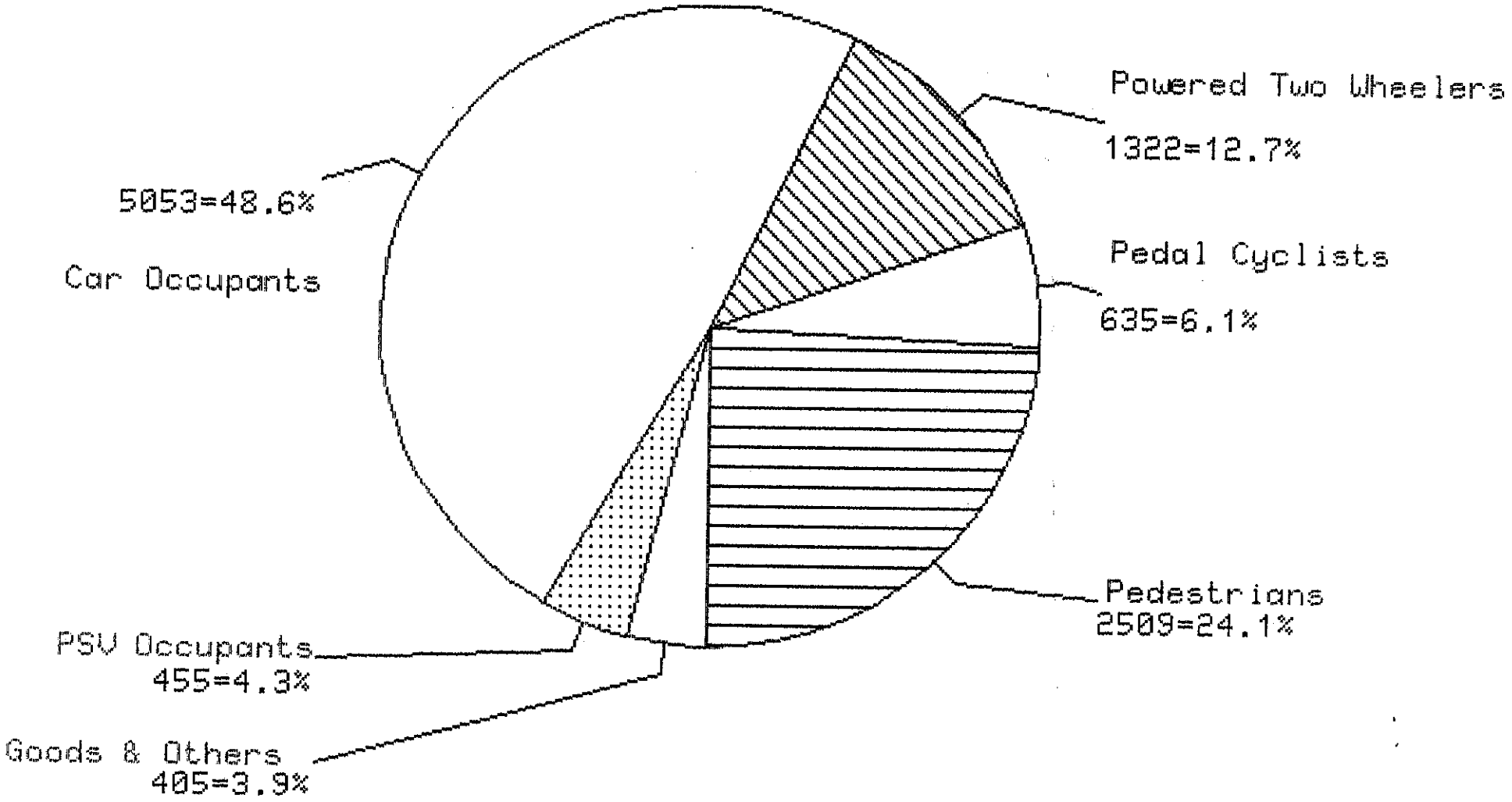

Figure 1

HETS Y24 Jan 88

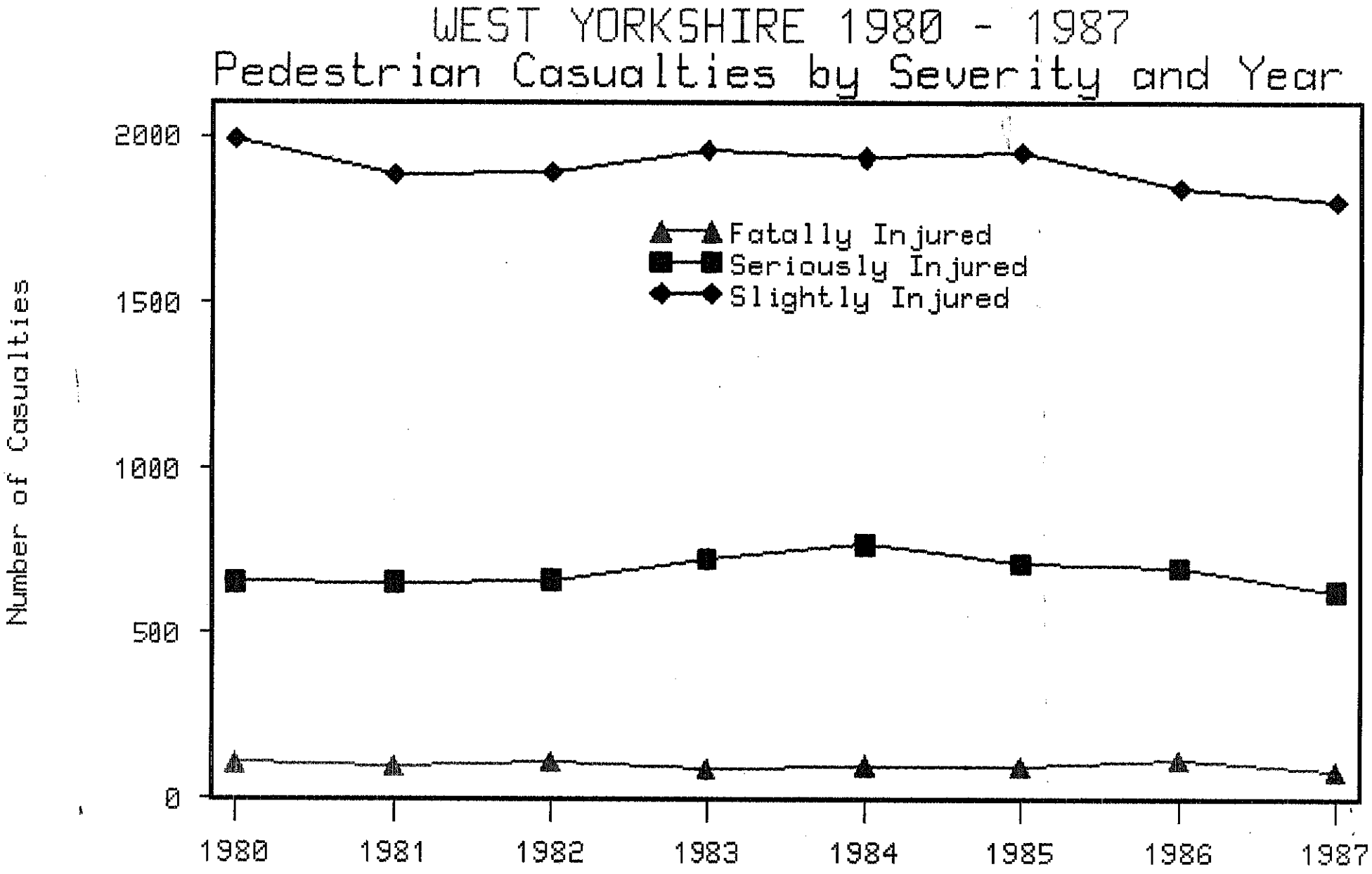

Figure 2

HETS WY5 Feb 88

BRADFORD DISTRICT 1987
Casualty Distribution by Road User

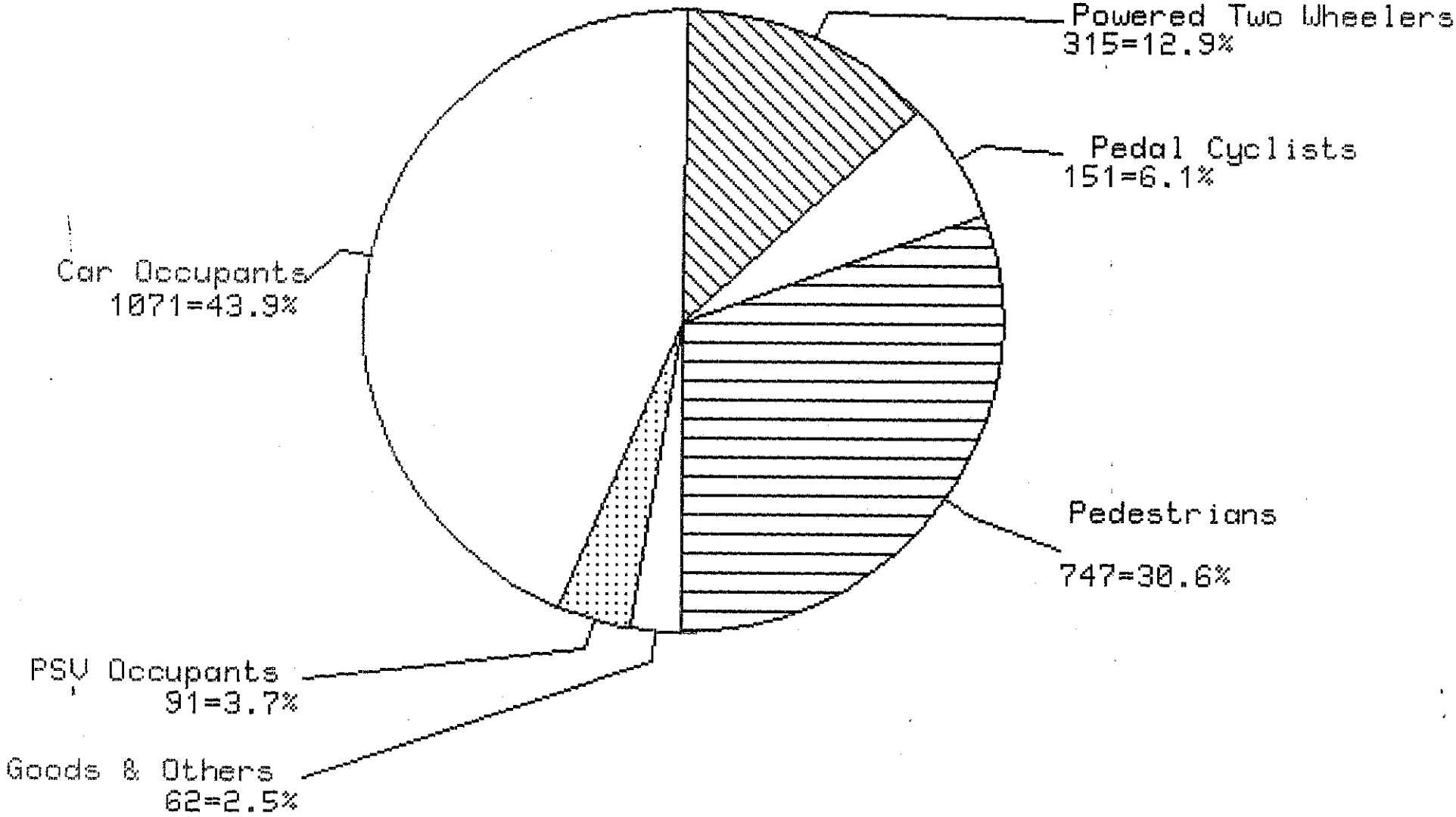

Figure 3

HETS B24 Feb 88

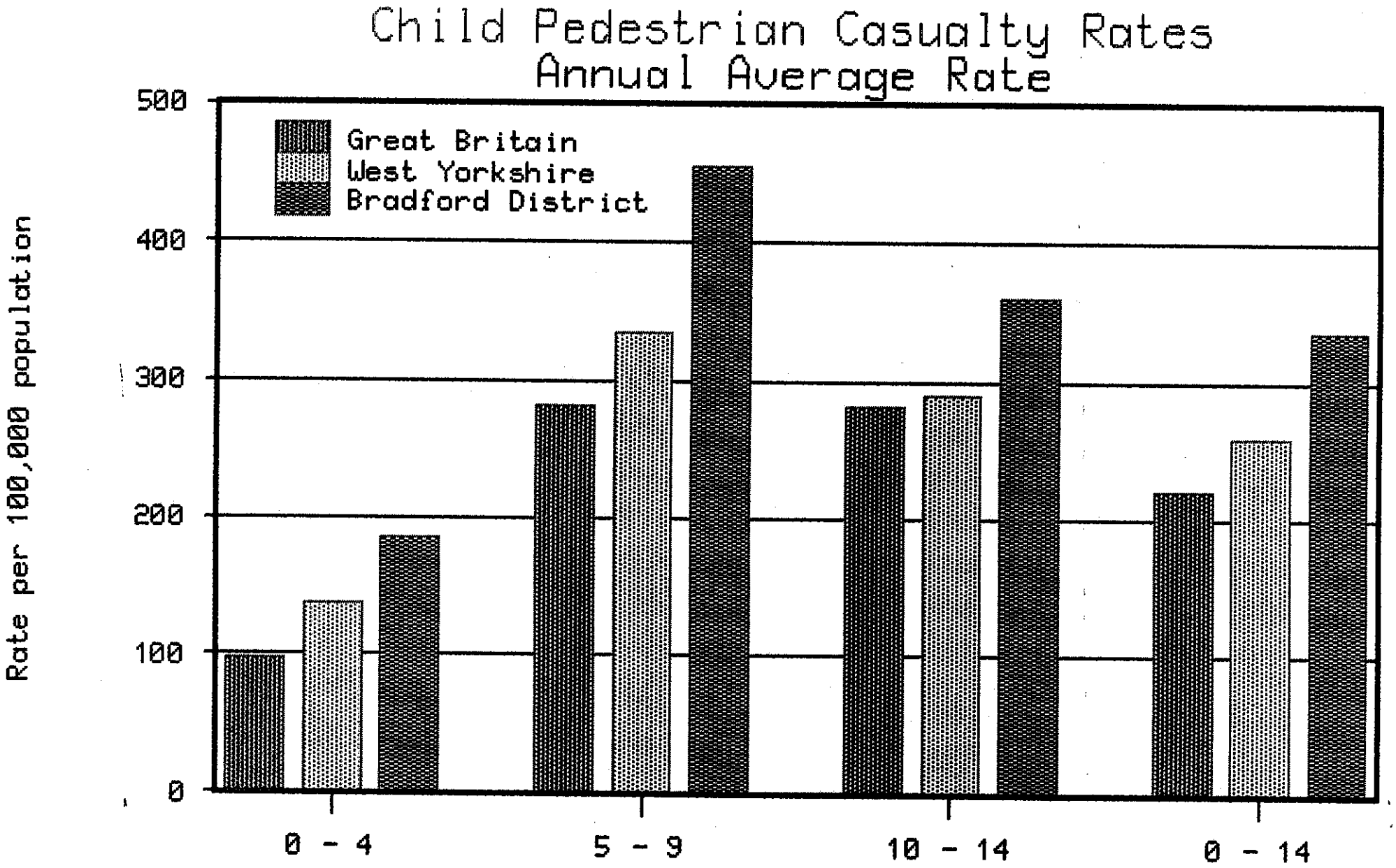

Figure 4

Bp71 HETS Jun 88

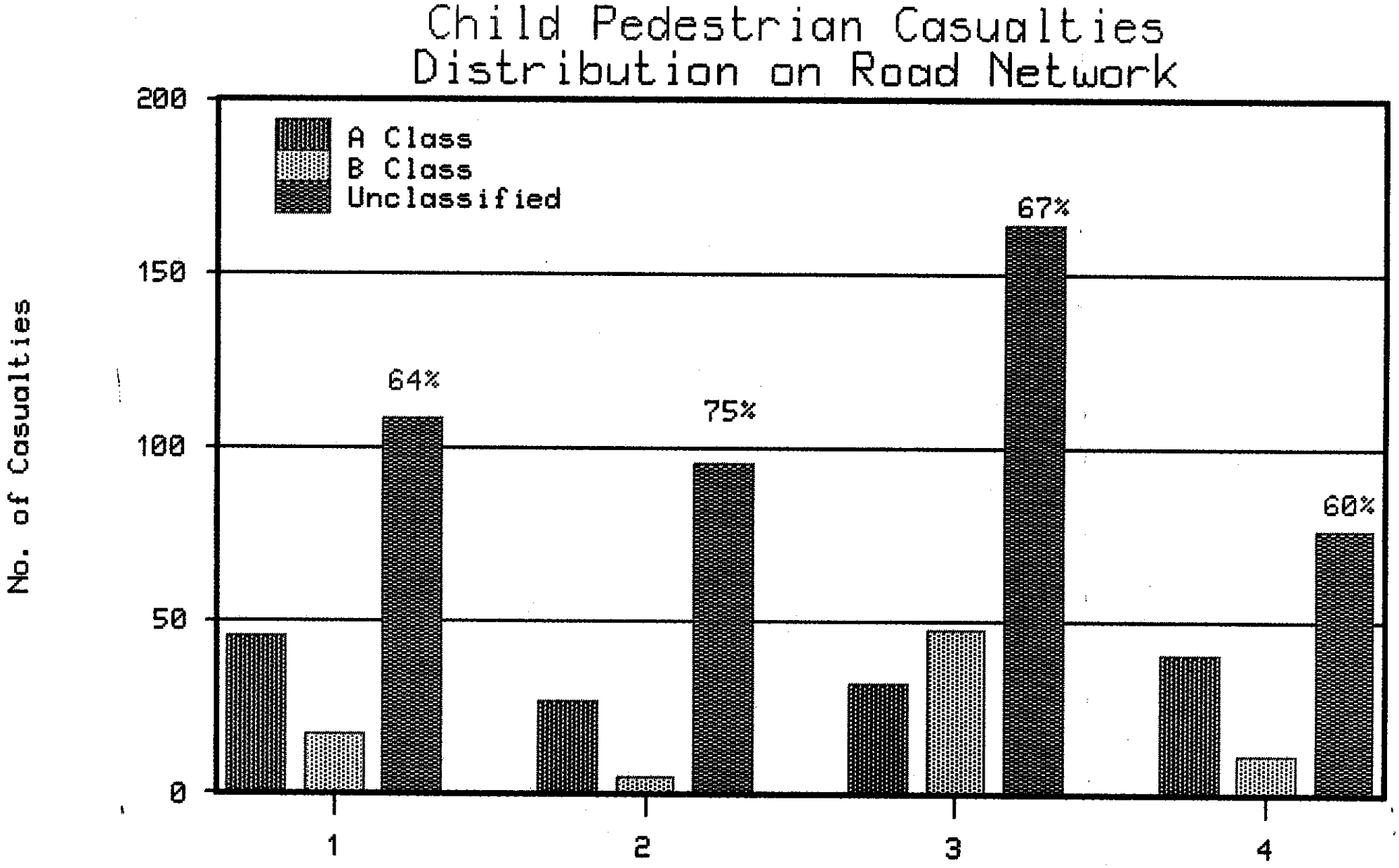

Figure 5

Bp72 HETS Jun 88

Figure 6:
LAISTERDYKE 'GB'
MAIN CLUSTERS.
A+B ROAD MAIN CLUSTERS.
BRADFORD
Wilsden
Calverley
Eccleshill
Undercliffe
Manningham
Heaton
Girlington
Laisterdyke
Thornbury
Tyersal
Bowling
Bierley
East Bierley
Little Horton
Great Horton
Clayton
Thornton
QUEENSBURY
Wibsey
Buttershaw
Odsal
Shelf
Low Moor
Oakenshaw
Birkenshaw
Farsley
Pudsey
Idle
Shipley
Cottingley
Toftshaw
Westgate Hill
Scholemoor
Lidget Green
Stone Chair
Woodside
Royds Hall
Dudley Hill

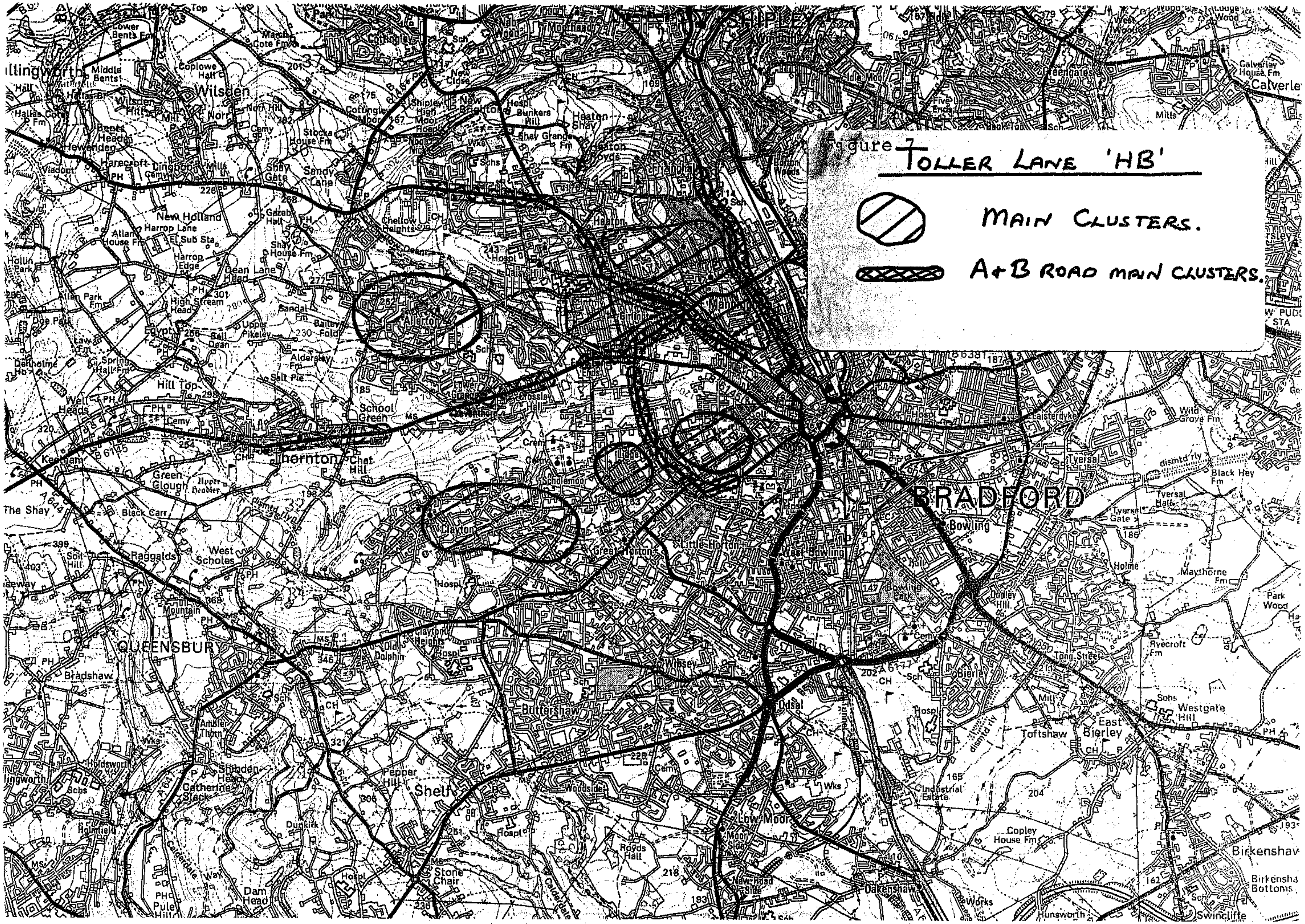
Figure 7
TOLLER LANE 'HB'
MAIN CLUSTERS.
A+B ROAD MAIN CLUSTERS.
BRADFORD
SHIPLEY
QUEENSBURY
Thornton
Allerton
Clayton
Wilsden
Buttershaw
Shelf
Low Moor
Odsal
Bowling
Great Horton
Little Horton
West Bowling
Wibsey
Birkenshaw